UNIVERSITY OF TURKU

ABSTRACT

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Abstract

Due to the Covid-19 pandemic, many organizations that did not do so before have switched to working virtually. At the same time, an increasing number of businesses are adopting the frameworks of Lean Management and Continuous Improvement in attempts to reduce waste in their knowledge work processes. The purpose of this study is to explore the impact of virtual collaboration on waste reduction in organizations. The research assesses how virtual working affects organizations' collaborative process, and what wastes organizations have before and after the introduction of full-scale virtual working.

Through six focus groups, six teams from different organizations, five from Thailand and one from the Netherlands, were interviewed about waste and collaboration within their teams since virtual working. Interview results are discussed in detail, seen in the light of existing literature. To further explore collaboration, surveys that include questions about Teamwork Quality in a virtual setting were distributed to all focus group participants.

While it is yet unclear whether virtual collaboration only has positive or negative impacts on waste reduction, the impacts are apparent. Results show that different teams are impacted differently. This could be linked to the way that organizations use technologies to support virtual working, as well as differences in organizational and national cultures. Future research should explore this further, taking into account the framework provided by this study and adding more elements to it.

Key words	Virtual collaboration; Waste; Lean; Continuous Improvement

REDUCING WASTE IN KNOWLEDGE WORK AT THE WORKPLACE: A VIRTUAL EXPERIENCE

An exploratory study on the impact of virtual working on waste reduction in the Lean Management framework, in organizations

Master's Thesis
in IMMIT

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1.1 Background

1.1.1 Research context

A world where communication is performed virtually on a daily basis is no longer a world in imagination. Today, due to the worldwide Covid-19 pandemic, working from home is not an anomaly in multiple corporations, which have been forced to fully integrate themselves with digitalization (Fogarty et al., 2020). The change has been burdensome to various stakeholders (Semuels, 2020). The impact of remote work might not only affect the quality of work, but also the productivity of employees (Monteiro et al., in press).

Some major players have adopted the concept of Continuous Improvement and Lean Thinking into their manufacturing sectors (Bittencourt et al., 2019). The concept revolves around the reduction of waste (Caldera et al., 2017). Meanwhile, many companies are not yet aware of the concept, though an attempt to remove or avoid waste in business processes is not brand new. In essence, reducing waste leads to a variety of positive outcomes, including lowering costs, improving efficiency, and better satisfying customers (Caldera et al., 2019).

Several empirical research papers address the need and impact of integrating a Lean point of view into manufacturing settings (Dombrowski et al., 2019). However, there is still a lack of research on how the use of the Lean concept in Continuous Improvement can be adopted in office sectors in corporates, especially when virtual working has become part of everyday work (Casado et al., 2020). Hence, my interest lies in finding out the effects of virtual collaboration in the office environment following the Continuous Improvement and Lean frameworks.

1.1.2 Lean Management

The academic research selected for this study relates to Lean Management in the Continuous Improvement area. The concept, which was first recognized as the Toyota Production System by Taiichi Ohno, a Toyota executive, has been utilized by a number of companies (Sutherland & Bennett, 2007). The companies mostly adapt the Lean principles to their production process in an effort to eliminate waste (Rodríguez et al., 2020).

To elaborate, the concept of Lean Management, initially used in manufacturing, is focused on creating value for customers by reducing waste. Any unnecessary steps in a

business process are waste and should be identified and withdrawn. The framework has also been adopted in the service sector where, no goods are produced to satisfy customers, but a service is delivered (Helmold, 2020). However, with knowledge work, many tasks are not repeatable and its processes are often designed within the worker's head (Kelloway & Barling, 2000). Therefore, the value is not tangible and cannot easily be seen (Santhiapillai & Ratnayake, 2018). To understand more about the knowledge work, the definition of knowledge sharing will also be explored in a later part as well as its explanation.

Furthermore, the essential steps of the Lean principles described by Womack and Jones (2003) are worth taking into consideration. It starts with *Value*. The value specification is the important action taken by the manufacturer, or herein employees in the offices, who tries to capture what customers, or whom those employees serve, see as value. The second is to define the *Value Stream*, which represents all the steps needed to produce the goods or carry out services. Third, for the value stream to be effective, it should *Flow*. For that to happen, any unnecessary steps need to be removed. "Batch-and-queue" (circulating tasks from department to department), also known as task batching, can be banished in order to create a continuous flow. Fourth, since the production can be done faster, the customers can simply *Pull* the products or services from the providers whenever and however they want the final piece to be delivered. The customers tend to demand more products or services when their needs can be served almost immediately.

Moreover, since Lean thinking helps companies work towards value creation for customers and decreasing non-adding value processes (Silva, et al., 2013), any activities that do not add value are waste (Rodríguez et al., 2020). Waste has been divided into seven types by Taiichi Ohno (Sutherland & Bennett, 2007): *Transportation*, *inventory*, *motion*, *waiting*, *overproduction*, *overprocessing*, and *defect*. Liker (2003) also adds one final important waste, *Unused employee creativity*. According to Conner (2001), one of the essential forces that supports the concept of Lean is *people*. When people work together towards the same goals, collaboration exists (Chudoba et al., 2005; Kayser, 2011).

To summarize, this research focuses on three main areas: virtual working, collaboration, and waste in Lean Management. A qualitative study using focus groups composed of a set of interview questions and a short questionnaire as a supporting method was created based on these three areas. It allows a thorough understanding of current circumstances, and a structured analysis.

Besides waste identification, the need to analyze and standardize processes is apparent (Anand et al., 2009). Papazoglou and Ribbers (2006) describe the business process as a set of activities performed to fulfill requirements of a business. All processes within an organization are interdependent and designed to achieve the results that will satisfy the customers, who trigger different processes.

Within an organization, there are different functions. Each function consists of members who work together on a team level in order to achieve particular goals and satisfy people who use their team output (Ahmady et al., 2016). Therefore, it is important to define waste within their workflow. Six teams from different organizations are studied. Five of them are from Thailand and one of them is from the Netherlands. Therefore, the interview questions and questionnaire were created in two languages: English and Thai, to accommodate teams that are not comfortable speaking English.

The purpose of this research is to find out if the remote working helps reduce, maintain, or increase the aforementioned waste.

Although it was initially not part of the research focus, during the research, unexpected findings revolving around the influence of culture came up. This cultural aspect is briefly discussed in the Findings and Discussion chapters.

1.2 Definitions

In this manuscript, the following definitions are used for the concepts featured in this research. More context to these definitions is given in different sections.

Organization: a form of relationships between people, positions, and units within organization. Also, it is formed to accomplish certain goals (Ahmady et al., 2016).

Waste: non value-adding activities remaining from any input in the system with the purpose of achieving certain outcomes, that cannot be altered into any valued output (Thürer et al., 2016).

Continuous Improvement: a systematic effort to seek out and apply new ways of doing work (Anand et al., 2009).

Virtual work: the environment where employees work disconnectedly from colleagues or physical work location on interdependent work activities (Watson-Manheim & Belanger, 2002).

Collaboration: a joint effort between two or more people (parties), free from hidden agendas, to produce an output in response to a common goal or shared priority (Kayser, 2011).

Knowledge work: work in which workers create, apply, transmit, and acquire knowledge (Kelloway & Barling, 2000).

Business process: a set of activities performed to fulfill requirements of a business (Papazoglou & Ribbers, 2006).

1.3 Research questions

Two research questions are established to support the research topic. The questions are as follows.

1. How does virtual working (workplace mobility) affect the organization's collaborative process?
2. What are the wastes that the organization has before and after full-scale virtual working (workplace mobility)?

The first question is for finding out the work practices and technologies in the organization used to support the Teamwork Quality, which is deployed in this research to measure collaboration of a team in a virtual setting, and seeing in which way it impacts the processes within the organization. The second question is answered by results from the interviews with different teams, who now work from home but have experience working in person with each other before.

Besides answers to both research questions, a dimension of the influence of culture on virtual collaboration and Lean Management was found after concluding research.

Table 1 Research overview

Research question	Measure	Method	Result	Conclusion
1. How does virtual working (workplace mobility) affect the organization's collaborative process?	TWQ - Work practices - Technologies CI cycle - PDCA	Questionnaire to function members working from home - Focus on work practices and technologies used, and knowledge work Focus group interviews with function members working from home - Semi-structured interviews	Work practices and technologies used to support collaboration of each team	- Unstable technology and tools adoption have a negative impact on organizational process. - Technology lessens personal boundaries. - Cultures can either expedite or delay the processes.
2. What are the wastes that the organization has before and after full-scale virtual working (workplace mobility)?	Eight types of waste	Focus group interviews with function members working from home - Semi-structured interviews	Relationship between virtual collaboration and different types of waste	- Different teams show similar and different types of waste. Due to the type of business and nature of the work, waiting demonstrates to be the most commonly experienced waste. - Culture plays a part in the types of waste a team experiences. - There are non value-adding activities that do not have a big impact on customer satisfaction, so teams do not look for solutions.

2 THEORETICAL BACKGROUND

2.1 Virtual work

The term virtual work has been used in different contexts, including an academic sphere. It is present in various research for both main and subtopics. It is essential to have a clear interpretation of the term for this study as it allows the virtuality to be measured more precisely. Watson-Manheim and Belanger (2002) define virtual work as the environment where employees work disconnectedly from colleagues or physical work location on interdependent work activities. The collaboration is performed through information and communication technologies (ICT) among workers distributed into separate places (Chudoba et al., 2005). Chudoba et al. (2005) agree that working from home is virtual work and also agree with the general assumption that one of the challenges in virtuality is distance.

2.1.1 A measure of virtuality

To begin with, a measure of virtuality by Chudoba et al. (2005) will be introduced. This measure consists of six discontinuities, which represent barriers to good cohesion and a good environment for virtual work. The six discontinuities are geography, time zone, culture, work practices, organization, and technology. Their explanations are as follows.

First, the *geography* emphasizes the work done in separate locations. The transportation is replaced by the use of internet-based means. Communication, in turn, is hampered by the cumbersomeness of the distant work.

Second, the *time zone* is used to represent the situation where team members perform work in different time zones. Some members of the team have to work longer or work during unusual hours to communicate with other team members in other geographic locations.

Third, the *culture* is a value shared by one group of people, such as people from the same nation or sharing a common cultural background. A team can be composed of workers with diverse cultural backgrounds. How one connects to others or makes decisions can be influenced by the culture one carries.

Fourth, the *work practices* are asserted as ways for team members to perform the work based on similar perceptions. Each team member can sometimes have different

ideas on how tasks could be carried out, in terms of both processes and tools. Therefore, having a set of shared understandings or work practices when working together is important to avoid conflicts and reduce miscommunication.

Fifth, the *organization* can be referred to as either intra-organization: different functions or business units within the same organization coordinate with each other, or inter-organization: one or more team members from different organizations work together. The intra-organizational collaboration members may have different priorities that can cause some conflicts. Meanwhile, the members involved in the inter-organizational collaboration work towards common goals, shared by each organization. The problem with inter-organizational collaboration is that while workers share common goals related to the specific task, they remain loyal to their organization and prioritize the demands from their employers.

Last, the *technology* is the foundation of virtual collaboration. ICTs are needed for members to communicate. By not having or having limited access to ICTs, some members find it difficult to fully contribute to the team.

2.1.2 Three dimensions of virtuality

One aspect of virtuality is how the work is perceived as virtual. This brings us to the three dimensions concluded by Chudoba et al. (2005) The mentioned dimensions are team distribution, workplace mobility, and variety of practices.

First, the *team distribution* can be explained as working with people in different locations and different time zones. The work can be done at the local office to collaborate with colleagues positioned in different office locations.

Second, the *workplace mobility* can be described as working away from the office locations of the organization and having different working environments.

Third, the *variety of practices* is related to workers dealing with different cultures and work processes established among their teams.

In this research, the focuses are on two discontinuities of a measure of virtuality and one of virtuality's dimensions. To start with, the focused discontinuities are work practices and technology. The reason is that one of the purposes of this study is to gauge how working from home affects the knowledge work process within the organization. Having a clear shared understanding or work practices within a team or when collaborating is the

main part of the knowledge sharing in the knowledge work, which will be further elaborated in the upcoming part 2.4: Knowledge work.

The measures of work practices are to investigate how team members work with others who might have different ways of working and how they deal with changes, such as a change of some team members or different tools and collaboration technologies used by others.

The measures of technology are based on the selection of technologies or tools used for working with each other, for instance, internet-based conferencing applications or mobile devices, or both.

As for the focused dimension of virtuality, the research emphasizes the workplace mobility dimension because nowadays, due to the Covid-19 pandemic, a working condition where people have to work in different locations is not only experienced by people from different teams or different counterparts in different time zones anymore, but also people within the same team, who used to work together in person.

2.1.3 Information and Communication Technologies (ICT)

As technologies continue to improve collaboration in the virtual environment, it is important to learn what is understood as ICT. Although it is difficult to arrive to the universal definition of ICT, Zuppo (2012) presents definitions of ICT from the business environment perspective that can be concluded as technologies, including devices and their supported networks and systems, that individuals and organizations use in order to process information, and communicate in a business.

2.2 Continuous Improvement

The notion of Continuous Improvement (CI) revolves around changes in the process for the better. Anand et al. (2009) define it as "*a systematic effort to seek out and apply new ways of doing work i.e. actively and repeatedly making process improvements*". It was at first adopted in the manufacturing industries (Singh and Singh, 2012) and has now been applied to knowledge work as well (Kropsu-Vehkapera & Isoherranen, 2018). The idea does not require a big investment but an ongoing effort in introducing new working methods (Singh and Singh, 2012; Anand et al., 2009).

CI stands in contrast to the - in business more traditional - notion of disruptive innovation, which is characterized by big leaps forward by coming up with new ideas shaped

by individual minds. Between moments of improvement triggered by innovation are periods of standstill during which research and development takes place to find the next innovation (Singh & Singh, 2012).

On the other hand, Singh and Singh (2012) mention that the success of CI depends on moving forward with many small steps as an ongoing process fueled by the minds of (ideally) every worker in the organization. Innovation still takes place, but on a smaller, more frequent scale. This eliminates the periods of standstill.

Organizations are required to constantly deal with a rapid shift in the customers' needs (Singh & Singh, 2012). Demands of customers can sometimes be erratic (Lu et al. 2011), especially when it comes to tacit knowledge work, as perspectives can be discrepant (Chudoba et al., 2005). Therefore, according to Singh and Singh (2012), the organizations need to comprehend the current situation, plan an improvement according to it, and examine before executing the plan as a standardized process. This is where the plan-do-check-act (PDCA) cycle plays a role.

The PDCA cycle represents four steps that can be used in learning and improvement repeatedly.

1. *Plan*: assess the status quo and come up with new improvements.
2. *Do*: try out these improvements.
3. *Check*: study how the improvements work, and if they actually deliver an improved result.
4. *Act*: make a permanent standardization of the improvements.

When looking into the infrastructure of CI, for this research, the main focuses can be placed on process and people. The reason is that the aim of CI is to improve processes, and according to Helmold (2020), people are the main drivers of improvement to achieve the organization's goals.

2.3 Collaboration

The heart of this research comprises looking into various aspects of collaboration in a virtual work setting. More specifically, it focuses on collaboration in functional teams within an organization. The next paragraph explains how the level of collaboration will be measured for this research.

First, however, there must be a definition for collaboration. Kayser (2011) defines collaboration as "*a joint effort between two or more people (parties), free from hidden agendas, to produce an output in response to a common goal or shared priority*".

From this, it is clear that collaboration entails multiple people working together, and that there is a goal they are working toward.

2.3.1 Teamwork Quality

Teamwork Quality (TWQ) is a term coined by Hoegl and Gemuenden (2001), with the purpose of measuring the level of collaboration in organizations. It can be a valuable tool to measure the level of collaboration in organizations in all sorts of teams (Easly et al., 2003).

Although a link can be established between TWQ and a multitude of outcomes of collaborations, such as efficiency or total productivity (Lindsjørn et al., 2016), TWQ is a stand-alone variable which depends solely on how team members act in their collaboration. Once the level of TWQ in a team is established, it can then be linked to other variables. In the context of this research, that will be the identification and reduction of waste. This research will therefore use the framework of TWQ to measure the level of collaboration.

2.3.2 Six aspects of TWQ

TWQ can be split up into six distinct indicators that, taken together, will provide a measure of collaboration. A low "score" on one indicator could be compensated by a high "score" on others. The six aspects are *Communication*, *Coordination*, the *Balance of Member Contributions*, *Mutual Support*, *Effort*, and *Cohesion*.

Communication: teamwork is impossible without communication. This facet of TWQ can itself be measured by taking into account four factors, derived from the work of Pinto and Pinto (1990). The first is the frequency of communication, or: how much time team members communicate. Second is the degree of formalization of communication, or how spontaneous communication is (does it require planning, preparation etc.). The third factor concerns the directness of communication. In other words: do team members all communicate directly to each other, or is there a mediator involved? Finally, there is the degree of openness of communication, relating to the question whether team members hold back any information for any reason.

Coordination: teamwork implies having input from multiple team members. In order for the collaboration to work well, it is essential that contributions of team members are collected in a structured and synchronized manner. This prevents gaps in and overlap of work.

Balance of Member Contributions: while the relevance of this facet depends on the kind of team (does every team member have a different expertise or not), it is beneficial to the quality of teamwork when no members of the team are limited in contributing their knowledge and expertise to the team.

Mutual Support: while individual tasks can improve from competition with coworkers, work in a team often implies people depending on each other for the completion of tasks. In such a scenario, competition is less effective than cooperation between team members. This includes guiding each other, respecting each other, and helping shape each other's ideas instead of trying to one-up one another (Tjosvold, 1995).

Effort: part of collaborating with others, is putting in effort, i.e. sharing the workload and giving priority to tasks in the team. It can come to conflict when some team members put in too little effort. Setting norms and expectations on effort spent prevents this conflict, by ensuring that team members all put in the same effort.

Cohesion: perhaps the most elusive element of TWQ is team cohesion, or team members wanting to work together in the team. Mullen and Copper (1994) find three elements of cohesion: first, how much team members like each other; second, how committed everyone is to the task the team performs; and third, the existence of pride about being in the team, or: "team spirit".

2.4 Knowledge work

Knowledge work is work in which workers create, apply, transmit, and acquire knowledge (Kelloway & Barling, 2000).

Kelloway and Barling (2000) argue that how knowledge is used by workers is more important than how much knowledge there is within an organization. Knowledge may be categorized in different ways (Blackler, 1995) but in this research, the focus is on how knowledge work, both creative and routine, is managed through various activities within a process (Kropsu-Vehkapera & Isoherranen, 2018). Walker (2017) also proposes that for information that is not explicit, it may be found in prior knowledge or routine workflows.

Within an organization driven by knowledge work, sharing knowledge is critical. Boer (2005) clearly states, "*Knowledge sharing, therefore, refers to a social-relational process through which individuals try to establish a shared understanding about reality and to establish the (potential) ability to transform this understanding into (collaborative) actions to yield performance. They do this by using diverse combinations of signs (e.g. language, gestures, illustrations) and tools (e.g. physical objects, communication technologies, mental models)*". The explanation of knowledge sharing by Boer (2005) can be associated with the aforementioned concepts of virtuality where the work practices are important for a team to work together. So are proper technologies for maintaining good communications.

2.5 Functional structure

According to Ahmady et al. (2016), an organization is formed to accomplish certain goals. Different organizations may select different structures that are consistent with their goals, environments, strategies, and sizes.

The type of structures of each organization can be based on the social relations among its people, positions, and units (Ahmady et al., 2016). This research concentrates on the functional team in the organization since now, everyone or most of the people in the same organizational unit has to work from home. Ahmady et al. (2016) explain a functional structure as a tool to group activities based on how similar their work functions are. Each function is filled with people, with a particular set of skills, who share common goals and their duties are dependent on each other.

2.6 Business process

The business process is given a definition by Papazoglou and Ribbers (2006) as a structured set of activities or steps required for achieving an output, transformation of data or products, or creating values desired by a customer or a market. Moreover, every process has a customer who is not necessarily the one who places an order but the one who triggers the process.

Furthermore, Van Looy et al. (2011) define business process as "*a repeatable set of coherent activities, triggered by a business event and performed by people and/or machines, within or among organisations, for jointly realising business goals and in favour*

of internal and/or external customers". Furthermore, there are a myriad of classifications of business process, and they help better understand its complexities.

There are two main types of customers, internal and external customers. The internal customers can be the processes that needs the input from the producer of another process. The example of the external customers is the final customers who uses a product or service produced for them. (Papazoglou & Ribbers, 2006).

Moreover, Papazoglou and Ribbers (2006) state that communication plays an essential role within any business process, either planed or unplanned. The frequency of communication also depends on the uncertainty of the process operations.

One of the important demonstrations in the business process management is workflow view, a business process description presentation (Kock, 2005). Anand et al. (2009) mention that the standardized process is essential to establishing guidelines for additional process improvement.

Furthermore, Van Looy et al. (2011) mention how business processes are categorized depending on how they function and how they are structured. The functional categories were further categorized by Armistead et al. (1999) as first, "*core, operational, primary or value-adding processes*"; second, "*support or value-enabling processes*"; and third, "*management processes*" (Van Looy et al., 2011).

The first is concerned with producing and delivering products or services, contributing to creating value, and relates directly to external customers. The second focuses on supporting the value-creating processes and enabling performance in organizations, characterized by internal customers. Examples include processes concerning information management, and human resources. Lastly, the third involves strategy and determining policy, managing the general planning, and monitoring all activities in the organization.

The business process can then be categorized by structure. They can be fully structured, semi-structured or fully unstructured. Van Looy et al. (2011) argue that knowledge intensive processes should be less structured, given that they depend on human interactions instead of the more mechanical nature of manufacturing.

In contrast, Papazoglou and Ribbers (2006) explain that there are two dominant definitions of business process: workflow view and data view. The workflow view sees business processes as groups of interrelated activities that are carried out in a specified order, among which activities, data or physical materials are exchanged. The trouble with the workflow view is that materials do not move among activities but instead flow between functions or roles in the organization. The data flow view stresses how data flows within

business processes. Data is regarded as flowing in and outside business processes and between organizational functions. Papazoglou and Ribbers (2006) prefer this last view as it keeps its simplicity and better explains that what mostly flows between functions is data, independently of whether the studied company is a manufacturing company or not.

2.7 Waste

The concept of waste was first introduced in 1988 by Taiichi Ohno, along with Lean Management. It was initially applied solely in the manufacturing sector. Later on, the concept was as well adopted in the service sector (Helmold, 2020), and in knowledge work (Kropsu-Vehkapera & Isoherranen, 2018).

Thürer et al. (2016) argue that there are several definitions of waste by different authors. Ultimately, they came to a conclusion that waste can be characterized as non value-adding activities remaining from any input in the system with the purpose of achieving certain outcomes, that cannot be altered into any valued output.

Ohno (1988) and Shingo (1989) subcategorized waste into 7 types, which are over-processing, transportation, inventory, defect, overproduction, unnecessary motion, and waiting (Thürer et al., 2016). Helmold (2020) and Thürer et al. (2016) explain them as follows.

First, the overprocessing waste implies taking more steps or providing higher quality than what a customer demands or than what needed to satisfy the customer. Santhiapillai and Ratnayake (2018) describe this type of waste in knowledge work as the act of processing the data more than needed by people who use an output. Some illustrations of this waste are excessive paperwork, defective data processing, and unnecessary remakes.

Second, the transportation waste concerns too much movement of products or materials between different places. This can be applied to the explanation made by Santhiapillai and Ratnayake (2018) that this type of waste is associated with information's unnecessary movement among people and organizations. Examples of this waste are having too many stakeholders handling data before it reaches a user and having to contact many people or perform too many actions before getting the desired information.

Third, the inventory waste regards having too many raw materials and (semi-)finished products at hand. When referring to knowledge work, it shows a similarity, for instance, unprocessed data and hoarding of knowledge. The reason is that any data received

could be transformed into the output desired by the customers (Santhiapillai & Ratnayake, 2018).

Fourth, the defect waste relates to producing defective products that need to be produced again. In knowledge work, this means creating bad quality or inaccurate data, designs, or features, which can be of no use to anyone in the organization (Santhiapillai & Ratnayake, 2018). This can be linked to the first waste, overprocessing, as defective information may create more steps for colleagues to proceed.

Fifth, the motion waste represents the movement or action that does not add value or contribute to a transformation of any input. This type of waste can be demonstrated in the knowledge work as an unnecessary motion to gather required information. Unnecessary keyboard typing movement and poor office space arrangement are a few examples (Santhiapillai & Ratnayake, 2018).

Sixth, the waiting waste involves any periods in which machines, for example computers, or workers are not producing, because they have to wait for another process to finish. As for this waste in knowledge work, Santhiapillai and Ratnayake (2018) assert that this waste can cause a delay in process and hence, a value stream to stop flowing due to the insufficiency of required inputs and resources. For example, waiting for necessary information or feedback, unexpected events causing the whole process to stop, adjournment of tasks that others depend on, and late approvals.

The seventh waste, overproduction, points out the transformation of any input into a product without demands. It can be illustrated in the knowledge work as the process of producing and distributing before being asked which can be considered as pushing information to others, as well as producing and distributing unnecessary information. Deliverables that are produced by different groups are also part of the overproduction waste. (Santhiapillai & Ratnayake, 2018).

Thürer et al. (2016) also mention one key type of waste, which is talent or skill, misapplying of worker's creativity. When people's capabilities are not utilized to the fullest, ideas and possible improvements are wasted (Douglas et al., 2014; Gibbons et al., 2012). Employees not being given the assignments that match their skills or not receiving clear instructions provided by the organization to perform work (Sarkar, 2007) are examples of the talent waste.

2.8 Research focus and research model

To begin with, the research starts with the concept of virtuality of work, in this case, workplace mobility, where its measures are set to understand the virtuality in a certain environment, working from home. Next, to understand the waste identification and waste reduction within the workplace, the research emphasizes their main purpose, which is the business process improvement. The idea of CI is concentrated where the processes and people are focused on. The reason is that the studied types of waste concern the processes in which people in the organizations drive them. The people within each process collaborate to identify waste and reduce it in order to yield the best workflows and eventually satisfy their customers.

The waste concept in Lean Management is selected to categorize waste found in different types of organizations as the Lean framework can be placed in all industry types (Randhawa & Ahuja, 2017). As for the people part, their virtual collaboration is determined to recognize how it affects people's attempt to improve their processes. Do they realize waste in their processes? If they do, how does virtual collaboration impact their usual way of reducing it?

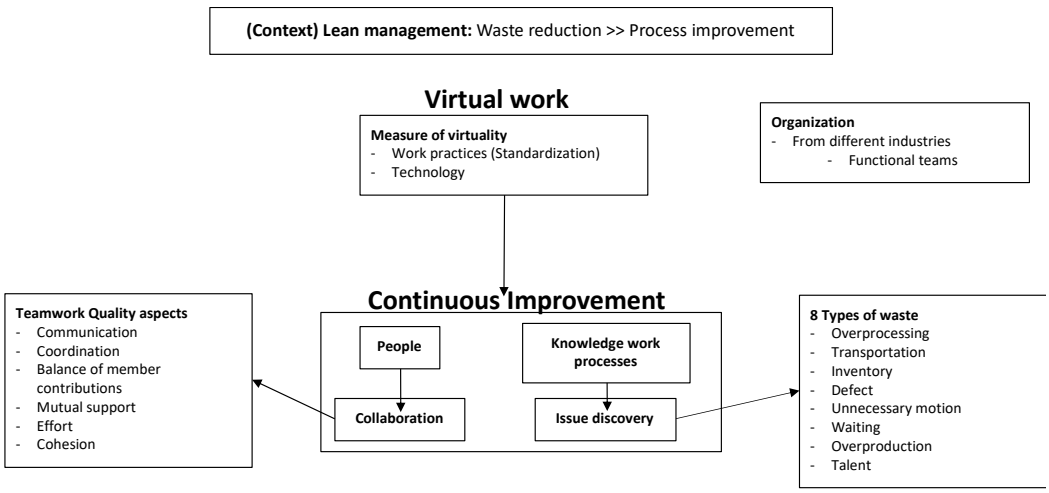

Figure 1 Research focus

2.8.1 Research model

The virtual work is evaluated by focusing on how people within teams, who work from home and experienced working in the office, collaborate and use ICT to support it. While different types of waste, that those people might have found, are to see if their styles of virtual collaboration have any kind of impact on those waste types.

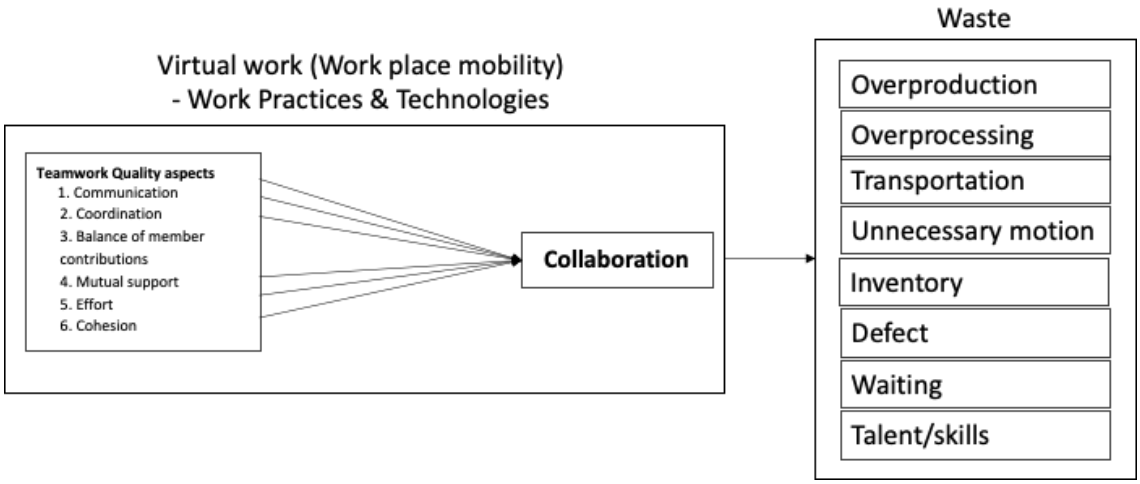

Figure 2 Research model

3 DATA COLLECTION PLAN

3.1 Chosen Methodology

A qualitative approach is chosen to be the main method for data collection of this research, together with a short questionnaire as a support method. Thus, a focus group interview and a short questionnaire are used to answer the research questions.

The focus group interviews are used to evaluate how participants in each focus group, representatives of each team, realize waste in their work and are involved in the process of waste reduction while virtually working. The reason for selecting this method is that this research is focused on a team level or the functional organization. Therefore, a consensus of each team as a whole can well be interpreted as group perception made by that specific group.

The focus group is a means to involve participants in exploring a focused topic while having an in-depth discussion. The participants are selected based on certain criteria, on their knowledge and experience on the given topic, and on their willingness to discuss with the interviewer and other participants. The main advantage of the focus group interview is the interactions among participants which help make the discussion fruitful and create more insightful data (Rabiee, 2004).

Philips and Stawarski (2008) also mention other benefits of doing the focus group interviews. First of all, it saves cost as it takes a shorter time than interviewing the same number of people one by one. Moreover, one participant's answer might ignite ideas in other participants which could possibly bring unanticipated outcomes. However, despite how good this method sounds, the challenge is to keep the whole group focused on the main topic and its subpoints in order to get useful and expected types of information. Consequently, good planning is essential.

As for the short questionnaire, this method is adopted to support the interviews. The questions are based on the six aspects of the Teamwork Quality framework which are combined as a proxy to measure the virtual collaboration of each team. The reason for choosing this method is that the level of collaboration can be depicted subjectively as it measures attitudes of individuals in the team. Moreover, as stated by Siniscalco and Auriat (2005), the aim of the questionnaire is to gather data from personal points of view about themselves or about a social unit, herein a team. The participants may as well feel

more comfortable estimating their team's collaboration and evaluating their relationships with others within their team anonymously.

3.2 Focus group participants and method

The focus group interviews are intended to gain thorough information from the interviewees of each team. Hence, the group size of each focus group interview is rather small. According to Krueger and Casey (2014), for non-commercial topics, the ideal numbers of participants are five to eight. Yet, smaller groups of four to six people are becoming more favored.

The planned number of participants in each group for this research is five as the participants may be more comfortable to attend a small group discussion as well as having opportunities to all share their experiences and opinions (Krueger & Casey, 2014). Eventually, the numbers of participants per group depend on the availability and voluntary of everyone in the team to have the discussion at the same time. Therefore, each group has slightly different numbers of participants ranging from three to five. Moreover, Devine et al. (1999) explain that a team is a closely interactive group composed of three or more people for providing products, plans, decisions, or service to an organization.

The focus group interviews are conducted with different teams from different types of organizations. The purpose of this arrangement is to compare how different teams from different organizations see waste and to see if their styles of virtual collaboration have any impact on how they see or deal with the waste, compared to when physically working together in their offices. The number of focus groups is six and in total, there are twenty-one participants.

The first five groups are from five different companies in different industries, located in Thailand. Most of them have little to no knowledge of Lean Management as their companies do not yet adopt or widely promote this concept into their operations. However, they all deal with issues at work where they seek for their workflows' improvement. Additionally, one of the groups is immensely familiar with the concept of process improvement. The groups' details are as follows.

The first group is a public relation and marketing team from an educational organization. Five members of this team joined the interview. They are delegated to work on different tasks that are meant to be combined together to satisfy their customers. The group is mixed between manager, senior, and junior employees.

The second group has three participants from an online merchandise and marketing team from a home improvement retail company. All three participants collaborate with each other through project-based tasks. One participant focuses on the communications content and other two are delegated to deal with different clients and to perform slightly different types of work as well.

The third group is a customer development team for E-commerce in an international oral care company. All participating members are mid-level employees in the team. They work together to develop the relationships between their company and different clients, in terms of sales.

The fourth group is a digital transformation team under an Information Technology unit in an agricultural and food company. All three participating members are well experienced in process improvement and resource utilization. They mainly work on project-based tasks in creating strategies and finding solutions for their associated companies to protect benefits of the organization.

The fifth group is a human resources (HR) team from a multinational medical device company. Four participants are responsible for the main human resources processes such as recruitment and training, as well as working on different projects related to human resources affairs.

The last focus group is a Continuous Improvement team in a global health technology company located in the Netherlands. All three members in this group are long-term experienced professionals who are specialized in Lean Management and Continuous Improvement. This group is the only group in which all members actually experienced virtual collaboration before the Covid-19 pandemic as they often traveled for business purposes and some members are located in other countries. Nevertheless, they are still going through changes and are continuously looking for ways to improve their working conditions.

Because of the Covid-19 situation, there can be no direct communication with the participants. Therefore, the focus group interviews were conducted, based on the participants' convenience. Different online communication tools, Microsoft Teams, Google Meet, and Zoom, were used. There, besides the results from the questionnaire, participants' group dynamics could be observed during the interviews to understand more of their relationships within their respective groups. Although some participants refused to turn on their cameras due to personal reasons or their unstable internet connections, all

participants from the sixth group all had their cameras on which helped a lot in enriching the interview.

Table 2 Interview participants

Group	Industry	Number of participants per group	Code name for each participant
1. Public relation and marketing team	Education	5	PR1 PR2 PR3 PR4 PR5
2. Online merchandise and marketing team	Home improvement retail	3	OM1 OM2 OM3
3. Customer development team for E-commerce	Oral care	3	CD1 CD2 CD3
4. Digital transformation team	Agricultural and food	3	DT1 DT2 DT3
5. Human resources team	Medical device	4	HR1 HR2 HR3 HR4
6. Continuous Improvement team	Health technology	3	CI1 CI2 CI3

3.3 Research protocol

3.3.1 Focus group interview protocol

The main construct of the focus group is the evaluation of waste identification and waste reduction of each group. The items for the construct have been created based on the literatures clarifying different types of waste and exemplifying processes within each type. The idea is to allow the team members to brainstorm about each item, which can be linked to each type of waste. However, the links are not revealed in order to avoid any bias in their opinions as different teams or organizations may see waste differently.

Interactive activities are adapted in all focus group interviews to keep the group engaged. The activities include open discussion and selecting options via menti.com, an "interactive presentation software", and card sorting through miro.com, "an online visual collaboration platform for teamwork". However, some participants preferred to only verbally discuss as for them, it was not convenient.

The content was initially created in English and translated into Thai (see **Appendix 3** and **Appendix 4**) for participants who prefer not to talk in English. Since the interviews are semi-structured, the presentations were made with questions relating to different processes based on examples of the operational waste in the product development knowledge work concluded by Santhiapillai and Ratnayake (2018) and examples of waste identification and elimination by Al-Baik and Miller (2014), as well as on the virtual work scope by Chudoba et al. (2005) in order to support the thematic analysis, technique in analyzing written materials, herein interview transcriptions, where patterns and repeated ideas from responses can be analyzed (Gavin, 2013).

The insight gained from the interviews gauges how a particular team identifies waste and how they choose to reduce them. Furthermore, the groups can also have a chance to reflect on their situation on a team level.

The interview transcriptions are coded into different themes based on eight types of waste: Overprocessing, transportation, inventory, defect, unnecessary motion, waiting, overproduction, and talent. Moreover, the Teamwork Quality aspects will be taken into consideration to interpret the results from the questionnaire and to find links between virtual collaborations and waste identifications or reduction of each team.

3.3.2 Questionnaire protocol

The short questionnaire is filled with questions measuring six aspects of Teamwork Quality by Hoegl and Gemuenden (2001). Though the relationships between people within each group can be seen from how the group interacts with each other, one individual may feel more or less close to others. Therefore, the questionnaire can help cross-check the assumption about each team from the interview results and interviewer's observation, but is not meant to represent a bigger population, just their own teams.

The aforementioned six aspects are measured to evaluate the collaboration in each team while they work from home, as well as to understand their work practices. There are three to five items under each construct: Communication, coordination, balance of member contributions, mutual support, effort, and cohesion. The virtuality is taken into account by firstly combining the workplace mobility view "When virtually working together" into the beginning of each item and secondly adding the technology facet into each construct. The questions also concern the potential of each organization in supporting their employees in performing virtual collaboration.

The questionnaire was first developed in English and later was translated into Thai in order to support several participants who were not comfortable answering in English.

A Likert-type scale is applied to each item. The respondents choose the answer ranging from (1) Strongly disagree to (5) Strongly agree. The scale is used to measure attitudes of each individual (Likert, 1932) towards their team collaboration when virtually working together which may be slightly to completely different from when they were working in the office.

The results of the questionnaires are calculated using an SPSS software to perform the descriptive statistical analysis to find the average score of each team regarding each aspect, along with the analysis of the unprocessed answers as the numbers of respondents of each team are relatively low and the questionnaire was only used to avoid asking the participants rather sensitive questions, which they might find uncomfortable to answer during the group interviews. Moreover, the median score of each question is calculated to compare teams and rule out outliers that may have skewed the data distribution. The median scores are concluded into the stacked bar chart in **Figure 3**.

However, as for the last group, since only one participant completed the questionnaire and another participant decided to have a one-on-one follow-up discussion instead, the result of one complete questionnaire of this group is not included in the questionnaire

results to protect the privacy of the respondent. Nonetheless, the result is used together with the extra discussion to assess the virtual collaboration of this group. Therefore, this research includes only eighteen questionnaire responses.

4 FINDINGS AND ANALYSIS

4.1 Customers of a team

The first team, public relation and marketing, was formed by people with different skills within the same field: marketing communications. The team has both internal and external customers. The internal customers are the management team, and colleagues within the team, while the external customers are students who attend the school that this team works for, and the students' parents. It can be implied that there are also different workflows within the team.

The team emphasizes on its customers' needs by regularly listening to them. All activities are organized to fulfill one of the services that team members provide to their customers which is, for instance, improving students' experiences. One focus group participant (PR1) mentions, "*It's like when I organize activities for children, I have to find activities that the children will be satisfied with. Those activities that they want to actually do. Or for a field trip outside, I have to choose from their interests*". This approach demonstrates the Lean concept, where the value is pulled from the customers, not pushed to them (Lu et al., 2011).

As for the second team, online merchandise and marketing, two members often communicate with their external clients who are, for example, DIY stores and home product stores. The other team member normally discusses her work with her boss. She relies on her superior's directions on how to create their communications content.

The third team, customer development for E-commerce, has to maintain relationships with different external customers for E-commerce, for instance, different online retail stores, to boost sales of the company, while trying to follow the directions from the team's superiors. Team members always have to brainstorm on how they can process the data received from their external clients and their superiors, because they have to come up with strategies and a way to present and clarify them for their customers.

The fourth team, digital transformation, provides strategies for internal customers. Its members work on different projects for different businesses within the main corporation. The team clearly expresses intentions to understand customers better.

The fifth team, human resources, mainly works for internal customers such as different functions and business units as well as some external customers such as business

partners in Southeast Asian countries. Members also provide trainings and facilitate newcomers with their onboardings. The reason they say that their main customers are internal is that they usually get in touch and get feedback from those who already work within the company.

The sixth team, continuous improvement, serves internal employees of the company, in terms of coaching. As team members are certified experts in Lean Management, they assist anyone and any team that is interested in applying the Lean concept to their work. They also help others who aspire to be Lean trainers by providing training materials. People they train can be anywhere in the world.

4.2 Virtual collaboration

4.2.1 Technologies used and work practices in a team

In terms of virtuality, different teams demonstrate different levels of technology usage and work practices within the teams. This part also demonstrates how organizations play a role in the level of virtual collaboration that each team can perform.

The first group communicates using a technology provided by the organization, Microsoft Teams, along with other communication tools. Within the team, each member often communicates to others by texting via a chatting application, Line, as it promotes a faster and less formal communication. Team members also make phone calls to each other for matters including different topics. Nevertheless, when having meetings with other teams and management, a more formal conferencing application, Microsoft Teams, is used. Since their jobs are relatively standardized, members of this team do not often use other collaborating tools in performing their work.

Meanwhile, when it comes to using technologies to facilitate work, the interview with the second group implies that the organization has not promoted any updated technologies for smoother collaboration. However, the participants use all possible resources they can find to communicate with each other. Their main ways of communication are phone calls and texting via Line. They claim that within this organization, no online meetings are held. Therefore, they usually do not use any visual tools to support their discussions. Besides, most people in this organization are not familiar with shared drives or any collaborative tools because, revealed by one member (OM3), "*Many of them don't know how to use Google Share like OneDrive or something like that*". However, one member discloses that this team does not usually encounter unexpected situations and the team's

work is quite routine. Most of the time, team members know exactly what to do, who to go for, and when to perform tasks.

Members of the third group claim that they use different tools and technologies available within the company to communicate and share knowledge to each other. During working from home, they often use Google Hangouts for having a group video call when discussing within their team or with other teams, while Zoom, another conferencing application, is only used when talking with their clients. Moreover, they mention that, because their jobs are to manage online channels, they did not even meet some clients in person when they were working in the office. Therefore, they have had no problems with online calls as they always had them with external clients before. However, they also feel that the tools granted by their company are not yet well developed, which may cause an issue that will be discussed in the upcoming part.

The fourth group's members admit that the technology is already there, but they do not have enough company-provided tools for collaborating between themselves. Certain company policies also restrict them from fully adopting some tools. One participant (DT1) of this group asserts, "*I have to say that each company in Thailand has a different level of capabilities for working from home. For XX, it is quite behind [the others]. Sometimes, we can get by with it, but most of the time, can't*". Moreover, most of their projects require intense team collaboration and thus they also use various other tools, which they used before when working in other companies, in order to work together during the Covid-19 pandemic. The majority of the people in their team were consultants in information technology (IT) companies before, which helped them in finding the right tools to collaborate, such as Objectives and key results (OKR) software. One of the reasons for being underdeveloped in terms of tools is that the company is new to a situation in which their office employees all have to work from home, and is still in the initial phase of adopting tools to help with virtual work.

Meanwhile, the fifth group affirms that its company has provided enough tools and technologies for team members to work virtually from home. They can easily communicate with each other. One member (HR3) happily claims, "*our company also provides the internet, so we feel like if our internet is stable, our lives are already easy*". Some team members also tell that they have been quite familiar with online communications since before the pandemic disruption. "*So we do one face-to-face session and also have a zoom call for employees who cannot enter the office for the training. And to train newcomers, it's not that much. Therefore, it's like we are already familiar with the zoom*

calls because like I said, they were field employees, so they didn't always need to come to the office"; this statement by another member (HR2) shows that they had to come into contact with many field employees who were not always in the office and the company has been well equipped with technologies for this sort of situation. Besides, different instant messaging applications such as Jabber, WhatsApp, and Line are frequently used within this team.

As for the sixth group, the whole team affirms that its company has provided enough technologies to them to communicate and transfer knowledge. Nonetheless, one member (CI3) believes that the company does not yet offer devices with suitable capacity that are fully compatible with the technologies that are currently available. For example, a substantial part of her work computer's memory is used up by Microsoft Teams, the video conferencing and collaboration application used within the company. She also mentions that some platforms or programs, for instance a Google shared drive that is used by certain companies, are not allowed due to company policies. Moreover, one participant (CI2) mentions an interesting point that the company may not have completely understood what is needed for each individual to perform work effectively. He also pays more to have a better internet connection and that increases his individual costs. As for the company's cybersecurity, it is not yet seamless and one of the participants (CI3) still finds complications when parts of it, for example a Virtual Private Network (VPN), are in use, but all team members have seen the improvement, and all agree that the security system is essential for the company.

Table 3 Technology usage summary per team

Team	Industry	Technology
1. Public relations and marketing	Education	- Mainly talk via phone calls and Line application within the team - Use Microsoft Teams for formal video calls with management and other teams - Use emails for formal communications - VPN is required

2. Online merchandise and marketing	Home improvement retail	- Mainly communicate via phone calls and Line application within the team - Have online video calls only with external customers - Not use any shared drives, only send emails for sharing work and knowledge - Use emails for both formal communications and approval process (still needs actual signatures) - VPN is required
3. Customer development for E-commerce	Oral care	- Often discuss within a team through Line application - Use Google Hangouts with colleagues in the organization, both within the team and with other teams - Use Zoom with external customers - VPN is required
4. Digital transformation	Agricultural and food	- Use different alternative not-company-provided tools in collaborating with each other: OKR - Use Microsoft Teams for all virtual meetings within the organization - Use emails for formal communications - VPN is required
5. Human resources	Medical device	- Use any kinds of chatting applications available: Jabber, WhatsApp, Line, interchangeably - Sometimes use phone calls

		- Use Zoom for all virtual meetings - Use emails for formal communications - VPN is required
6. Continuous Improvement	Health technology	- Use Microsoft Teams for formal communications and collaborating: whiteboard and shared drive - Have one-on-one calls or chat via Microsoft Teams for both formal and informal communications - WhatsApp is used for urgent cases, personal matters within the team, and when working with external parties - VPN is required

4.2.2 Teamwork Quality of a virtual team

All participants of each team filled in the questionnaire after attending the focus group interview.

The standard deviation of each aspect is below 1 which shows that the data is not widely distributed or spread. The team that demonstrates the highest average score of 3.79 for Teamwork Quality in a virtual setting (virtual collaboration) is the fifth interviewed group: the HR team. There are two teams that share the lowest average score of 2.88, which are the second and the fourth teams: the online merchandise and marketing team, and the digital transformation team. The first and third teams, however, exhibit scores higher than the mean or median score (3) of the Likert Scale, ranging from 1 to 5.

Table 4 Team 1's Virtual Collaboration: Descriptive Analysis

	Team 1 (N = 5)	
	Mean	Std. Deviation
Communication	2.80	.42
Coordination	3.10	.22
Balance of member contribution	3.05	.27
Mutual support	3.15	.14

Effort	3.15	.29
Cohesion	3.40	.60
Virtual collaboration	3.10	.17

For the first team, though the average score for its virtual collaboration is just above the Likert scale's mean, the only aspect that is quite low is the communication aspect. The reason for this could be that, according to one member of this team, the culture and language used in this team play a part in the communication aspect. As one member (PR5) mentions, "*It is understandable, but sometimes the text just didn't get through. The emotion didn't get through*". This statement could show how team members emphasize the interpersonal relationships among each other. Also, they think that tools or technologies provided by their organization are just adequate for virtual communication.

Furthermore, the average scores of the team's coordination, mutual support, and effort aspects are almost on the same level. This follows the example from one member (PR5): "*it's maybe due to already knowing each person strong suit. So, I know I should assign this type of task to who, and some tasks can be done by anyone. Therefore, in some tasks we might be able to discuss, then assigned. We mostly help each other in overseeing the task, we all have our own strong suits. For example, if you want any quick idea about cool activities that can engage with the kids, you would have to ask XX, what does he think about the idea? Is it okay? XX will be able to give you the thing you want right away*". However, the team is certain that team members agree on the team's shared goal and each member's subgoals. Team members are trying to support each other by using different technologies – not necessarily provided by their organization – as well.

The team also tries to balance the contributions among members, yet some members do not have enough tools to fully contribute, as stated by one participant (PR1) himself, "*Not the same! Because I do nothing when staying at home. (...) Besides, I'm the only one who doesn't have a laptop. I have to say that everyone else has a laptop, but mine is a PC on my desk at the office. (...) when we work from home, I don't have a computer, I don't know what to do. Do you get it?*" This statement shows how close the team is. Close enough for a member to not feel strange in telling that he can do nothing because he has no proper tools.

The highest average score of this team falls into the cohesion aspect. This follows the observation of the interviewer and the interview results that this team has a high team

spirit. However, the participants admit that they have had fewer communications since they are not working in the same place and hence, feel lonely from time to time.

Table 5 Team 2's Virtual Collaboration: Descriptive Analysis

	Team 2 (N = 3)	
	Mean	Std. Deviation
Communication	2.60	.60
Coordination	2.58	.29
Balance of member contribution	2.92	.72
Mutual support	2.75	.25
Effort	3.00	.43
Cohesion	3.50	.66
Virtual collaboration	2.88	.21

Although the second team's virtual collaboration score is not high, they confirm that they are friends. Their assertion can also be seen in their cohesion's average score of 3.50. The team members share similar backgrounds and started working in the company at the same time, but due to the Covid-19 pandemic, they have had fewer informal communications and meetings for some time before the focus group interview was concluded. In addition, there are other members in their teams whom they are not close with and those did not participate in the interview. The interviewees from this team believe that their company has not provided them enough tools to have good communication while working from home, but they have been quite open to exchange information among themselves.

In terms of coordination, according to the interview results, each member knows their own responsibilities, and members' shared understandings of how to work together are fairly structured. As stated by one member (OM1), "*We are really having a clear cut of whose work that is*". With an average score of 3.00 for effort and the claim from the same member that "*some work can wait to be done but like it's easier to just think to yourself that okay I'll finish this like for an extra 30 minutes because like I don't have to do this again, but like if you're at the office then you just say like I can do this tomorrow. It's already off working hours*", the team also thinks that it has sufficient tools to keep up effort, but team members have not put much more effort into their work when working separately. Still, it is easy to lose track of time.

Table 6 Team 3's Virtual Collaboration: Descriptive Analysis

	Team 3 (N = 3)	
	Mean	Std. Deviation
Communication	3.40	.20
Coordination	2.75	.66
Balance of member contribution	2.83	.58
Mutual support	3.08	.38
Effort	3.58	.52
Cohesion	4.08	.29
Virtual collaboration	3.29	.40

The third team from the international oral care company has an average score of 3.29 for their virtual collaboration. Standing out as the highest rated virtual TWQ aspect in this team, its average score for cohesion is 4.08, followed by an average score of 3.58 for effort. According to the interview results, the team's work requires brainstorming to a great extent. The way team members interreacted to each other in the group interview also proves how close they are. They also agreed to most things that each member said.

The team members still communicate often even when they work from separate places, as their work is about strategic planning that they all must align in order to correctly communicate to their clients in the same direction. This also appears in their average communication score of 3.40. However, they still see the importance of face-to-face meetings, as said by one member (CD2), "*Because by having more interaction with your colleagues, it can help to improve the efficiency of working*". The communication style within the team also depends on the type of project each member is responsible for as one of the team's members often finds herself in meetings that are led by their leader.

As for this team's coordination, balance of member contribution and mutual support average scores, they are relatively low. However, as stated by one member (CD1), "*I don't wanna exhaust myself, so I'm just like, okay, I'm not gonna do this a lot, something like that. And it's still the same either in the office or working from home*". It shows that by not working together in the same place, team members still share similar work practices but are willing to support each other when one is in need.

Table 7 Team 4's Virtual Collaboration: Descriptive Analysis

	Team 4 (N = 3)	
	Mean	Std. Deviation

Communication	2.73	.70
Coordination	3.08	.29
Balance of member contribution	2.92	.58
Mutual support	2.75	.43
Effort	3.08	.38
Cohesion	2.75	.90
Virtual collaboration	2.88	.46

For the fourth team, despite having a low average score for its virtual collaboration, the coordination and effort average scores are above the mean. Following the previous part, team members have tried their best to use both off-the-shelf and alternative tools to work. Albeit that each individual can manage more projects, they communicate about work less than when they worked in person due to their non-standardized co-projects that are better dealt with real-time discussion. Also, they think that everyone in the team has to make an effort to talk, which is different from when they were in the office, where they could just walk to another person and talk. Besides, they raise a concern that it is sometimes harder to push through a project. When any project gets stuck because certain information or pieces are still needed to continue, it is harder to inquire someone for it which is different from when members in the team could meet those people face-to-face. Sometimes, another member needs to mention someone who is higher ranked to expedite the process. However, it still depends on the person involved.

Table 8 Team 5's Virtual Collaboration: Descriptive Analysis

	Team 5 (N = 4)	
	Mean	Std. Deviation
Communication	3.40	.43
Coordination	3.56	.24
Balance of member contribution	3.81	.31
Mutual support	4.25	.46
Effort	3.75	.00
Cohesion	4.06	.47
Virtual collaboration	3.79	.12

The fifth team shows the highest average score of 4.25 for the mutual support aspect. However, according to the interview results, team members reveal that they know their own responsibilities and already have quite a heavy workload, so they do not do jobs

of others if not asked. This also explains their average score of 3.81 for balance of member contributions, since they are aware of their roles. Also, by having a culture of delivering quality work, they always put their best effort into completing all work. Besides, as the team members have had a good relationship, they often use instant messaging applications to have informal talks or share their personal stories and non-work-related news. They try to have some online gatherings to encourage informal communications, interact more, and maintain their cohesion. According to one member (HR4), "*XX has a virtual evening party, where people can join and talk to each other. It makes us feel relaxed*". This helps create a casual environment.

As for the sixth team, when asked about how its members maintain their "team", two of them (CI1 and CI3) express how much they emphasize the need to find time to learn about colleagues' well-being: "*you have to take the time out to be 'human' and not just so focused all the time on the business at hand*" (CI1). No matter how often people can meet over online meetings, one participant (CI2) thinks that there is no complete substitute for face-to-face contact. He also brings up one gripping point related to an office space that contributes to how this team collaborates. This company introduced an open working space before the Covid-19 pandemic. Since then, he has not thought that there has been strong networking within the company. Although he has been working at this company for more than five years, he still does not feel "attached" to this place as there were many people whom he did not meet on a regular basis when they could work in the office.

All members feel that they have been putting the same level of effort as before there was a restriction on real-life encounters. Also, the team members always support each other when needed, not competing. In terms of contributions and coordination, everyone takes high responsibility as they see the importance of giving their leader more time to take care of the bigger picture. Therefore, the leader is not required to constantly give this team guidance. However, one member (CI2) discloses that issues within the team do not always get solved. Since everything is online and no physical contact is allowed in the workplace, the team members emphasize more on their shared understanding and trust, as one member (CI2) says, "*if there's trust in the group and it's okay, then it can be extremely efficient doing the whole thing virtually*", and their subgoals are clearly defined. Moreover, each of them is well-experienced and has authority to use their skills and judgement in their own work. Finally, as for their communications, the team has a scheduled weekly meeting where all members catch up and update their work to each other.

All of them get along well. Still, there tend to be smaller groups within this team in which people may get in touch with each other more.

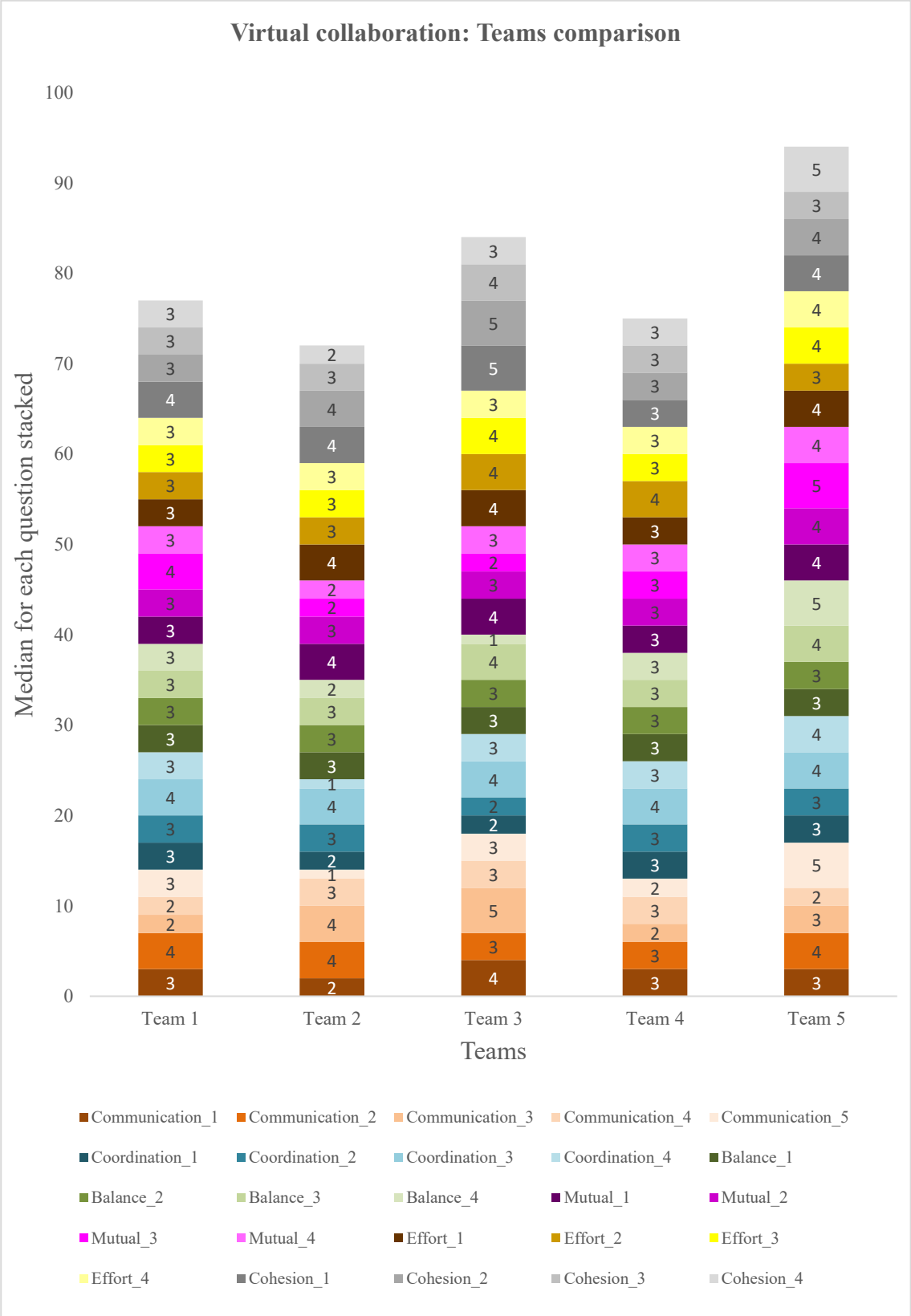

Figure 3 Virtual collaboration: Teams comparison

Figure visualizes the different questionnaire results per team. Different colors represent different aspects of TWQ. Each Likert scale type questionnaire item is represented by a different shade. Numbers shown are the median score for each item. The questionnaire items can be found in **Appendix 3**.

4.3 Waste identification

4.3.1 Overprocessing

To begin with, the first group, when working from home, some members feel that they are not provided enough tools and data to perform their work as well as when they are in the office. The lack of physical connection increases steps in finishing a process such as grabbing a phone to send a message before performing any actions or to confirm them via a chatting application, instead of turning and telling the receiver or even saying out loud right away.

What interesting is that sometimes, a culture plays a role in how processes are changed. A statement claimed by one member (PR5), "*sometimes XX might be having a meeting with the executives and we have to wait for the information about the meeting from XX later. XX will then have to convey the information of the meeting to us. But if we were to join the meeting ourselves, then XX wouldn't have to pass on the information, since we would also be in the meeting*", shows that when the meeting with management is online, participants, here in superiors, are selected and for lower ranked employees in the hierarchy to join, the process is not as convenient as when the meeting was physical where the lower ranked employees could just attend in the same room or even join their conversations. Therefore, the number of messages being conveyed is higher.

As for the second team, they disclose that the fact that their company lacks proper tools, they experience overprocessing during the approval process. One member (OM1) reveals, "*Like, to just do a price adjustment you need a signature from like 5 different people and I think that's insane. You have to get the signature on paper and deliver it to the database team and I think like if you already are a product owner, and you have to have all decisions, all the authority need to approve that decision already*". Though they were informed that the approval via email was allowed during working from home, they are constantly reminded to get actual signatures on their documents and submit them on the system.

Third, all participating members from the third team agrees that when virtually working, the possibility of receiving unclear requirements is higher which also increases the processes, for example, of going back and forth for information, producing unnecessary

data, and sometimes, reworking. As one member (CD2) claims, "*So then we just do it by ourselves and then get back to our boss to see if this actually answers his question. If it doesn't, then we have to come back and we do it again. Double work.*", it can be insinuated to the process of remaking work, which is part of the overprocessing waste.

One captivating point from this team is that the security process stagnates their working speed. One member (CD3) says, "*If we want to log in to the computer, we need to verify by our phone. Like, type in the password from the phone first. It's kind of annoying. Sometimes it happens quite a lot during the day. We have to repeat doing it, several times, and it's kind of annoying*". Then, another member (CD2) adds, "*It [verification process] slows me down. Sometimes, we have to do it twice, we normally have to do that to access our email. And there's another system. At last, we have to access that again*". These two statements from the participants fall into the explanation of overprocessing.

The fourth team experiences the situation in which they receive a big chunk of information to analyze by themselves which is different from when they were working in the same room. Sometimes, their doubts could be read through their facial expression or body languages by another person, then the explanation would be given without having to ask. As one member (DT2) mentions, "*Imagine that someone just threw an Excel file with 200,000 lines at you and tells you that this is the trend, it takes long to really understand it*", it manifests signs of overprocessing as he has to take more steps in analyzing the data.

Another member (DT1) also comments that how work is communicated now can be unclear in terms of what is required, therefore it is not always clear since the first time. This point is agreed by another participant as he feels like people just prefer sending texts via chatting application, Line instead of emails and the messages are often short and not clear.

One of them makes it clear how multiple online meetings increase the number of steps in productions. They often have conflicted meetings, and one participant admits that he has to listen to recordings at night. One of the reasons is that putting the agendas in their calendars is not a norm here, hence other colleagues feel that they can set up meetings anytime. Moreover, they believe that it is more difficult to get results when they do not meet others face-to-face even though it is definitely faster when they have to set appointments and there is no hassle looking for a meeting point or walking to a person just to see that he or she is busy.

As for the fifth team, according to the interview, they barely experience overprocessing. They claim that they may have to change their ways of working but during this

time, if employees and the management understand, they rarely face problems. Nonetheless, since everything is performed online, they have to carry out some more steps such as assisting their clients and candidates in attending virtual interviews. Still, they are certain that those steps are necessary for each process to be completed. Also, this is already their third time working from home due to the pandemic, thus they get quite accustomed to all new processes and those have become their new work practices.

The sixth team raises a similar point as the fourth team on how easy it is to reach out to people as the members assume that people are always available if they have no restricted statuses on their Microsoft Teams. Even though they do not always get results from those calls, they affirm that virtual work does not make the situation worse.

4.3.2 Transportation

For the first group, going back to the transmission of message within this team. Though there are more conveyances of data, the receivers are more selected. Therefore, the transportation of the data or information is actually decreasing. By having to select the receivers, the team can be sure that only members who need the specific piece of information to work can have it, without waiting for others who might have nothing to do with it knowing it, then passing it on to the right receivers. The following statement is told by a member (PR5) of this team: "*when XX received the information from the meeting, XX would know whom XX should pass on the information to. The information should be passed on to YY first, the paperwork should be done first, or tell 1-3 so that everyone would know what they should be doing, in order to make progress*".

As for the second team, continue from the approval process that cost them unnecessary processes, by having too many people approving one document, it means that the information has to be passed on within an organization multiple times. The comment from one participant (OM1), "*Not have to like pass all the 5 people I think it's a waste of resources*", can be connected to the waste of transportation in knowledge work as the data are handled by different people before arriving the customers.

The third team claims that they only experience the barriers of virtual communication that make it harder for the work materials, which in this case are necessary pieces of information, to produce work. Therefore, their work materials are moving the same way as when they were working in the office. Nevertheless, sometimes, they have to work on others' projects where they are not familiar with how to get them done: "*you know, in the*

situation where it's not really our project, for instance, you know, feeling of marketing assets and stuff, we would have to go to multiple persons to get the result" (CD2) but they are sure that the movement of their work materials now has no change due to virtuality.

As for the fourth team, following the excessive data transfer in the overprocessing waste, they also experience the transportation waste since too much data, including unnecessary information, is moved within their own team. Moreover, by not having clear work instructions in the company, they often find themselves in the position that they have to go extra miles to get information they need to produce work regardless of virtual work. One member (DT2) calls it "*Investigate from dead bodies*", which, according to him, means that the information they look for is known by many people, but none of them tells the same thing. One member (DT3) states, "*assuming we ask something to five people, none of them answers the same thing. It's like there is no written work instruction or procedure*". She claims that people tell different things because they only memorize processes and without officially writing them down, others are not aware that their perceptions or understandings could be wrong. Besides this statement, another member (DT2) adds, "*So when working from home, these problems multiply a lot*". By asking around, the information is moved unnecessarily within the organization before reaching customers.

The fifth team proudly claims that most of the data they need for working is on their company system where it is quite convenient to access when they have a good connection. One member (HR4) shares a following example: "*To give you an example, when it's work from home as a global, it makes the channels for gathering information more updated. For example, HR department is more up to date because we know people are looking through online sources*". One (HR3) also adds, "*I agree. I think, like XX said, everybody is like, you know, people are working from home, so everything should be more digitalized*". And another one (HR2) confirms, "*Our system is quite good. The system is quite supportive*". This shows that by having a well-established data respiratory, the employees do not need to go through a waste of transportation of their working materials.

For the sixth team, as a team in a global company, data needed for production can be anywhere. If clear roles are given, people always know who to go for when specific pieces of information are needed. They also have an automatic data system for standardized processes in their trainings, for example the certification required for new candidates. These candidates also automatically receive improvement suggestions.

4.3.3 Inventory

The first group tells that some processes have to be postponed due to the limitation of physical contact. Some processes can be transformed to online activities, but some are still under a consideration phase. One member (PR4) explains the impact, "*But when it comes to Covid, to work from home situations, they cannot come to school [to pick up the uniforms] on the date set in the original schedule and not be able to take the foundation classes as before. The school has to adjust the plan to see when the foundation courses can be arranged and when the uniforms can be picked up. So there will be new processes, which are still unclear*". However, this does not seem to be a problem from virtual collaboration, but the pandemic itself that restrains them from providing their clients the services that they expect.

The second team does not say that it has had more inventory waste since working from home. This is because they have experienced unprocessed data no matter when and where. When working in the office, they regularly received emails from people they had not met before as well. One member (OM1) says, "*We get too much data and we don't use [it]*". She also tells that people in their company like to use emails as a method to verify what they have or have not said to various people, not necessary stakeholders. She tried to open all of them before but eventually, as there are too many of them, she decides to ignore some emails that seem unimportant and as a result, she also misses important ones. However, another member (OM2) tells that sometimes, she finds herself doing a similar thing when she does not know who to ask for some matters. She chooses to ask her questions in different Line group chats filled with people within the company. Unfortunately, this action may actually increase inventory waste to others.

For the third team, so far, they do not experience any situation where they have to hold raw materials or any knowledge due to virtual collaboration. However, they give an interesting example for the situation that happens whether it is work from home or in the office: "*like we got inaccurate data and we know it's wrong, we don't have any time to fix it and work on it, so we just leave it*" (CD2). It appears that some projects are left unprocessed due to incorrect information.

For the fourth team, their projects revolve around group workshops and brainstorming within their team. However, with the tools currently provided by the company which are not yet advanced enough for everyone in the team to share real time ideas and solu-

tions, some projects have to be postponed to avoid defects. One member (DT2) inarguably states, "*[any] project [that they work on] needs a whiteboard. For the brainstorming phase, it is really impossible [without a whiteboard]. For many projects, I have to consult with my boss to let it be delayed because if we force doing it, it'll just not be good*". This means that many projects cannot be processed and consequently, cannot be transformed and delivered to their customers.

The fifth and sixth teams do not at all mention anything that can be related to inventory waste. They think that the volume of information they receive is not different from when they worked in the office. They still have to process every piece of information.

4.3.4 Defect

The first group does not think that they have been delivering lower quality work due to virtual collaboration. Rather than that, they have experienced incomplete data, which causes a delay in production as explained in the inventory part above.

As for the second team, two participants (OM1 and OM2) mention that they received incorrect data one time from another team. The situation was caused by the fact that they received the information a few days after it was requested, therefore the data was not updated by the time they received it. However, the situation seemed insignificant for their work and they could still work with that data. They revealed that their production had minor defective information that did not impact their clients. However, among their team, as they can communicate quite effectively, they find it easy to prevent defects from happening for the projects that need no data from other teams.

Members of the third team tell that as their company is multinational, they assured that they work with reliable sources of data. Therefore, if they receive good and accurate data, they can always produce the finished work for their customers with no defect. However, one member (CD2) from the third team thinks that tools in their organization themselves are sometimes not useful for them since before the pandemic. She clearly states, "*I think the tool is defects. Like, the tool produces too much defects. Progress! I think it's a defect, because it needs to be improved. Like, it doesn't help to, you know, like improve anything from doing work*". This statement shows that when tools are not developed to the capabilities of the employees and they still have to use them, those tools are waste themselves.

As for the fourth team, the participants do not say that they deliver defective results, however, as described earlier in the transportation part, along the processes, they might have received conflicting information that delays their work but eventually, they put their best effort to carry out quality to their customers.

One member (HR3) of the fifth team raises an interesting issue. She feels like she cannot deliver the same quality in terms of emotional support since people are the heart of HR work and managing them can be complex. She also says, "*There were many times when we had problems or when leaders really faced problems, they were more willing to walk into my room and discussed. And when it's working from home, it's like they can still make an appointment to talk to me, but before, many times, they would just stop by when they had anything to discuss. Now, many problems have been delayed and we have to make appointments for them, sometimes so we don't get to brainstorm right away. (...) It's like we have a time bound for one hour so we cannot be sluggish. We have to be concise and get it done*". To illustrate, this can be compared to the products that cannot be delivered with the same quality as before, in another word, defective products.

The sixth team tends to deliver the same quality of work. They only need to adapt themselves into full virtuality by training themselves and others on how to use different collaborative tools. Also, by not having to travel for work, they are able to better plan their schedules and be productive.

4.3.5 Unnecessary motion

As for the first group, besides the lack of system integration, the protected connection as VPN that users are required to use does not help accelerate the process either. First, there is no manual for how to use these systems, therefore the users have to take notes and memorize the steps in order to work. One member (PR3) who has to manage an abundant number of documents finds herself changing or moving back and forth between systems all the time. Now, with the VPN, things seem slower and so she sometimes decides to go to the office to search for those documents. Also, the company still tremendously emphasizes the importance of paper-based documents, hence working from home just increases the distance between necessary materials, herein supporting documents, and their producers.

As for the second team, one member (OM1) mentions that for her, online communication is not efficient enough because to get the conclusion, it takes a few more times

than usual. Also, as they work in a retail business, physical products still play a large part in their processes. Therefore, showcases of products are needed when dealing with suppliers. With virtual calls, they cannot see those products in detail as well as when they could see them with their own eyes. Moreover, now, they have to send a message every time after each discussion to confirm that the next process can be started. Therefore, they see that virtual meetings cost them unnecessary motion, though they can pay better attention to their work as they do get a lot less ad hoc work compared to when they were in the office.

The third team agrees with the situation that when working from home, people assume that others are always available because now, everyone has a smartphone and messages can easily reach a receiver. This sometimes causes them to work longer hours. Some matters can be dealt with during normal working hours but now, many colleagues make things seem more urgent.

Also, as they have to perform verification before accessing their company's systems to work, besides having mentioned unnecessary processes, they also need to move their bodies more to reach their phones for getting the password to verify themselves on their laptops. This proves that too many tools can also cause employees to deal with motion waste.

The team also thinks that having online meetings could also be the waste of movement as they think that it is not as efficient as before. One member (CD3) claims, "*And also if you're in front of the screen, you can do something else and not listening to what's happening in the meeting. It's less productive*". As well as typing to chat to each other, the problem that this team found was that sometimes text cannot render the emotion. Meanwhile, they thought that for simple matters, typing is easier than having an actual talk.

The fourth team reflects that the virtual meetings give them more motion waste regarding the initial phase of the projects where they have to brainstorm and collect requirements. They suppose that having online discussions for this phase hardly leads to any good conclusions. In contrast, when it comes to general or standardized work, though they get easily fatigue, virtual meetings save them time and unnecessary travel. Also, since working from home, there are fewer interruptions and so they can focus better on their work.

The fifth team experiences a similar situation as the third team. Since their company pays attention towards cybersecurity, they are required to frequently verify themselves

through a two-factor authentication in order to access their company's data. They feel that they have more movement, from grabbing the phone, to align with this policy. One participant (HR1) comments, "*Sometimes, the phone is far away*".

However, they do enjoy working from home as they feel like they can save their movement from doing unnecessary steps, for example commuting to just sign the papers, and focus on their work can concentrate better as they are less distracted.

One participant (CI2) of the sixth team says that looking for a meeting room to train people is no longer a concern. Another member (CI3) also adds that she does not need to move from her desk to a conference room and do many other steps such as closing a laptop, carrying it, and stopping by at a printer for materials before arriving the destination anymore. Therefore, for her, the virtual work is more productive.

4.3.6 Waiting

For the first group, one member (PR3) argues that with no real-time communication, they cannot perform work as fast as they did. She states, "*I have to request additional documents to do the reimbursement again. It limits me from continuing the work. Like today, I was informed that the parents are contacted but I haven't received any documents [from parents] yet, [so] I have to wait*". This proves that when a worker has no sufficient information, the process can be halted and lead to a late submission to a customer.

The second team thinks that their company does not purchase the premium versions of the VPN service and so they have been struggling to access it. One of them (OM2) often has to restart her computer for the VPN to work and eventually finds herself doing nothing while waiting for it to work. This is her statement: "*I have to wait. I can do nothing if I cannot access that VPN. I have to wait, like I can't check the time, I can't check the process, I have to wait, I can do nothing about that*". They also tell that their work requires communications to a lot of people. Therefore, they need to wait for responses multiple times. Since working from home, they cannot just walk to those people to get the response within a day anymore. Now, it takes at least a few days and sometimes, they only want to follow up the work.

The third team asserts that since working from home, the approval process has been expedited by the company allowing the change from actual to electronics signatures. Yet, some people still take a while to approve requests and so they still have to wait. It is asserted by one participant (CD2) of this group that "*I think for me, it's between waiting*

and not waste, because some of them have to wait longer, but some can be digitally approved".

The fourth team assures that the approval process takes longer due to the virtual work. One member (DT2) first sarcastically mentions, "*I have to manage tools, and when I have to make tools available for anyone, I have to manage the process. And our IT is just 'awesome'*", then adds, "*we submit the request, we have to wait. We cannot expedite it*". He thinks of it as a "break" as he cannot continue his work or make any further decisions. All participants feel like it is grueling when they need to connect to someone who is not responsive because they do not know where they are, which is different from when they were all in the office, where they could just walk to the person. However, they think that it is a lot easier and faster to get people into the meetings even though they do not always get results out of them. One member (DT3) talks about her surprising experience: "*I experience this 'You should find someone else to work on this'. And I was in shock. I tried to call her. I was surprised 'Was she that mad at me?' And when I called, you know what happened? She asked me 'Were you hurt? Just kidding' I was super confused*". This shows that if you persistently contact others, sometimes it can turn out to be an uneasy situation.

For the fifth team, it seems like the verification process does not only cost them more movement or processes, but also time. The situation is quite similar to the second team as one member (HR4) says, "*And sometimes, my phone is about to die. Then, I will have to sit and wait. Wait to put the code in. But when I'm in the office, I just type and then access the system right away, faster. Accessing the system at the company is faster*". This condition delays her working process.

However, as for the approval process, this team mentions a similar benefit of working from home as the third team. All the approvals have been digitalized and so the process is not a waste for them at all. "*This one's even faster. Using an e-signature, we can just copy and paste. Let's say, if we need an actual signature, sometimes some executive is still in the meeting or not coming into the office today. So, we cannot get it yet, then there's a delay. But if we use an e-signature, it's just fast. We get [the paper] done, they just put their e-signature and send it back to us. It's faster*" (HR4). One member (HR2) also adds that this improvement actually makes her more productive.

Members from the sixth team think that when everyone in the organization has to perform virtual work, they save a lot of time, as mentioned earlier, looking for meeting rooms for training or waiting for people to attend meetings. Also, they suppose people

have no more excuses for not being on time. For some of them, these benefits even compensate the lack of spontaneity in discussion. However, one member (CI2) mentions that virtual brainstorming makes it easy for him to lose track of the big picture of the discussion as a presenter may keep moving screens or zooming in. He also says that he wants to have big and more screens to see everything. This point reflects what they mention about technologies in their company earlier.

4.3.7 Overproduction

The first group generally faces overproduction when working, not necessary caused by the limitations of virtual work. However, their comments on the overproduction waste they have may be interesting to mention. One participant (PR5) reveals, "*With the standards of Thai reports, what you have to put in it is beyond insane. In reality, we only want to communicate the last line, the last paragraph, saying what the readers need to do*", as she thinks that the information, which she has to normally produce is unnecessary, but required by regulations. Meanwhile, another member (PR2) sees it another way: "*In my feeling, making and handing out reports here, it's not too much. We do the reports and inform the customers what they really need to know. But it's more about the way we provide the information in the report. We write in a blathering way and it's so much that it's hard to get the main points*". However, with online communications, one member (HR3) feels that it is harder to gather what others actually need, so she ends up producing more data than what another person asks for.

As for the second team, with online discussion, sometimes they also experience overproduction waste. One member (OM1) gives an example of when people tell her that they want results only but actually want to know details as well. Therefore, she needs to produce the same work again. Also, regardless of virtual work, she discloses, "*I've seen that they use the same data to do like same kind of report but in different format and then when management have to look at it, they only choose to pick one report to look at and the rest will just be something else that they do and I think you can use that time to make report to do something more productive*". The management has received information pushed by different departments due to the company policies. The situation matches the explanation of overproduction.

While for the third team, they have always had to provide their clients various strategies in terms of promotions as they work for the online channels. However, when working from home, they still feel like they support their clients the same way as one of them (CD2) mentions, "*We do what we promise to them. Not over expectation*". They also consider the reports they produce that are not used are waste. One member (CD3) emphasizes, "*Instead of doing other things, building a report takes time. But then the report isn't being used. It's become really waste, you know*".

As for the fourth team, one member (DT3) gives an observation that since everyone is mostly at home during the pandemic, some employees assume that other people are all the time available and so make everything urgent which makes it difficult for her to prioritize her work, as she mentions, "*It's like when we work online, urgent cases happen too easily*". As a result, they are able to get more work done but it may not be necessary. One member (DT1) also says that before, if people did not see you in the office outside working hours, they would be hesitant to make a call if their matters are not pressing.

The fifth team believes that it always gets results from each online meeting. However, they feel that they have had too many meetings that sometimes make them question if those matters are that urgent. Following the statement by one participant (HR4) of this group, "*I think we get more results. It makes us feel fatigued working. It's like people could wait before*", they suppose that if their customers get their jobs done, they will also get theirs done but because of the high frequency of online meetings, sometimes, they just want a break.

As the sixth team coaches anyone who is interested in Lean Management, their product is a training session. Consequently, they only train or answer questions regarding their expertise when they are asked to. Therefore, by getting more calls, they can deliver to more customers in a shorter period of time.

4.3.8 Talent

First, participants in the first group give different opinions on this subject. One member (PR5) mentions that the levels of different skills used are adjusted to fit the situation. She reveals that the uses of some skills are increased, while some skills have been utilized less or very little by saying, "*And then [I] have to come up with new ways to do things. How should we present?*". Then, she adds, "*Things that were different are the places, or the things we used. But if we are talking about other aspects, imagine at the school you*

might use just a little bit of skill A, but mostly use skill B. However, when you work from home, you might need even more of skill B, and even less skill A. So, it is kind of the same, but you might need to adjust some methods. That's why I don't feel like it's that different, the different is in the aspect of socializing".

Being forced to work from home due to the Covid-19 pandemic has also made members of the team more creative. One team member (PR1) asserts that the patterns for activities are normally provided by the school policy, however, since all activities can only be done virtually, new types of activities and processes are required. Therefore, they have to replan their processes to adapt with the new situation. Meanwhile, some members (PR1 and PR3) still feel that they cannot work to the same capacity as they lack tools and materials to do so, especially for the designing work and document-related work.

The final remark for the first team is from the saying by one member (PR5), "*everyone knows their roles and skills, what kind of task that will fit with them, or due to the formal role, whom should we see first? Something like that. And because we have been working together for a long time, how close we are, it makes us know whom we should assign the task to*". This statement shows that within the team, if the collaboration is strong and the talents are recognized, fewer skills will go to waste.

As for the second team, one member (OM1) feels that her skills can be used differently which is similar to the first group. However, there are processes that often limit the use of their creativities as well as a lack of acknowledgement of their skills by management. One member (OM3) complains, "*I experience the same thing, so I think there are so many reports, like XX said, so we don't have that much time to dig down into details and see what the real problem of this kind of data is. So it would be better if we have more, like, good system like XX that can make like the data for us, and so we can focus on just analyzing, not just making data*".

Next, the lack of system integration also impairs the improvement of their skills. One member (OM3) voices that "*This is because each tool or each system have their limitations. They cannot sync so if they have to check stock, they have to check on this system if they have to check CRM, they have to check on this system or something like that, that's so waste of time and our computer is very old*".

The third team does not notice any changes in their skills usage since working from home. One participant (CD3) affirms, "*Maybe we are used to working as a team. So everyone knows what to do. And if there is a task coming up, so you know what to give to this person, or okay, this one is your responsibility, and you take it to your own. So it's*

like working as a team, you know what kind of the process and make it easier, faster". The statement shows that when roles and responsibilities of team members are clear, no skills have to go to waste.

The fourth team gives one compelling example concerning the lack of tools that could contribute to the waste of talent: "*Some people, for example, XXX's team, someone is a very talented engineer. But there's nothing to accommodate him. So he is just like, squirming right there*" (DT2). This statement demonstrates that when skills of workers are not well applied, the company may lose chances in receiving fresh ideas from them.

The fifth group also exhibits similar situation to the first group. Every participant affirms that they have developed different critical skills, for example, presentation and technology skills. First, being in a familiar environment has made each of them feel more comfortable in presenting their work to stakeholders. In addition, they feel more enjoyable in learning about and using different technologies to assist their work.

As for the sixth team, one member (CI3) has improved technology skills and believes that they will continue to grow. However, when it comes to virtual collaboration, technologies can only be effective if people are comfortable with them and have the right tools for them. Another member (CI1) feels that his social skills are challenged as he does not see his colleagues face-to-face on a daily basis, as he mentions, "*I've noticed that I've had a few people in my surroundings where you find out that they're under too much work pressure or are actually close to a burn-out or have some difficult experience in their personal life*". Therefore, the skill he has to learn is how to get keep in touch with people when you do not see them in person. He himself also struggles with maintaining his energy as working virtually eight hours a day inside his house makes him fatigued.

Table 9 Waste identification caused by virtual work of each team

Team	Overprocessing
1. Public relations and marketing	- Share the same topics to different stakeholders multiple times due to limited access of some meetings - Texting to confirm an action: sending an email
2. Online merchandise and marketing	- Send emails for approval process, reach out to different people for actual signatures on documents, then record them on database

3. Customer development for E-commerce	- Communicate back and forth multiple times, produce unnecessary data, and rework due to unclear communications through online means - Multiple verifications reduce working speed
4. Digital transformation	- Analyze a tremendous amount of data received from others
5. Human resources	-
6. Continuous Improvement	-
Team	**Transportation**
1. Public relations and marketing	-
2. Online merchandise and marketing	-
3. Customer development for E-commerce	-
4. Digital transformation	- Excessive working materials, big files of data, movement
5. Human resources	-
6. Continuous Improvement	-
Team	**Inventory**
1. Public relations and marketing	-
2. Online merchandise and marketing	-
3. Customer development for E-commerce	-
4. Digital transformation	- Project postponement due to unavailable collaborative tools, which can support same brainstorming quality
5. Human resources	-
6. Continuous Improvement	-

Team	Defect
1. Public relations and marketing	-
2. Online merchandise and marketing	- Receive outdated data due to a delay in online communications
3. Customer development for E-commerce	-
4. Digital transformation	-
5. Human resources	- The quality of work in terms of emotional support which is also an important aspect of HR work
6. Continuous Improvement	-

Team	Unnecessary motion
1. Public relations and marketing	- Lack of system integration and written manuals cause users to switch back and forth between systems all the time - Farther distance to working materials due to the emphasis of paper-based documents
2. Online merchandise and marketing	- Virtual discussions do not help get work done as details of physical products cannot be seen
3. Customer development for E-commerce	- Work longer hours instead of sticking to business hours as others assume they are always available - Reach out to phone for verification often - Virtual meetings can be waste when others do not pay attention
4. Digital transformation	- Virtual discussions lead to no conclusion in project's beginning phase
5. Human resources	- Reach out to phone for verification often
6. Continuous Improvement	-

Team	Waiting
1. Public relations and marketing	- Insufficient information causes a delay for project submissions
2. Online merchandise and marketing	- Unstable tools and technology cause idle time while waiting for them to work - Waiting for responses from people who they cannot just walk to
3. Customer development for E-commerce	- Wait for approvals from colleagues they do not meet since working from home
4. Digital transformation	- Wait for information from others or tools approval from IT team during working from home halts completion of work
5. Human resources	- Wait for verification code from phone causes discontinuity
6. Continuous Improvement	-

Team	Overproduction
1. Public relations and marketing	-
2. Online merchandise and marketing	- Rework due to unclear requirement from online communications
3. Customer development for E-commerce	-
4. Digital transformation	- Work gets done when there are not yet requirements
5. Human resources	- Too many meetings since others make many matters urgent
6. Continuous Improvement	-

Team	Talent
1. Public relations and marketing	- Not able to perform work as well as before due to the lack of tools and materials suitable for working from home

2. Online merchandise and marketing	- Lack of system integration with incompatible laptops undermine skills improvement
3. Customer development for E-commerce	-
4. Digital transformation	- Real-time creativity and ideas cannot be created due to the lack of tools for online collaborations
5. Human resources	-
6. Continuous Improvement	- Social skills are not used to the maximum

4.4 Special Finding

The unexpected aspect that is out of the scope of this research but can potentially increase or decrease the effects of virtual collaboration on waste is culture. Culture comprises a value set shared among people from the same group, for example country, which can influence the way one behaves (Chudoba et al., 2005; Erthal & Marques, 2018), thus different organizations in different countries may carry cultural differences (Erthal & Marques, 2018).

Martins et al. (2015) explain that the cultural differences can influence how and how quickly changes can be made, and that it is dangerous to ignore this aspect and only center on tools and technology when implementing Lean. Moreover, the cultural aspect can shape workers' behaviors in the change process.

Organizations in which a high level of hierarchy (with a large distance in power between different employee levels) exists have a hard time trying to promote good communications between subordinates and their superiors (Martins et al., 2015). This can be related to the first team when only superiors in the team can attend the meetings with management which increases the number of information transmission.

The second team experiences intensive bureaucracy when it comes to the approval process. As stated by one participant (OM1) of this team, the number of stakeholders for one approval seems overly high and the project owners should already have the authority to approve any project-related matters by themselves to avoid unnecessary processes.

According to Erthal and Marques (2018), countries with higher level of collectivism are more likely to have a successful implementation of Continuous Improvement and

Lean Management as they stress collaboration. They tend to make decisions as a group and pay more attention towards objectives and goals of their groups. However, many teams from Thailand, a country with high collectivism (Christopher et al., 2021) and high context culture (Rotchanakitumnuai & Speece, 2003), have shown how being part of it can incur unnecessary steps for working respecting virtual environment.

Gudykunst et al. (1996) clarify that communications styles can be directly affected by an individualism-collectivism cultural dimension. Countries with individualistic cultures generally adopt low context communications where meanings are explicitly conveyed in the messages, while those with collectivistic cultures use high context communications where meanings are implicitly transferred in the messages but show in the personal or cultural context.

One member (HR3) from the fifth team says, "*When it's a face-to-face discussion, we might keep talking aimlessly. It's chilled. But well, we get relationships*". This shows how relationships are emphasized within the team as presented in the part 4.2.2: Teamwork Quality of a virtual team. Also, the member (CD2) of the third team thinks that more real-life interactions have a positive impact on their working efficiency. Meanwhile, the sixth team from the company in the Netherlands, a country with high individualism (Ersoy et al., 2011), does not find any complications in this regard during virtual work, as one participant (CI1) from this team states, "*For me, this hasn't really changed. Or to put it differently, working virtually has definitely not made it harder to get clear requirements. I feel like I can do that just as well*", and others (CI2 and CI3) in the team agree.

Furthermore, the second team also talks about how people in the organization have a hard time adjusting to the new normal, in terms of technology. This can be associated with the facet of uncertainty avoidance. However, according to Martins et al. (2015) when it is high, though it is more difficult to have an adaptable organization, it is more suitable for the Lean implementation (Erthal & Marques, 2018).

As for the organizational culture, according to Erthal and Marques (2018), companies should be employee-oriented as a prerequisite for Lean implementation. However, with Lean Management, employees often have goals for perfecting processes to achieve which eventually causes more stress and pressure and results in a job-oriented culture instead. The sixth team portrays both dimensions. As mentioned above, the team pays attention to the welfare of their colleagues, nevertheless they continue to embrace their professional culture and perform their best at work. The fifth team, despite having good relationships within its own team, reveals the job-oriented dimension as its participant (HR3) says,

"*Working here, if you don't deliver quality, you'll get reproached*". Also, with virtual work, she (HR3) claims that she has been having a "work-life integration" instead of a work-life balance.

5 DISCUSSION

5.1 Reduction of waste

First, what many participating teams do to prevent the inefficiencies in working is listening to their customers to find out what they actually value, before starting any projects. As for knowledge work, when processes are standardized, it is commonly easy to define all steps necessary for production and customer satisfaction as those steps may be repeated (Kropsu-Vehkapera & Isoherranen, 2018). However, problems can always arise and how to solve them may not be easy to put in writing as well as tacit knowledge work, which is placed in experience of individuals (Kelloway & Barling, 2000). Despite all hassle, all teams show how their shared understandings or work practices help in their effort to make the processes flow.

Next, they all emphasize the importance of communications both within team for an attempt to share knowledge and information, and with their customers in order to let them pull the production or trigger the processes. However, with the virtual collaboration, some teams often find difficulties in transferring and receiving knowledge and ideas simultaneously. Despite the fact that the first five teams are not familiar with the Continuous Improvement framework, they all have been attempting to enhance their working situations, which is not much different from the practice of CI itself.

To elaborate, many teams see how important it is to brainstorm ideas or individually plan their work ahead, which can be implied to the process of Plan in CI. According to the fourth and sixth teams, with repetitive work, analyzing current situations and planning on improvements can be easy. Nonetheless, to put forward strategies and creative work, without actual meetings, spontaneous ideas cannot completely be produced as people's body languages cannot be fully seen. The first, third, and fifth teams highlight how having clear roles and responsibilities within their teams helps them in understanding and self-managing their work.

Moreover, in virtual work, all teams still do their best to initiate improvements according to plan as usual which can be inferred as Do in CI. Nonetheless, they can no longer gather to perform their work together and get real-time feedback. Therefore, trust should be well positioned within each team.

Furthermore, even though the process of Check, the third stage of CI, should be essential, many teams tend to disregard this phase of reviewing the outcomes of their plans

together due to the inconvenience of having another online meeting for this purpose only. Some individuals within the fifth team go through this process by themselves. For instance, after the work is done and there is no complaint, they assume that it means each of them has done it right. Also, if the culture of the company is to always deliver the best quality of work, they believe that if they do their best, that is how the work should be done. Meanwhile, the sixth team does not ignore the Check stage, but members admit that it has proved to be the most challenging stage because it is difficult to check by themselves if what they have done is good enough, as most of the time the results of their work are not tangible or cannot be seen right away. The first team sees the necessity of meeting up after each event to discuss and discover good practices and improvements.

In addition, after each participant in the second team analyzes their work, performs it, and checks its results, they find which part of the process adds no value, then they go back to the plan process and start all over again by themselves. Since their work is routine-based, according to Kropsu-Vehkapera and Isoherranen (2018), it is easier for them to identify waste in their processes. Nonetheless, though their work processes are standardized, they have to solve problems and do a lot of analyzing, for example customizing product portfolios for each client. They also have to submit weekly reports to management in order to inform them of the work results. Moreover, what is clear from the fourth team's statement in terms of improvement is that their management is understanding and involved in enhancing the process to reduce cost, time, and effort of the employees. The obvious example from this team is when the management decided to change the approval process to digital.

Even though participants from all teams tend to do the first three processes in PDCA cycle both together with the team and by themselves, the third team often needs to listen to the leader's feedback and directions as its work is only partly standardized.

The process of Act is normally how each team executes their plans of improvement into standardized practices. All teams have had well-established standardizations and continue to improve their processes, however, some teams may overlook waste in their processes from time to time due to different arrangements they also face with other teams whom they have no control over. With the pandemic disruption, many teams have to change their ways of working and therefore, start to emphasize more on recognizing waste and searching for improvements as working from home is already proved to be troublesome for many of them. One example is that during working from home, the third team finds the activity that can actually be done by itself without having other departments

involved because its members have all the necessary data to make decisions. This removes task batching which saves them time on waiting for feedback, and makes their work flow.

5.2 Answers to research questions

5.2.1 Introduction

First of all, since the main purpose of Lean Management is to reduce waste or so-called non value-adding activities, to answer research questions, the need to understand what each team considers waste in their processes is crucial. However, since many teams are not familiar with the concept of waste in Lean Management, several processes and activities were shown to the participants with the aim that they could relate them to their own team's collaboration processes and see what activities they think are not required or are non-value added.

Following the interview results, the same processes can demonstrate as different types of waste for each team due to the nature of their work and the culture of their companies. The processes that do not enhance the satisfaction of the customers, decrease cost, time, or effort, and are not mandated by a legal authority are labeled as waste (Al-Baik & Miller, 2014) for each group.

5.2.2 First research question

To answer the first research question, "How does virtual working (workplace mobility) affect the organization's collaborative process?", it is essential to point out that working from home does not mean that the level of virtuality can be increased automatically. For certain, the mobility is in the picture as everyone in the team is not in the same place or office as usual because of the pandemic. Due to this regard, the shared work practices are still manifested to be a foundation of a good virtual collaboration.

Technology is both a good and bad guy in this situation. For the fifth and sixth teams, the participants reassure that by having good technologies and new practices by the management in dealing with the work from home situation, all tasks can be performed almost equivalent to before, and they start to like working virtually. Meanwhile, other teams still see lots of limitations of remote working. Even one participant from the sixth team (CI2) admits that he loses a whole picture of the brainstorming session every once in a while, as when others present, they do not always keep the whole screen on but zoom-in to point

out what they are talking about. This shows how different needs of meeting attendees at a specific moment cannot be shown right away. The third team also experiences a variety in the use of technologies and tools of different individuals. People show different technology skill levels or they actually have no access to those technologies and tools, for example having been given different laptops with different specifications or having no access to a single integration of different platforms, which, according to Chudoba et al. (2005), can be deduced as a boundary for working together. In addition, no team affirms that their ideas can be explicitly expressed as immediately as before, whether it is because of unstable connection, video resolutions, or the lack of body languages through online meetings.

The findings also demonstrate three captivating observations: first, for the company, only adopting dated technologies, but no training or standard practices, does not help in improving efficiencies and performances of the workers, second, technology does not slow down their work, but unstable or outdated technology and tools adoption does. Third, the challenge still lies on how to make communications more real-time and effortless as face-to-face meetings.

When reviewing more benefits of working from home, every participant upholds that they get less distraction which was either from surrounded noises, other colleagues talking to them, or being asked to do ad-hoc tasks. Thus, they can concentrate better, and some get even more productive.

One concern taken from the interview results is that technology tends to lessen personal boundaries: People take for granted the availability of other people. This causes some participants to often work longer hours or without a proper break. Another concern is that many of them experience fatigue during working from home which is caused by being inside adhering to their rooms working, while those rooms were once their relaxing places after work. They often have to remind themselves to find time for breaks or to change environments. However, some of them just cannot get away from it due to their full meeting schedules. Also, they sure miss interactions. Even though ICTs are supposed to enable interactions between employees towards a more spontaneous and broad way (Chudoba et al., 2005), one participant (CI2) is certain that there is still nothing comparable to real-life social interaction and others (CI1 and CI3) still feel that they have to make more effort to have non work-related conversations. Chudoba et al. (2005) explains how important social interaction is in developing mutual understandings between team members. It can help them effectively work with each other as it builds up trust within a

team and therefore, the ideas about their work process can be shared in confidence. The aforementioned concerns seem to have impact on individuals in a way that is called *burn-out*, which can also affect work performance of an organization (Maslach, 2011).

The analysis of each team is interpreted and compared with others. Once again, virtual collaboration concerns six aspects in Teamwork Quality: Communication, Coordination, the Balance of Member Contributions, Mutual Support, Effort, and Cohesion, together with how virtual they are and how much work practices play a part in their collaboration. Also, according to the interview results, types of work such as planning, problem solving, or routine-based, and types of organizations, which in this case are international and national, are demonstrated to partake in the differences in how each team sees certain processes as waste.

5.2.3 Personal and cultural perception

As each group is from a different organization, it is a challenge to give a definite answer as to which team's process is more involved with the improvement process. However, how each team's virtual collaboration impacts the level of waste or the attempt to reduce waste within the team can be explained.

But first, it is worth to mention that *trust* is exhibited to be placed in the teams where roles and responsibilities are well allocated. It is harder to build and maintain trust in teams that do not meet in a face-to-face setting (Hossain & Wigand, 2004). All teams put effort and commitment into performing at their best in virtual working.

Next, as for the teams that have to deal with a process that is mandated by law - for instance the human resources team needs consents from all candidates to keep and use their personal data and the public relations and marketing team needs consents from their students who appear in their promotional content - they understand, find advantages from it, and support it. The public relations and marketing team thinks that this process can help protect both parties, students and school.

Furthermore, all teams from Thailand show a concern for personal perception when it comes to texting. This concern associates with their culture, high context, where people usually complete transferring messages by using expression and body language as they pay more attention towards intimate relationships (Kim et al., 1998). Therefore, with limited physical context being allowed, they find it burdensome to convey a message as they need to check the message at least a few times before sending it to some team members.

Also, the most common action among these teams is texting to confirm the sending of an email to a receiver. Despite the notion of high level of collectivism, which supports the implementation of Lean Management, this cultural characteristic can have an impact on the collaborative processes during virtual work.

What is fairly apparent in the interview results is that the leader involvement is essential in the process of improvement. One participant of the sixth team (CI2) clearly states that the team leader has been in an attempt to persuade others in the organization to consider adapting the concept of Continuous Improvement. At any rate, the management of the fourth team also understands the need to reduce superfluous activities and improve processes, for example facilitating the approval process by making it digital. As for the third team, the approval process has been digitalized as well, but they still need to collect actual signatures when the situation allows them to. Though the fourth team has experienced difficulties in integrating and sharing tools into their organization's processes, the concern is positioned in the second team as their management or leaders have not shown their interest in adapting any collaboration tools such as a shared drive into the company's work practices. One participant of the third team thinks that it relates to the fact that all leaders are from an older generation, which sometimes, refuses to learn new things. However, one interviewee from the fourth team does not think that it is about the generational gap, as she points out that there are some older leaders who are quite familiar with technologies, but it actually connects to how familiar they are with technologies and tools that makes them understand how new technologies play a role in the improvement of virtual work.

5.2.4 Second research question

To answer the second research question, "What are the wastes that the organization has before and after full-scale virtual working (workplace mobility)?", referring back to part 4.2.2: Teamwork Quality of a virtual team, it can be seen that the two teams that have the lowest average scores of virtual collaboration also reveal more types of waste in their collaboration processes. However, some teams have shown more non value-adding activities within each type.

Some processes within each organization continue to carry waste in them and some of them get worse during virtuality. Meanwhile, some processes exhibited more waste before the pandemic and with virtuality being required, many teams have been looking

more into what interferes their work or slows them down, and finally find ways to reduce those non value-adding activities and adapt themselves into the new normal. The study demonstrates a correlation between virtual collaboration and waste in each team's processes which can be concluded as following.

The first team, public relations and marketing, which shows a decent virtual collaboration level, demonstrates how its good relationship and teamwork help in maintaining the members' coordination, effort, and contribution, even though they informally communicate less frequently with each other during work from home.

Nonetheless, they disclose four types of waste: overprocessing, unnecessary motion, waiting, and talent, from virtuality. First, as for the overprocessing, they need to convey the same message several times because for the meetings with executive management, not everyone in the team, except for the superiors, can attend. Second, as for unnecessary motion, with the prominence of paper-based documents in the organization, some member feels that they live farther from the working materials and sometimes, has to make an effort to visit the office. Third, as for waiting, they cannot continue or finish their work as quickly as before as they have to wait longer for information due to the lack of simultaneous communications. Fourth, as for talent, some of them cannot work as effectively as before because they have no suitable tools and materials for virtual work.

Moreover, there have been some types of waste that the team members have experienced before, and they still continue. For example, the company's regulation for writing a report letter to their clients increases the number of steps in their information sharing process. They have to explain different topics in the report in a very formal way, while the readers only want to read the conclusion. This situation has given them more work to do, and one of the examples is answering parents' questions through both phone calls and a chatting application, while the parents lose the main point of the report and get confused, or they even decide to not read as the report is too long. They think that if they could write the report letter in a more concise way, the parents could have understood what they try to tell since the first time they read. This way, they could have saved their energy in doing some other activities that help them work more productively.

Fortunately, one type of waste is reduced during their virtual work: transportation. Since the number of attendees is limited to prevent the unstable connection that may affect communications, lower-ranked employees may not attend all meetings, especially with management as the organization emphasizes the hierarchy. The attendees, or in this case information receivers, are more selected and therefore, there is no need for some

pieces of information to be moving around among employees who may not need to know them at all. Also, even if they still have the talent waste, they have been forced to use their creativity to create new activities suitable for virtuality, both for themselves and for their customers.

The second team, online merchandise and marketing, does not exhibit the high-level virtual collaboration and while working from home, reveals six types of waste: overprocessing, defect, unnecessary motion, waiting, overproduction, and talent. First, as for the overprocessing, the approval process in their company has never been easy since when they physically worked together. And with work from home, they only feel that they have more unnecessary steps in their process. The company's common work practice for this process is not completely clear to begin with. They are told that emails can be used for approval instead of actual signatures, but they keep being reminded to collect them. Second, as for defect, with no face-to-face meetings, data is sometimes not shared immediately and hence, they have to use outdated data, which can also be called as defective. Third, as for unnecessary motion, having virtual discussions makes them move, either to set up meetings or talk, for nothing in terms of work. They need to have online meetings multiple times to eventually, get the conclusions that they need due to the type of their business, retail trade that involves physical products, which have to be customized into different strategic portfolios for different channels. Fourth, as for waiting, with unstable VPN provided by their company, they find themselves waiting for the technologies to work well enough to continue working. This slows them down and prevents them from working on more projects. Also, they used to walk to people to get their answers but now, they cannot do that anymore. Therefore, they sometimes cannot continue working as they have to wait for the necessary working materials. Fifth, as for overproduction, with the unclear requirements getting from online communications, they have to produce the same work over again. Sixth, as for talent, with no system integration and incompatible laptops, they can hardly improve any skills because they spend more time dealing with the mentioned complications.

Furthermore, their individual skills have not been acknowledged by their leaders since before the pandemic and it is likely that during working from home, they are still neglected. Their chance in improving their skills is low. Also, the organization has been experiencing the overproduction waste because the same information is often presented in different reports made by different departments for the same group of people, management. It takes their time away from doing more worthwhile projects.

Despite how much effort they put or how close they are, without good technologies and tools, they find it difficult to virtually work with no obstacle. However, they can still perform their work since it is quite routine based, although it includes day-to-day problem solving, and their roles are communicated clearly.

The third team, customer development for E-commerce, during working from home, has shown a good level of virtual collaboration and three types of waste: overprocessing, unnecessary motion, and waiting. First, as for overprocessing, they often have to perform extra steps in order to verify themselves and they decrease their speed in working. Second, as for unnecessary motion, when their audiences do not pay attention to their presentations during online meetings, their work becomes waste. Also, they have been working longer hours as their colleagues suppose they are always with their phones and so available to discuss work, while some matters are not actually as urgent as they are shown to be. Third, as for waiting, they regularly wait for approvals from their leader and colleagues who they cannot meet while working from home. They have no idea where these people are and after sending a message asking them to approve their work in the system, they can only wait.

In general, there are many tools that they are required to use and are underdeveloped so for them, these tools are defects by themselves. They have been using these tools, which are not improving their work and now, during virtual work, they are still not changed for the better. They sometimes receive inaccurate data and instead of going forward with it, they decide to leave the data unprocessed which is implied to the inventory waste that is nether increased nor decreased during in the course of their virtual work. From time to time, they produce projects that are not used afterwards and hence, those are waste in terms of overproduction.

In spite of all the wastes they experience, there is one process that has been improved during virtual work: the internal approval process. It now can be done directly on the system, and it has been reducing working their steps improving their working flow.

The fourth team, digital transformation, giving a relatively low average score to the virtual collaboration, exhibits seven types of waste: overprocessing, transportation, inventory, unnecessary motion, waiting, overproduction, and talent. First, as for overprocessing, the team receives data in a very big file where they have to do a lot of analyses in order to find the answer they are looking for. This leads to their second waste, transportation, as the immoderate working materials are moved unnecessarily. Third, as for inventory, with no access to the proper collaboration tools to brainstorm, some projects

have to be postponed and the data they already have is left unprocessed. Fourth, as for unnecessary motion, having virtual discussions wastes their time and energy as it rarely leads to any conclusions. Fifth, as for waiting, the time for waiting for information or approval has been longer and it sometimes discontinues every activity in the process. Sixth, as for overproduction, they are urged by others to discuss work outside working hours, even though they get more work done, most of the time, it is not yet required to be finished soon. Seventh, as for talent, ideas and creativity are not presented immediately because still, there are not available tools within the organization that can make the discussions as real time as face-to-face meetings.

When working together in the office, the team never had to postpone their projects, except for when there were external circumstances, which could not be controlled by them. Besides all wastes they have, one thing that this team is certain of is that they always deliver good quality of work. However, according to this team, it depends on each individual and the nature of this team may play a part: this team is new, and all members are well-experienced and bought from other well-known organizations.

The fifth team, human resources, rates its virtual collaboration higher than the first four interviewed teams and while working virtually, demonstrates four types of waste: defect, unnecessary motion, waiting, and overproduction. First, as for defect, the team cannot provide their customers concerning emotional support with the same quality. Their customers do not have the spontaneous moments for discussions and now, each discussion has a time limit, as everything is literally scheduled, so unplanned topics can hardly be talked over. Second, as for unnecessary motion, the members have to often reach out to their phones, which are sometimes far away, for the verification process. Third, as for waiting, they have to wait for the code generated from their phones in order to continue working. Fourth, as for overproduction, they have been having excessive numbers of meetings because others keep filling in their schedules wherever they find a space.

The same goes to this team regarding their approval process. Since everyone has to work from home, the company has changed the approval process to be totally digital which means that only the electronic signatures are required and if there are actual documents involved, they can be submitted on the system as a picture taken from their phones. Their leaders and colleagues also check their emails and approve faster. This definitely saves them from overprocessing or waiting wastes. Also, the data on the system has been more updated than ever which supports their work to a great extent. Therefore, there is

no need for them to run around looking for people to sign the paper-based documents or even print the documents that they may use only once.

The sixth team, continuous improvement, being a virtually operating team since its inception, only has one concerned type of waste: talent. They spare time to discuss personal matters of team members and even occasionally organize virtual drinks. However, since they cannot meet their colleagues, their social skills have not been utterly utilized.

For this team, the verification process within the organization has been improved. They do not need to verify themselves frequently. Also, they can easily reach out to people as their statuses on Microsoft Teams show if they are online. Besides, they save an enormous amount of commuting time, business travel time, and unnecessary movement. Finally, no more waiting for people who are late to the meetings.

Following the conclusion, it shows that many teams have problems with the VPN and verification process. According to Ameen et al. (2021), cybersecurity is meant to protect the company data, which may contain clients' data and properties as well. If these data are out into the wrong hands, the loss will not only be on the company, but also the customers of the company. Therefore, it is necessary but with unstable cybersecurity, workers can experience different types of waste which affect their work efficiency.

In **Table 7**, the fourth team shows the lowest average cohesion score. Even though according to Hoegl and Gemuenden (2001), when the team members do not feel that they belong to the team, they can hardly have a close collaboration, this team affirms that they can collaborate less effectively while working from home because they lack the proper tools. As stated in Part 2.6: Business process, the communication is an important part of every process. In order to have a successful collaboration, every part of the process needs to be communicated among stakeholders and the closer the team is the more engaged the members are in collaboration (Hoegl & Gemuenden, 2001). However, the result indicates that if the companies do not invest in having up-to-date technology and tools, the online communications cannot be as effective as having discussions in person.

The waiting waste has been experienced by the majority of participants. This type of waste is caused by different reasons but the common one is waiting for responses from colleagues whom they cannot meet in person and do not know how to reach them. The type of the company may be relevant to this regard. Even though the interview results do not display a solid answer for this part, it can be observed that international companies tend to be more prepared for this situation and as claimed by the participants from these

companies, they had experience collaborating using different technologies and tools with others whom they had not met before.

There are also activities that some teams see as waste but with the current work practices of the team, those activities do not interfere their work or slow them down much enough for them to look for solutions.

5.3 Limitations

The original plan was to interview different groups within one organization, but it was proven to be a challenge. First, finding stakeholders within an organization already took some amount of time and some of them gave no reply. Second, as the focus group interviews are the main method in answering research questions, many people in the same team need to be available at the same time. Third, some teams are bigger than five people, but it was impossible to interview a bigger group in a short amount of time and still get good insights because each of them would not be able to have time to process questions and produce enough good answers. Therefore, the number of participants in each group is ranging from three to five. According to Krueger and Casey (2014), the larger the group, the more ideas and insights are likely to be delivered. Nevertheless, the total number of participants is 21, with only one team that has five participants. Fourth, some questions can be sensitive to openly discuss within a team, therefore, the questionnaire was used to support the interviews. The example statements in the questionnaire are first, “When virtually working together, the team members contribute more to the achievement of the team’s goals in accordance with their specific potential” and second, “When virtually working together, my team and I have more personal conflicts”, adapted from Hoegl and Gemuenden (2001). However, some participants eventually refused to fill it in and one of them decided to have an extra online one-on-one call instead. Consequently, the questionnaire result of one person in the team was not shown, to protect the respondent’s privacy, but was used together with the additional call to interpret the team’s virtual collaboration.

Furthermore, the reliability of this research is impacted by the fact that there is no actual observation for a concrete comparison between each team. It has to be taken into account that some participants may not fully disclose all information or even forget to mention some details. Therefore, there may be more types of waste from other teams that cannot be extracted from interviews themselves.

Finally, it is beyond the scope of this study to find solutions for wastes identified in this paper as well as scrutinizing the effects of cultures, in terms of individual and organizational, and types of organizations. However, the latter is not disregarded but briefly analyzed as the special finding.

6 CONCLUSION

There is no definite answer which tells if the virtual collaboration has only positive or negative impacts on the waste reduction process within the Lean Management framework. However, the impacts are apparent. When employees experience wastes, their companies are also affected by those wastes. The process of Continuous Improvement relies on employees on every organizational level to find the points where the organization can improve. After this discovery, improvements may be implemented, for the company, to avoid having to spend more money, time, and effort in order to allow their employees to satisfy customers right in time.

The research emphasizes collaboration in the virtual setting of each team by using Teamwork Quality as a measurement of the level of collaboration within teams. Asking team members about the perceived level of Teamwork Quality after switching to working virtually provides insight into the comparison between working in a physical office and working from home.

The results of the interviews also demonstrate different impacts on the processes within each studied team. Some processes convey more waste during virtual collaboration, while some have been improved. However, different organizations reveal that they have experienced more waste than improvement. Working from home on collaborative projects itself is challenging, therefore it often takes their time away from evaluating their current situations and looking for non value-adding activities. This shows how important it is for the management to get involved into the process of improvement as they can normally see the big picture and whole process pipelines of the company.

Communications still greatly contribute to a good collaboration, both verbal and text. However, with virtual meetings, body languages and spontaneous ideas are still missing. Therefore, the company should consistently emphasize the adoption and development of ICT. Also, the collaboration tools pose to be crucial for the innovation and ideas creation.

The set of work practices or shared understanding can help employees work more productively and effectively. The attempt in writing down steps in a process as instructions may help them from wasting their time asking around or looking for ways to work for the tasks that have been repeatedly done before.

Business process management still plays a big part in assisting companies to capture the value in the process. No matter what is changed, if the customers are not satisfied by the end results, the attempt can possibly mean nothing.

These results of the research should be taken into account when considering how to improve the processes of the organization. It helps to make each individual within the organization realize the essence of continuously searching for waste in their processes and looking for ways to reduce them. Moreover, this research could help organizations consider if the Lean Management framework can be the right tool for them to better their processes.

Future research should be conducted highlighting individual and organizational cultures as this aspect appears to have affected some teams' operations even when they are from the same country or culture. The contradiction regarding cultural angle may lead to a new methodology to study and understand more about how cultural factors play a role in Lean management in a virtual experience. Also, the observation should also be one of the main methods so that actual processes can be observed and analyzed. One interesting aspect that may be worth observing is how much cost the company may have saved since the employees do not need to travel for business purposes anymore to see if there is a significant improvement that can outweigh the disadvantages or waste.

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APPENDICES

Appendix 1. Focus group guided interview questions (EN)

1. Which superpowers or magic tools would you like to have now to help you with working from home?
2. Who are you customers? (Who uses your output?)
3. Since working from home, you provide incentives/features to customers_____what they ask for!
    a. More than
    b. Just as
    c. Less than
4. Are the levels of unclear requirements that you receive the same as when you were working in the office?
5. Do you receive which data, unclear requirements or inaccurate data, more?
6. How do you think about this quote and have you experienced this situation?: "Producing and distributing reports that are not required, and providing more information than is necessary" (Al-Baik and Miller, 2014)
7. Have you encountered any unnecessary tools, technologies, or methodologies?
8. How does cybersecurity affect working?
9. What are the differences that you might have seen between physical brainstorming and virtual brainstorming?
10. How is the response time for waiting for information/review/approval to continue working or complete a task? And why so?
11. How do you make people understand the urgency of your work when working from home? (How is the response time now compared to when working in the office?)
12. If I _____, more movement will go to waste!
    a. Book and walk to a meeting point to discuss in person
    b. Make some clicks and set a meeting to have a virtual discussion
13. With full-on virtuality, which stage of the CI can easily be overlooked?
    a. Plan
    b. Do
    c. Check

   d. Act
14. Have you noticed any change in your skill usage?/ How much are your skills used in your team?
15. What do you think about consent requests?
16. How is your situation when trying to gather data/get information?
    a. 1-1
    b. 1-2
    c. 1-many
    d. All applied
    e. None of them!
17. Has this situation happened more often while working from home? Some emails/documents/requirements are not yet processed
18. Do you agree with this statement: “I’d rather type than talk to my team!”?
19. Working from different places, how do you maintain a “team”?
20. How has working from home been affecting your working hours?
21. Do you agree with this statement: “Some tasks/processes could have been done easier or faster by other members, but I can just do it by myself”?
22. Which emoji typically represents you at the end of your virtual work day?

Appendix 2. Focus group guided interview questions (TH)

1. พลังวิเศษหรือเครื่องมือวิเศษอะไรที่คุณอยากมี เพื่อช่วยอำนวยความสะดวกในระหว่างทำงานที่บ้าน
2. ใครคือลูกค้าของคุณ (ใครคือคนที่ใช้ผลงานของคุณ)
3. ตั้งแต่ working from home คุณทำงาน ____ที่ลูกค้าของคุณขอ
    a. มากกว่า
    b. เท่ากับ
    c. น้อยกว่า
4. คุณได้รับข้อมูลที่ไม่ชัดเจนระดับเดียวกับเมื่อตอนทำงานที่ออฟฟิศหรือไม่
5. ข้อมูลแบบไหนที่คุณมักได้รับมากกว่ากัน ระหว่างข้อมูลที่ไม่ชัดเจนกับข้อมูลที่ไม่ถูกต้อง

6. คุณคิดยังไงกับข้อความนี้และเหตุการณ์นี้เคยเกิดขึ้นกับคุณหรือไม่:

   “ทำหรือแจกจ่ายรายงานมากกว่าที่คนอื่นต้องใช้ และให้ข้อมูลในรายงานมากกว่าที่จำเป็น” (Al-Baik and Miller, 2014)

7. คุณเคยพบเจอสิ่งเหล่านี้หรือไม่: เครื่องมือ เทคโนโลยี และวิธีการที่ไม่จำเป็น

8. ความปลอดภัยทางด้านไซเบอร์มีผลอย่างไรต่อการทำงาน

9. อะไรคือความแตกต่างที่คุณอาจพบเจอระหว่าง

   การระดมความคิดแบบเจอกันตัวต่อตัวกับการระดมความคิดแบบเสมือนจริง

10. ระยะเวลาในการรอข้อมูล รีวิว และการอนุมัติ เพื่อที่จะได้ทำงานต่อหรือทำงานให้เสร็จ เป็นอย่างไร และทำไมถึงเป็นเช่นนั้น

11. คุณทำอย่างไรให้คนอื่นเข้าใจถึงความเร่งด่วนของงานเมื่อคุณทำงานที่บ้าน

    (ระยะเวลาในการตอบสนองในปัจจุบันเป็นอย่างไร เมื่อเทียบกับตอนทำงานที่ออฟฟิศ)

12. ถ้าฉัน_____ การเคลื่อนไหวของฉันจะสูญเปล่ามากกว่า

    a. จองและเดินไปยังจุดนัดประชุม เพื่อพูดคุยกันตัวต่อตัว

    b. คลิกสองสามทีและนัดประชุม เพื่อพูดคุยกันทางออนไลน์

13. ด้วยการทำงานแบบเสมือนจริงอย่างเต็มรูปแบบ ขั้นตอนใดใน CI ที่มักจะถูกมองข้าม

    a. วางแผน

    b. ปฏิบัติ

    c. ตรวจสอบ/ประเมิน

    d. ทำให้เป็นมาตรฐาน

14. คุณสังเกตเห็นถึงความเปลี่ยนแปลงในการใช้ทักษะของคุณหรือไม่/

    ทักษะของคุณถูกใช้มากแค่ไหนในทีมของคุณ

15. คุณคิดอย่างไรกับการขอความยินยอมในการใช้ข้อมูล

16. สถานการณ์ของคุณเป็นอย่างไร เมื่อต้องหาข้อมูลสำหรับใช้ในการทำงาน

    a. 1-1

    b. 1-2

c. 1-หลายคน

d. ทุกแบบ

e. ไม่ใช่สักอย่าง!

17. สถานการณ์นี้เกิดขึ้นมากกว่าเดิมหรือไม่ในช่วง work from home: มีบางอีเมล เอกสาร หรือความต้องการของลูกค้า ที่ยังไม่ได้รับการดำเนินการ (หรือประมวลผล)
18. คุณเห็นด้วยกับข้อความนี้หรือไม่: “ฉันชอบพิมพ์มากกว่าพูดคุยกันตัวต่อตัวกับคนในทีม”
19. เมื่อทำงานต่างที่กัน คุณรักษาความเป็น “ทีม” อย่างไร
20. การทำงานที่บ้านมีผลอย่างไรกับเวลางานของคุณ
21. คุณเห็นด้วยกับข้อความนี้หรือไม่: “งานบางอย่าง ให้คนอื่นทำจะง่ายและเร็วกว่า แต่ฉันทำเองก็ได้”
22. อิโมจิตัวไหนบ่งบอกอารมณ์โดยส่วนใหญ่ของคุณได้ดีในช่วงเวลาเลิกงาน

Appendix 3. Questionnaire – Virtual collaboration (EN)

This questionnaire is to understand the collaboration within the team when working virtually, compared to when physically working together in the office.

*Please rate how each statement below relates to your team.

(The questionnaire takes about 5-10 minutes)

---

*Required

1. What is your function/team in the organization?*

2. Communication in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My team and I communicate more frequently.					
My team and I communicate with each other in a more spontaneous way.					
The communication among my team is more likely to be mediated by our team leader.					
My team and I are more open to exchange information than when working in person.					
My team and I have adequate tools/technologies provided by my organization to have a good and clear					

virtual communication.					

3. Can you think of any technologies/ platforms/ applications used for communication in your team? If yes, please give examples.

4. Coordination in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My team and I have a good set of work practices to coordinate better than when working in person.					
The work done on individual subtasks is more closely harmonized (easier to be well-combined).					

My team and I agree on a common task-related goal structure and we have clear subgoals for each member.					
My team and I have adequate tools/technologies provided by my organization to have a good virtual coordination.					

5. Can you think of any technologies/ platforms/ applications used for coordination in your team? If yes, please give examples.

6. Balance of member contributions in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My team recognizes my specific potentials					

(strengths and weaknesses) more.					
The team members contribute more to the achievement of the team's goals in accordance with their specific potential.					
Imbalance of member contributions causes more conflicts in our team.					
My team and I have adequate tools/technologies provided by my organization to maintain the balance of member contributions.					

7. Can you think of any technologies/ platforms/ applications used for a balance of member contributions in your team? If yes, please give examples.

8.Mutual support in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My team and I help and support each other more.					
If conflicts come up, they are easily and quickly resolved.					
My team and I use a variety of technologies (not necessarily provided by my organization) to support each other.					
My team and I have adequate tools/technologies provided by my organi-					

zation to support each other in the team.					

9. Can you think of any technologies/ platforms/ applications used for mutual support in your team? If yes, please give examples.

10. Effort in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Every team member makes the team's projects their highest priority.					
Our team puts more effort into our projects.					
There are more conflicts regarding the effort that team members put into projects.					

My team and I have adequate tools/technologies provided by my organization to maintain the effort in the team.					

11. Can you think of any technologies/ platforms/ applications used for maintaining effort in your team? If yes, please give examples.

12. Cohesion in virtual collaboration, compared to when physically working together in the office.

When virtually working together, _____.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I get along well with my teammates.					
My team and I have more personal conflicts.					
My team and I stick together more.					

My team and I have adequate tools/technologies provided by my organization to support cohesion in the team.					

13. Can you think of any technologies/ platforms/ applications used for supporting cohesion in your team? If yes, please give examples.

14. How do you like this focus group interview? (Not included in the research)

★★★★★

15. Please leave any comments

Appendix 4. Questionnaire – Virtual collaboration (TH)

การทำงานร่วมกันเสมือนจริงบนโลกอินเตอร์เน็ต

แบบสอบถามนี้จัดทำขึ้นเพื่อช่วยให้ผู้ทำวิจัยได้เข้าใจการทำงานร่วมกันภายในทีมของคุณ

เมื่อทำงานเสมือนจริงบนโลกอินเตอร์เน็ต เปรียบเทียบกับการทำงานด้วยกันในสถานที่ทำงานหรือออฟฟิศ

*กรุณาให้คะแนนข้อความด้านล่างว่าตรงกับทีมของคุณแค่ไหน

(แบบสอบถามใช้เวลาในการตอบประมาณ **5-10** นาที)

_____

*จำเป็น

1.คุณอยู่ทีมอะไรในองค์กรของคุณ*

2. การสื่อสาร (Communication) ในการทำงานร่วมกันเสมือนจริง เปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ

เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ทีมและฉันสื่อสารกันบ่อยครั้ง					
ทีมและฉันสื่อสารกันแบบเป็นปกติวิสัย/โดยธรรมชาติ					
การสื่อสารในทีมของฉันส่วนใหญ่จะมีหัวหน้าทีมเป็นตัวกลาง					
ทีมและฉันสะดวกใจที่จะแลกเปลี่ยนข้อมูลกันมากกว่าตอนเจ					

อกันแบบตัวต่อตัว					
ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเราที่ช่วยให้การสื่อสารแบบเสมือนจริงบนอินเทอร์เน็ตเป็นไปด้วยดีและมีความชัดเจน					

3. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้ในการสื่อสารในทีม หากใช่ กรุณาให้ตัวอย่าง

4. การประสานงาน (Coordination) ในการทำงานร่วมกันเสมือนจริงเปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ

เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ทีมและฉันมีแนวทางปฏิบัติงานที่เหมาะสม					

สำหรับการประสานงานกันมากขึ้นกว่าตอนทำงานร่วมกันแบบตัวต่อตัว					
งานที่ทำของแต่ละคนสามารถนำมาประสานกันเป็นงานของทีมได้ดีกว่า (แต่ละคนแบ่งงานกันแล้วนำงานแต่ละคนมารวมกันได้ง่ายกว่า)					
ทีมและฉันเห็นชอบร่วมกันในเป้าหมายการทำงานของกลุ่มและแต่ละคนก็มีเป้าหมายย่อยของตนเองที่ชัดเจน					

ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเราที่ช่วยให้การประสานงานแบบเสมือนจริงบนอินเทอร์เน็ตเป็นไปด้วยดีมีความเหมาะสม					

5. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้ในการประสานงานในทีม หากใช่ กรุณาให้ตัวอย่าง

6. ความสมดุลของการช่วยเหลืองานกัน/การมีส่วนร่วม (Balance of member contributions) ในการทำงานร่วมกันเสมือนจริง เปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ทีมรับรู้ประสิทธิภาพการทำงานของฉัน					

(จุดเด่นและจุดด้อย) มากขึ้น					
ทีมเราช่วยเหลืองานกันมากขึ้น(มีส่วนร่วมมากขึ้น)ในทีม เพื่อช่วยกันบรรลุเป้าหมายของทีม ตามแต่ประสิทธิภาพของแต่ละคน					
ความไม่สมดุลของการช่วยเหลืองานกัน (มีส่วนร่วมในทีม) ทำให้เกิดปัญหาความขัดแย้งในทีมของฉัน					
ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเรา					

ที่ช่วยรักษาระดับความสมดุลของการช่วยเหลืองานกัน (การมีส่วนร่วมกัน) ให้มีความเหมาะสม					

7. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้ในรักษาความสมดุลของการช่วยเหลืองานกัน (ความมีส่วนร่วมกัน) หากใช่ กรุณาให้ตัวอย่าง

8. การสนับสนุนซึ่งกันและกัน (Mutual support) ในการทำงานร่วมกันเสมือนจริงเปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ

เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ทีมและฉันสนับสนุนกันมากขึ้น					
หากมีปัญหาความขัดแย้งต่าง ๆ ในทีม เราสามารถแก้ไ					

ขปัญหาความขัดแย้งได้ง่ายและรวดเร็วมากขึ้น					
ทีมและฉันใช้เทคโนโลยีที่หลากหลาย (ไม่จำเป็นต้องมาจากองค์กร) ในการสนับสนุนกัน					
ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเรา ที่ช่วยให้การสนับสนุนกันเป็นไปได้ด้วยดี					

9. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้ในการสนับสนุนซึ่งกันและกัน หากใช่ กรุณาให้ตัวอย่าง

10. การทุ่มเท่พยายาม (Effort) ในการทำงานร่วมกันเสมือนจริง เปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ

เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ทุกคนในทีมให้ความสำคัญกับงานหรือโครงการ(Project)ของทีมเป็นอันดับสูงสุด					
ทีมของเราใช้เวลาและทุ่มเทความพยายามให้กับงานหรือโครงการของทีมมากขึ้น					
มีความขัดแย้งมากขึ้นในเรื่องของการทุ่มเทพยายามของแต่ละคน					

ในการทำงานในทีม					
ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเรา ซึ่งช่วยรักษาระดับความทุ่มเทพยายามในทีมให้เป็นไปด้วยดีและมีความเหมาะสม					

11. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้สนับสนุนระดับความทุ่มเทพยายามในทีม หากใช่ กรุณาให้ตัวอย่าง

12. ความสามัคคี (Cohesion) ในการทำงานร่วมกันเสมือนจริงเปรียบเทียบกับการทำงานร่วมกันในสถานที่ทำงานหรือออฟฟิศ

เมื่อทำงานเสมือนจริงด้วยกัน _____*

	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	เฉย ๆ หรือปานกลาง	เห็นด้วย	เห็นด้วยอย่างยิ่ง
ฉันเข้ากับทุกคนได้ดี					

ทีมและฉันมีปัญหาความขัดแย้งส่วนตัวกันมากขึ้น					
ทีมและฉันสนิทกันมากขึ้น					
ทีมและฉันมีเทคโนโลยีที่เพียงพอจากองค์กรของเราที่ช่วยสนับสนุนความสามัคคีในทีมให้มีความเหมาะสมและเป็นไปด้วยดี					

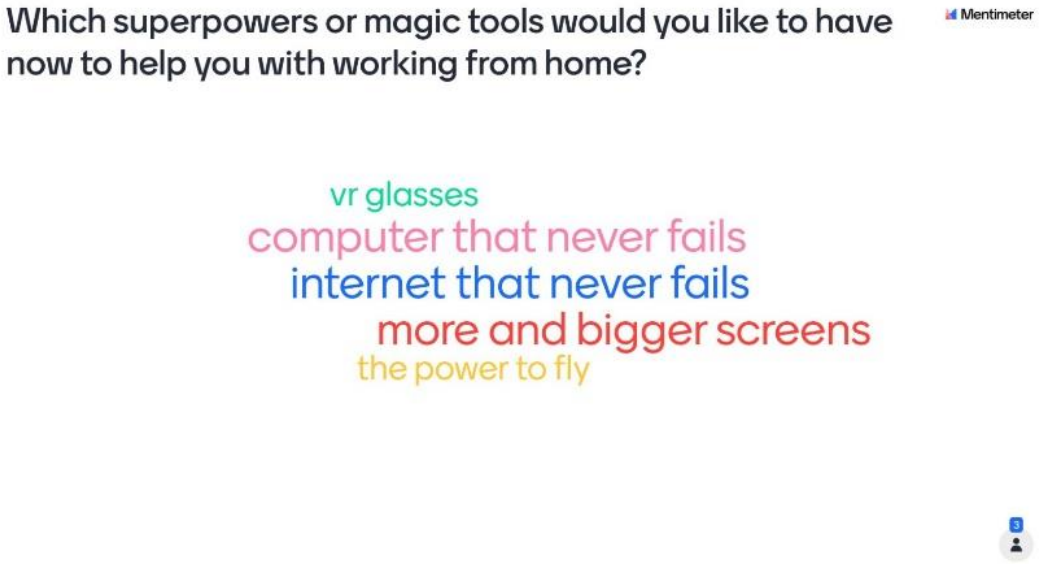
13. คุณนึกออกหรือไม่ว่ามี เทคโนโลยี/ แพลตฟอร์ม/ แอปพลิเคชัน ที่ใช้สนับสนุนความสามัคคีในทีม หากใช่กรุณาให้ตัวอย่าง

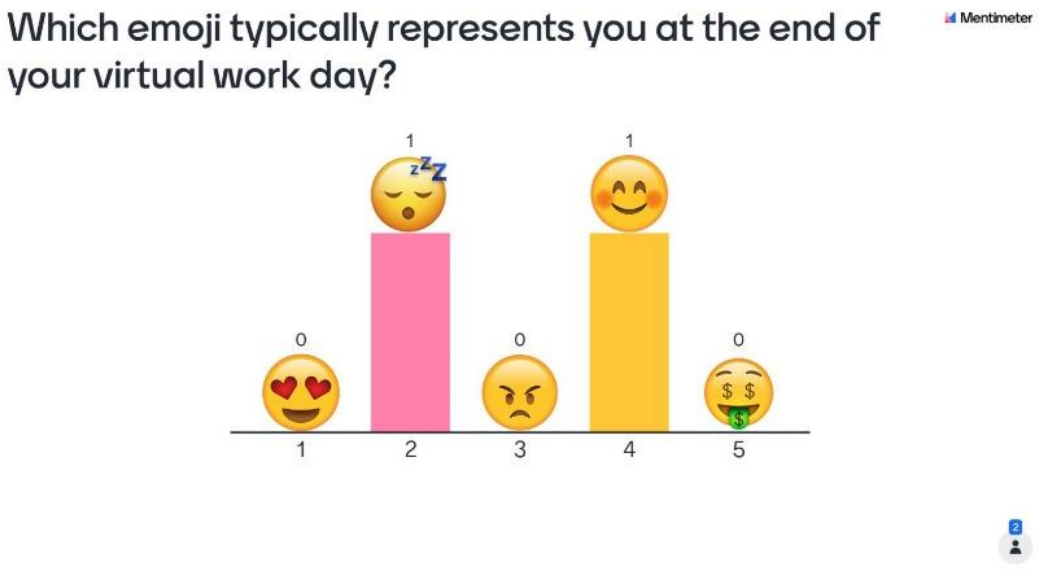
14. คุณคิดอย่างไรกับการสัมภาษณ์กลุ่มในครั้งนี้ (ไม่ใช่สำหรับงานวิจัย)

★★★★★

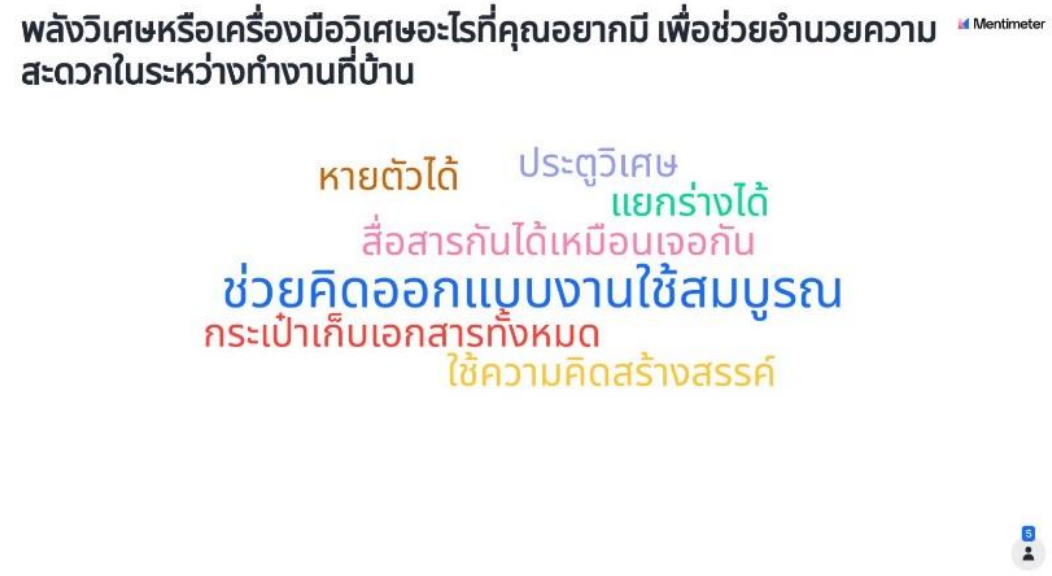
15. กรุณาให้ความคิดเห็น

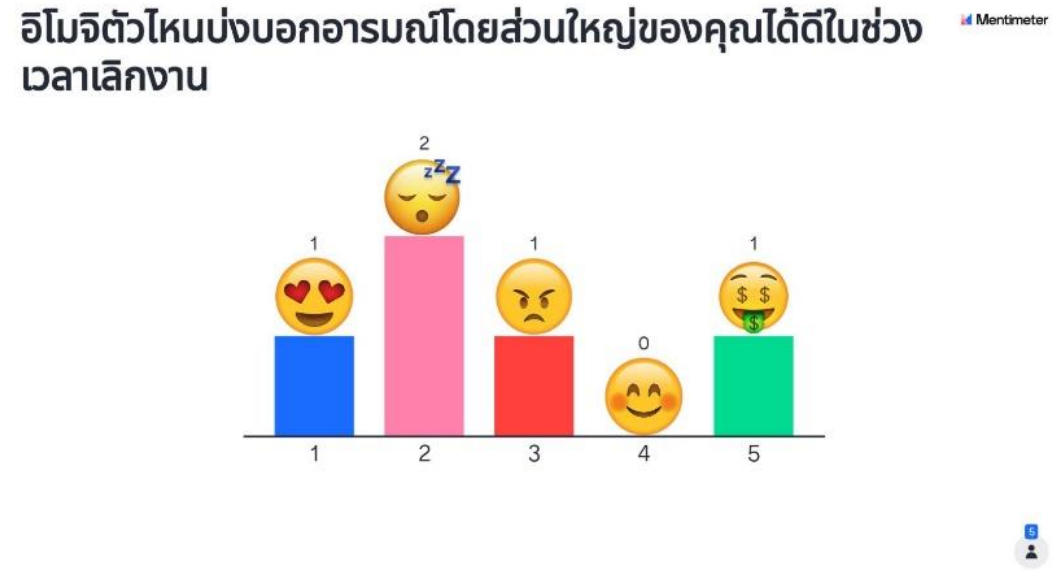
Appendix 5. Sample interview presentation (EN)



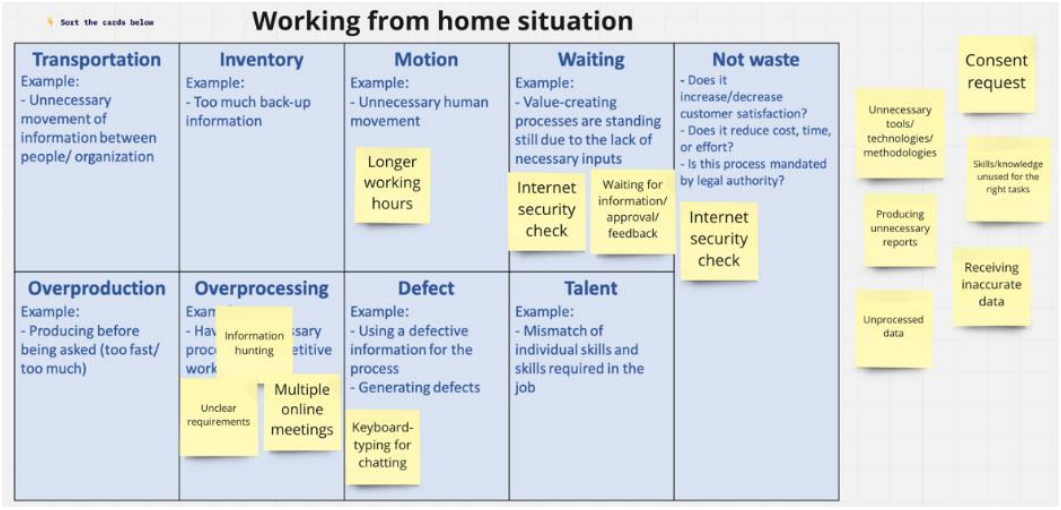


Appendix 6. Sample interview presentation (TH)





Appendix 7. Sample card sorting (EN)



Appendix 8. Sample card sorting (TH)