Perception, use and impact of Social Media in disaster management: case of North and South Kivu regions, DRC

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Abstract.

The eastern region of the Democratic Republic of the Congo (DRC) has faced natural disasters such as volcano eruptions and their associated plume pollution, the outbreak of haemorrhagic virus of Ebola and manmade crises. The same region is potentially exposed to carbon dioxide and methane from Lake Kivu. For the people living in such conditions, it is very important to steadily access to real-time situational information. In order to examine the perception and the impact of social media use in managing disasters, we proposed and empirically validated a research model drawn on the following: the perceived ease of use, perceived usefulness, social media use, and two usage impacts. The model was tested with 402 respondents using the structural equation modelling partial least square method. Because social media is perceived to be easy to use and useful, they are used in disaster management. Their use impacts the information accessibility and adaptability.

Keywords: Social media, disaster management, perceived ease of use, perceived usefulness, DRC Introduction

1 Introduction

Since 1994, the Democratic Republic of the Congo (DRC) has been facing instability because of many kinds of crises, especially in the eastern regions [1]. War and natural disasters in eastern DRC have brought about far-reaching repercussions, including deaths, posttraumatic stress disorders among adolescents, and displacement status [2], armed conflicts, loss of social capital, changes in population distribution, job closures [3] and women victims of sexual violence[4]. Indeed, while the region was already plagued by armed conflicts, more than one Nyiragongo and Nyamulagira volcanoes eruptions are being recorded, bringing in their wake tremendous volcanic plume

pollution, destructive earthquakes, landslides, dry gas vents, and limnic eruptions [5]. Another potential danger is the accumulation of dissolved gas in Lake Kivu, which can pose a threat to human lives if released. Called “killer lake”, Lake Kivu contains a great amount of carbon dioxide and methane and has been always compared to Lakes Nyos and Monoun in Cameroon, the eruption of which caused several animal and human deaths [6]. In August 2018, the Ebola outbreak [7] was reported in the North Kivu and Ituri provinces. The dangerous outbreak of haemorrhagic virus of Ebola have killed more than one thousand people and still continue killing[8].

When a disaster occurs, it is very important to access to situational information in order to inform critical decision-making [9, 10]. Social media applications have achieved substantial penetration into the everyday life of many people in the country, and has become an invaluable source of data and an outstanding real-time information channel between users from diverse backgrounds and from different locations [3]. Social media platforms such as Facebook and Twitter are ranked as fourth most popular source for emergency information and government members have been increasingly using them, together with blogs, to communicate with citizens [11]. According to Hootsuite (January 2019), more than 40 million (i.e. 47%) of DRC population use telephones. Only 5.30 million of the population (6.20 %) have access to internet services, 2.7 million of them are social media active users i.e. 3.2 % of penetration. This number is expected to increase constantly, following the global trend: the number of social media users is continually increasing worldwide [12]. The report of Hootsuite (January 2019) indicates that from January 2018 to January 2019 for example, more than 500 thousand (+500 thousand) joined social media in DRC, i.e. more [13]. So, Social networking has become open social media services [14] because social tools media are increasingly being significant for the various steps of the disaster management lifecycle. They assist in disaster management activities by including speedy detection of socially disruptive events, facilitating crises communication and attaining situational awareness [15]. For example, in Germany, some Facebook groups were set up to deal with the floods by informing population and coordinating field actions of volunteers [16]. In the case of Baton Rouge in Louisiana, USA, social media networks such as Facebook and Twitter are actively used to deliver real-time emergency information to the affected people in a timely manner [17].

Despite all advantages of social media in the daily life and during crises, it appears that no study has been conducted on the perception, use and impact of social media in managing disasters in Kivu regions at the east of DRC. So, in this study, we propose a research model based on perceived usefulness, perceived ease of use and consequences of social media usage in managing disasters. More specifically, we aim to answer the following questions to contribute to bridging the knowledge gap in countries facing multiple crises at the same time, especially the DRC context:

How does the use of social media influence crises management in north and south Kivu?

What are the impacts of using social media during a disaster in north and south Kivu?

2 Research background

The research background is interested in two key aspects: (i) the review of social media usage as a whole, and (ii) the management of crises, together with the development of research models.

2.1 Social media use in disaster management

The use of information technologies, and of social media in particular, has become commonplace in virtually all organizations [18], where they have become essential in a wide array of operations, including disaster management [19, 20]. McFarlane and Norris (2006) have defined a disaster as 'a potentially traumatic event that is collectively experienced, has an acute onset, and is time-delimited'[21]. For Montz and al. (2017), a crisis (or disaster) is a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of [the] affected society to cope using only its own resources [22, 23]. Disasters may be natural (e.g. earthquakes, hurricanes, volcanoes and outbreaks of the haemorrhagic virus of Ebola), technological (oil spills), or man-made (terrorism and armed conflicts) [24], and may produce 'physical, social, psychosocial, sociodemographic, socioeconomic, and political consequences [19, 23, 25]. Normally, a disaster is conceptualised in three main phases, including all events before, during and after a crisis [21].

Disaster actors frequently exhibit optimism regarding the potential of social media to enable improved disaster communication [19, 20, 26]. Social media has great capacity, dependability, and interactivity, each of which may be beneficial for disaster communication [19, 27]. At any phase of disaster lifecycle [28], social media channels and tools are important and have so many functions [19]. One of their functions is the listening function, as social media can give a voice to people who do not normally have one. By so doing, social media describe people's behaviours and reactions in the advent of a disaster [29]. However, it should be noted that the listening function for of social media is somehow a passive collection of information. Another social media's function consists in monitoring a given situation [29], which is important when it comes to expanding people's reaction to events and better managing their behaviours through learning what they are thinking and doing about the event [29]. If there are rumours the dissemination of messages on social media and even on their credibility [30], such situations are easily and so quickly coped with by well-informed people [31]. So, disaster information produced and shared by people from affected areas may be not only original information, such as eyewitness reports or other personal observations, but also links [27]. Generally, in such cases, shared information is factual information [27].

Prior studies on the use of social media show how people use them during crises [30, 32, 33], extract and analyse useful disaster-related social media data [27, 34-36]. Other studies demonstrate that such social media applications can be used for different types of disasters and disaster lifecycle phases. Natural disasters covered by social media networks include hurricane [37], floods [38-40], earthquakes [41, 42], tsunamis [43, 44] and the like. Furthermore, many studies have been conducted on disaster

recovery operations and techniques [45-47]. Manmade disasters have also been at the centre of research through a few of studies [23, 48, 49].

2.2 Research model

Greater part of the literature on social media as applied to disaster management generally focuses on the communication role and factual information access [19], both of which are considered as the real impact of the actual use of social media, but there are also a number of studies on the perception of the actual use by people. To understand users' perception, we resorted on perceived usefulness and perceived ease of use, which are specific to the Technology Acceptance Model [50], in order to further explain the actual use of social media.

The Technology Acceptance Model is the most prominent research model for explaining and predicting diverse technological systems acceptance [51], [7]. His ascendant theories are: theory of Reasoned Action (TRA), which is the first to increase the widespread acknowledgement of technology adoption and use, proposed in 1975 by Fishbein and Ajzen [50, 52, 53], [54-56]. The main criticism of TAM is its necessity for additional variables to enhance its predictive power and "the lack of actionable guidance to practitioners" [57, 58], [59, 60]. Despite these criticisms, TAM is parsimonious making it possible and easy to extend in a number of different ways, without ensuing in a very complicated model [61, 62]. In addition, TAM is robust, reliable, operationally efficient, and offers sufficient explanatory power for technology acceptance [62]. Thus, numerous recent studies present TAM applied in diverse contexts and explaining wide range of phenomena around the world have given relevant results [51].

In fact, TAM posits that perceived usefulness and perceived ease of use determine an individual's intention to use a system while serving as a mediator for its actual use [51, 52, 63, 64].

According to Davis [50] "perceived Usefulness" is the potential user's subjective probability that the use of a certain system (e.g. social media) will improve his/her action. Perceived Ease of Use refers to the degree to which the potential user expects the target system to be effortless Perceived usefulness and perceived ease of use are grounded on behavioral psychology and the observation of technology adoption [62]. For motivation theory, there are key factors that determine both the intention to use and the actual use of IT [51, 65-69] and it would be wiser to specify the same! Based on all these studies, we hypothesized that:

H_1: Perceived ease of Use positively influences perception usefulness.

H_2: Perceived ease of Use has a positive significant effect on social media use.

H_3: Perceived usefulness has a positive significant effect on social media use.

The use of social media in emergency/crisis situations enables access to required information, including on how to reach the affected areas, as presented in the previous subsection. The information accessibility is one of the most important impacts of social media use and refers to informational benefits in DeLone and McLean's understanding. It includes information access, information quality and information flexibility [70]. As a reminder, social media usage enhances accessibility of information and information

dissemination [71-75], while affecting agility and adaptability to emergency cases and contingencies **[**76**]**. Agility is defined as an "organizational and individual capacity to inspect and monitor events and changes in the surrounding environment in a timely manner" [77]. As for adaptability, it implies that actors need to change or adapt their behavior to better fit in the new environment[78]. Thus, the following hypotheses were set forth:

$H_{4:}$ Social media usage positively influences adaptability.

$H_{5:}$ Social media usage positively influences information accessibility.

Therefore, the following conceptual model and hypotheses were proposed

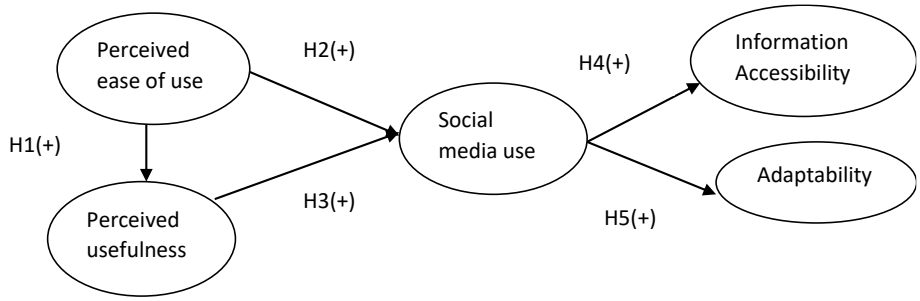

Fig. 1. Research design model

3 Methodology

Following the adoption of a quantitative approach, we administrated an online questionnaire survey in North and South Kivu cities (Beni, Butembo, Goma and Bukavu) and territories (Beni, Kalehe, Uvira, Kabare, Rutsuru, and walungu).

3.1 Measures

The questionnaire was composed of items tested in prior studies to measure constructs but adapted to our research field. Four items for the Perceived usefulness (PU) and perceived ease of use (PEOU) constructs were adapted from [50]; the social media use construct used 6 items adapted from [75], while information accessibility had 7 items adapted from [71]. Lastly, 6 items adapted form [78]referred to adaptability. All constructs were measured using a seven-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). To assess our research model, we used the component-based partial least squares structural equation modelling (PLS-SEM). So, we used the SmartPLS 3 software for data analysis.

3.2 Data collection

The data was collected in all cities (Beni, Butembo, Goma and Bukavu) and territories that form the northern and southern region of Kivu, in the eastern territories of DRC. The survey population included all categories of people: young and old, women and men, urban and rural people using social media (through smartphones or computers) in case of crises to manage life cycle operations.

So, an online questionnaire was administered through online platforms, especially Google forms. We chose to use an online survey because it is recognized as a useful, precise, fast, inexpensive and easy means of receiving responses to a questionnaire [79-81]. Moreover, such a means was suitable for an environment with difficult physical access (poor roads, lengthy journeys, insecurity) like several areas of the eastern DRC.

The link to the survey was shared with some respondents via social media, especially WhatsApp and Facebook and emails. To reach more people, we printed a poster (that was made using Photoshop creative cloud) with clear indications on the investigation. The poster had a link to the questionnaire. The Bitly software enabled us to shorten the link (the shortened link is bit.ly/enqtRDC). The printed version of the poster was placed in universities of Bukavu and the image format was published on Facebook pages. As part from our strategy, we formed paid groups of 3 or 4 persons per city to distribute the link and explain how to respond to questions to potential participants.

Data collection began on March 2019. Prior to conducting the main survey, a pilot study (pilot test) was carried out on 15th March 2019 with 54 participants to test the model. Till the end of April, a total of 449 respondents submitted the forms, 402 of which had complete responses, as 15 respondents were non-users of social media while 32 others lived in regions not covered by the survey. In a final analysis, a total of 402 valid responses were obtained and considered for this study.

Globally, the respondents of this questionnaire were young. About 86.8% of respondents were aged between 18 and 35. 68 % of respondents were men and 32 % were women. Finally, more than 76 % of respondents have a university degree.

4 Results

The proposed model was assessed in terms of constructs validity, model measurement and structural model evaluation.

4.1 Assessment of constructs validity

The construct validity was assessed in terms of item loadings, Cronbach alphas, composite reliability (CR), rho, and Average Variance Extracted (A. V. E).

Table 1. *Assessment of the construct validity*

Constructs	Items	Loadings	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Adaptability	AD1	0.918	0.975	0.975	0.980	0.889
	AD2	0.925				
	AD3	0.963				
	AD4	0.954				
	AD5	0.958				
	AD6	0.937				
Information Accessibility	INFA1	0.921	0.961	0.963	0.968	0.812
	INFA2	0.925				
	INFA3	0.914				
	INFA4	0.913				
	INFA5	0.908				
	INFA6	0.885				
	INFA7	0.838				
Perceived Ease of Use	PEOU1	0.915	0.930	0.931	0.950	0.827
	PEOU2	0.868				
	PEOU3	0.929				
	PEOU4	0.926				
Perceived Usefulness	PU1	0.909	0.925	0.930	0.947	0.816
	PU2	0.932				
	PU3	0.908				
	PU4	0.863				
Social Media Use	SMU1	0.889	0.945	0.949	0.956	0.784
	SMU2	0.889				
	SMU3	0.883				
	SMU4	0.877				
	SMU5	0.889				
	SMU6	0.885				

For each construct, we measured the internal reliability (Composite Reliability-CR and the Cronbach's

Alpha) and the convergent validity measured by the Average Variance Extracted (A.V.E). Fornell and Lacker (1981) recommend that all factor loadings must exceed the threshold of 0.7. The composite reliability and Cronbach alpha values must be greater than 0.70 and higher than 0.5 for the A.V.E [82-84].

Table 1 allows us to confirm the reliability and convergent validity of all model constructs. All the factor loadings exceeded 0.838. All the AVEs were higher than 0.812 while the various alphas values were greater than 0.925. This result shows and confirms both acceptable reliability and convergent validity.

4.2 Assessment of the measurement model

Apart from the internal reliability and the convergent validity, another property that must be verified is the discriminant validity. The discriminant validity indicates the extent to which each construct in the research model is unique and different from the other constructs [80]. It shows the degree to which constructs are correlated each other. The average variance must be higher than the variance shared between a construct and the other constructs to show good discriminant validity [80, 82], i.e. the square root of the construct AVE (average variance extracted) must be higher than the correlation coefficients in the column. This has been verified for all the constructs of this study (see Table 2). So, each construct of the model is unique and different from the others.

Table 2. *Discriminant validity*

	AD	INFA	PEOU	PU	SMU
AD	**0.943**				
INFA	0.695	**0.901**			
PEOU	0.626	0.773	**0.910**		
PU	0.561	0.734	0.740	**0.903**	
SMU	0.709	0.811	0.716	0.692	**0.885**

4.3 Assessment of structural model

The assessment of the direction, strength and significance level of the path coefficients (betas) was taken into account to test the research hypotheses of this study. All variances were explained in more than 50 % according to R^2 values. Hair and al. (2016) suggest that the minimum level for an individual R^2 should be greater than a minimum acceptable level of 0.10 [85, 86]. The R^2 value of all endogenous variables ("perceived Usefulness, "social media use", "adaptability", and "Information accessibility") was accepted and found high, as shown in the following figure.

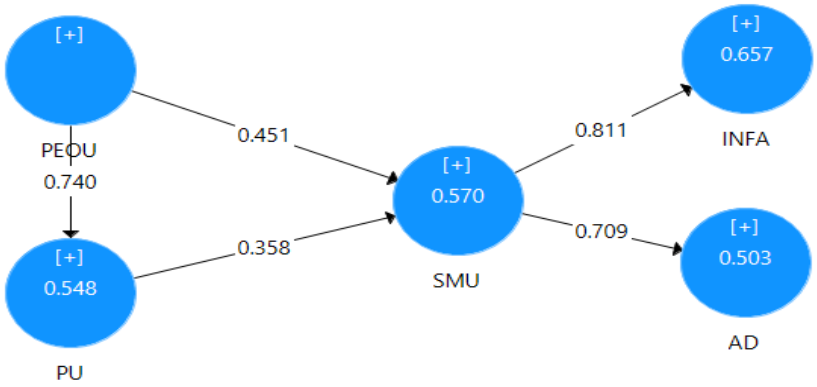

Fig. 2. Test of the research design model.

PEOU=Perceived ease of use, PU=Perceived usefulness, SMU=social media use, INFA=Information accessibility and AD=adaptability.

In Figure 2, we confirm that all the relations between variables are positive. The relationships between Perceived ease of use and Perceived Usefulness (H1), as well as between perceived usefulness, Perceived ease of use and social media use (H2 and H3) are positive and statistically significant. The use of social media contributes positively to information accessibility and adaptability (H4 and H5). The summary of hypotheses is presented in the following table.

Table 3. *Summary of hypothesis testing*.

	Original Sample (β)	T Statistics (|O/STDEV|)	P Values	Sign. level	Decision
Perceived Ease of Use -> Perceived Usefulness	0.740	22.701	0.000	****	Supported
Perceived Ease of Use -> Social Media Use	0.451	6.920	0.000	****	Supported
Perceived Usefulness -> Social Media Use	0.358	5.766	0.000	****	Supported
Social Media Use -> Adaptability	0.709	16.744	0.000	****	Supported
Social Media Use -> Information Accessibility	0.811	29.696	0.000	****	Supported

*p < 0.1; ** p < 0.05; *** p < 0.01; **** p < 0.001 [65].

Table 3 highlights the path coefficient between the latent variables, the hypotheses of the study and the bootstrap T-Statistics. For Hair and al. (2016), all T-Statistics are considered acceptable if they are greater than 1.96 at 95% confidence interval [85]. All T-Statistics in this study are higher than 1.96. For POEU->PU, t-value=22.701>1.96 with p-value=0.000 is accepted. For PEOU->SMU, t-value=6.920>1.96, p-value=0.000; therefore, the hypothesis is accepted. For PU->SMU, t-value=5.766>1.96, p-value=0.000, which means that the hypothesis is accepted. The hypothesis is also supported for SMU->AD, t-value=16.74>1.96, p-value=0.000 as well as for SMU-> INFA, t-value=29.696>1.96, p-value=0. 000.So, all hypotheses were supported.

These results provide a foundation for discussion in the next section, where an additional interpretation of the results is presented.

5 Discussion

This article is about the perception, use and impacts of social media in the management of disasters. In accordance with TAM postulates, perceived ease of use positively influences social media's perceived usefulness even in crises situation. In other studies related to social media usage within organizations, it is being abundantly demonstrated that the perceived ease of use leads perceived usefulness [65]. The findings of this

research show that both perceived ease of use and perceived usefulness have a significant positive effect on social media use. In disaster management, social media's functions (easy to use and very well perceived by people, real-time dissemination of information, affordability, etc.) play a fundamental role [29], irrespective of the kinds of stakeholders involved in the disaster/emergency. The suggestion would be to make functionalities easier, mostly publishing events on online social media.

Social media usage is found to have a significant influence on information accessibility [27] and adaptability[78]. Considered as one of the most significant impact of the social media use by Tajudeen [70], the information accessibility refers to informational benefits in DeLone and McLean's means. It includes information access, information quality and information flexibility. Adaptability, on the other hand, involves changing or modifying oneself or one's behaviour to better fit in the new environment [76, 87]. Using social media in crises context enables people to alter their living behavior depending on changes imposed by the disaster [27]. Mukkamala and Beck [27] and Cai, Huang [78] show in their investigations that by getting access to factual information, the individuals adjust their daily behavior to fit the new setting. Thus, People affected by or involved in disasters use social media in order to disseminate or get real-time and factual information [27], locate the affected people, describe the magnitude of damages and guide in rescue operations.

Taking an example of Ebola outbreak or insecurity induced by armed groups, we believe that with no social media used these disasters could be more devastating. In fact, social media helps people in taking precautions so as to mitigate the risks of catching the virus. Even if DRC has one of the lowest rates of Internet use in the world, 6% only and 3.2 % of social media active users -perhaps because of poor internet infrastructure- information from social media can be shared with social media non-users using word-of-mouth channel. In this way, information disseminated through social media becomes accessible to all. Everyone at their level knows the prevailing situation, can easily locate the possible danger and can even access precautionary measures. Thus, it becomes easy for citizens to adapt to the changes imposed by the current situation. It clearly appears that information accessibility to be one of the main impacts of social media use [71, 75]. In crises situations, social media are used as communication tool [19, 27] to collect and disseminate information. The monitoring function of social media usage [29] helps to build and reinforce their adaptability and other agility dimensions[78]. By enhancing information accessibility and adaptability, social media are life's savers.

6 Conclusion, limitations and future research avenues

Many researches are interested in the application of information technologies [30], especially social media, to understand how they are used in disaster management lifecycle and how to extract and analyse useful disaster-related data. Different types of disasters, including natural disasters, have benefited from the many functions of social media.

To better understand how social media are perceived, used and what are its impacts in regions facing various kinds of disaster the same time, such as the Kivu regions in DRC, we theorized and empirically validated a research model based on the two main constructs of TAM (perceived ease of use and perceived usefulness), the actual use of social media, and the impacts of information accessibility and adaptability. Our findings showed that social media are perceived to be easy to use and are useful, all of which have a positive significant influence on the use of social media. The actual use of social media leads to information accessibility and adaptability in disaster situations.

Some limitations of this study include the fact that only a quantitate approach was applied, and the fact that our review of relevant literature might have been less holistic, because most of studies on social media social use and impacts are typically organization-oriented and do not discuss disaster issues.

In terms of future research directions, it would be of real interest to apply other methods, such as qualitative or mixed methods, to help academics and practitioners, as well as disaster management stakeholders, to have a deeper understanding of the use and impacts of social media in crisis/emergency settings.

Appendix: Constructs Measurement

Considering the Social Media, you are using in management of disasters; choose response ranged from totally disagree to totally agree, for each of the following propositions.

Perceived Usefulness[50**]**

PU1: Using social media improved my decision-making abilities when doing tasks

PU2: Social media allowed me to understand the task problem more quickly

PU3: Using social media enhanced my problem-solving behaviour for activities.

PU4: I found social media useful

Perceived Ease of Use [50**]**

PEOU1: Social media are easy to use

PEOU2: It was easy to get social media to do what I want it to do

PEOU3: Social media are easy to operate

PEOU4: My interaction with social media is clear and understandable.

Social Media Use[75**]**

SMU1: I often use social media to contact other people

SMU2: I regularly use social media to communicate with friends and partners

SMU3: The frequency of usage of social media to do the following things in my daily work is to ask questions.

SMU4: The frequency of usage of social media to do the following things in my daily work is answering questions.

SMU5: The frequency of usage of social media to do the following things in my daily work is sharing information.

SMU6: The frequency of usage of social media to do the following things in my daily work is socialization.

Information Accessibility[71**]**

INFA1: Social media use enables easier access to general information

INFA2: Social media use enables easier access to real-time information

INFA3: Social media use enables faster delivery of information to my community

INFA4: I can obtain the information necessary to events

INFA5: When I need additional information to events, I usually get it from social media

INFA6: The amount of information available to me is sufficient for me to make good decisions

INFA7: I have found that information is generally complete enough for me to make good decisions

Adaptability [78**]**

AD1: I can change my behavior to work more effectively with other people.

AD2: I can accept critical feedback.

AD3: I can adjust to new situations

AD4: Use new equipment

AD5: Keep up-to-date.

AD6: I can quickly adapt to switch from one project/situation to another.

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