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Article

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A communication overload scale for use with mobile instant messaging in work management



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ABSTRACT

Mobile instant messaging (MIM) applications have an exceptionally large number of users worldwide. Businesses and organizations are attracted to their capabilities, making them the apps of choice for the formation of virtual groups and communities. While this development is plausible, there are possibly some overlooked disadvantages. One of them is technostress, a phenomenon caused by employees who are unable to cope with the use of communication and information technologies for work management. Unfortunately, the existing knowledge on technostress is ill-equipped to tackle this phenomenon because it is more occupied with information compared to communication overload; the latter is more relevant to MIM applications. No scale has been specifically developed to measure communication overload, especially in the context of MIM. This article develops such a scale, comprised of 19 items in five dimensions. The scale was validated based on expert reviews and refined through feedback in a survey of 200 MBA student respondents. The scale enables academics to link communication overload to mental health concepts and allows practitioners to measure employees' communication overload. The latter measurement would enable appropriate interventions and appropriate policies to be developed. These interventions and policies could be useful to manage technostress in the workplace.

1. Introduction

Mobile instant messaging (MIM) shares some similarities with text messaging and instant messaging technologies. MIM is similar to text messaging because both allow users to compose and send a brief electronic message, image, video, or sound content between two or more mobile phones (Wu, Lu, Gong, & Gupta, 2017). However, in terms of the network used to relay the messages or images, MIM is more similar to instant messaging (Viber, 2018). While text messaging relies on the phone network, MIM uses the Internet to achieve the same outcome. Instant messaging users are confined to their desktops and notebooks. In contrast, MIM users are mobile because they can access the applications from anywhere using their mobile phones. Among the most popular MIM applications are WhatsApp, WeChat, and Telegram, downloadable from the Apple, Google, and Windows App Stores.

MIM applications have attracted a substantial number of users worldwide due to the advantages over the older SMS communication method and previous versions of instant messaging applications, which are mostly personal computer (PC)-based. According to Statista (2018a), WhatsApp had 1.5 billion users around the world in December 2017. Malaysia demonstrates the second-highest use of WhatsApp, with a reported population share of 68% (Statista, 2018b). There are several reasons for its popularity.

First, the applications are free to download and use from the Apple, Google, and Windows App Stores. Hence, users are not constrained by mobile phones or operating systems such as iOS, Android, or Windows. Second, mobile phones' ubiquity makes MIM the preferred application, as users are not constrained in space and time to transmit and receive messages (Gao & Bai, 2014). Third, the decrease in mobile data cost has led more people to subscribe to data services. Eventually, they will use applications that rely on Internet technologies such as MIM for their daily needs (Sutikno, Handayani, Stiawan, Riyadi, & Subroto, 2016). Fourth, the current technologies allow MIM applications to seamlessly transmit and share images, audio, and videos, making them the apps of choice for forming virtual groups and communities (WhatsApp, 2018).

The last advantage has attracted the attention of businesses and organizations, which have increasingly been using MIM applications for internal communication and document sharing. Organizations use these applications to disseminate information and issue instructions to their employees. Some of them even conduct meetings over MIM applications and produce enforceable decisions over the technology. This increase in usage bodes well with studies by Björkdahl and Holmé (2018) and Cappa, Oriani, Peruffo, and McCarthy (2020), which found digitalization of the population, diffused in all age groups, drive the easy uptake of technology such as mobile applications.

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While this development is plausible, there are possible disadvantages that businesses and organizations may have overlooked. In South Korea, there are concerns that the use of technology has infringed on employees' time outside of office hours (Guardian, 2016). In Malaysia, many employers use MIM randomly to communicate with their employees outside office hours; this led to one trade union proposing that the government develop legislation to ban such practices (World of Buzz, 2018). If these developments went unchecked, the employees might experience technostress. It is a situation where people have difficulty coping with technology such as MIM (Tarafdar, Tu, Ragu-Nathan, & Ragu-Nathan, 2007).

While the existing knowledge of technostress is extensive (Nisafani, Kiely, & Mahony, 2020), most of the studies and scales for measuring the phenomenon (Tarafdar et al., 2007; Chandra, Shirish, & Srivastava, 2019; Tarafdar, Cooper, & Stich, 2019) were developed for large enterprise systems. Consequently, very few were conducted on mobile or communication technologies such as smartphones and tablets (Hung, Chen, & Lin, 2015), despite its increasing application in the workplace (Cui, 2016). Even then, the studies relied on scales developed for enterprise systems ill-fitted for communication technologies. They are vastly different in terms of how they were developed and their intended use. Enterprise systems are purposely built software platforms that function to support business processes, while communication technologies such as MIM is developed as a social communication tool. As a result, communication overload's operationalization is still limited (Stephens et al., 2017). Furthermore, there is no way to gauge the extent of stress that employees experience by introducing MIM to manage work. Consequently, organizations cannot develop appropriate policies and enact plans to overcome the stress caused by using the technology.

There are several contributions to this study. The main contribution of the study is the specialized and dedicated communication overload scale. Next, the new scale developed will urge academics to view information and communication overloads as two different constructs, rather than merely combining them or, worse, using them interchangeably. Furthermore, the scale allows practitioners and policymakers to gauge the level of stress caused by mobile technologies and instant messaging apps more accurately.

The remainder of this paper is structured as follows. First, we review the literature on mobile instant messaging, technostress, communication overload, and end with the theoretical framework. Second, we continue with the methodology for developing the communication overload scale and discussion on scale development steps. We conclude this study with research contributions and limitations.

2. Literature review

2.1. Mobile instant messaging

We found MIM to be composed of four main themes: (1) adoption and continued usage of the application; (2) building customers' relationships with businesses; (3) security and privacy concerns; and (4) work management. The Web of Science (WoS) indexed database was used for the review. WoS is a scientific citation indexing service that can only be accessed through institutional subscription-based services and provides a comprehensive citation search function. The papers reviewed were based on keywords identified from several relevant information sources such as encyclopedias, dictionaries, thesauri, keywords from previous literature

Table 1

Keyword and search strings.

Database	Keywords used
Web of Science	"mobile instant messaging" OR "mobile instant messaging services" OR "Mobile Instant Messaging Application*" OR "Mobile Instant Message*" OR "Mobile Instant Messaging Service*" OR "Mobile Instant Messenger*" OR "Mobile Messaging Application*" AND ("WhatsApp" OR "WeChat" OR "line" OR "telegram" OR "kakaotalk" OR "Viber" OR "QQ"

and keywords suggested by WoS (see Table 1.) The search returned 86 articles. The papers were then screened using criteria we determined to be useful to this paper's research question, mainly papers that discussed MIM's use for managing work. The papers were filtered for publication years between 2011 to August 2020; this is because the first paper that specifically mentioned a MIM application as the information technology artifact it studied was published in 2011. In the end, 28 papers were selected for the use of this study.

The first theme focuses on adopting MIM and its continued usage (Sun et al., 2017. Kim, Park, Yun, & Kwon, 2017; Gan, 2016). For example, Yoon, Jeong, and Rolland (2015) reveal that technical characteristics (convenience), individual characteristics (computer playfulness), and social influence (perceived critical mass) factors play an essential role in MIM adoption. Tseng, Pham, and Cheng (2018) demonstrate in their study that user loyalty to MIM depends on the ability to satisfy three needs (competency, autonomy, and relatedness) of the user. More recently, a study based in South America analyzed MIM user feedback and identified four types of values the users realized from MIM use: maintaining and strengthening relationships; improving role performance; emotional support; and entertainment and fun (Cruz-Cárdenas et al., 2019). The present study proposes a conceptual model of consumer value creation as it applies to MIM.

The second theme considers how the application allows businesses to build relationships with customers (Marino & Lo Presti, 2018; Padmavathy, Lee, Pattusamy, Dey, & Swapana, 2018; Vazquez, Dennis, & Zhang, 2017). Padmavathy et al. (2018) found that users choose MIM due to its ability to send and receive messages, create groups and post information, and enable video and voice calls for interactions. These functions increase the reputation of MIM apps in social interactions, and at the same time, satisfy users who prefer to bridge relationships, create bonding, and maintain relationships in virtual communities. Research by Vazquez et al. (2017) demonstrates that the perception of a channel or app as media-rich can lead to feelings of involvement. A study by Lee and Gan (2020) examined the relationship of the intrinsic factors: para-social interaction (PSI), impulse buying tendency (IBT), normative evaluation (NE), positive affect (PA) with the urge to buy impulsively (UB) during the purchase interaction with the sellers on mobile instant messaging, and found that IBT, NE, and PA positively related to the consumers' urge to buy by interacting with the sellers on MIM.

The third theme of the study focuses on how MIM's use affects users' security and privacy (Siddiqui, Najam, Saeed, & Touheed, 2017; Wang, Ma, Luo, & Gao, 2018). Research by Wang et al. (2018) proposed Elliptic Curve Cryptosystem secure instant messaging to meet the requirements of protecting the received data. Siddiqui et al. (2017) found that some instant messaging applications are extremely secure, such as WhatsApp and Viber. However, apps such as ooVoo, Telegram, QQ, Facebook Messenger, and Mo + are not as secure and do not provide full privacy. A paper studied the dynamics that influence users' self-disclosure behavior on a MIM app (Ma, Ding, Zhang, & Zhang, 2020). Hayes, Cappa, and An Le-Khac (2020) found that mobile apps, such as MIM, both consumers and organizations, are susceptible to excessive app developers' excessive data collection. This undesired data collection happens despite the existing permissions and privacy policies being in place. The authors assert that studies on this practice are still limited. They further suggest a comprehensive approach for mitigating privacy violation issues, and improper use of data by apps are studied more extensively.

The fourth theme of study comprises a few studies that focus on MIM's use for managing work; these have a positive outlook on the technology artifact. For example, Mahatanankoon (2016) asserts that MIM has a vital role in enhancing workgroups' memory and, eventually, groups' effectiveness. Cui (2016) identified four workplace interaction modes through MIM: general information exchange, experience articulation; technical support; and sympathetic companionship. While these studies are timely, none of the articles reviewed focused on looking at its usage's negative implications. Inappropriately employed technologies can lead to stress among users (Chandra et al., 2019).

2.2. Technostress and communication overload

Technostress can be defined as an adaptation problem faced by an individual when that person cannot cope with, or get used to, ICTs (Tarafdar et al., 2007). It can also be understood as a negative link between people and technologies. The negative link can be psychological or physical (Mayank and Amarjit, 2015). For example, the high usage of technology, such as mobile apps, for managing work in today's organization has contributed to users' technostress problem (Mak, Nickerson, & Sim, 2018; Hung et al., 2015). Research by Tarafdar et al. (2007) found that technostress has lowered productivity, job satisfaction, and decreased user commitment. An important concept highlighted in the technostress study is overload. Work overload, which is caused by work that exceeds an individual's capability or skill level (Moore, 2000), has been identified as one of the stressors in technostress.

One of the most important concepts related to technostress is technology overload (Karr-Wisniewski & Lu, 2010). It consists of three dimensions: information, communication, and system features (Karr-Wisniewski & Lu, 2010). Currently, most overload studies focus on information overload. This happens when people are exposed to more information than they can handle, that is, more than what they can process at a certain point in time (Lee, Son, & Kim, 2016). One study suggests that information overload can influence students' participation and cognitive processing levels in on-line discussions (Chen, Pedersen, & Murphy, 2012). Another study suggests that mobile technologies have helped ease information overload by "spreading the load" over more people (Allen & Shoard, 2005).

A lesser number of studies have been dedicated to communication overload (Lehman & Miller, 2020). This overload occurs when communication messages received by users exceed their capacity to either manage or correctly interpret the meaning of the messages, or both (Marques & Batista, 2017). One study suggests that communication overload can create problems for librarians when it detracts them from assisting their users competently (Burns & Bossaller, 2012). Another study suggests that communication overload can affect job satisfaction, depending on organizational identification (Cho, Ramgolam, Schaefer, & Sandlin, 2011). Despite these studies, communication overload has been under-conceptualized. One possible cause is the tendency to combine communication with information overload (Lee et al., 2016).

There is an urgent and immediate need to develop a specific scale to measure communication overload separately from information overload. Modern organizations are increasingly relying on smaller, simpler, and nimbler technologies such as smartphones, tablets, and MIM apps for work-related communication (Cui, 2016; Mahatanankoon, 2016). Because almost all users are already familiar with the technologies in the social context, they do not detest nor resist their usage in the workplace (Yoon et al., 2015). Hence, using the existing scales for mobile phone usage in the workplace, such as Hung et al. (2015), may not capture the actual stress caused by the technologies as they are primarily used for communication. Therefore, a specific scale to measure communication overload is needed, considering the usage increase of mobile technologies such as smartphones and MIM apps in the workplace.

One of the most prominent studies to conceptualize the communication overload concept is that of Stephens et al. (2017). Using the Q-method to capture the subjective perspectives of people who experienced communication overload, they have conceptualized it into the following seven formative dimensions.

- Compromising message quality;
- Having many distractions;
- Using many ICTs;
- Feeling responsible to respond;
- Feeling pressured to make decisions;
- Being overwhelmed with information; and
- Piling up of messages.

However, these dimensions are still conceptual. Although the researchers have proposed dimensions and their items, they still need to be tested for validity and reliability. This paper aims to address this concern

by presenting structured dimensions and items that were adequately tested for validity and reliability.

2.3. Theoretical framework: the communicative affordances of mobile technology

Affordance is the relational perception and use of objects in particular ways by an actor or a set of actors (Gibson, 1986). A single object could serve different purposes for different people; these different uses are the objects' affordances. Taking notes and printing signatures are different uses afforded by using a pen. Affordances exist separately from, but are activated by, perception (Schmidt, 2007). Individuals interpret affordances by perceiving different uses, but they do not create affordances through perception. Gibson (1986) considers the ability to see in one's environment to be automatically linked with the perception of utility. However, Gaver (1991) suggests that "hidden affordances" exist that are not perceived by the use of objects. Norman (1999) similarly distinguishes between "affordances" and "perceived affordances." Later studies, driven to describe how particular technologies shape social action, began to describe "social affordances" (Bradner, 2001; Wellman et al., 2003). Social affordances were also described as the ability of communication technologies' intrinsic properties to affect their adoption and use (Boase, 2008). The continued use of technologies would draw particular affordances. Gaver (1996) suggests that individuals are exploring and predicting the results of technology use. Most studies on affordances are placed in human communication research and have investigated both perception and outcomes of affordances.

Affordances are thought to exist in the interaction between an individual's subjective perception of utility and the objective qualities of technology. Thus, a relational perspective on affordances is also emphasized (Leonardi, 2013; Majchrzak, Faraj, Kane, & Azad, 2013; Treem & Leonardi, 2012). According to Majchrzak et al. (2013), affordances are potentiality activated by certain groups rather than technology's innate capabilities. As a result, affordances are useful to describe how technology alters communicative practices (Vitak & Ellison, 2012).

Mobile technologies such as MIM have provided users with four communicative affordances: portability, availability, locatability, and multimediality (Schrock, 2015). Portability refers to the size and weight of the mobile devices that allow users to carry them wherever they are going. It can also refer to the technology's ability to allow users to perform many things at one time, such as reading their emails and posting Instagram pictures. Availability may be interpreted as a combination of multiplexity, direct contact, and increased frequency. In contrast, increased frequency is the increasing amount of communication, usually through frequent short bursts (Schrock, 2015).

On the other hand, locatability refers to the device's ability to enable users to be located wherever they are. This ability enables users to hold impromptu meetings that could scale up to groups or communities. Finally, multimediality is the multiple media features that exist in today's mobile devices, such as taking pictures, capturing videos, and recording audios (Schrock, 2015). This study will be based on these four communicative affordances.

3. Method: the process of developing the communication overload scale

In developing the communication overload scale, we adapted the technique proposed by Moore and Benbasat (1991), Wang, Wang, and Shee (2007), and Boateng, Neilands, Frongillo, Melgar-Quinonez, and Young (2018). We chose Moore and Benbasat's technique because many studies have used it in developing new scales. A search in the Web of Science revealed that 3261 studies had cited their work, where their techniques for developing new scales were adopted or adapted. Furthermore, their technique was developed purposely for the domain of information technology/systems, especially for the adoption of innovative and emerging technology. On the other hand, Wang et al.'s (2007) and Boateng et al.'s (2018) techniques are more recent and better elaborated than Moore and

Benbasat's (1991). As a result, it provides better guidance in developing and validating the new communication overload scale. The adapted steps in the scale development consisted of three phases and seven tasks. The first phase, item development involves the identification of items and assessment of validity and reliability. The second phase, scale building, involves administering the survey, while the third phase, scale evaluation, involves tests of dimensionality, reliability and validity (Boateng et al., 2018).

4. Scale building phases

4.1. The item development phase

The development phase involves two important tasks: domain identification and item generation (Boateng et al., 2018). Identification of the domain will specify the boundaries of the domain and facilitate item generation. On the other hand, item generation enables this study to identify appropriate questions that fit the identified domain. The questions can be identified through deductive (review of existing scales) or inductive (focus group discussions) methods.

For this study, the relevant domain is technostress, specifically communication overload due to the use of MIM at the workplace. In order to relate to this domain, the communicative affordances of mobile technology (Schrock, 2015) were chosen as a theoretical framework. It offers a different, but nevertheless interesting, perspective on communication technologies such as MIM. Affordance is not mere functionalities of one technology. Instead, it represents the objectives one can achieve by using that particular technology (Alper, 2019). It also represents a new way of fulfilling one's needs as a human being (Schrock, 2015). For this study, the MIM application opens a new way of communicating and sharing documents in organizations that lead to positive and negative consequences.

According to the theory, mobile technologies such as MIM provide four types of communicative affordances: portability, availability, locatability, and multimodality. In this study, these affordances act as antecedents of stress factors (Nisafani et al., 2020). Portability refers to mobile device users' ability to use it almost anywhere, either at the workplace, home or while commuting. On the other hand, availability refers to users' ability to be in "perpetual contact" with, or constant reach by, other users. Meanwhile, locatability refers to the users' ability to be located geographically by other users, thus allowing easier and faster actions, such as coordination of activities and surveillance. Lastly, multimodality refers to users' ability to employ diverse types of media through existing mobile technologies. They include text, pictures, audio, and videos (Schrock, 2015).

In the next step, we matched the four communicative affordances with the relevant dimensions of communication overload (Stephens et al., 2017). These dimensions are the stressors or the factors that cause stress. As far as possible, we tried to balance the number of dimensions with the number of affordances. Unfortunately, we found the attempt to be infeasible. First, the number of dimensions (seven) outnumbers the number of affordances (four). Second, some dimensions fit logically with certain affordances compared to others. In other words, some affordances can accept more than one dimension. As a result, some affordances will have one dimension, while others have two. Third, some dimensions do not fit the context of the study. These dimensions were left out of the scale. As a result, it is impossible to balance the number of dimensions for the scale to the number of affordances.

Table 2
Communicative Affordances, Communication Overload's Dimension.

Communicative Affordances	Communication Overload Dimensions
Portability	Immediacy of responses
Availability	Accumulation of messages
	Multiplicity of MIM-based groups
Locatability	Pressure to make decision
Multimodality	Overwhelmed by content

The matching is shown in Table 2. Portability is matched with the immediacy of response because employees' ability to bring the devices anywhere denies them any excuse not to respond to a message concerning workplace issues. On the other hand, availability is matched with the accumulation of messages and MIM-based groups' multiplicity. The technology's ability to keep the users constantly connected causes them to receive messages throughout the day, including work-related messages continuously. This negative impact is made worse by the number of MIM-based groups to which users belong. It is common for a user to be involved in many MIM groups in his/her workplace (Omar, Su Mustaffa, & Abu Talib, 2018).

Meanwhile, locatability is matched with the pressure to make decisions. The ability of technology to determine the employee's location leaves them with no option but to be involved in the decision-making process via MIM. Finally, multimodality is matched with being overwhelmed by content. The technology's ability to allow many types of files, such as pictures, audio, videos, and documents to be shared, in addition to the existing messages, can inundate employees.

In the process, two formative dimensions from Stephens et al. (2017) were left out: compromising message quality and having many distractions. They were left out because their relevance with MIM's use in the context of work management is minimal. Compromising message quality does not present a considerable problem to organizations that use MIM. The nature of communication in an organization is often interactive. Thus, users can always seek clarification for vague or murky messages. Meanwhile, having many distractions is a situation that is not directly and necessarily linked with the use of MIM for work management. In order to better ascertain the impact of the technology's use at the workplace on communication overload, the dimension needs to be directly related to its usage. Consequently, the dimension was left out.

4.2. Assessing the scale's validity and reliability through expert panels

The validity and reliability assessments were conducted to assess whether the proposed instruments would elicit an accurate description of communication overload and possess dependability, replicability and consistency virtues (Ruel, Wagner III, & Gillespie, 2016). To conduct the assessment, we sought highly experienced researchers in the field of information systems. For us, to be an experienced researcher, one must have gone through the process of refining their work in leading journals in the field such as MIS Quarterly, Information Systems Research and Journal of Management Information Systems. Preferably, they have been involved in reviewing articles submitted to those journals as well. We believe that this experience would enable them to assess the proposed scale to a high standard.

After a rigorous search, we obtained assistance from two information systems (IS) researchers in the Asia-Pacific region. One of them is a senior academic of a university in Hong Kong, with approximately twenty years of experience teaching and researching in the field of IS. He also serves as an associate and senior editor in leading IS journals such as MIS Quarterly, Information Systems Research, and Information Systems Journal. The other assessor is a junior academic from a prestigious university in Sydney, Australia. Although relatively new in the IS field, her resume is remarkable; her Ph.D. work has been published in leading IS journals such as MIS Quarterly and the Journal of the Association for Information Systems (JAIS).

The assessors were asked to perform several tasks that would enhance the scale's reliability and validity (Ruel et al., 2016). In terms of the scale's reliability, they were asked to assess the clarity of the items. Next, they were asked to determine the adequacy of the responses for each item. Regarding the scale's validity, the focus was on assessing its face and content validity because they were easier to detect through the assessors' experience. For face validity, they were asked to determine whether the scale measures the construct intuitively. They must also determine whether the new communication overload scale is adequate and precise for content validity.

The two assessors were unanimous in their verdict of the proposed scale. They concurred that the new communication overload scale possesses reliability and validity. They were generally satisfied with the clarity

of the instruments and the adequacy of each item's responses. However, they did point out grammatical errors on some of the items. They also agreed that the scale measures the construct while being adequate and precise intuitively. We addressed the scale based on their feedback before commencing the validity and reliability testing phase.

4.3. Administering the survey

A small-scale survey was conducted among those who work in organizations where MIM was used to manage daily tasks like discussions, document sharing, and decision-making to test the scale's validity and reliability. The survey had 200 respondents, most of whom were students of the Master of Business Administration (MBA) program at the University of Malaya. They were asked to rate each item from 1 to 5, with 1 being "strongly disagree" and 5 being "strongly agree."

The respondents are almost equally represented in terms of gender, where female slightly outnumbered male (see Table 3). In terms of age, the highest number of respondents is between 30 and 37, followed by those between 22 and 29 (see Table 4). Around 50% of the respondents work at the executive or managerial level in organizations (see Table 5). The highest number of respondents come from the manufacturing industry, followed by the banking and financial services and the public sector (see Table 6). An overwhelming 77.8% of the respondents have undergraduate degrees or diplomas (see Table 7). Subsequently, most have between 1 and 20 years of working experience (see Table 8) in various industries.

4.4. Items testing

The next step is testing the items in the scale. It involves fitting the items to the most appropriate dimension among the five, determining their reliability, and assessing their relationships' strength. The results of the three analyses are shown in Tables 9, 12, and 13. To test for the scale's validity, we have applied confirmatory factor analysis. Factor analysis is a technique that is generally used to reduce many variables into fewer factors. At this stage, we wanted to reduce the number of items so that only the ones that fit their respective dimensions remain. Specifically, we applied the principal component analysis. It is the most common method used by researchers, whereby the process starts with the extraction of the maximum variance, which is then loaded into the first factor. This process is repeated for the second up to the last factor. We "forced" the analysis to terminate after five components (or dimensions). The Varimax Rotation Method was applied, as it is also mostly used by researchers.

In order to reach the final dimensions (Table 9), the analysis went through several steps. First, we chose the factors with Eigenvalues of more than 1.0 (Hair, Babin, Andersen, & Black, 2018). Second, the cumulative percentage of variance explained must be more than 60% (Hair et al., 2018). Third, the values of rotated factor loading should be more than 0.50. Fourth, items that load at 0.35 or higher on more than one factor were removed to avoid difficulty when the factor loading matrix is interpreted (Hair et al., 2018). Six, in accordance with the communication overload dimensions that we have developed, we chose the five highest components in the results.

Table 10 shows the Eigenvalues of the components in the analysis. The results show that there are seven components with Eigenvalues of more than 1.0. The combined seven components explain 69.358% of variance. However, we decided to work with only the first five components as we were looking for the items that fit the five dimensions in our proposed

Table 3
Demographic data: Gender.

Gender	Frequency	Percentage
Male	95	46.8
Female	108	53.2
Total	203	100

Table 4
Demographic data: Age.

Age	Frequency	Percentage
22 to 29	60	29.6
30 to 37	92	45.3
38 to 44	38	18.7
45 to 55	13	6.4
Total	203	100

Table 5
Demographic data: Position in Company.

Position in company	Frequency	Percentage
Entry level/ non-executive	74	36.5
Executive	90	44.3
Manager	32	15.8
Senior manager and above	7	3.4
Total	203	100

Table 6
Demographic data: Types of Industry.

Industry	Frequency	Percentage
Banking & finance	27	13.3
Health	8	3.9
Electrical/ electronic	9	4.4
Construction	12	5.9
Import/ export	20	9.9
Oil/ gas	3	1.5
Manufacturing	34	16.7
Accounting	12	5.9
Real estate	5	2.5
Government	24	11.8
Others	49	24.1
Total	203	100

Table 7
Demographic data: Education background.

Education background	Frequency	Percentage
SPM/ STPM	26	12.8
Diploma/ Degree	158	77.8
Mater/ PhD	16	7.9
Others	3	1.5
Total	203	100

Table 8
Demographic data: Years of working experience.

Years of working experience	Frequency	Percentage
1 to 5	60	29.6
6 to 10	57	28.0
10 to 20	70	34.5
21 to 32	16	7.9
Total	203	100

communication overload scale. Furthermore, the cumulative percentage of variance is already more than 60% (Hair et al., 2018), and the value-added to the scale by including two more components is minuscule. Table 11 shows the Pattern Matrix from the Principal Components Analysis.

Table 9
Principal component analysis – pattern matrix.

Component	1	2	3	4	5
co_abc3	0.698				
co_abc5	0.677				
co_abc2	0.551				
co_abc4	0.479				
co_ptmd6		0.841			
co_ptmd5		0.761			
co_ptmd4		0.417			
co_mc3			-0.719		
co_mc7			-0.599		
co_mc8			-0.570		
co_ior7				0.747	
co_ior2				0.555	
co_ior1				0.509	
co_ior8				0.478	
co_puom5					-0.851
co_puom2					-0.738
co_puom6					-0.645
co_puom4					-0.615
co_puom3					-0.609

Only the items with loadings more than 0.50 were retained, while the cross-loading items were removed. We managed to reduce the scale of communication overload to only 19 items. Specifically, we reduced the immediacy of

Table 10
Total variance matrix.

Component	Total	Initial Eigenvalues		Extraction Sums of Squared	
		% of Variance	Cumulative %	Total	% of Variance
1	17.963	46.060	46.060	17.963	46.060
2	2.832	7.262	53.322	2.832	7.262
3	1.518	3.893	57.215	1.518	3.893
4	1.332	3.415	60.630	1.332	3.415
5	1.234	3.165	63.794	1.234	3.165
6	1.151	2.952	66.747		
7	1.018	2.611	69.358		

Extraction method: principal component analysis.

response (co_ior) from 8 to 4 items; accumulation of messages (co_puom) from 11 to 5 items; multiplicity of MIM-based groups (co_mc) from 9 to 3 items; pressure to make decisions (co_ptmd) from 6 to 3 items; and

Table 11
Component transformation matrix.

Component	1	2	3	4	5
1	0.516	0.464	0.463	0.399	0.380
2	0.782	-0.494	-0.350	0.086	-0.123
3	-0.177	0.311	-0.658	0.662	-0.033
4	0.287	0.631	-0.133	-0.382	-0.597
5	0.094	0.216	-0.460	-0.499	0.695

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

overwhelmed by content (co_abc) from 5 to 4 items. Additionally, all dimensions demonstrate positive factor loadings except for MIM-based groups' multiplicity and accumulation of messages. The negative factor loadings suggest that the survey respondents have a dissimilar experience to the ones suggested in the items. However, the results should not be of paramount concern as the negative loadings are demonstrated by all the items in the components, suggesting their convergence and reliability. These characteristics are more important in determining the scale's goodness-of-fit.

Once the items for each dimension has been determined, their reliability had to be measured. A reliable scale will consistently reflect the construct that it is measuring. In this study, the reliability of the scale was measured by the values of Cronbach's alpha. The results of Cronbach's alpha for each dimension are shown in Table 12. The results suggest that each dimension's reliability is reasonably good within the range of 0.833 (multiplicity of MIM-based groups) to 0.895 (overwhelmed by content). The values are also not extremely high (more than 0.9) to suggest that the items did not force the respondents to answer in a certain way that favors the research – a phenomenon called “self-fulfilling prophecy”. Hence, the scale is ready to be used in a comprehensive research study.

For further validation, the five dimensions were analyzed for multicollinearity, i.e., the dependency of one dimension to another dimension (Hair et al., 2018). An elevated level of multicollinearity suggests that the two dimensions are the same, indicating they measure the construct's same aspect. On the other hand, a low level of multicollinearity suggests that the two dimensions are significantly different. Consequently, the findings from the variable are more trustworthy. This study tested multicollinearity using the Component Transformation Matrix (Table 11) and Pearson product-moment correlation analysis in Table 13. Results from the Component Transformation Matrix suggest that there is a moderate relationship between the five dimensions. The highest value is 0.782, while the lowest is 0.86. The results are unsurprising as the dimensions belong to a single scale: the communication overload scale.

Meanwhile, the results from the Pearson product-moment correlations suggest that the relationships between each dimension are significant. More importantly, they suggest that their relationships, even though significant, are moderate. The strongest relationship is between the accumulation of messages and the immediacy of response at 0.5111. The weakest relationship is between the multiplicity of MIM-based groups and overwhelmed by content at 0.261. Thus, the existence of multicollinearity in this construct can be confidently discarded.

Further analysis shows that the demographic profiles do not affect the results of the study. The evidence of their non-effect is shown in Tables 14, 15 and 16. Table 14 compares the means between gender across the five dimensions. The results show that there are no significant differences between gender for pressure to make decisions (significance level 0.216), multiplicity of MIM-based groups (significance level 0.062), immediacy of response (significance level 0.064), and overwhelmed by content (0.686). The only dimension that shows significant differences between gender is the accumulation of messages (significance level 0.047). The same results are also demonstrated by the level of education (Table 15). The results show that there are no significant differences between diverse levels of education for pressure to make decisions (significance level 0.601), multiplicity of MIM-based groups (significance level 0.235), immediacy of response (significance level 0.214), and overwhelmed by content (0.230). The only dimension that shows significant differences between gender is accumulation of messages (significance level 0.047).

Meanwhile, means comparison between distinct positions in the organization show slightly different results (Table 16). The results show that there are no significant differences between position in organization for pressure to make decisions (significance level 0.218), multiplicity of MIM-based groups (significance level 0.698) and overwhelmed by content (0.385). The differences lie in the immediacy of response and accumulation of messages. While there are no significant differences shown by the immediacy of response construct between gender and level of education, it shows a

Table 12
Cronbach's alpha - reliability analysis.

Component	Cronbach's Alpha
Overwhelmed by content	0.895
Pressure to make decision	0.841
Multiplicity of MIM-based groups	0.833
Immediacy of responses	0.848
Accumulation of messages	0.883

Table 13
Pearson Product-moment Correlation.

	Overwhelmed by Content	Pressure to Make Decision	Multiplicity of MIM-Based Groups	Immediacy of Response	Accumulation of Messages
Overwhelmed by Content	1.000				
Pressure to Make Decision	0.218**	1.000			
Multiplicity of MIM-Based Groups	0.261**	0.438**	1.000		
Immediacy of Response	0.492**	0.280**	0.289**	1.000	
Accumulation of Messages	0.328**	0.331**	0.356**	0.511**	1.000

Table 14
Means comparison between gender.

Means Comparison Between Gender					
	Gender	N	Mean	F	Sig. (2 tailed)
Total pressure to make decisions	Female	108	12.1667	1.142	0.216
	Male	95	11.6842		
Total multiplicity of MIM-based groups	Female	108	12.8333	2.470	0.062
	Male	95	12.1684		
Total immediacy of response	Female	108	12.7315	0.419	0.064
	Male	95	12.0842		
Total accumulation of messages	Female	108	12.3704	1.088	0.047
	Male	95	11.6421		
Total overwhelmed by content	Female	108	12.4722	0.013	0.686
	Male	95	12.3263		

significant difference in terms of position in the organization (significance level 0.016). On the other hand, while there are significant differences shown by the accumulation of messages construct between gender and

Table 15
Means comparison between the level of education.

Means Comparison Between Level of Education					
			Mean Square	F	Sig. (2 tailed)
Total pressure to make decisions	Between Group		4.796	0.623	0.601
	Within Group		7.703		
Total multiplicity of MIM-based groups	Between Group		9.133	1.432	0.235
	Within Group		6.378		
Total immediacy of response	Between Group		9.220	1.506	0.214
	Within Group		6.121		
Total accumulation of messages	Between Group		21.296	3.240	0.023
	Within Group		6.573		
Total overwhelmed by content	Between Group		9.411	1.447	0.230
	Within Group		6.506		

Table 16
Means comparison between position in organization.

Means Comparison Between Position in Organization					
			Mean Square	F	Sig. (2 tailed)
Total pressure to make decisions	Between Group		11.347	1.492	0.218
	Within Group		7.604		
Total multiplicity of MIM-based groups	Between Group		3.088	0.447	0.698
	Within Group		6.469		
Total immediacy of response	Between Group		20.867	3.510	0.016
	Within Group		5.945		
Total accumulation of messages	Between Group		11.800	1.757	0.157
	Within Group		6.716		
Total overwhelmed by content	Between Group		6.680	1.020	0.385
	Within Group		6.547		

level of education, it shows no significant difference in terms of position in organization (significance level 0.157). Since the demographic profiles do not influence most of the dimensions, we conclude that they are usable

for assessing the level of communication overload construct in the use of MIM for work management.

4.5. The final scale of communication overload in the use of MIM for managing work

The development of the communication overload scale started by identifying the communicative affordances of mobile technology. The four communicative affordances – portability, availability, locatability, and multimodality – were matched with the relevant communication overload dimensions. Once they were matched, the proposed instrument for assessing communication overload was evaluated by two highly experienced experts in conducting information systems research. After refining the instrument based on their feedback, we proceeded to test the items for validity and reliability. The tools used for the purpose of item testing include confirmatory factor analysis (CFA), principal component analysis, total variance matrix, Cronbach's alpha, component transformation matrix and Pearson product-moment correlation.

The final scale of communication overload consists of 19 items in five

dimensions. The items for each dimension are almost equivalent. Two of them are represented by four items (overwhelmed by content and accumulation of messages) and two by three items (pressure to make decisions and

multiplicity of MIM-based groups). Only one dimension (accumulation of messages) is represented by five dimensions. The items for each dimension are illustrated in Table 17.

5. Conclusion

The study develops a scale for measuring communication overload due to the use of MIM in work management. The development of the scale was motivated by the lack of suitable alternatives to measure technostress caused by using MIM apps, despite their increasing uptake for communication purposes in the workplace. The development went through several steps. First, the dimensions of communication overload were identified through the communicative affordances of the mobile technology framework (Schrock, 2015). Second, the dimensions were filled with relevant and appropriate items. Third, the affordances and their items were assessed for face validity by expert panels. From their feedback, the items were refined before they were tested through a pilot study. Finally, the responses were statistically analyzed, and the items were further refined to develop the definitive version of the communication overload scale.

The study brings several theoretical contributions. The most important contribution of the study is the specialized and dedicated communication overload scale. The scale explicitly distinguishes information and

Table 17
Final communication overload scale.

Dimensions	Items	Author
Overwhelmed by content	<ul style="list-style-type: none"> • It frustrates me when I received poorly constructed messages through MIM apps. • It frustrates me when I encountered overlapping information through various communication channels. • When I received messages that provided inadequate information, I felt that they increased my workload. • I received more communication messages and news from colleagues on MIMs than what I can process. 	Stephens et al. (2017); Schrock (2015).
Pressure to make decisions	<ul style="list-style-type: none"> • I may use MIM during non-working hours to make work-related decisions. • I often try to arrange, schedule, or perform decision-making activities outside of regular working hours using MIM. • The decisions made over MIM have to be as effective as those made during a face-to-face meeting. 	Stephens et al. (2017); Schrock (2015).
Multiplicity of MIM-based groups	<ul style="list-style-type: none"> • Even in a single MIM app such as WhatsApp, many virtual groups have been formed. • My work-related group chats are created for sharing information about specific projects, departments, or teams. • I always have multiple group discussions opened in the MIM at the same time. 	Stephens et al. (2017); Schrock (2015).
Immediacy of response	<ul style="list-style-type: none"> • I feel pressured to react immediately to the MIM discussion. • I waste a lot of time responding to MIM messages that are work-related, but not directly related to what I need to get done. • I often feel that I have to send more information than I wish to. • I am expected to respond as soon as possible to a MIM discussion. 	Stephens et al. (2017); Schrock (2015).
Accumulation of messages	<ul style="list-style-type: none"> • Using MIM, I am able to see other people's evaluation of information through their recommendations, comments, liking, or tagging. • I received all of the information that others in my department have. • Using MIM, I am able to see other people's answers to other people's questions. • The MIM app even informed me about others' activities, opinions, or locations. • I receive all of the information that others outside of my department have 	Stephens et al. (2017); Schrock (2015).

communication overloads. Furthermore, this scale extends the communication overload construct by identifying its dimensions and their corresponding items. This development has several implications for academics and policy/practitioners. For academics, the new scale will urge them to view information and communication overloads as two different constructs, rather than to combine them or, worse, using them interchangeably.

Additionally, the scale offers an enhanced and in-depth investigation of communication overload by expanding the construct with several dimensions, followed by specific items for each. Researchers of technostress are invited to refine the scale by adopting it in other contexts. They are also welcomed to test the relationship of communication overload with its impact on employees and inhibitors of technostress (Nisafani et al., 2020). The scale suggested by this study may also be relevant to policymakers and practitioners. This scale will allow them to gauge the level of stress caused by the use of mobile technologies and instant messaging apps more accurately. The urgency for countermeasures to mitigate and prevent technostress, especially if it can cause a drop in productivity, should be a policy priority. The benefits of acting in this capacity would mitigate corporate risk while reducing a stressed workforce's adverse effects. Additionally, they will also be able to specify precisely which dimensions of communication overload affect their employees significantly. As a result, the practitioners and policymakers can formulate and enact interventions to address their employees' exact problems.

The scale, however, must be used with several caveats. First, the scale was tested on only 204 respondents. This figure may be inadequate to some researchers, although we would argue that it is sufficient to develop an initial scale that requires further testing in other contexts (Hair et al., 2018). Second, we did not control for types of respondents according to certain criteria such as age and industry type. As a result, the scale does not cater for differences in usage between different contexts, such as industries. However, we believe that the scale is generalizable enough that it can be used across many contexts. These limitations also present researchers with opportunities to expand on this research and pave the way for future communication technologies studies.

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Authors contribution

All the authors have agreed to submit the paper in its current form. The work for the paper was divided as follows:

- Shamsul Bahri - co-designed the study and the article; performed the analysis and wrote the corresponding section.
- Ali Fauzi - co-designed the study, co-performed the data collection and co-wrote the corresponding section.
- Nur Syazwani Ahmad - co-performed the data collection and co-wrote the corresponding section.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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