Using Wiki for Enhancing the Knowledge Transfer to Newcomers: An Experience Report

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Abstract—Software development is intrinsic human-based knowledge-intensive. Due to globalization, software development has become a complex challenge and we usually face barriers related to knowledge management, team building, costly testing processes, especially in distributed settings. In this paper, we present the use of experimental studies to improve our knowledge management process using the Wiki system. According to the results, it was possible to identify learning preferences from our software projects leader team, organize and improve the learning experience of our Wiki, and facilitate collaboration by newcomers to improve Wiki with new contents available in the Wiki.

Keywords—Mobile products, knowledge management process, Wiki system, Global Software Development.

I. Introduction

THE software globalization process has been changing how we can provide new products and services. This scenario creates new challenges to ensure enhanced competitiveness in new businesses [1]. One of them relates to the transfer of knowledge needed to fulfill the required tasks, especially for newcomers.

Due to distributed settings, where development teams are geographically dispersed, people may be susceptible to barriers such as communication lacks, misunderstandings software development, and other problems that impact the product development cycle [2]. Thus, knowledge is a valuable resource for the competitive advantage of an organization. For this reason, it is indispensable for companies to look for strategies to organize knowledge management processes in order to reduce technical and sociological difficulties.

One way to enhance these processes is to adopt software technologies as alternatives to support management knowledge [3], [4]. However, effective knowledge management practices, still have difficulties due the Global Software Development (GSD) environment. In this paper, we report our experience using Wiki as an alternative for sharing knowledge and for helping newer software project leaders with our software development process. The Wiki usage, as a social media technology approach, has introduced an effective way of collaboration, communication, and knowledge sharing, especially in distributed environments [4]. Wiki technology, with its collaborative characteristics, can allow users to deconstruct and reconstruct expertise in a way that allows for organic knowledge growth and self-correction [5]. Moreover, when Wikis' social engineering ideas are paired with training, onboarding time is reduced, expenses and errors are reduced, and productivity is increased. Inspired by this, we present how we have been improving knowledge management process through experimental studies from our Sidia Institute of Technology, using Wiki [4]. The aim of this paper is sharing an extend evaluation applied on a new wiki page, and afterward, previous results [4]. We carried out a survey, using online questionnaires to identify improvements in the current version of the Wiki, outdated pages, knowledge grouping based content, and usability issues that can affect the Wiki organization. The main contribution of this paper is comparing between 1st and 2nd Wiki versions that allowed us to understand the issues that can affect engagement and collaboration on improvements and maintenance of our Wiki.

According to results, considering learning preferences, Wiki is the main knowledge source query by 43% of participants, 23% prefer to ask first to an experienced co-worker and 13% prefer ask to people who have more contact. About the perception of usefulness, the Wiki had a positive result, with 44% of participants related that Wiki is effective during the learning process. Considering the usability perception, 48% of participants reported that wikis have good usability. As improvements, the new Wiki version still has usability issues that need to be changed.

The remainder of this paper is structured as follows: Section II provides the background related to the review process improvements. Section III describes our case study, results and important findings. Finally, we present the lessons learned and final considerations.

II. Background

Learning efficiency is an important parameter for collaboration [5]. Thus, the learning process depends on some factors such as: on boarding process and knowledge sharing effectiveness. In this scenario, companies that are able to properly manage knowledge and become cost-effective or innovative can survive in the long run. In this environment, technologies are critical for team member participation, improved communication, and more effective knowledge management [7]. In a GSD context, tools can support as much

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communication, coordination, and documentation as knowledge management [6].

Many studies have looked at the importance of the Knowledge Management Process [4], [7]. The goal of these researches was to figure out how technologies can help with cooperation, communication, and knowledge management. Companies have been using Wiki as a knowledge management option due to cost savings. Nevertheless, when a Wiki has a lot of content, users may find it difficult to use it, which may be an issue during the onboarding process [8].

This study took place at Sidia, it is an R&D Institute responsible for improvements on the Android Platform of Samsung products in all Latin America. The employees work in a distributed environment, with the Wiki adopted as an alternative for knowledge management [9]. In Wiki, we provide information about project processes, tools used, focal points of each telephony partner, stages of the software development process, etc. However, we observed that new project leaders (PLs) still faced difficulty in using the Wiki due to a large amount of information and difficulty in using and exploring information access [13]. As a response, we conducted experimental investigations to determine the challenges experienced by our newcomers, as well as another study to learn how they overcome problems [4]. We use the findings of this research to categorize knowledge into categories that we believe can have a direct or indirect impact on newcomer engagement in collaborative processes. The following section describes a previous study that was completed, demonstrating how it was beneficial to restructure the team's Wiki pages.

A. First Evaluation Study

We aimed to uncover issues faced by our team in the first study. New members received basic training relating to work tasks during the newbie onboarding process, and we used the first edition of all activities detailed in Wiki as a reference. They did, however, identify some difficulty in locating information, lessons, and PL exercises [4], [13]. In this context, our first experimental study was designed to assess Wiki content utilized for knowledge transfer from the perspective of new PLs.

TABLE I
FIRST STUDY RESULTS [4]

Exp. Design	Summary Results
Participants	We chose 24 volunteer participants of the PL team by convenience. These participants were composed of only newcomers and only had initial experience with Sidia project processes.
Indicator	To evaluate the quality of use and acceptance when participants interacted with wiki, we analyzed perceived usefulness and perceived ease of use indicators within the Technology Acceptance Model [6].
Results	Considering ease of use, 42% reported that they had difficulty with Wiki content presentation, and another 32% considered Wiki easy to find information. Considering useful perception, 76% of users reported as positive results.

The findings helped the researchers discover usability issues, obsolete information, and training gaps that hampered their onboarding process. We used the findings to fix usability issues and update Wiki articles. As result, a content template was created based on the 5H2W model, and this new method helped the newcomers understand and associate the Wiki material with the work process [13].

The training program was another significant feature of this study. During the pandemic, a tool was introduced to allow for online training to be recorded and accessed at any time. The Wiki material was being rewritten based on these findings. However, another intriguing topic for future research is how to reduce the impact of newcomers' misunderstandings throughout their integration. In our case, we applied Wiki, but it is possible to recommend a set of data analytics based on the learning of developer profiles. However, it is an aspect that still needs further investigation. Hence, we designed a study to evaluate the proposed Wiki version, described in the next section [13].

III. EVALUATING WIKI IMPROVEMENTS THROUGH NEW CASE STUDY

After applying the changes and improvements to the Wiki, we decided to plan a study to use quality of new Wiki version. For this reason, we use a Goal Question Metric (GQM) model [13]. GQM is an objective-oriented model aimed to measurement of software products and processes [10]. The goals of this study are shown in Table II.

TABLE II
GOAL OF EXPERIMENTAL STUDY USING GQM [10]

Analyze	New Wiki version
With purpose of	Evaluate
In terms of	Ease of use and useful perception in comparing previous Wiki version
From point of view	Software Project Leaders
In context of	Onboarding process

We create an online questionnaire to collect responses from Software PLs about their perceptions, which provides us a general perspective about how they felt and the Wiki value. In addition, the case study provides us more details about the learning process that newcomers follow during the onboarding process. In Subsection *A,* we describe the Experimental Design with the planning, procedures and indicators used on this study.

A. Experimental Design

In order to evaluate the updated Wiki version, we decided to apply a survey, through questions using a Likert-scale [11]. Data were collected by creating a questionnaire combining Technology Acceptance Model (TAM), created by Davis, 1989, and Unified Theory on Acceptance and Use of Technology (UTAUT) model as a basis [14]. While TAM focuses on ease and usefulness perception, UTAUT integrates theories' technology adoption and provides a comprehensive view of the factors affecting users' adoption behavior. Moreover, we create open-ended questions to identify gaps and suggest improvements in a comparison with the first Wiki version. We aimed to identify pages that are decrypted or that need updating. After defining the questions and grouping by each construct, based on the models' acceptance, we share the online survey to volunteer participants chosen by convenience sampling.

In the next subsection, we describe the participation criteria

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for the participants of this study.

1. Participants

Using convenience sampling, considering internal skills, we consider newcomers PLs who have been working at Sidia

company for 2 years. In this case, we chose 26 volunteer participants. PLs members need to have high technical skills to work on critical projects, for instance, new model projects. Fig. 1 shows information about the team profile.
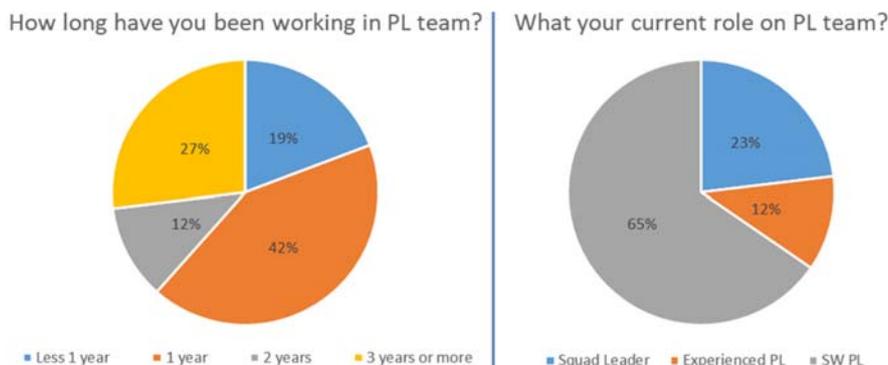

Fig. 1 Team profile results

We also identify roles played in the work chart organization of the team. This information is useful to identify who participants have more engaged to use and update Wiki pages. According to results, we have most of the team made up of newcomers, with 42% of participants, about 11 participants. Also, 27%, about three participants have one year and 19% have less than one year into a company. About role played we have two groups: Squad Leader and SW PL. Squad Leader is main responsible for projects, he works on external communication, planning, and negotiating of projects. SW PL is a project leader responsible to assist the Squad Leader with internal communication and project development. Fig. 1 shows that 65% of participants are SW PLs and 23% are Squad Leaders and only 12% are experienced PLs.

Considering frequency of Wiki usage, most of the team usually access the Wiki page. About 36% use it more than 10 times a week, and 32% use it between five and 10 times a week, 20% use it between one and three times a week, and 12% of participants usually use the Wiki page three and five times a week, as summarized in Fig. 2.
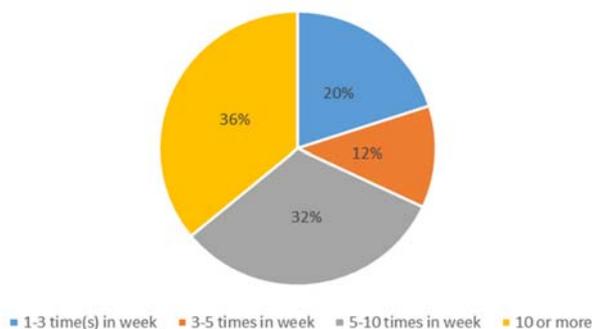

Fig. 2 Wiki usage frequency results

Considering the previous version, described in [4], in the first study, the team members reported strong difficulty to use Wiki,

for this reason, they used the Wiki with low frequency. In this case, we had a substantial increase in usage after the Wiki update, from 17% of the first version to 36% of the new version.

2. Indicators and Procedure

We applied the survey using an online questionnaire over a one-week period (14–s19 February 2022). Data were collected by creating a questionnaire combining TAM and UTAUT model as a basis. TAM focuses on aspects that are strongly correlated to user acceptance of a given technology [11]. The UTAUT model integrates theories' technology adoption and provides a comprehensive view of the factors affecting users' adoption behavior [15]. This model focusses on four main constructs – performance expectancy, effort expectancy, social influence, and facilitating conditions. For this reason, it is possible to be used to check the learning process through cross-cultural validation [12], [15].

The online questionnaire provides us with subjective data related to performance expectancy, effort expectancy, social influence, and facilitating conditions; the questionnaire is available in Appendix 1. To help us understand potential added Wiki value, it was created two open-ended questions to collect difficulties perceptions and improvement suggestions. Also, we collected learning preferences adopted by newcomers. This result was useful to create the onboarding process most effectively.

IV. RESULTS

Following the first goal of the study, data were collected during a week in February 2022. The questions were grouped using TAM and UTAUT perspectives. The results were useful to characterize learning strategies adopted by our team that can be used to improve training and learning objects such as online tutorials, content, and FAQs. About 26 participants answered questions and reported improvements into opened questions.

Considering the learning strategies, the results show that 43% first look for information on Wiki. In addition, 25% of

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participants prefer to ask an experienced co-worker and 15% first ask from people that have more contact. Only 5% prefer to watch video training online, as shown in Fig. 3.

Fig. 3 Learning strategies results

The results show that Wiki is the main option when team members have doubts related working process. Thus, we need to improve Wiki content to support better knowledge transfer and sharing. Another important analysis considered was the order interaction flow when participants have a question-related process, activities, and information is required. We divided the questions into options that were previously mapped, such as 1. I Look for Wikis; 2. I ask to Project main PL; 3. I ask in PLs Knox group; 4. I ask experienced PLs (private chat or personally) and; 5. I never ask. We ask them to participants answer us which interaction order they follow when they have

questions. Fig. 4 shows the most option they follow.

Fig. 4 Flow interaction results

According to Fig. 4, the option with more frequency was option "2. I ask to Project main PL". So, when the participants have questions they prefer ask to main project PL, usually Squad Leader. Considering performance expectancy, we have positive answer that indicates Wiki as good for improve performance, specially to search important information, see Fig. 5.

According to Fig. 5, 23% strongly agreed that Wiki saves time when participants use it, and 42% agreed that Wiki saves time when they use it. However, 11% disagreed that Wiki is important to saving time when using it. So, current Wiki version meets performance expectations. Considering effort expectancy, 53% use Wiki effortless, others 43% reported that current Wiki version is friendly. However, about 38% reported that disagreed that using Wiki enables to accomplish task more quickly, see Fig. 6.
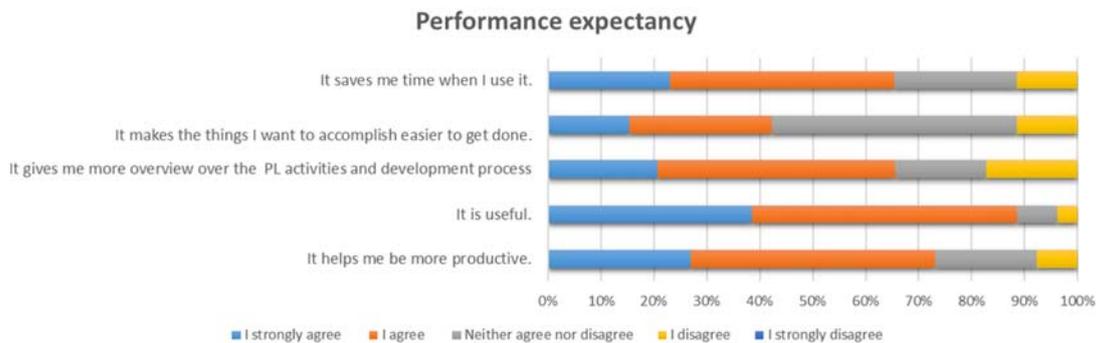

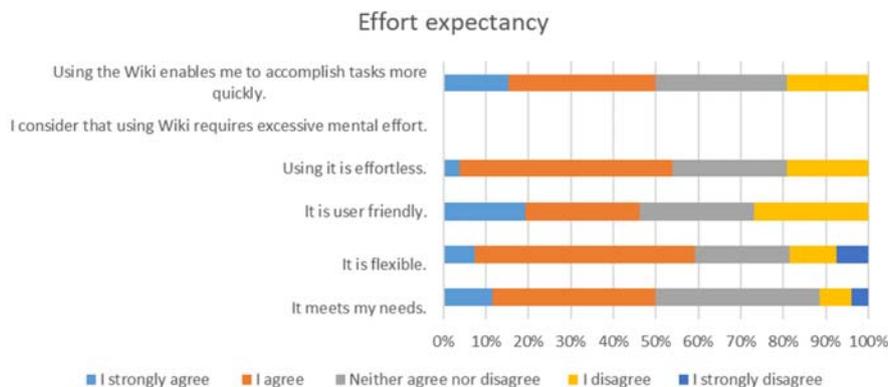Fig. 5 Performance expectancy results

Fig. 6 Effort expectancy results

The results show that Wiki meets effort expectancy, however, needs more improvements related to a friendly user interface and to minimize mental effort due to a lot of information. Considering the social influence factor, we can see

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from the results that most of the team feel engaged using Wiki for creation and update contents pages.

About the social influence factor, the results show that people feel encouraged to update Wiki information. According to the results, 65% feel encouraged positively, and 15% disagreed that they did not feel encouraged or engaged to update Wiki information. Another important finding is related to the influence of social collaboration; 78% agreed that they feel encouraged when people with whom they share social intimacy (mentors, experience PL, SL) recommend Wiki usage.

The results related to the perception of facilitating conditions were about 75% of participants reporting that they feel comfortable using Wiki. Also, 80% reported that do not feel hesitant to use Wiki, see Fig. 7. Moreover, we use open-ended questions to understand some of the difficulties still faced by participants of the study. As suggestions, we extract improvements as reported by participant 3, who said: *"It needs more visual pages and with more examples."* And other participant who reported that *"Monitoring pages updated. There are some processes/systems that have changed but the pages remain the same way from when they were created."* Hence, we can check there are still pages decrypted that need to be updated.
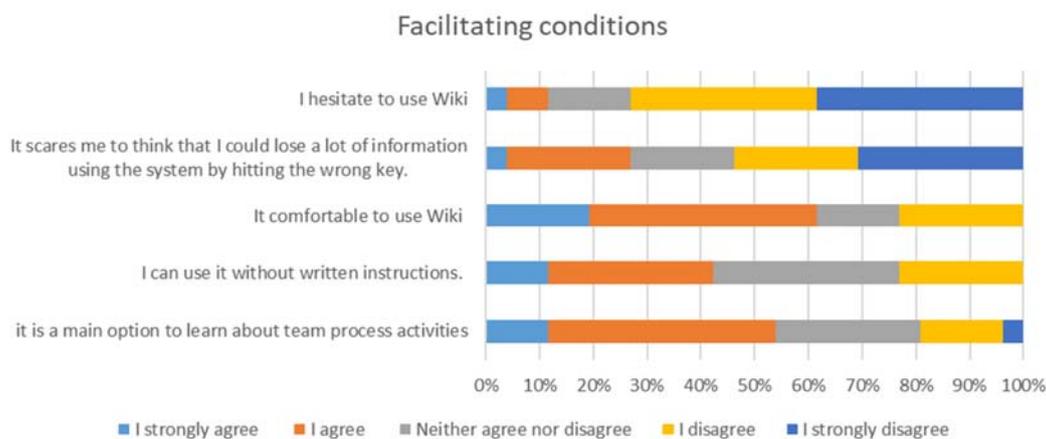

Fig. 7 Facilitating conditions results

Other important contribution was reported by participant 18 who said: "One way to help improve this [system] would be to always emphasize the use of the wiki in every training and have more and more pages with great content on the wiki.". Thus, we need to combine Wiki content with training applied during the onboarding process. Also, we collected learning preferences followed by newcomers. This perception was useful to create the onboarding process most effectively.

V. SUMMARY AND FUTURE WORK

This paper presented a study performed related to Wiki, collecting information about how newcomers learn about the work process. The collected data were used to understand the learning process of newly PLs hires and to improve the knowledge process, specifically about knowledge transfer. In this sense, we conducted an empirical study attended voluntarily by 28 new PLs from Sidia.

As future work, we intend to improve the Wiki content, redesigning based on group learning. Thus, we will replicate this study after improvement and compare the results with the current work. It is expected this experience report to show through practical examples, as it is possible to improve the learning process. In addition, we hope to encourage the software development industry to improve knowledge transfer to improve newcomers' onboarding to better support difficulties faced by them.

APPENDIX 1

TABLE III
SURVEY QUESTIONS

Construct	Question(s)
Profile Characterization	Q1. How long have you been working in the PL team?
	Q2. What is your current role in the PL team?
	Q3. How many projects have you worked on as a PL (main PL or auxiliar PL)?
	Q4. Which project types have you worked in?
	Q5. How many wiki pages have you published or updated?
Learning preferences	Q6. How many PL trainings have you participated in?
	Q7. About your learning preferences, choose which best matches your preferences: (reading, online or personal trainings, mentoring by experienced PL, from myself).
	Q8. If you experience doubt during an activity, how do you proceed?
	Q9. About PLs wiki use, how often do you access the Wiki page?
Questions using the Likert Scale	
Performance expectancy	Q10. The Wiki page helps me be more productive.
	Q11. The Wiki page is useful.
	Q12. The Wiki page gives me more overview of the PL activities and development processes.
	Q13. It makes the things I want to accomplish easier to get done.
Effort expectancy	Q14. The Wiki page meets my needs.
	Q15. I consider that using the Wiki page requires excessive mental effort.
	Q16. Using the Wiki page enables me to accomplish tasks more quickly.
	Q17. Using the Wiki page is effortless.

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Construct	Question(s)
Social influence	Q18. The Wiki page is flexible.
	Q19. The Wiki page is simple to use the Wiki page.
	Q20. I feel encourage to use the Wiki page.
	Q21. I feel encouraged to edit, improve or create new Wiki pages.
	Q22. The Wiki page allows to improve collaboration and knowledge sharing.
	Q23. People with who I acquire social intimacy (mentor, experience PL, SL) recommend using the Wiki page.
	Q24. I feel apprehensive about using the Wiki page.
	Q25. It is somewhat intimidating for me to collaborate in the Wiki page improvement
Facilitating conditions	Q26. The Wiki page is a main option to learn about team process activities.
	Q27. I can use the Wiki page successfully every time.
	Q28. It is comfortable to use the Wiki.
	Q29. It scares me to think that I could lose a lot of information using the Wiki page by hitting the wrong key.
	Q30. I hesitate to use the Wiki page.

REFERENCES

[1] J. Kroll, J. Mäkiö and M. Assaad, 2016. "Challenges and Practices for Effective Knowledge Transfer in Globally Distributed Teams - A Systematic Literature Review," In: 8th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (IC3K 2016).

[2] N. B. M. A. Š. C. W. Darja Šmite, 2017. "Software teams and their knowledge networks in large-scale software development," Information and Software Technology, pp. 71 - 86.

[3] G. Avram, 2007. "Knowledge Wok Practises in Global Software Development," ECKM2007- Proceedings of the 8th European Conference on Knowledge Management, Barcelona, Spain, p 87-97.

[4] Cunha. et al 2020. How do newcomers learn work process in Global Software Development (GSD)? A survey study from the perspective of newly project leaders. in Proceedings of the 15th International Conference on Global Software Engineering, 2020, pp. 117–121.

[5] Biswas, S. 2017. Adoption of Knowledge Management Systems: A Study on How Wiki Systems Should Be Adopted by Minimizing the Risk of Failure. In Journal of Information and Knowledge Management 7 (7), 1-7.

[6] F. S. K. D. a. E. A. G. Kanakis, 2019. "Supporting a flexible grouping mechanism for collaborating engineering teams," in: Proceedings of the 14th International Conference on Global Software Engineering.

[7] E. Hustad, 2014. "Knowledge networking in global organizations: the transfer of knowledge," SIGMIS Conf. on Computer Personnel Research: Careers, Culture, and Ethics in A Networked Environment, 299-239.

[8] Mahmood Niazi et al, 2015. "Empirical investigation of the challenges of the existing tools used in global software development projects," IET software, vol. Vol 9, p. 135 – 143.

[9] Lima, et al. 2020, Identify Difficulties in the Knowledge Transfer Process in Global Software: A qualitative Analysis. XIX International Conference WWW/Internet – ICWI 2020, p 20-28.

[10] Heredia, A. et al., 2017. "Tool-supported continuous business process innovation: a case study in globally distributed software teams" European J. International Management, pp. 388 - 405.

[11] M. Chuttur, 2009. "Overview of the Technology Acceptance Model: Origins, Developments and Future Directions," Sprouts: Working Papers on Information Systems, vol. 9, nº Sprouts, pp. 9 - 37.

[12] Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: toward a unified view. MIS Quarterly, 27(3), 425–478.

[13] Bonifacio, Bruno A. et al (2021). Improving Knowledge Management Using Wiki Tool Through Experimental Studies. 20th International Conference WWW/Internet 2021.

[14] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information tech-nology. Management Information Systems Quarterly, 13(3), 319–340. doi:10.2307/249008

[15] Kang, Myung Soo & Im, Il & Hong, Seongtae. (2011). The Meaning and Measurements of the UTAUT Model: An Invariance Analysis. International Conference on Information Systems 2011, ICIS 2011. 3.