Scrum Team Competencies in Information Technology Professionals in the Global Software Development Environment

Anita Hidayati, Universitas Indonesia, Indonesia
https://orcid.org/0000-0002-6114-0459

Eko K. Budiardjo, Universitas Indonesia, Indonesia*

Betty Purwandari, Universitas Indonesia, Indonesia
https://orcid.org/0000-0003-0409-3745

ABSTRACT

The product owner and scrum master are members of the scrum team that play an essential role in global software development. They must have some competencies that can overcome challenges in the global environment. This study aims to develop the competencies of these two roles and explore issues of global competencies. Researchers conducted a literature study to produce a list of competencies and in-depth interviews to explore the issues. Data processing uses content analysis and descriptive statistics. The author compiled questionnaires and generated three issues, then held a focus group discussion for validation. Without reducing the nature of scrum, the consensus of experts had approved 31 competencies for the product owner while 34 for the scrum master. This research enriches scrum.org and has a global impact on improving scrum and global software development human capital and IT professionals.

KEYWORDS

Competencies, global Software Development, Human Capitalit Professionals, Product Owner, Scrum, Scrum Master, Scrum Team

INTRODUCTION

The globalization of the world economy in the 21st century has made Global Software Development (GSD) a trend in the software industries (Britto et al., 2014). Agile Software Development (ASD) is widely used in GSD projects because it is a solution to overcome its challenges (Hidayati et al., 2020). The use of agile methods in GSD promises many advantages for both the company and the client (Sriram & Mathew, 2012). Among various Agile methodologies, the authors chose Scrum in consideration of current trends. Based on the 14th Annual State of Agile Report in 2020, Scrum got the most votes (58%) as the most common Agile methodologies used by respondents' organizations. It is followed by ScrumBan (10%), Other/Hybrid/ Multiple Methodologies (9%), and other methodologies (Scrum/XP hybrid, Kanban, Iterative Development, Lean Startup, XP) (Digital.ai Software Inc., 2020). Another study also mentioned that Scrum is the best known for agile development (Gellweiler, 2019).

Research on Scrum has emphasized the need to improve the Scrum method by developing or modifying its practice to suit the GSD environment (Vallon et al., 2018). The collocated implementation

DOI: 10.4018/IJHCITP.293233 *Corresponding Author

of Scrum is very different from when Scrum is implemented in a global context. There is an adjustment of Scrum practices to overcome the challenges in this environment (Hossain et al., 2011). So, the competencies required by the Scrum Team at GSD are more numerous and complex than in traditional Scrum. Building up competencies for teams that support Scrum practices in a GSD environment is necessary to support the success of their work. With the provision of mature competency mastery, they will be able to drive the success of the GSD project.

A few kinds of research have discussed human resources as Information Technology (IT) professionals in this context. While social factors are at the core of the Scrum methodology, Human Resource Management (HRM) is a crucial challenge in GSD projects (Colomo-palacios et al., 2012). In this research, Human Capital Management (HCM) is more appropriate than HRM. It is because Scrum is a methodology that focuses on people and views human resources as human capital. In Scrum GSD, it is also necessary to apply Scrum values that follow the HCM focus not found in HRM.

Scrum.org is the official reference that becomes the general reference when someone wants to know everything about Scrum. The existing competencies at Scrum.org are still not sufficient to accommodate the application of Scrum in GSD; further, development is still needed. GSD professional Scrum competencies are required by the Scrum team and stakeholders involved and interested in it. This research aimed to develop competencies in the GSD context by using Scrum.org as a primary reference. These competencies are expected to be a guide for preparing the Scrum project team at GSD.

The researchers have explored the reasons, benefits, constraints, and other issues related to prepare a list of competencies to justify this research's importance. In this study, the authors only explored two roles of the Scrum team that play an essential role in maintaining software quality globally. The Product Owner and Scrum Master must have the competence to support the GSD environment. Therefore, the research question in this study is, "What is the competency list needed for Scrum Masters and Product Owners in a GSD environment?"

There are no previous studies that specifically discuss the competencies of Product Owners and Scrum Masters in the context of GSD. So, this research contributes to the Scrum GSD body of knowledge. This research is very relevant to the current conditions where globalization occurs in the business environment—coupled with the Covid-19 pandemic that has swept across the world, forcing business people, including the software industry, to develop software globally. Team virtualization will become a greater need in the future. A Scrum company has a great chance of success in this situation if it has a valuable asset in the form of a Product Owner and a Scrum Master competent in the GSD environment.

The steps for compiling this research refer to the guidelines from (S. Misra, 2021). The structure of this article is organized as follows: The background section contains Scrum's reasons for appropriate GSD methodology. The methodology section describes the research steps taken to answer the research questions in the Introduction. Then, there are four sub-sections (identifying, analyzing, preparing, validating) that contain the methods and results obtained to clarify the stages of research. Next, the research results are presented and discussed in the Results and Discussion section. The last section includes conclusions from the study and future research directions.

LITERATURE REVIEW

Human capital is all the workforce capabilities that develop into valuable talents or features when combined with investment (Schultz, 1961). Human capital combines intelligence, skills, experienced, competence, formal and non-formal education, and expertise. Human Capital Management (HCM) is a human development philosophy that focuses on human value creation (Afiouni, 2013). The purpose of HCM is to manage IT professionals as a company asset effectively and develop it continuously, so its value will increase that it can contribute to the company's performance.

Human capital is essential for survival and competitive advantage in a changing environment (Wujarso & Dameria, 2013). GSD has such an environment. GSD was established in the early 1990s

(Kroll et al., 2018) and is the latest and newest software engineering paradigm (Asiri & Qureshi, 2014). GSD has developed from a phenomenon into a paradigm in the last ten years (Sievi-korte et al., 2018). GSD may refer to Global Software Engineering (GSE) (Beecham et al., 2015), Follow the Sun (FTS) (Budgen et al., 2018), offshore software development (Ruano-Mayoral et al., 2014). The need for quick and easy software development that meets consumer investment and quality needs makes GSD the optimal way of doing business (Marinho et al., 2018). In addition, many commercial and technical factors support the growth of GSD as a software and economic development strategy. For example, the revolution in internet communication development made the world a global village (Sharma et al., 2015). As a result, an increasing number of software companies implement GSD to improve quality (Razzak, 2016), increase operational efficiency, reduce time-to-market, accelerate development within 24 hours, facilitate skilled labor, and leverage a global talent pool (Whitaker et al., 2019).

Carrying out GSD projects in locations extending beyond national boundaries gives it some unique characteristics. GSD teams comprise stakeholders from various countries and organizations collaborating across geographical, time zones, and cultural and linguistic boundaries (Colomo-Palacios et al., 2014) to develop software projects. They are considered virtual teams that engage in shift work due to differences in working hours across countries, primarily if their branches are spread worldwide.

Along with its unique characteristics, GSD can involve challenges in communication, coordination, and control due to distance constraints in the geographical, temporal, and socio-cultural dimensions of the work involved. It can affect the quality of the output of the GSD project (S. Misra & Fernández-sanz, 2011). The human factor plays a vital role in overcoming these challenges and producing projects that meet client expectations (S. Misra et al., 2013). HCM, which views humans as valuable assets, is suitable for using this study's results to manage its human capital.

Competency is essential and relevant to improve human capital (Saldaña-ramos et al., 2014). GSD companies need IT professionals who have a balance of both socio and technical skills. They must have the skills to collaborate and interact effectively with team members in various locations and time zones with different cultural and linguistic backgrounds. Scrum Teams who work in a GSD environment need additional competencies.

Scrum.org has generally identified professional Scrum core competencies to aid the training and certification of individuals in Scrum. Organizations use the competencies and focus areas on evaluating and balancing their team expertise according to their needs. For an individual, the competencies and focus areas will help their personal development with Scrum. That is why the team members in all Scrum roles need a professional Scrum competency. There are three roles in Scrum.org, namely, the Product Owner, Scrum Master, and Development Team. Product Owner is a role in Scrum accountable for maximizing the value of a product, primarily by incrementally managing and expressing business and functional expectations for a product to the Developers. Scrum Master is a role within a Scrum Team accountable for guiding, coaching, teaching, and assisting a Scrum Team and its environments in a proper understanding and use of Scrum. Development Team is any member of a Scrum Team committed to creating any aspect of a usable Increment for each Sprint regardless of technical, functional, or another specialty.

According to the Scrum Guide, Scrum is a lightweight framework for developing and sustaining complex products (Sutherland & Schwaber, 2017). Scrum helps people, teams, and organizations to generate value from complex problems through adaptive solutions. The skills of a Scrum team largely determine the successful implementation of Scrum in a GSD project. Scrum project's success depends on the high performance of team members who handle specific software projects.

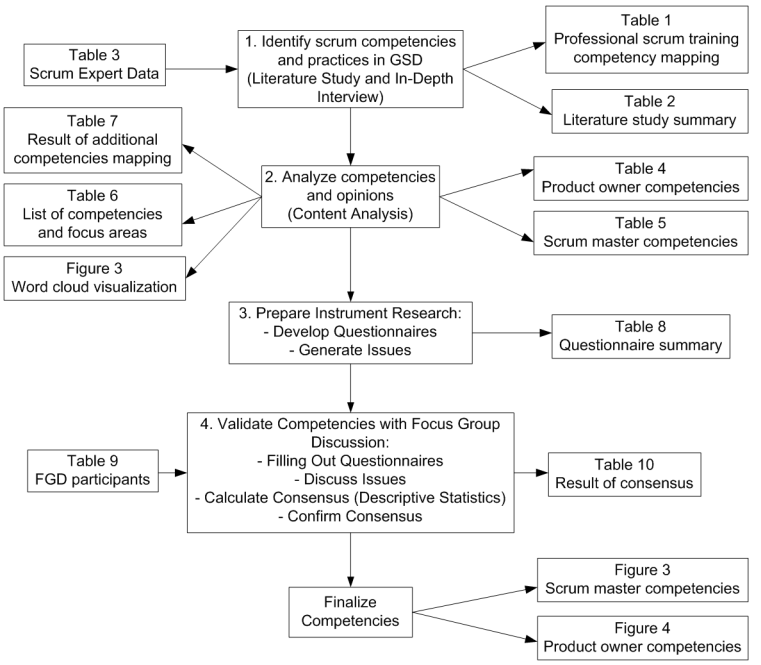
METHODOLOGY

This study used a sequential embedded mixed-method design. Secondary data was collected qualitatively from the academic databases and official references. For primary data, the researchers

used a qualitative method through in-depth interviews with open questions. Data processing used content analysis, followed by validating by experts in FGD. Figure 1 shows the methodology used to answer the research questions. There are six main steps in this research. The first step is to collect data from several sources: official sources (Scrum.org), research articles, and experts' opinions. Professional Scrum training competency mapping for Product Owners and Scrum Masters was taken from Scrum.org. Second, it collected articles discussing GSD, competencies, Scrum, Product Owner, and Scrum Master using a literature study. Finally, content analysis with open coding compiled a list of competencies from the obtained papers.

The researchers conducted in-depth interviews with Scrum experts to explore their various opinions about competencies and issues around Scrum Team competencies in GSD. The qualitative method in interviews with open questions is appropriate to explore why and how questions (Creswell & Creswell, 2018). Based on the recorded results, some views will strengthen this research's foundation using qualitative content analysis. Generated issues were presented in the form of open questions. Besides, the interview results are also an initial validation list of competencies from the first step. The composition of these competencies was outlined in questionnaires. Finally, the researchers held an FGD by involving experts from various parties with experience and interest in the Product Owner and Scrum Master's GSD competencies to validate the list of competencies and problems. The FGD consisted of three rounds. In the first round, the experts filled out the questionnaire directly. The moderator led a discussion about the open questions in the second round; meanwhile, the data-processing team processed the questionnaires using descriptive statistics. In the last session, the moderator read and confirmed the questionnaire results and discussion of the issues. The final result of the FGD was a consensus agreed upon by all experts. Below is a detailed explanation of the research steps.

Figure 1. Research flow



Identify Scrum Competencies and Practices In GSD

The authors identified data from several sources using a literature study and in-depth interviews.

Literature Study

The first step was to get a list of competencies from scrum.org. The researchers used the data as a base for the preparation of further competencies. The critical foundation of Scrum competency is *Understanding and Applying the Scrum Framework* (UASF). The Scrum team will understand the Scrum values, empirical principles, roles, events, and artifacts vital to Scrum's success by having this competency. This competency also enables them to determine the definition of "done" criteria of the product. When several groups work together while scaling Scrum, they can adapt to face various problems. The second competency, *Developing People and Teams* (DPT), aims to produce self-organizing teams who can work together effectively and solve complex problems creatively. To increase team collaboration, knowledge, and skills, the team must have the ability to teach, facilitate, coach, and mentor. It takes individuals who are proficient in implementing different leadership styles and can communicate effectively to influence them. The third competency, *Managing Products with Agility* (MPA), aims to provide valuable business results. Understanding product vision can help align product development with the organization's business strategy.

Product value is related to continuous improvement in the product. Effective Product Backlog management requires collaboration and input from stakeholders and customers. Likewise, forecasting and release planning use an iterative and incremental approach. The fourth competency, *Developing & Delivering Products Professionally* (DDPP), aims to produce high-quality software products repeatedly and gradually. The Scrum Team uses emergent software development approaches to decide the detailed design needed as soon as possible. Understanding continuous integration and delivery (CI/CD) can provide a set of practices and techniques to continuously deliver value, combining frequent learning ideas with small batch-size concepts and automation. The Scrum Team must also focus on optimizing flow and continuous quality to consistently deliver fully integrated tested and potentially released "done" product improvements each Sprint. Finally, it must be able to manage technical risk in a way that ensures organizational agility. The last competency, *Evolving the Agile Organization* (EAO), includes concepts and tools to measure and enable business agility through Evidence-Based Management (EBM). It also examines the importance of organizational design and culture, which consists of the human factors, processes, and structures that can promote or inhibit agility with Scrum. Furthermore, Scrum uses empiricism and self-organization to tackle portfolio planning.

The authors mapped the focus area with professional certifications, such as Professional Scrum Master (PSM), PSM II, Professional Scrum Product Owner (PSPO), Professional Scrum Product Owner-Advanced (PSPO-A). Scrum.org mapped courses to the competencies and focus areas. Table 1 contains a mapping for the competencies of the Product Owner and Scrum Master. The (Ö) shows that the focus area is covered in the class, and (Ö+) shows that it has in-depth coverage. The CI/CD and optimizing flow do not belong in Product Owner or Scrum Master competencies. Still, they have been included because this study's objective was to evolve competencies that already exist in Scrum.org when applied to GSD.

The researchers conducted a literature search that discussed the Scrum Team competencies in GSD. Finding literature used some academic databases for publication between 2014 and 2020. This research used the search string by deriving the primary terms from the research question: Global Software Development, Scrum, Product Owner, Scrum Master, and competency. The relationship of the major terms is AND, which means that all the terms must be fulfilled. Of the five primary terms, Global Software Development has synonyms and alternative spellings: Global Software Engineering, Distributed Software Development, GSD, GSE, DSD. Boolean OR is used to incorporate them. So that the resulting search string is as follows:

Table 1. Professional scrum training competency mapping[1]

Competency	Course/Focus Area	PSPO	PSPO-A	PSM	PSM II
Understanding and Applying the Scrum Framework (UASF)	Empirism, Events, Artifacts	Ö		Ö+	Ö
	Scrum Values, Roles	Ö		Ö+	Ö+
	Done	Ö		Ö	Ö+
	Scaling	Ö	Ö		
Developing People and Teams (DPT)	Self-Organizing Teams			Ö+	Ö+
	Coaching and Mentoring			Ö	Ö+
	Facilitation	Ö		Ö	Ö+
	Leadership Styles		Ö	Ö	Ö+
	Teaching	Ö			Ö
Managing Products with Agility (MPA)	Forecasting and Release Planning, Product Backlog Management	Ö	Ö	Ö+	Ö
	Product Value	Ö	Ö	Ö+	Ö+
	Product Vision	Ö+	Ö		Ö
	Business Strategy, Stakeholders, and Customers	Ö	Ö+		
Developing and Delivering Products Professionally (DDPP)	Emergent Software Development	Ö		Ö	
	Managing Technical Risk	Ö		Ö	Ö
	Continuous Quality			Ö	Ö
	Continuous Integration / Continuous Delivery (CI/CD), Optimizing Flow				
Evolving the Agile Organization (EAO)	Organizational Design and Structure		Ö+		Ö
	Portfolio Planning		Ö		
	Evidence-Based Management (EBM)	Ö+	Ö+		Ö

("GLOBAL SOFTWARE DEVELOPMENT" OR "GLOBAL SOFTWARE ENGINEERING" OR "DISTRIBUTED SOFTWARE DEVELOPMENT" OR "GSD" OR "GSE" OR "DSD") AND ("SCRUM" OR "SCRUM MASTER" OR "PRODUCT OWNER") AND (COMPETEN)*

The strings have been used to search the metadata relating to journal articles and conference proceedings. The search produced 136 references (SpringerLink (53), ACM Digital Library (41), Taylor & Francis (4), Emerald Insight (6), EBSCOHost (30), IEEEXplore (1), JSTOR (1), and ScienceDirect (0)). After reading all articles thoroughly, from the title, abstract, and conclusions, only one discusses the Product Owner and Scrum Master's competency in the Scrum GSD team. The authors did a snowballing method to explore other related papers. The results are four articles, as shown in Table 2, then analyzed using content analysis. There are three columns in this table containing the title, publisher, and summary of the paper. The title column helps readers to see the topic of the articles immediately. A summary of each article is in the summary column. The publisher column shows that the articles obtained come from journals with good quartiles and a quality conference.

In-depth Interviews

The researchers conducted in-depth interviews to explore the perspectives of experts about Scrum Team competencies in GSD and the urgency of their development. The questions also considered

Table 2. Literature study summary

Title	Publisher	Summary
How Product Owner Teams Scale Agile Methods to Large Distributed Enterprises (Bass, 2015)	Empirical Software Engineering (Quartile 1)	Explored practitioner descriptions of Agile method tailoring in distributed enterprises, especially regarding Product Owner roles in globalized projects with many development teams. Showed that nine roles help Agile coaches guide large-scale, Agile teams.
Scrum Master Activities: Process Tailoring in Large Enterprise Projects (Bass, 2014)	2014 IEEE 9th International Conference on Global Software Engineering	Tailored the Scrum Master role in large projects with geographically distributed teams. Showed that six roles help coaches guide large-scale, Agile teams.
A Teamwork Model for Understanding an Agile Team: A Case Study of a Scrum Project (Moe et al., 2010)	Information and Software Technology (Quartile 1)	Provided understanding of the nature of self-managing Agile Teams and teamwork challenges. Used Dickinson and McIntyre's teamwork model and focused on the inter-relations between essential teamwork components.
Employee competency maturity model and its application in global software outsourcing (El-baz & Zualkernan, 2011)	International Journal of Computer Application in Technology (Quartile 3)	Presented an Employee Competency Maturity Model (ECMM), which captured the dimension of Job-Focus, Role-Focus, and Person Focus, and mapped it with the Scrum process.

the findings and results of the previous steps. In addition, the authors asked open-ended questions to seven experts in Scrum. Six experts came from various companies in Indonesia, and one expert from Singapore, engaged in multiple fields. Table 3 lists the data of experts and their companies.

Table 3. Scrum experts data

Company	Location	Interviewee(s)	Business Type
A	Singapore	Software Development Manager	Agile Software Development
B	Indonesia	Senior Test Engineer	e-Commerce
C	Indonesia	Founder	Professional Agile Coaching, Scrum Training Agency
D	Indonesia	Scrum Master	Data Processing Services
E	Indonesia	Chief Agility Officer	Integrated Health Information Technology
F	Indonesia	Scrum Master	IT Service Solution
G	Indonesia	Scrum Master	B2B tech

The authors conducted in-depth interviews during the annual Scrum event held in Bandung, West Java, Indonesia. The experts became key speakers and coaches at the event. This research took personal approaches between events to get a chance to interview them. Each interview had an average time of 20-30 minutes. The authors also transcribed the interviews' results, processed them using a qualitative content analysis approach (Krippendorff, 2018) by using the NVivo tool. The following summarizes the experts' opinions from Company (A) until (G) regarding the Scrum Master and Product Owner competencies at GSD.

The agent of change from Scrum is Scrum Master (C). Scrum Master covers people so that they are more humane at work (B). The primary role of the Scrum Master is the servant leader (F). He

has become a facilitator, coach, and mentor (C). In coaching, Scrum Master does not go directly to the rituals and principles, but more to the pillars' essence than the values (F). They make sure that their team understands Scrum (F). Scrum Master can direct the team to apply Scrum properly (D) and adapt to the needs of his team as an initiator (E). The Scrum Master must be able to find loopholes to create improvisation and innovation (A). Therefore they must know the agility scrum (D). Another essential role of Scrum Master is impediment remover (F). Scrum Master must be able to eliminate SILO (G). For that, they must know the constraints & problems in the company (A)

Product Owner has an entrepreneurial spirit, can make decisions, and legalize (F). Product Owner covers the business side to adapt to the market and get revenue (B). So that the Product Owner must have a product vision. In technical terms, the Product Owner has a role in determining the selection or sorting of jobs. The Product Owner ensures that the backlog is straightforward and understood by the Development Team (D). The new competencies from the literature's data processing results and strengthened through in-depth interviews are shown in Table 4 and Table 5.

Table 4. Product owner competencies

Competency	Definition
Communication	Able to carry out new activities and bridge communication between consumers and the Development Team, onshore and offshore, illustrating challenges by providing support, direction, and clear structure to the Development Team
Coordination	Able to carry out new activities to manage clients and a development team geographically distributed
Architectural Skills	Able to design, implement, and coordinate technical architecture for teams on large scale projects
Technical Skills	Able to evaluate technical complexity and risk management
Requirement Skills	Able to identify, assess and reconcile the strategic needs of clients from various segments/ organizations to produce priority needs for the development team
Business Skills	Able to translate business goals and reconcile the interests of business competition into business value to build or complete projects in stages
Problem-Solving	Able to resolve conflicts
Decision-Making	Able to participate in the decision-making process
Product Knowledge	Able to create a product roadmap and ensure continuous development
Cooperation	Able to work with corporate governance structures to drive large-scale development programs
Cultural Understanding	Able to understand the influence and implications of cultural differences
Management Skills	Able to adapt and adjust strategies, goals, and planning in dynamic situations

It is a summary of the experts' opinions regarding scrum team competencies in GSD. According to the senior test engineer (Company B), "Each Scrum team and company *has unique characteristics. As a result, there is no competency benchmark in the Scrum community."* Scrum Master (Company D) gave his opinion that *"The technical and non-technical competencies of the GSD can be added to the competencies of the Scrum team."* Founder of Senior (Company C) considered that *"For the scope of competence, the organizational cluster must be made first so that it can mean general but not broad scope, but generally in certain clusters."*

Table 5. Scrum master competencies

Competency	Definition
Programming Language Skills	Able to master various programming languages, integration and code synchronization, and the incorporation of software elements
Technical Skills	Able to master several technical aspects of the project and provide technical support for the Product Owner
Combination	Able to facilitate a combination of collocated and distributed Scrum Teams
Accommodation	Able to facilitate large Agile projects and accommodate Agile methods tailored to distributed work allocation
Requirement Skills	Able to choose, estimate and prioritize needs
Coordination	Able to coordinate and attend meetings in teams and between teams
Peace-Making	Able to remove insecurities from each individual
Decision-Making	Able to contribute to policy decisions and a selection of Scrum practices
Communication	Able to manage synchronous and asynchronous communication in a global context with multidisciplinary teams
Time-Management Skills	Able to manage working hours to obtain efficiency from the FTS concept
Cultural Understanding	Able to understand the influence and implications of cultural differences
Problem-Solving	Able to investigate and eliminate work obstacles, so team member performance is consistent and reliable

Analyze Competencies and Opinions

The researchers compiled a list of Scrum Master (SM) and Product Owner (PO) competencies by synthesizing Table 1. They included all focus areas that have the sign (Ö) or (Ö+) in the competency and marked them with (Ö). Table 6 shows the list of competencies and focus areas.

Table 6. List of competencies and focus areas

Competency	Course/Focus Area	PO	SM
UASF	Empirism, Scrum Values, Roles, Events, Artifacts, Done	Ö	Ö
	Scaling	Ö	
DPT	Self-Organizing Teams, Coaching and Mentoring		Ö
	Facilitation, Leadership Styles, Teaching	Ö	Ö
MPA	Forecasting and Release Planning, Product Value, Product Backlog Management, Product Vision	Ö	Ö
	Business Strategy, Stakeholders, and Customers	Ö	
DDPP	Emergent Software Development, Managing Technical Risk	Ö	Ö
	Continuous Quality		Ö
	CI/CD, Optimizing Flow		
EAO	Organizational Design and Structure, EBM	Ö	Ö
	Portfolio Planning	Ö	

Figure 2. Word cloud visualization

Content analysis (Sensuse & Purwandari, 2018) used NVivo software tools to process literature data. The researchers created nodes to identify Scrum Team roles and tasks in the context of GSD. Figure 2 shows some dominant words in the Product Owner role, such as "project," "release," "business," "technical development," and "requirements." In addition, the data also showed the use of Scrum Master authoritative words like "team," "planner," "anchor," "members," "process," "integration," and "facilitator." Roles and tasks based were group base on the competency and frequency of those words. Not all authoritative words became competencies.

Table 7. Result of additional competencies mapping

Competencies	Additional Focus Area from Literature Study		Focus Area Scrum.org (not exist in the role)	
	Product Owner	**Scrum Master**	**Product Owner**	**Scrum Master**
UASF		Decision-Making		Scaling
DPT	Problem-Solving	Coordination, Peace-Making, Problem-Solving	Self-Organizing Teams, Coaching & Mentoring	
MPA	Product Knowledge, Business Skills			Business Strategy, Stakeholders & Customers
DDPP	Technical Skills, Requirement Skills, Management Skills	Requirement Skills, Programming Language Skills, Technical Skills	Continuous Quality, CI/CD, Optimizing Flow	CI/CD, Optimizing Flow
EAO	Cooperation, Cultural Understanding, Architectural Skills, Communication, Coordination	Communication, Cultural Understanding, Time Management Skills, Accommodation, Combination		Portfolio Planning

Table 7 is the result of mapping the addition of competencies from the competencies in Table 6. The "Additional Focus Area" column is competency obtained from the literature study results in Table 4 and Table 5. These competencies are used as focus areas of the five competency groups in Table 6. Grouping the focus areas into these competencies is based on the analysis of its definition. The "Focus Area Scrum.org (not exist in the role)" column contains all the focus areas on Scrum.org but is not owned by the Scrum Master or Product Owner role. The authors deliberately include this focus area to enrich the existing competency array. An example is scaling, which is only owned by the Product Owner, which is tried to fit into the Scrum Master role. Likewise, CI/CD on scrum.org is not included in the Product Owner or Scrum Master. In mapping, it was placed in both roles.

Prepare Instrument Research

The researchers compiled two questionnaires which were a combination of Table 6 and Table 7. Thus, there are five columns containing competencies, focus areas, definitions of focus areas, and two answer columns containing the Yes/No option. This questionnaire was validated by members of the laboratory where the research was conducted. They did a readability test and provided input on the content, writing, and questionnaire preparation to make it easier for the participants to understand. Table 8 is a summary of the questionnaire. Competence with standard style is innate from Scrum.org. Competencies written in bold are additions from scrum.org that were not previously attached to the Product Owner or Scrum Master roles. At the same time, additions from the literature study are written in bold italic.

Table 8. Questionnaire summary

Competency	Product Owner	Scrum Master
UASF	Empirism, Events, Artifacts, Scrum Values, Roles, Done, Scaling, ***Decision-Making***	Empirism, Events, Artifacts, Scrum Values, Roles, Done, **Scaling,** ***Decision-Making***
DPT	**Self-Organizing Teams, Coaching and Mentoring**, Facilitation, Leadership Styles, Teaching, ***Problem-Solving***	Self-Organizing Teams, Coaching and Mentoring, Facilitation, Leadership Styles, Teaching, ***Problem-Solving, Coordination, Peace-Making***
MPA	Forecasting and Release Planning, Product Backlog Management, Product Value, Product Vision, Business Strategy, Stakeholder & Customers, ***Product Knowledge***, ***Business Skills***	Forecasting and Release Planning, Product Backlog Management, Product Value, Product Vision, **Business Strategy, Stakeholder & Customers**
DDPP	Emergent Software Development, Managing Technical Risk, **Continuous Quality, CI/CD, Optimizing Flow**, ***Technical Skills, Requirement Skills, Management Skills***	Emergent Software Development, Managing Technical Risk, Continuous Quality, **CI/CD, Optimizing Flow**, ***Requirement Skills, Programming Language Skills***, ***Technical Skills***
EAO	Organizational Design & Culture, Portfolio Planning, EBM, ***Cooperation***, ***Cultural Understanding***, ***Architectural Skills, Communication, Coordination***	Organizational Design & Culture, **Portfolio Planning,** EBM, ***Communication, Cultural Understanding, Time Management Skills, Accommodation, Combination***

The authors generated the opinions in three open questions, as follows:

- Should the GSD competency be an essential competency of Scrum Teams?

- Is the Scrum Team competency unique and cannot be generalized?
- Does standardization reduce Scrum humanization?

Validate Competencies and Issues

The researchers held the FGD in a quiet and comfortable room, and it lasted about 150 minutes. The moderator facilitated the discussion, while observers and note-takers helped record the participants' communication. The data-processing team was responsible for processing the questionnaires directly. All focus group activities were audio and video recorded. Table 9 contains details about the expertise of FGD participants. There are eight IT professionals from practitioners, academics, government, and associations. They were involved came from various organizations. It aims to gain a broad perspective of curricula in education, industrial application, government policies, and certification from associations. From academia, both public and private universities are involved. Likewise, with industry, there are public and private organizations. From government circles, there were representatives from the Ministry of Communication and Information Technology. It is because they are closely related to competency matters in Indonesia. Besides that, it also included experts from the association who actively prepared competency certification and government policies. Although not all of them have all three viewed from their expertise, they can support and complement each other with their respective expertise.

Table 9. FGD participants

Organization	Business Type	Position	Expertise	Years of Experience
H	Software Association	Deputy Chairman General	GSD, Scrum	15
I	Ministry of Communication and Information Technology	Head of Division	Competencies	12
J	International Business Machines Corporation	Project Manager	GSD, Scrum	14
K	Training Company and Software Developer	Director	Competencies, Scrum	22
L	Agile Company	Editor in Chief	Scrum	6
M	Public University	Lecturer, Researcher, Consultant	Competencies, Scrum, GSD	32
N	Private University	Lecturer, Researcher, Consultant	Competencies, Scrum	10
O	Public Organization	Scrum Master	Scrum	5

There are three sessions in FGD. In the first session, participants filled out the questionnaire. The expert determined whether the competency's focus areas were needed in the GSD context. They could choose the Yes or No option. The second session was a roundtable discussion with open-ended questions to explore participants' opinions about the three questions. There were three rounds, and each round addressed one question. Each expert was allowed to give ideas on a given topic. During the second session, the data-processing team processed the questionnaire to get a consensus about each

focus area. The authors used the discussion results during the second session to extract the research findings and conclusions. The third session was a confirmation of consensus with the experts.

Finalize Competencies

The authors analyzed questionnaires filled out during the FGD to reach a consensus. A minimum consensus limit of 60% was obtained, as eight experts answered Yes/No questions. Table 10 contains a consensus list of competencies. There are three rows of sources. The data in the first row is competencies that currently exist on Scrum.org. However, IT professionals did not approve some competencies and were eventually excluded from the list. The second row Finalize contains additionals from Scrum.org, including competencies that already exist in Scrum.org but are not attached to the Scrum Master or Product Owner roles. The last is additional from literature, which provides for competencies that are acquired outside of Scrum.org. Next, the authors explained which competencies are accepted or rejected from each source.

Table 10. Results of consensus

Sources	Consensus	Product Owner	Scrum Master
Currently exist on scrum.org	Rejected	• Teaching • Emergent Software Development	Product Vision
Additional from scrum.org	Accepted	• Self-Organizing Teams • Continuous Quality • CI/CD	• Scaling • Stakeholders & Customers • CI/CD • Optimizing Flow • Portfolio Planning
	Rejected	• Coaching & Mentoring • Optimizing Flow	Business Strategy
Additional from literature	Accepted	• Problem-solving • Product Knowledge • Business Skills • Technical Skills • Requirement Skills • Cooperation • Management Skills • Communication • Coordination	• Decision-making • Coordination • Peace-Making • Problem-Solving • Management Skills • Communication • Time, Management Skills • Cultural Understanding • Accommodation • Combination
	Rejected	• Cultural Understanding • Architectural Skill	• Requirement Skills • Programming Language Skills • Technical Skills

Currently Exist on Scrum.org

Consensus unanimously accepted most of the competencies listed in Scrum.org. Only three were rejected, two from the Product Owner and one from Scrum Master. *Teaching* is not a competency that Product Owners should have, but it is a Scrum Master's competency. While knowing and understanding *emergent software development* is not the Product Owner's responsibility, it is a competency that the Development Team must have. One Scrum Master competency the experts rejected was *product vision*. They thought that it should belong to Product Owners and be only optional for Scrum Masters. According to the Director (Organization H): *"In managing products with agility, a product business is the Product Owner's responsibility. Still, the one who must execute is the Product Owner. So, the*

Scrum Master needs to know how to do product management, realize product vision, and spawn the definition into value. So this competency becomes 'a nice to have' for Scrum Masters."

Additional Form Scrum.org

All experts agreed that as a member of the Scrum Team, the Product Owner must also have the ability to be a *self-organizing team*, the same as the Scrum Master and the Development Team. Of the three roles in the Scrum Team, the Product Owners are most responsible for the product. Therefore, they must guarantee the *continuous quality* of the series of products produced by the Scrum Team. While the Scrum Master has to use the optimizing flow approach with Scrum if implemented within GSD's scope. GSD also opens up opportunities for project enlargement. Therefore, Scrum Masters must be able to do *scaling* when applying Scrum in large-scale projects, one of them with a mechanism called Scrum of Scrums (Mundra et al., 2013). Other studies have discussed the challenges faced during scaling in the GSD environment and their success factors in more depth (Shameem et al., 2020).

Moreover, the Scrum Master must be competent about *stakeholders and customers*. Although not directly related to them, Scrum Master still has to negotiate when problems occur with the Development Team. Finally, Product Owners and Scrum Masters must understand and apply *CI/CD* in each Scrum activity to ensure that software quality assurance works.

The consensus results rejected the competencies proposed by taking competencies at Scrum.org that are not attached to roles. *For example, coaching, mentoring,* and *optimizing flow* are associated with Scrum Masters. The Product Owner does not have to master these competencies; however, the "*business strategy*" competency is appropriate for Product Owners. According to the lecturer (Organization N): *"In my opinion, these competencies are more suitable for the Product Owner than the Scrum Master, and vice versa. These competencies are not very important for the Scrum Master. Maybe nice to have, but these are more important for the Product Owner."*

Additional from Literature

The experts agreed that the following competencies need to be carried out or possessed by those who play in the global world. First, product Owners must be competent in producing a product, so they must have *skills* in *requirement* and *product knowledge* to thoroughly and deeply explore needs to build products following customer expectations. Second, they also must have *business skills* to assess and create business value from the product. Finally, the Product Owner must work with various parties to handle the GSD project in good *cooperation*.

As the conductor, the Scrum Masters must ensure that the team can work efficiently according to the Follow the Sun concept. They must have good *time management skills*. The Scrum Master must be able to contribute to the *decision-making* needed during the Scrum activity. Scrum Masters must have the *peace-making* competency to provide security for the development team to work optimally. Scrum Masters as facilitators must provide *accommodation* for Agile methods and ensure the team's agility when serving the GSD project's needs. In the GSD project consisting of various groups from various parts of the world, the Scrum Master must combine the local and distributed teams. The Scrum Master must have a *cultural understanding* when working within GSD's scope; this competency is optional for the Product Owner.

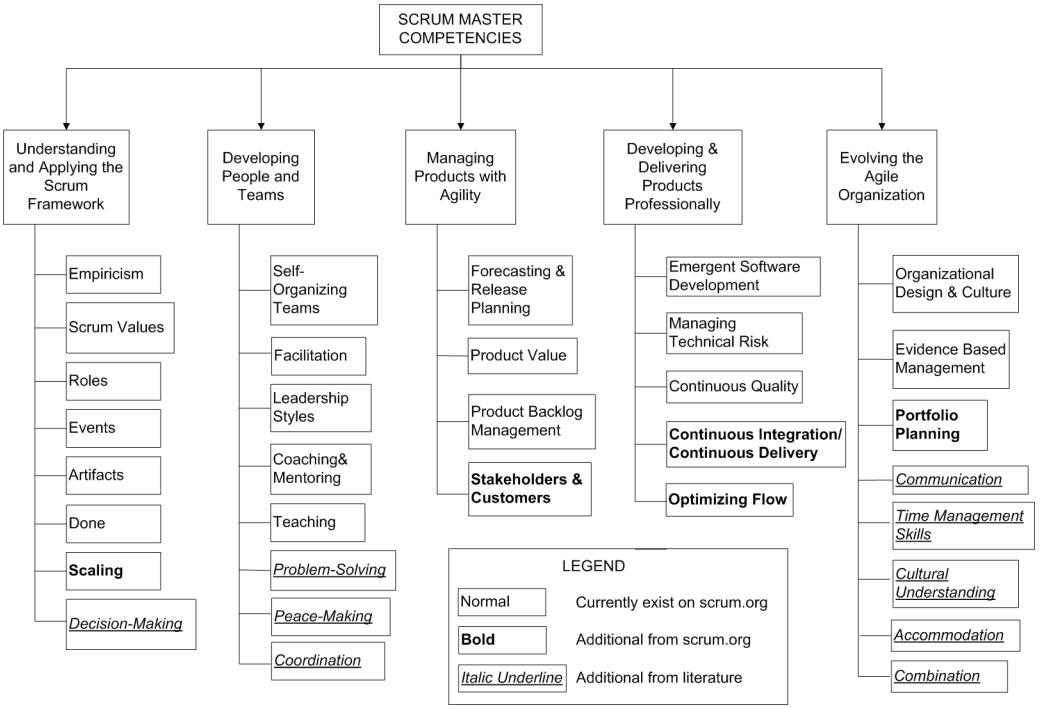
Communication and *coordination* competencies are needed when the Product Owner and the Scrum Master work in a GSD environment. Under the results of previous research, it is stated that people who work in distributed teams spend a long time communicating and coordinating (Stray & Moe, 2020). Therefore, they must master management skills in various ways, including managing people. In addition, they must have *problem-solving* competency to understand conflicts that arise and solve them. *Problem-solving* is necessary, as Product Owners mediate between stakeholders who disagree about the software's direction, and Scrum Masters mediate between teams. Product Owners need not have *architectural skills*. According to the Editor in Chief (Organization L): "*A Product Owner is not required to have architectural skills because that is the Development Team's competency."*

The researchers included *requirement skills* and *technical skills* in the competencies of the Product Owner. Scrum Master does not need to master *technical skills*, although this competency can help if the team has technical problems. The Project Manager (Organization J) stated that "*The Scrum Master is required to facilitate and direct the team, but there is no need for mastering the competency of the object."*

Programming language skills are not crucial for the Scrum Master but are "nice to have." However, Development Team must master Pair Programming (PP) skills (Misra, 2021). According to the Scrum Master (Organization O), "*Not all Scrum Masters need to be proficient in programming languages; just knowing is enough."*

Figure 3 shows the competency list results for the Scrum Master, and Figure 4 shows Product Owner competencies. The two figures show that the Product Owner and Scrum Master have five competencies similar to those listed on Scrum.org.

Figure 3. Scrum master competencies

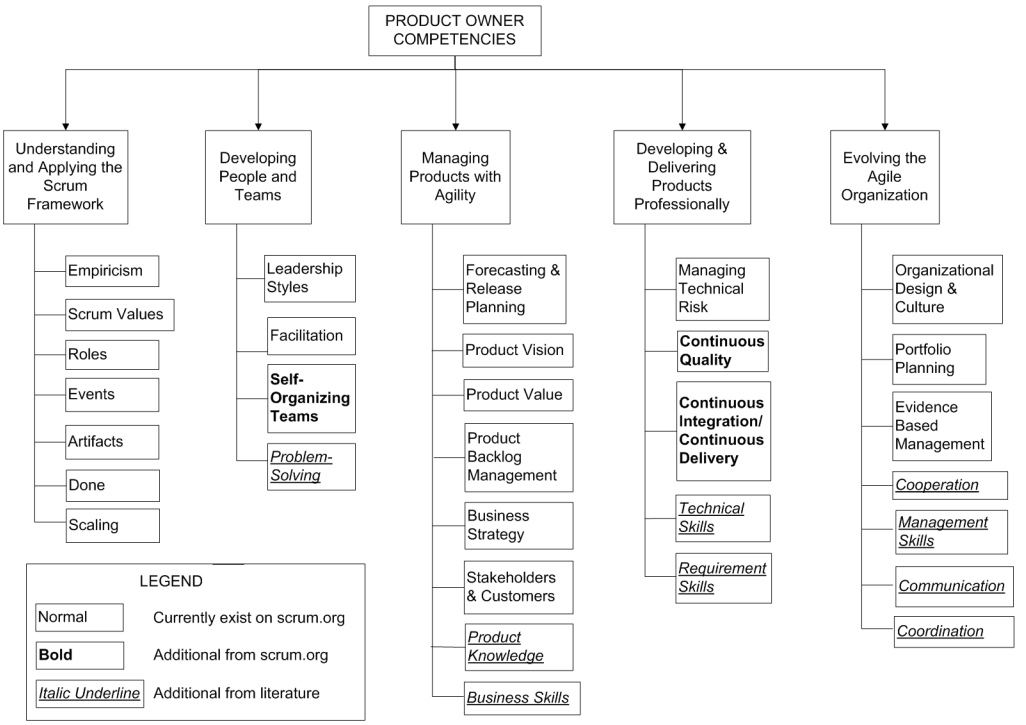


The difference lies in the focus area of each competency. For easy understanding, existing focus areas on Scrum.org and approved by experts assigned to the Product Owner or Scrum Master role are in **bold**. In comparison, writing in *italic underline* indicates that the focus area is an additional from the literature. There are a total of 34 focus areas for the Scrum Master. As shown in Figure 4, the Product Owner has 31 fewer focus areas than the Scrum Master.

FINDINGS AND DISCUSSION

The researchers used a roundtable discussion to answer three questions. All experts unanimously accepted the first question, "Should GSD competency be an essential competency of Scrum Teams?"

Figure 4. Product owner competencies



They all agreed that not all companies understood GSD competency's urgency when working in global Scrum projects. GSD competency should be an essential competency of Scrum Teams, as the Scrum project's success in GSD depends on the team's competence. So far, there are no competencies addressed for the Product Owner and Scrum Master, even though most GSD projects have used Scrum. The more precise the competency perspective, the more beneficial it will be for providers and prospective employees.

Companies need a GSD competency framework to guide them in recruiting and improving Scrum Teams. According to the Deputy Chairman General (Organization H), "*When recruiting a software project team, the company needs the Scrum Team's specific competencies as a guide, especially for the Product Owner and the Scrum Master, but we never facilitated these two roles. Simultaneously, the Development Team will prefer a Scrum organization staffed by a Scrum Master and a Product Owner. The Development Team will automatically adjust to the workflow. So those two roles must take precedence.*"

The Director (Organization K) argued that "*Still, not many companies have an understanding of Scrum implementation itself, so some guidance is needed. I feel that there is a need for commitment, culture, and policies in the industry to adapt and adopt these guidelines.*" According to the Scrum Master (Organization O) that "*In my opinion, the first issue is obvious. If we want to implement Scrum with GSD, specific GSD competencies must be precise because the implementation method is different. Then, later the next team can use that competency as guidance.*"

The Editor-in-Chief (Organization E) stated his agreement "*I agree that we can add this GSD competency to the competency of the Scrum Team. The first issue is possible. We can include GSD competencies in addition to the essential competencies of the Scrum Team. Because from a competency perspective, the more specific a competency is, the more helpful it will be for both the user and the service provider.*" The government can use these competencies as input for Indonesia National Work

Competency Standards (SKKNI). The Head of the Division (Organization B) revealed her opinion "*Concerning SKKNI, especially SKKNI software development, has been compiled from 2016. Maybe later, we can use Scrum and GSD competencies as input for reviewing software development."*

75% of experts rejected the second question from the total sample, "Is Scrum Team competency unique and cannot be generalized?" while 25% accepted it. Experts who agreed with the second question argued that Business to Business (B2B) is still accustomed to employing Waterfalls, whereas Business to Customer (B2C) must use Scrum. So, competency development must consider the company clusters so that it is more appropriate and applicable. They also believed that the Scrum Team is unique and cannot be generalized. The fact shows different Scrum applications in companies because of differences in companies' needs and capabilities. Some companies do not use Scrum as a whole; for example, a Product Manager has a role as a Scrum Master, and the Scrum Master doubles as a Product Owner.

Meanwhile, the expert who rejected question 2 argued that the competencies are not too unique to be clustered, while Scrum and GSD have been generalized all this time. Scrum is a general framework, so it does not matter when GSD competencies are added to Scrum core competencies. The authors considered the emergence of internal company problems, especially in GSD's culture and policy competencies. The most dominant factor in GSD is cultural issues. All competencies defined for GSD may be involved in non-GSD settings. According to the Director (Organization D), "*The underlined in this research is competency. But, in my opinion, competency can be generalized. Because project management is being discussed here, so what is different is the use case, not the competency."* The Project Manager (Organization C) stated that "*The Scrum Team has general competency. However, it becomes unique after being used under its roles."*

The Editor-in-Chief (Organization E) argued that "*I disagreed with the second issue because Scrum itself is a generalization and the GSD topic is also a generalization."* The opinion of the Lecturer (Organization F) is "*In my opinion, the Scrum team's competency in general and can be used as a reference or outcome for the standard. But still, it can be tailor-made according to the cluster."*

All experts rejected the third issue, "Does standardization reduce Scrum humanization?" They unanimously agreed that the case was wrong. The experts concluded that standardization would not reduce the nature of Scrum. On the contrary, standardization will greatly help Product Owners and Scrum Masters to improve their competencies.

From the results of the discussion above, a consensus was obtained the experts approved that. Consensus results showed that GSD competencies could be included as additional essential competencies of the Scrum Team. These competencies are not something unique to apply in general according to the nature of Scrum and GSD. The competency framework generated from this research is essential for the Product Owner and Scrum Master to make the Scrum GSD project a success. Furthermore, the competence of the GSD Scrum team is helpful for the stakeholders involved, such as companies, associations, governments, and the key actors, namely the Product Owner, the Scrum Master.

Conclusion

The consensus results show that to succeed in doing business in GSD, Product Owners and Scrum Masters must have additional competencies. The practical competencies on Scrum.org are not sufficient and must be reviewed and updated from various academic references. The researchers have compiled and validated the proposed list of competencies to produce a list of final competencies that have undergone additions and subtractions to match the GSD context. This competency standardization can generally apply without reducing the nature of Scrum, and it will even enrich competencies in Scrum.org. In addition, the results of this study can be used as a reference for research in GSD governance with a focus on the people aspect (Manjavacas et al., 2020).

These competencies could be a guidance for companies on improving their human capital and IT professionals. First, they can assess the competence of their employees. Then they can use the results

to develop strategies for improvement. Companies can plan policy for all sectors, such as preparing the training, mapping human capital strength, distributing personnel workloads, formulating the appreciation schemes, and setting the financial policy. Associations use competencies for developing certifications and organizing training.

Meanwhile, for the government, this competence helps develop policies to gradually increase competence and involve all relevant parties, such as the workforce, education, and finance ministries. It is in line with another study's opinion, which states that the government cooperates with educational institutions and industries to prepare students for future jobs (R. K. Misra & Khurana, 2018). Countries trying to increase their participation in GSD can use this study's results as a reference for improving their professional Product Owner and Scrum Master competitiveness. The GSD actors named Product Owners and Scrum Masters can conduct self-assessment of their abilities and at the same time carry out self-learning by using the results of this research as a guide. If they find it difficult, they can follow the existing training. By preparing themselves well, they will be better team members to participate in the GSD Scrum project.

Further research should add more competencies to the list of competencies. For competency validation, accurate testing can be done at Scrum companies on a global scale. The development of maturity and assessment models for the GSD Scrum Team can use this list of competencies to reference the future. The team's competency levels can be assessed by using these two models and facilitate the onboarding of the GSD Scrum Team. One example of competency-based assessment is by using a semantic model (Ilahi et al., 2014).

ACKNOWLEDGMENT

This research was supported by the PDUPT grant at the University of Indonesia, funded by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia [1/E1/KP.PTNBH/ 2019 NKB-1498/UN2.R3.1/HKP.05.00/ 2019].

REFERENCES

Afiouni, F. (2013). Human Capital Management: A New Name for HRM? *International Journal of Learning and Intellectual Capital*, *10*(1), 18–34. doi:10.1504/IJLIC.2013.052081

Asiri, S., & Qureshi, M. R. J. (2014). The Proposed GSD Model to Solve Coordination and Communication Problems. *Modern Education and Computer Science*, *6*(November), 25–30. doi:10.5815/ijmecs.2014.11.03

Bass, J. M. (2014). Scrum Master Activities : Process Tailoring in Large Enterprise Projects. *IEEE 9th International Conference on Global Software Engineering, 3*, 6–15. doi:10.1109/ICGSE.2014.24

Bass, J. M. (2015). How product owner teams scale agile methods to large distributed enterprises. *Empirical Software Engineering*, *20*(6), 1525–1557. doi:10.1007/s10664-014-9322-z

Beecham, S., Richardson, I., & Noll, J. (2015). Assessing the Strength of Global Teaming Practices: A Pilot Study. *IEEE 10th International Conference on Global Software Engineering*, 110–114. doi:10.1109/ICGSE.2015.14

Britto, R., Usman, M., & Mendes, E. (2014). Effort Estimation in Agile Global Software Development Context. *XP 2014 Workshop, LNBIP*, 182–192.

Budgen, D., Brereton, P., Williams, N., & Drummond, S. (2018). The contribution that empirical studies performed in industry make to the findings of systematic reviews: A tertiary study. *Information and Software Technology, 94*(September), 234–244. 10.1016/j.infsof.2017.10.012

Colomo-palacios, R., & Casado-lumbreras, C. (2014). Analyzing Human Resource Management Practices Within the GSD Context. *Journal of Global Information Technology Management*, (November), 37–41. doi:10.1080/1097198X.2012.10845617

Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., García-Peñalvo, F. J., & Tovar, E. (2014). Project managers in global software development teams: A study of the effects on productivity and performance. *Software Quality Journal*, *22*(1), 3–19. doi:10.1007/s11219-012-9191-x

Creswell, W. J., & Creswell, J. D. (2018). Research Design: Qualitative, Quantitative adn Mixed Methods Approaches. *Journal of Chemical Information and Modeling*, *53*(9).

El-baz, H., & Zualkernan, I. A. (2011). Employee competency maturity model and its application in global software outsourcing. *International Journal of Computer Applications in Technology*, *40*(3), 170–180. doi:10.1504/IJCAT.2011.039138

Gellweiler, C. (2019). Collaboration of solution architects and project managers. *International Journal of Human Capital and Information Technology Professionals*, *10*(4), 1–15. doi:10.4018/IJHCITP.2019100101

Hidayati, A., Budiardjo, E. K., & Purwandari, B. (2020). Hard and soft skills for scrum global software development teams. *ACM International Conference Proceeding Series*, 110–114. doi:10.1145/3378936.3378966

Hossain, E., Bannerman, P. L., & Jeffery, R. (2011). Scrum Practices in Global Software Development : A Research Framework. *PROFES*, 88–102.

Ilahi, M., Belcadhi, L. C., & Braham, R. (2014). Semantic models for competence-based assessment. *International Journal of Human Capital and Information Technology Professionals*, *5*(3), 33–46. doi:10.4018/ijhcitp.2014070103

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology*. Sage Publications.

Kroll, J., Richardson, I., Prikladnicki, R., & Audy, J. L. N. (2018). Empirical evidence in follow the Sun software development : A systematic mapping study. *Information and Software Technology*, *93*, 30–44. doi:10.1016/j.infsof.2017.08.011

Manjavacas, A., Vizcaíno, A., & Piattini, M. (2020). Global software development governance : Challenges and solutions. *Journal of Software Engineering Research and Development*, *32*(March), 1–26. doi:10.1002/smr.2266

Marinho, M., Luna, A., & Beecham, S. (2018). Global Software Development : Practices for Cultural Differences. *PROFES, 3*(Dc), 299–317. 10.1007/978-3-030-03673-7

Misra, R. K., & Khurana, K. (2018). Analysis of employability skill gap in information technology professionals. *International Journal of Human Capital and Information Technology Professionals*, *9*(3), 53–69. doi:10.4018/IJHCITP.2018070104

Misra, S. (2021). A Step by Step Guide for Choosing Project Topics and Writing Research Papers in ICT Related Disciplines. In *Information and Communication Technology and Applications* (Vol. 2, pp. 727–744). Springer International Publishing., doi:10.1007/978-3-030-69143-1_55

Misra, S., Colomo-Palacios, R., Pusatli, T., & Soto-Acosta, P. (2013). A Discussion on The Role of People in Global Software Development. *Tehnicki Vjesnik (Strojarski Fakultet)*, *20*(3), 525–531.

Misra, S., & Fernández-sanz, L. (2011). Quality Issues in Global Software Development. *ICSEA 2011: The Sixth International Conference on Software Engineering Advances*, 325–330.

Moe, N. B., Dingsøyr, T., & Dybå, T. (2010). A teamwork model for understanding an agile team : A case study of a Scrum project. *Information and Software Technology*, *52*(5), 480–491. doi:10.1016/j.infsof.2009.11.004

Mundra, A., Misra, S., & Dhawale, C. A. (2013). Practical scrum-scrum team: Way to produce successful and quality software. *Proceedings of the 2013 13th International Conference on Computational Science and Its Applications, ICCSA 2013*, 119–123. doi:10.1109/ICCSA.2013.25

Razzak, M. A. (2016). An Empirical Study on Lean and Agile Methods in Global Software Development. *IEEE 11th International Conference on Global Software Engineering Workshops (ICGSEW)*, 61–64. doi:10.1109/ICGSEW.2016.22

Ruano-Mayoral, M., Casado-Lumbreras, C., Garbarino-Alberti, H., & Misra, S. (2014). Methodological framework for the allocation of work packages in global software development. *Journal of Software: Evolution and Process*, *26*(12), 1172–1192. doi:10.1002/smr

Saldaña-ramos, J., Sanz-esteban, A., García, J., & Amescua, A. (2014). Skills and abilities for working in a global software development team: a competence model. *Journal of Software: Evolution and Process, 26*(February), 329–338. <ALIGNMENT.qj></ALIGNMENT>10.1002/smr

Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, *51*(1), 1–17.

Sensuse, D. I., & Purwandari, B. (2018). Defining e-Portofolio Factor for Competency Certification using Fuzzy Delphi Method. *The Turkish Online Journal of Educational Technology*, *17*(2), 25–33.

Shameem, M., Kumar, R. R., Nadeem, M., & Khan, A. A. (2020). Taxonomical classification of barriers for scaling agile methods in global software development environment using fuzzy analytic hierarchy process. *Applied Soft Computing*, *90*, 106122. doi:10.1016/j.asoc.2020.106122

Sharma, N., Singh, A. S., & Singh, K. (2015). Agile in global software engineering : An exploratory experience. *International Journal of Agile Systems and Management*, *8*(1), 23–38.

Sievi-korte, O., Beecham, S., & Richardson, I. (2018). Challenges and recommended practices for software architecting in global software development. *Information and Software Technology*, *106*(October), 234–253. doi:10.1016/j.infsof.2018.10.008

Sriram, R., & Mathew, S. K. (2012). Global Software Development using Agile Methodologies : A Review of Literature. *2012 IEEE International Conference on Management of Innovation & Technology (ICMIT)*, 389–393. doi:10.1109/ICMIT.2012.6225837

Stray, V., & Moe, N. B. (2020). Understanding coordination in global software engineering: A mixed-methods study on the use of meetings and Slack. *Journal of Systems and Software*, *170*, 110717. doi:10.1016/j.jss.2020.110717

Vallon, R., José, B., Prikladnicki, R., & Grechenig, T. (2018). Systematic literature review on agile practices in global software development. *Information and Software Technology, 96*(April), 161–180. 10.1016/j.infsof.2017.12.004

Whitaker, J., Mithas, S., & Liu, C. W. (2019). Beauty is in the eye of the beholder: Toward a contextual understanding of compensation of information technology professionals within and across geographies. *Information Systems Research*, *30*(3), 892–911. doi:10.1287/isre.2019.0837

Wujarso, R., & Dameria, R. (2013). Human Capital Management as a Resource in Achieving Competitive Advantage. *Budapest International Research and Critics Institute-Journal, 4*(2), 3052–3058.

ENDNOTE

[1] https://www.scrum.org/professional-scrum-certifications

Anita Hidayati is a doctoral student in the Faculty of Computer Science, Universitas Indonesia. The dissertation topic currently being worked on is Global Software Development. Her supervisors are Prof. Eko K. Budiardjo and Betty Purwandari, Ph.D.

Eko K. Budiardjo has been a faculty member of the Faculty of Computer Science - the University of Indonesia since 1985. Teaching, research, and practical services are aligned; give result in a full spectrum of academic achievement. Majoring in Software Engineering as a professional track record, he has made some scientific contributions such as Software Requirement Specification (SRS) patterns representation method, R3 Method, ZEF Framework, FrontCRM Framework, and Social CRM Framework for Higher Education Institution. Graduated from Bandung Institute of Technology (ITB) in 1985, holds Master of Science in Computer Science from the University of New Brunswick – Canada in 1991, and was awarded Philosophical Doctor in Computer Science from the University of Indonesia in 2007. He is a member of the International Association of Engineers (IAENG); a senior member of the International Association of Computer Science and Information Technology (IACSIT). Currently, he is the Head of Reliable Software Engineering (RSE) Lab., and Chairman of The Indonesian ICT Profession Society (IPKIN).

Betty Purwandari is a full-time lecturer at the Faculty of Computer Science, Universitas Indonesia. She receives her Ph.D. in Computer Science from the University of Southampton, UK; an M.Sc. in Data Communications, Networks, and Distribution System from the University College London, UK; and a B.Sc. in Computer Science from Universitas Indonesia. Her research interests include Software Engineering, Information Systems, Information Technology Management, E-Commerce, E-Participation, and E-Learning. She also has superb experience as an Information Technology practitioner. In 2016 she won the UK Alumni Award for Professional Achievement from the British Council as her contribution directing superb Information Technology improvement at Universitas Indonesia.