

Review

Use of Social Media in Disaster Management: Challenges and Strategies

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Abstract: Studies on social media (SM) and disaster management (DM) have mainly focused on the adaptation, application, and use of SM in each stage of DM. With the widespread availability and use of SM, the effective utilisation of SM in DM is impeded by various challenges but not yet comprehensively researched. Therefore, this paper aims to identify the challenges as well as the strategies to overcome the challenges and categorises them into a classified model. This study adopts a systematic literature review to present and analyse the challenges and strategies for using SM in DM. Utilising prominent databases, 72 publications were carefully selected and analysed qualitatively using content analysis. The findings revealed four key challenges to its users: the spread of misinformation; insufficient human resources to manage SM use; the lack of trust in information and authorities; and the poor information quality and content of messages. This study identified several strategies to overcome challenges, which can be classified into three sectors of the SM community: individuals, organisations, and SM companies. These findings contribute to enhancing the effective utilisation of SM in DM by community practitioners. Furthermore, this study provides insight into the current status of knowledge and identifies the research gaps around SM in DM for future research.

Keywords: social media; disaster management; challenges; strategies; systematic literature review



Citation: Seneviratne, K.; Nadeeshani, M.; Senaratne, S.; Perera, S. Use of Social Media in Disaster Management: Challenges and Strategies.

Sustainability **2024**, *16*, 4824.

<https://doi.org/10.3390/su16114824>

Academic Editors: Erick Mas and Sasha Zhijie Dong

Received: 27 March 2024

Revised: 18 May 2024

Accepted: 29 May 2024

Published: 5 June 2024



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1. Introduction

In recent years, the frequency and severity of natural disasters such as floods, earthquakes, hurricanes, and wildfires have increased worldwide [1]. According to the Institute for Economics and Peace (IEP), the number of natural disasters has increased by ten times from the 1960s to 2020s [2]. These disasters have devastating impacts on communities and individuals. For instance, according to the Emergency Events Database (2024) [3], 1.7 billion people have been impacted by natural disasters over the last decade (2013–2023), killing 319,931 people and resulting in over USD 1.9 trillion in damage costs. Natural disasters have caused substantial damage to human lives beyond mortality in many aspects. In terms of physical damages, people lose their properties, infrastructure, and services (electricity, transportation, water supply, and alike) immediately after a significant disaster [4]. Nevertheless, disasters often deliver long-term consequences to people's lives including job losses, emotional breakdowns, financial downturns, injuries, and disabilities [5,6]. In addition, there may be some inevitable uncertainties associated with disasters such as evolving environmental conditions and unpredictable weather changes leading to several sustainability issues. Yet, it is crucial for the disaster management community to seek and adopt novel and improved approaches to fully prepare, effectively respond, and successfully recover from disasters.

Social media (SM) has emerged as a valuable technology in aiding disaster management (DM) activities in the prevention, preparedness, response, and recovery phases of the

disaster management cycle [1,7]. It facilitates two-way communication, where people become both the producer and the consumer of the information [8]. In pre-disaster phases, SM is majorly utilised to disseminate information quickly to the public. It is used to send early warnings and raise awareness among the public by organisations and governments [9]. Also, in the preparedness phase, the use of SM increases community engagement by sharing disaster preparedness activities such as evacuation plans, locations, etc., and providing real-time updates about the disaster [9,10]. Furthermore, the ubiquitous nature of social media has ensured that real-time disaster information is shared with a wider audience, including individuals, government bodies, media, and non-government organisations. For example, according to Lam et al. [11], SM has served millions of requests by different community sectors, for information, donations, rescue requests, and protection during crisis events. Also, in the recovery phase, SM is often used by communities to stay connected, share information, collect donations, and rebuild services. For instance, following the Australian bushfire in 2019–2020, SM was used to mobilise donations, encourage tourism (e.g., hashtags like #HolidayHereThisYear), and reignite economic activities (e.g., hashtags like #buyfromthebush) [4].

Despite several applications and advantages, the use of SM in DM was also impeded by various challenges. With the widespread and increased reliance on SM data in disaster management, the risks of misleading information and improper conduct were inevitable. In addition, as discussed previously, people suffer from the consequences of a critical disaster in the long term. Yet all community members do not benefit equally from social media platforms [4,12,13]. For example, different age groups understand and use technology differently, whereas the younger generation is more efficient in using new technologies such as SM [11]. In some instances, people with a lower socioeconomic status may not have the ability to use or access this technology. Furthermore, vulnerable community categories such as people with disabilities, the elderly, and isolated people face specific challenges due to their inability to respond in the same way as the general population [4,12,14]. Undoubtedly, these circumstances of social media are creating serious challenges for the use of SM as a disaster management tool [15]. As a result, investigating the possible strategies to overcome these challenges in SM use for DM is also essential. Unfortunately, only limited attention has been given to exploring the challenges and strategies within the current research landscape. Several researchers, including the authors of [11] and Singla and Agrawal [16], have emphasised the need for new/improved concepts across disciplinary and methodological boundaries to address these challenges and to ensure the validity and reliability of SM data. Therefore, this study aims to conduct a comprehensive literature review to identify current challenges and possible strategies in the context of SM and DM. To achieve the research aim, the objectives established were (i) to identify the SM platforms used in different types of disasters, (ii) to identify the community-related challenges for using SM in DM, and (iii) to examine the strategies to overcome challenges for using SM in DM.

The rest of this paper is organised into three main sections. Section 2 explains the methodology adopted for this study. Section 3 presents the results and discussion which includes the bibliometric and content analysis. Finally, the conclusions, along with the practical implications, recommendations, and future research possibilities, are presented in Section 4.

2. Materials and Methods

This study conducted a systematic review of the literature to fully assess the challenges and strategies related to the application of SM in DM. The method of the systematic identification and collation of the available literature under a research focus is commonly referred to as a systematic literature review [17]. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 protocol was followed to conduct the systematic review. PRISMA, as a comprehensive guideline, aims to enhance the transparency and scientific quality of reported systematic reviews or meta-analyses [18,19].

According to Snyder [20], this type of review follows a rigorous and transparent process that involves the identification, critical appraisal, and synthesis of relevant research. The methodological process involved a preliminary database search, the screening of the retrieved literature, and a descriptive analysis of the most relevant literature. Subsequently, a four-stage selection process was employed to select the most relevant publications for content analysis. This process incorporated the identification of the available literature (Step 1), review of the title and abstract (Step 2), content review (Step 3), and descriptive content analysis (Step 4). Figure 1 depicts an overview of the research process adopted for this study.

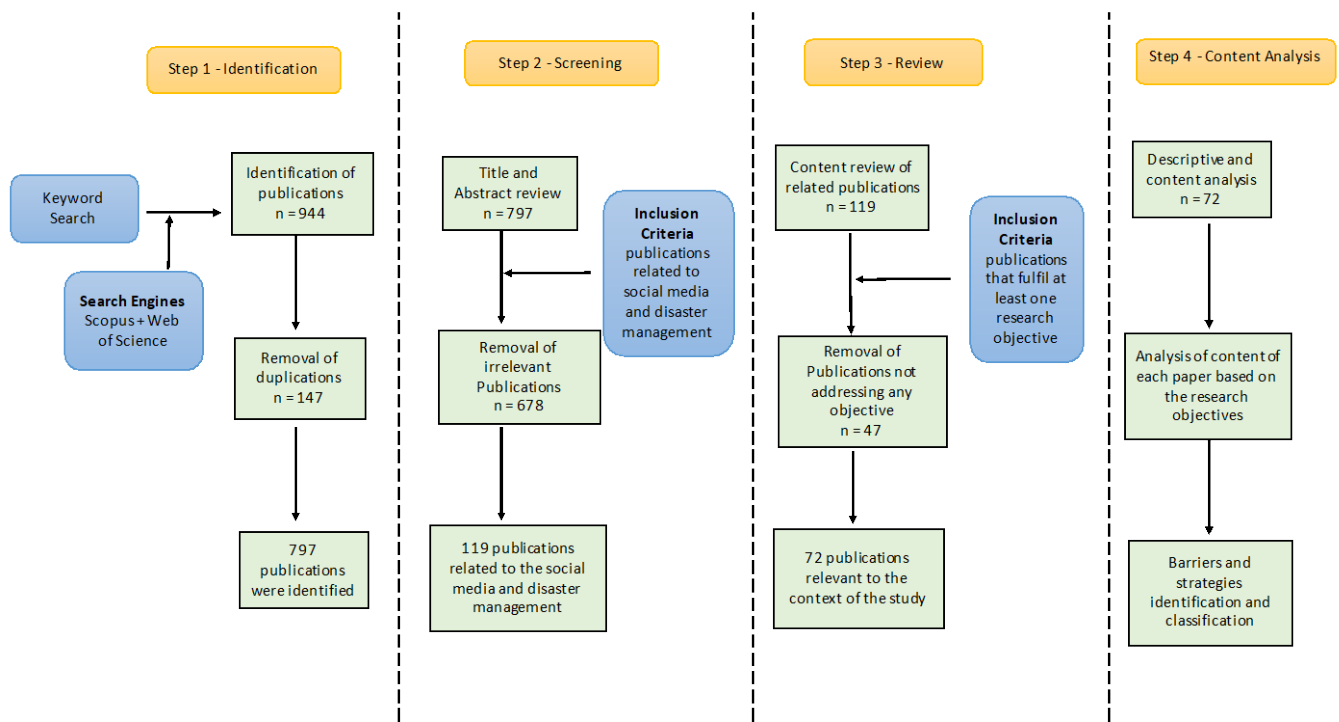


Figure 1. An overview of the systematic literature review process.

2.1. Identification of Papers

To identify pertinent publications related to the research focus, this study utilised two prominent databases, Scopus and Web of Science. The initial literature retrieval was performed using the Scopus database, given its extensive coverage of scientific publications [21]. A careful combination of keywords and Boolean operators was employed to retrieve publications from each database; ("Social media" OR "Facebook" OR "Twitter" OR "WeChat" OR "Instagram" OR "snapchat" OR "YouTube" OR "reddit" OR "WhatsApp") AND ("Prevent*" OR "prepare*" OR "response" OR "recover*" OR "manage*") AND ("Disaster" OR "bushfire" OR "Wildfire" OR "Flood" OR "Hazard" OR "emergenc*" OR "Earthquake" OR "Drought" OR "tsunami" OR "Cyclone" OR "Landslide" OR "Volcano*" OR "Hurricane" OR "Storm" OR "Heatwave") AND ("Communit*" OR "Generation" OR "Age cohort" OR "underserved" OR "vulnerable" OR "well served" OR "young") AND ("barrier" OR "obstacle" OR "challenge" OR "Strateg*" OR "tactic"). The asterisk (*) sign was used to include variations of the root words. For example, "strateg*" was used to capture the variations such as "strategy", "strategies", "strategic", and "strategise". This provides a broader search scope to capture relevant terms. To increase the likelihood of capturing all relevant academic papers, specific names of certain social media platforms and disasters were incorporated as keywords. Consequently, the identification of challenges was more focused towards communities to ensure that this study is contextually valuable, culturally sensitive, and inclusive.

The selection process was limited to articles written in English and published online before the cut-off date of 22 November 2023. There were no constraints on the year of publication during the retrieval of publications. However, the authors acknowledge the limitations of the database selection and search strategy. This study employed only two prominent databases, namely Scopus and Web of Science. Furthermore, the selection process reflected on the used keywords only. The keywords for the current study were adopted by observing the keywords used in previous studies of a similar context. Most of the studies used only key terms (e.g., disaster, social media) for their keyword search [5,22,23]. Some of the studies used some synonyms and specific names of the key terms [4,24]. However, the usage of synonyms and specific names (e.g., Facebook, Instagram, flood, earthquakes) with the Boolean operator “OR” only expands the scope of search but does not restrict the papers being retrieved from the key terms used. Therefore, there is a very low chance of missing a significantly relevant paper due to the absence of some synonyms. Finally, to uphold the methodological rigour of this systematic review, non-academic and technical documents such as reports, discussions, websites, and similar materials were deliberately omitted, notwithstanding their widespread accessibility.

Through a primary search in the Scopus database, 657 publications were identified in total. Following an expanded search in the Web of Science database, 147 papers were found to be duplicated. As a result, no further database searches were conducted. The expanded search in the Web of Science database resulted in retrieving 140 unique publications. Consequently, the preliminary database search yielded 797 distinct publications, all of which were published prior to the cut-off date of 22 November 2023. These 797 articles underwent a screening process, which involved a thorough examination of the title and abstract to assess their suitability for inclusion in the systematic review. All the identified papers were extracted into an Excel workbook along with the abstracts of the papers. The inclusions and exclusions were highlighted separately to shortlist the relevant papers to this study. This process and the workbook were consistently monitored, and any discrepancies were resolved through discussions by the authors. The studies which cover both the SM and DM contexts were included in this study. To elaborate, social network or resilience studies that are not about online SM platforms (e.g., modelling social network influence on hurricane evacuation decision consistency and sharing capacity), studies about other digital technologies (e.g., artificial intelligence for natural disaster management), and studies about the use of SM platforms but not relevant to DM (social media influences on youth with disabilities in the Global South) were excluded as irrelevant papers. Additionally, non-academic documents such as discussion papers and notes were also excluded in this process, resulting in the exclusion of 678 articles. In the subsequent phase of the process, a content review was conducted on the remaining 119 publications to further evaluate their alignment with the research objectives. This resulted in a selection of 72 articles as the most pertinent publications for descriptive and content analysis. A summary of the relevant papers and their sources is presented in Table 1.

Table 1. Summary of pertinent papers for research.

Code	Source (Journal/Conference)	No of Publications	References
JP	Journal Papers	54	[11,25–77]
CP	Conference Papers	18	[8,78–94]
	Total	72	

JP Journal Paper, CP Conference Paper.

2.2. Descriptive and Content Analysis

In this stage, a final number of 72 articles were used to conduct bibliometric and content analysis. Frequency counts were used to obtain an overview of the years of publication and the distribution of the articles. This was also supported by data visualisation and analysis software. The main software used in this study to perform bibliometric analysis is VOS Viewer version 1.6.20. It was used to analyse and visualise the data using a co-

occurrence network of the bibliometric data. Consequently, the content of the relevant 72 papers was categorised according to research objectives in the form of a codebook. All available information from each paper and for each objective was identified and reported. While some of the papers explicitly indicated the challenges and strategies, others required thorough analysis to identify them. Based on this analysis, the final set of challenges and strategies for the use of SM in DM was conceptualised.

3. Results and Discussion

3.1. Bibliometric Analysis of the Publications

3.1.1. Co-Occurrence Network of Keywords

The keywords of a particular study reflect the theme of the study. When all keywords are mapped together, in a specific field of study, it provides a clear representation of the existing knowledge area [95,96]. Also, the network of co-occurrence keywords illustrates the scholarly relationships between keywords. Therefore, a keyword co-occurrence network was created for the current study utilising the VOS Viewer software. Out of the available keyword types (author keywords, index keywords, and all keywords), the author keywords were used to illustrate the keywords' co-occurrence network. This limitation helped to generate a readable and clear image of the main keywords.

In VOS Viewer, the minimum number of occurrences of a keyword was set to 3, in order to generate the optimum legible network. Out of 208 keywords, 13 keywords met the threshold with five clusters, 35 links, and a total link strength of 51, as illustrated in Figure 2. Furthermore, the keywords which express the same meaning, such as disaster and disasters, crisis communication, communication, and disaster communication, were merged to appear as disasters and crisis communication, respectively. The size of each node indicates the number of occurrences of the keyword, while the link strength connecting two keywords shows the number of articles in which they appeared together [97]. The top keywords identified from the illustrated network are social media, crisis communication, emergency management, Twitter, and disasters. It was also identified that the 'social media' keyword is strongly linked (highly appeared) with the emergency management, crisis communication, disasters, and disaster management keywords, respectively.

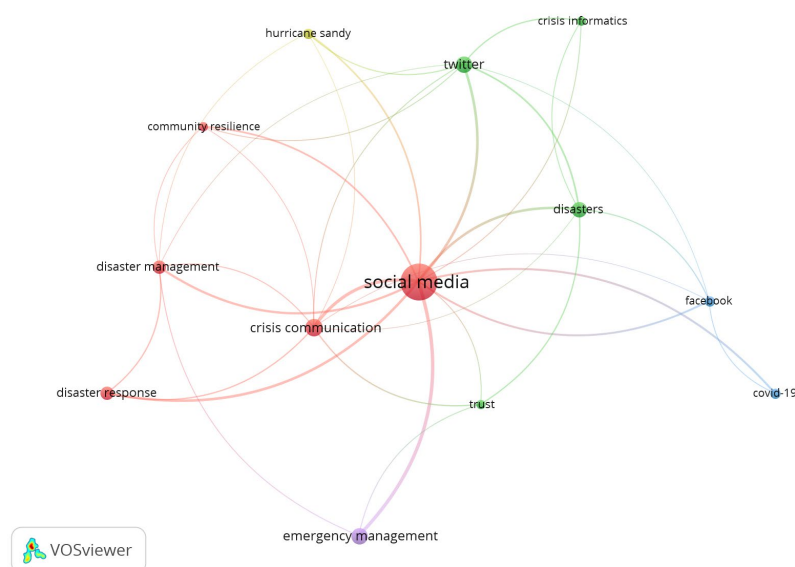


Figure 2. Co-occurrence network of keywords.

3.1.2. Collaboration Network of Countries

The collaboration network of countries helps determine which nations are leading the research in a particular field. Some countries contribute to a specific research domain more than others. Therefore, an internationally collaborative network of countries was

illustrated using the same software, VOS Viewer, to determine the leading publications and their collaborations across nations. The minimum numbers of the documents and citations of a country were both set to 2. This again helped in establishing the optimum legible network. Even though 9 countries out of 20 met this threshold, only 8 were found to be connected. Figure 3 depicts the international collaboration network of the countries with four clusters, nine links, and a total link strength of 10. The size of the node indicates the number of documents published by each country related to SM in DM. The United States, Australia, Germany, China, and the United Kingdom have published a relatively higher number of publications. The variation in publications among active countries is presented in Table 2, along with the number of citations and total link strength. The United States leads the SM in the DM research field, followed by Australia and the United Kingdom. This review is limited to articles published in English. This language limitation may certainly be a factor to this level of dominance by English-speaking countries. In terms of co-authorship, the United Kingdom and Italy emerge as highly collaborative countries in publications. Subsequently, the United States, United Kingdom, Australia, Italy, and Singapore exhibit a significant level of collaboration.



Figure 3. Collaboration network of countries.

Table 2. Variation in publications among active countries in SM in DM.

Country	Papers	Citations	Total Link Strength
United States	37	1848	5
Australia	14	652	2
United Kingdom	5	165	4
Germany	5	150	2
China	5	30	2
Italy	4	40	2
Canada	3	186	1
Indonesia	3	6	0
Singapore	2	183	2

3.1.3. Annual Trend of Publications

The annual publication trend indicates the level of attention given to a specific field of study by both researchers and industry practitioners. Figure 4 presents the yearly publication pattern for the current study. Despite having no restrictions on the publication year of the articles, the first relevant paper on the use of SM in DM emerged in 2011. This is not surprising, as a noticeable number of studies on the topic were published around 2010, following a very limited publication period of 2006–2010 [24]. Since then, the utilisation of SM in DM studies grew gradually until 2020, in line with the previous reviews of Ogie et al. [4] and Fauzi [24]. However, a slight decline in publications was observed in 2019 and 2020, possibly due to the shifted focus towards COVID-19 research. Nevertheless, there was a significant increase in the number of studies from 2020 to 2023. The number reached its peak with 13 articles in 2023. Overall, there was little and varied progress in the articles published on SM in DM until 2020, and the annual trend of published articles dramatically increased afterwards.

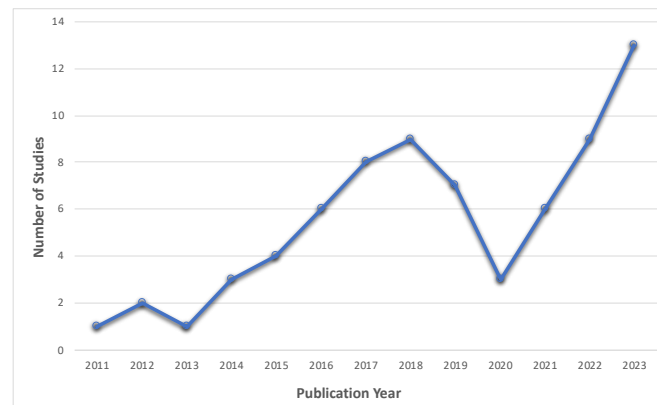


Figure 4. Annual trend of publications.

3.2. A Content Analysis of the Publications

3.2.1. Social Media Platforms and Disaster Types

In reviewing the articles, the SM platforms and disaster types were recorded and illustrated. This allows the researchers to understand the frequency of disaster types and SM platforms documented in the reviewed literature. It is common to encounter an article involving multiple disaster types and SM platforms in a single study. In contrast, some articles have not utilised any of the specific disaster types or SM platforms. Instead, they have generally investigated the use of SM for DM in their studies. Therefore, the total count of the illustrated SM platforms and disaster types is not precisely aligned with the overall number of studies (72) reviewed. Furthermore, the reviewed 72 papers have employed different information sources and data collection and analysis methodologies to conduct the research. Overall, 34 publications have used a content analysis of SM data (Tweets, FB posts, and alike), while 29 papers have employed survey methods such as interviews, questionnaires, and focus groups to conduct their research. Other methods such as reviews, online observations of SM activities, and workshops were distributed among the remaining nine publications. When analysing the SM data, most of the researchers have followed a qualitative method to capture the content, user behaviour, trends, and sentiments within SM platforms. Therefore, a greater number of studies have followed the qualitative research approach, and thereby, it may involve subjective interpretation.

As shown in Figure 5, hurricanes, pandemics, floods, earthquakes, and bushfires were the most prevalent disasters highlighted in the systematic review. From the reviewed literature, one-fourth (25%) of the papers discussed hurricanes, followed by the pandemic (16%), floods (15%), earthquake (13%), and bushfires (11%), respectively. Apart from the greater frequency of these disasters in the world, the high appearance of these disasters in the reviewed literature resulted from the geographical bias in the reviewed literature towards countries like the United States and Australia, as evident in Section 3.1.2. For example, the most common natural disasters in the 2010s (2010–2019) in the United States included hurricanes, floods, tornados, and bushfires, whereas, in Australia, the most common disasters included were bushfires, floods, and storms [98–100]. Additionally, Figure 5 excluded the least reported disasters, such as storms, landslides, tornadoes, heatwaves, and tsunamis, as they appeared only once in the reviewed literature.

The effective management of these disasters was mostly investigated using Twitter as the key SM platform, as depicted in Figure 6. Twitter was used in 55% of the articles, while Facebook, WhatsApp, and Instagram were used in 24%, 4%, and 4% of the articles, respectively. All these predominant SM platforms are more common and well known among social communities. However, this review identified platforms like Myspace, TikTok, Snapchat, Nextdoor, WeChat, Weibo, and Telegram as the least appearing platforms in the literature. Geographical bias, age cohorts, and low popularity might be the reasons for reduced investigations on these platforms by researchers. For instance, being domestic apps, WeChat and Weibo were mostly used in Chinese studies only. TikTok and Snapchat,

on the other hand, are still popular with the younger community. With the increasing number of users, especially among younger generations, who are expected to bear the burden of addressing future disaster risks, these platforms may evolve into a leading platform for future DM [4]. Hence, it will be important for future research to explore the possible and effective use of such platforms in DM.

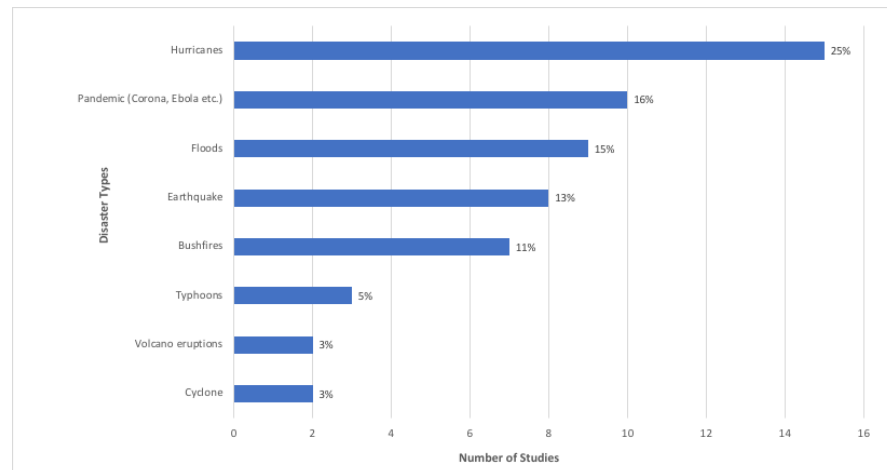


Figure 5. Disaster types presented in the literature.

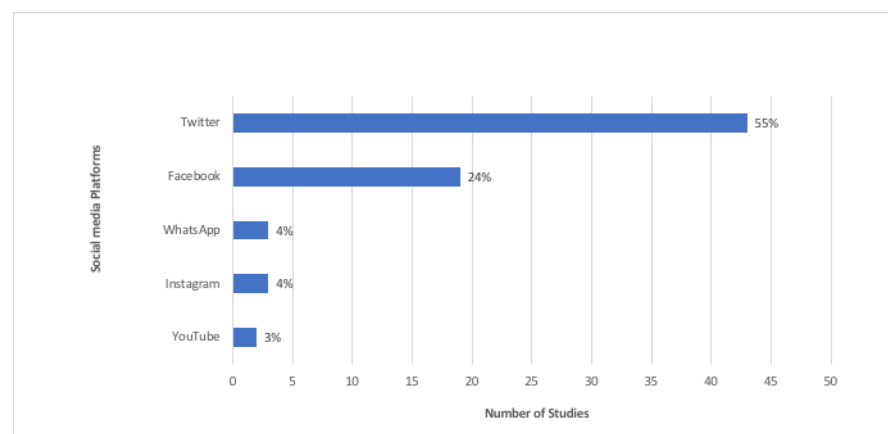


Figure 6. SM platforms identified in the literature.

Overall, the use of SM in DM is highly dominant by hurricanes and Twitter, in terms of disaster type and SM platform, within the reviewed literature. Notwithstanding, the pertinent papers also discussed the management of prevailing disasters such as bushfires, earthquakes, and floods using several social media platforms like Facebook, YouTube, and WhatsApp.

3.2.2. Challenges to the Use of SM in DM

Following the four-step methodology explained in Section 2, a total of 18 challenges were identified in this study. The challenges were ranked based on the number of appearances in the analysed papers. Even though the number of appearances is almost the same for most of the challenges, there are a few exemptions determined. For example, the spread of misinformation, insufficient human resources to manage SM use, the lack of trust in information and authorities, and poor information quality/content were mentioned by several researchers more significantly than other challenges. Additionally, some of the challenges emerged from practical evidence, when researchers conducted case studies on SM use in DM. Table 3 presents the identified challenges with their rank and references.

The references column of Table 3 provides the reference to the studies in which the relevant challenge was mentioned and explained.

Table 3. Challenges to the use of SM in DM.

Number	Challenges	Sum	Rank	References
1	Spread of misinformation and disinformation	10	1st	[8,27,33,34,38,41,57,75,81,83]
2	Insufficient human resources to manage social media use	9	2nd	[11,29,30,48,50,80–82,89]
3	Lack of trust in information and authorities	8	3rd	[31,44,45,47,48,69,82,92]
4	Poor information quality and content of message	8	3rd	[26,30,33,36,59,66,75,77]
5	Difficulties in information accuracy and verification	6	4th	[11,30,47,49,59,81]
6	Difficulties in data processing and analysis	6	4th	[8,38,48,80–82]
7	Problems with internet connectivity during emergencies	5	5th	[11,27,28,49,59]
8	Policy breaches and privacy violation issues	5	5th	[33,38,48,50,52]
9	Language barriers	3	6th	[11,27,29]
10	Low level of credibility of data	3	6th	[30,50,54]
11	Disparities in social media use across different social groups	3	6th	[26,28,43]
12	Miscommunication between victims and responders	2	7th	[26,33]
13	Difficulties in learning social media platforms	2	7th	[11,90]
14	Different levels of community expectations	2	7th	[36,44]
15	Digital divide	2	7th	[50,77]
16	Lack of data ownership	1	8th	[11]
17	Difficulties in identifying and clearing bottlenecks	1	8th	[33]
18	Resistant to change by authorities	1	8th	[30]

The challenges were categorised into four categories, namely data-, social-, technology-, and legal-related challenges. This categorisation improves the clarity, understandability, and simplicity of the challenges derived from the literature. Further, the categorisation leads this study to establish a conceptual model at the end of this study. The categorisation technique was adopted from the study by Anson et al. [29], where the challenges to the selection and use of SM analysis tools were classified using the same set of categories. The taxonomy of these categories was developed based on the main focus of each challenge. Subsequently, the four main categories with their associated challenges are depicted in Table 4. A detailed discussion of the categorised challenges is then presented in the subsequent sections.

Table 4. Classification of challenges.

Category	Challenges
Data	Poor information quality and content of message Difficulties in information accuracy and verification Difficulties in data processing and analysis Lack of data ownership Low level of credibility of data
Social	Insufficient human resources to manage social media use Spread of misinformation and disinformation Lack of trust in information and authorities Different levels of community expectations Disparities in social media use across different social groups Resistant to change by organisations Language barriers
Technology	Miscommunication between victims and responders Difficulties in learning social media platforms Problems with internet connectivity during emergencies Digital divide
Legal	Difficulties in identifying and clearing bottlenecks Policy breaches and privacy violation issues

Data-Related Challenges

The first set of challenges impeding the effective use of SM in DM is data-related challenges. This set of challenges is predominantly associated with the information and its features disseminated through SM platforms. This set of challenges includes problems

related to data verification, poor information, data ownership, data credibility, and data processing and analysis. As indicated in previous studies, rumours are a common concern during disasters [11]. But the growth of false information questions the point of using SM as a DM tool [33,75]. Consequently, the unavailability of any verification methods to ensure the authenticity of data makes it even more problematic. Further, this false and unverified information negatively affects both the victims and responders by causing failed rescue operations, the misallocation of resources, and confusion among the public. This misinformation becomes critical when mixed with the poor information quality and content of posts. Not only can these messages be easily mistaken as false news, but they also hinder the process of data processing and analysis. The poor quality and content of information include duplicate, incomplete, and vague information which results in information overload to process and analyse [75]. Additionally, data from unverified sources are being shared through SM platforms frequently. As a result, a low level of credibility for information disseminated through SM platforms arises. This limits timely and effective decision-making by officials unless reliable information is received [50]. Therefore, improving methods to detect false news, disseminate quality content, and validate the accuracy and reliability of SM data is urgently needed.

Social Challenges

The second set of challenges comprises the social aspects of a community or country, which prevent the smooth implementation of the SM in DM. The findings of the systematic review indicate that spreading misinformation, the lack of trust, resistance to change, disparities among social groups, different levels of community expectations, difficulties in learning SM platforms, and insufficient human resources establish the key challenges from a social perspective. Furthermore, language barriers and miscommunications resulting from the linguistic differences of users also fall under the social category of the classification.

First, the growth of misinformation (inaccurate/outdated information) and disinformation (intentionally misleading/false information) in the form of ‘fake news’ in SM platforms questions the point of using SM as a DM tool [33,101]. The continuous improvement in sharing false information in SM platforms is the most mentioned challenge in the literature. As evident in Table 3, this challenge was mentioned in 10 publications from different countries over different disaster types. Studies published on bushfires in Australia, pandemics in Ghana, and typhoons in Germany majorly discussed this challenge [27,34,57]. These studies employed several methods such as SM data analysis, interviews, document reviews, and surveys to conduct their studies. According to [27], in Australian bushfires (2019–2020), the hashtag #arsonemergency was used to spread a rumour that the fires resulted from an arson attack. Furthermore, a study in Ghana, which used document reviews as its research method, reported that high figures of infections were widely circulated on SM during the COVID-19 pandemic [34]. Additionally, the interviewees of the study in Germany were critical about the dissemination of false information due to the panic and errors it induces among the general public [57]. Therefore, these studies collectively highlight the challenge of misinformation and disinformation in SM platforms and require urgent attention to mitigate their impacts.

Trust, as a cultural aspect, generally influences how individuals perceive and rely on information. In some cultures, official sources, authorities, and institutions are highly trusted, while in others, mistrust is more prevalent. The latter, which is mistrust towards information and authorities, emerged as a challenge for the use of SM in DM [31,44]. Mistrust towards authorities mostly arises when people believe authorities do not utilise SM as a formal tool to communicate with citizens [69]. The nature of spreading false news, poor information, and rumours in SM platforms contributes to the lack of trust towards the information shared. This mistrust prevents community members from seeking information on SM during disasters, making it pointless to share disaster information with them. Community members are not motivated to use SM when their expectations are not met. Similarly, the gap between personal expectations of emergency services in responding to

requests on SM and the extent to which emergency services are aware of and able to respond to those requests plays a vital role in the effective utilisation of SM for DM. Additionally, the heterogeneous background of SM users is also a concern within the context of DM. For example, users are found to be biased in SM use, with young, educated, and urban citizens generally using it more [11]. Conversely, underserved communities, such as people with a low socioeconomic status, older/isolated people, minor populations, and people with disabilities, barely use any SM platforms [26]. This raises fundamental questions on the validity of using SM in DM. Finally, fear, uncertainty, and doubt among emergency managers about using new forms of data, such as SM, impose the ‘resistant to change’ behaviour within organisations and thereby challenge the official use of SM as a DM tool.

The effectiveness of using any tools and technologies in DM depends greatly on available resources, especially human resources. The successful management of disasters using SM is significantly influenced by the availability of human resources. In a survey of over 200 emergency managers, half of them reported not having made any use of SM, identifying a lack of staff as the key obstacle [82]. The current study also makes evident that the lack of human resources to manage SM is one of the frequently cited challenges in the literature. Training and time are the two key concerns related to the lack of human resources within DM organisations [50]. Initially, officials struggle with vast amounts of information due to the lack of training [30,48]. To comply, the personnel are required to perform and have expertise in communication tasks daily [80]. Secondly, as per McCormick [30], the staff does not have enough time to respond or receive information through SM during disasters, mainly due to the lack of staff and expertise. The volume of posts published by users also affects the time it takes officials to keep up with requests during a disaster [50]. Therefore, the proper allocation of human resources is also vital. Following these circumstances, SM platforms are often seen as a secondary element instead of a formal institutional tool, challenging the potential use of SM in managing devastating disasters [89].

Language challenges, as a result of the linguistic differences of users, can arise in several forms. The predominant form of challenge, in the context of SM, is communication among multilingual communities. Specifically, if the victim and the responder are from diverse language backgrounds, possible miscommunications are inevitable. Importantly, the lack of options available in languages apart from English has prevented indigenous people from using SM platforms during disasters [27]. Even though automated translation tools are provided by some SM platforms, their accuracy is questionable. Furthermore, the use of sublanguages or slang within some demographic groups, such as teenagers, can also act as a challenge when extracting disaster-related data [29]. For example, abbreviations such as TC (Take Care) are not understood by all users. These challenges may not only impede the use of SM but also result in data from such groups being excluded from the analysis during the disaster.

Technology-Related Challenges

This category refers to the challenges related to technological features that hinder the selection and utilisation of a social media platform by its users. It includes internet connectivity issues, the digital divide, and challenges in identifying and clearing bottlenecks. From a user perspective, internet connectivity problems and the digital divide are the primary challenges. The loss of internet connection, especially during disasters, poses significant challenges as it not only hinders victims’ access to critical information but also limits the surveillance operations by humanitarian actors [28]. For instance, in the Australian context, researchers have pointed out that the extensive use of SM for disaster communication is impeded by scarce internet coverage in rural and remote Australia [27]. The digital divide, which refers to the inaccessibility of internet services, yields similar consequences and impacts [77]. It is primarily evident in the least developed countries, but marginalised populations in developed countries also experience the same. Interestingly, for certain populations, the digital divide can also be a choice, as they decide not to engage with technology or refuse digital literacy [50]. However, the digital divide is a significant

challenge to the effective implementation of SM in DM, significantly impacting access to information, resource mobilisation, and social communication. Issues in the information flow of SM platforms (bottlenecks), resulting from technological issues such as algorithm limitations and capacity problems, also remain problematic for its use in DM.

Legal Challenges

The final category of challenges to the effective use of SM in DM is legal challenges. Based on legal considerations, policy breaches and privacy violations are classified under this category. Policy breaches and privacy rights violations, often visible in SM platforms, prevent the continuous use of SM in DM as a safe and potential tool. These violations include policy breaches imposed by SM platforms (ex: non-offensive comments policy) [33]. Sharing misleading information, offensive responses and comments, and the disclosure of the confidential data of an organisation or an individual are frequently common in SM platforms. However, there is no regulatory authority of SM for DM to prevent such violations and assure the privacy rights of individuals [16]. Therefore, the establishment and frequent monitoring of regulatory authorities, specifically for SM use in DM, is required.

3.2.3. Strategies to Overcome the Challenges for Using SM in DM

A total of 15 strategies to overcome challenges were identified following the process of the systematic literature review. The strategies were ranked based on the frequency of their mentions in the analysed papers. The results are presented in Table 5 along with their references and corresponding ranks. Subsequently, the strategies were categorised into three main categories for clear and simple representation, namely as follows: organisations, social media companies, and individuals. The strategies were thoughtfully distributed among these three sectors of the SM community that could contribute to improving SM use in DM. Lam et al. [11] followed a similar classification to categorise strategies related to improving SM use in disaster resilience. The proposed strategies for each of the three sectors are outlined in Table 6. As evident in Table 6, the number of strategies for organisations and social media companies is comparatively higher than for individuals. This highlights the crucial role that organisations and SM companies can play in overcoming the challenges associated with SM use for DM. Both of these sectors possess substantial ability to reform the prevailing conditions within the subject area if needed. A detailed discussion of the strategies, classified under each community sector, is presented in the subsequent sections.

Table 5. Strategies to overcome challenges of SM in DM.

Number	Strategies	Sum	Rank	References
1	Comprehensive policy development to enable the secure use of social media	3	1st	[30,50,89]
2	Adopting social media use guidelines	2	2nd	[11,29]
3	Integrating social media with incident management systems	2	2nd	[11,82]
4	Partnerships and alliances to adopt social media for emergency management	2	2nd	[29,50]
5	Development of methods to verify of social media information	2	2nd	[31,47]
6	Proactive engagement with the community using social media	1	3rd	[11]
7	Raising awareness of official accounts	1	3rd	[11]
8	Implementing rapid and automated data mining and visualisation tools in SM	1	3rd	[26]
9	Delivering consistent, factual, and official information	1	3rd	[33]
10	Open and honest communication	1	3rd	[33]
11	Revolutionising crisis intervention skills for digital environments	1	3rd	[43]
12	Management of myths and misinformation in social media	1	3rd	[34]
13	Protecting the data privacy of individuals/victims	1	3rd	[52]
14	Use of a social media plan for critical response phase	1	3rd	[54]
15	Strategic use of social media features	1	3rd	[11]

Table 6. Classification of strategies.

Category	Strategies
Organisations	Comprehensive policy development to enable the secure use of social media Adopting social media use guidelines Integrating social media with incident management systems Partnerships and alliances to adopt social media for emergency management Proactive engagement with the community using social media Raising awareness of official accounts Delivering consistent, factual, and official information Open and honest communication Revolutionising crisis intervention skills for digital environments
Individuals	Use of a social media plan for critical response phase Strategic use of social media features
SM companies	Development of methods to verify SM information Implementing rapid and automated data mining and visualisation tools in SM Management of myths and misinformation in social media Protecting the data privacy of individuals/victims

Organisations

The first set of strategies to overcome the challenges of SM use is organisation-related strategies. This includes all government and non-government organisations and agencies in the context of DM. As discussed previously, SM platforms are not yet considered a formal tool by officials to rely on during disasters. Instead, SM platforms are kept as a side tool. Therefore, strategies like comprehensive policy developments, the establishment of SM use guidelines, and the integration of SM with incident management systems can play a pivotal role in formalising SM use. For this to be possible, a broad policy framework is required that addresses user behaviour, information confidentiality, integrity, and availability when accessing data or distributing government information [30]. SM use guidelines, on the other hand, should address the best practices in emergencies that are valid across organisations to enable the inter-organisational overcoming of emergencies [29]. Additionally, integrating SM with existing incident management systems will enhance the useability of SM as a formal tool to manage disasters [11,82]. Particularly, public safety answering points (PSAPs) and emergency response systems (e.g., wired 911 emergency response system) are required to integrate with available SM platforms. Such integrations are already seen in some areas. For instance, an adaptable PSAP system, named Next Generation 911, is already being used in some parts of the United States [11].

This study also suggests that raising awareness of the official accounts, which serve as a source of true information, would reduce the chance of misinformation and disinformation [11]. Proactive engagement with the community, open and honest communication, and the delivery of consistent, factual, and official information will further increase public trust in official accounts [11,33]. Also, the formalised adoption and implementation of SM within the DM organisation requires new approaches, such as collaboration and partnerships. Establishing partnerships with private sector agencies, volunteer agencies, and more experienced agencies, as well as publishing policies to maintain consistency, can aid the formalised adoption and implementation of SM within the DM organisation [50]. Another important strategy to overcome challenges related to SM in DM is revolutionising crisis intervention skills for digital environments. Traditional crisis intervention, which aims to assist victims and prevent serious long-term problems, is not sufficient to secure satisfactory results in the digital environment [43]. Therefore, instead of using traditional methods like face-to-face emotional support, a hybrid mode of service, combining e-services with traditional methods, would be a great initiative. Finally, SM platforms can partner with relevant service providers to support this combination.

Individuals

The effective use of SM features by individuals greatly helps to overcome challenges related to SM use in DM. Starting with a fundamental set of features, SM platforms have undergone significant enhancements to fulfil the growing needs of users. For instance, real-time geotagging features, hashtags, and multimedia content integration in messages, provided by several SM platforms, help identify affected areas and locations immediately [59,75]. However, despite the availability of such practical features, the individual usage of these features is still low, which can be increased by their contributions. A survey conducted by Lam et al. [11] to understand the individual use of SM during disasters revealed that only 25% of respondents used hashtags (e.g., #hurricaneharveyrescue) for rescue requests. The survey was conducted using 1000 residents in the Houston metropolitan area in the United States. Only 11% of individuals used any type of SM platform as their primary source of information during disasters, whereas 60% of respondents indicated the television as their primary source of information. Moreover, geotagging enables users to share their location in real time, increasing the reliability of content [75,102]. Hashtags, on the other hand, improve the discoverability of content, while multimedia (images, videos, and alike) provides the community with a comprehensive and dynamic representation of the situation [102]. Thus, the strategic use of these features by individuals can contribute to overcoming challenges such as poor information quality and the spread of misinformation, analysed in Section 3.2.2.

Social Media Companies

The final set of strategies outlines the implementations related to SM companies. The key strategies included in this sector are developing methods to verify SM information, implementing rapid and automated data mining and visualisation tools, and the protection of data privacy of individuals. First and foremost, SM data verification has been a significant problem for every sector of the SM community. Therefore, the development of compatible methods to verify information, disseminated through SM, is an urgent need, especially during disasters [31,47]. Not only verification but the effective management of myths and misinformation is also required [34]. For instance, assigning a label and warning to posts that are false or potentially false could help eliminate the impacts of false news in a disaster event [11]. SM companies can collectively work with other companies, researchers, and industry practitioners to seek advice and explore possibilities. However, improving methods to detect false news, validate reliability, and manage misinformation by SM companies is urgently needed. Since manual fact checking is complex and time-consuming, researchers are currently working on developing an automated machine learning technique in this regard. Researchers have explored various algorithms to detect fake news based on user behaviour, linguistic features, and other signals [103–105]. However, a collaborative effort between SM companies, researchers, and other stakeholders is required to develop such methods. Secondly, manual searching, reading, and processing large amounts of data require intensive human resources and time, in the context of DM. On a positive note, rapid and automated data mining and visualisation systems enable the ability to deal with vast amounts of information, without the need for intensive human resources [26]. Hence, SM companies can significantly reduce the problems of information overload and the lack of human resources, by employing these systems. Finally, strict and improved regulations and actions to protect the data privacy of victims (e.g., prevention of disclosure of sensitive data of victims) are also required by SM companies to enhance the effective utilisation of SM in DM [52].

3.2.4. Conceptual Model

The identified challenges and strategies were mapped together to determine which barriers are addressed by existing strategies. The challenges were conceptualised together with the strategies that help overcome them. As some strategies can contribute to resolving more than one challenge, they were allocated to each challenge separately to enhance accu-

racy and reduce complexity in the conceptual model. Direct (D) and indirect (I) strategies were determined based on the main focus of challenges and strategies. Subsequently, the identified strategies were presented under each challenge by compiling findings from the literature review, as depicted in Figure 7.

Category - Challenges	Challenges	Strategies	Strategy type		Category - Strategies
			Direct	Indirect	
Data	Poor Information quality and content of message	•Delivering consistent, factual, and official information	✓		Organisations
		•Strategic use of social media features	✓		Individuals
	Difficulties in Information accuracy and verification	•Development of methods to verify social media information	✓		SM Companies
		•Delivering consistent, factual, and official information	✓		Organisations
		•Raising awareness of official accounts	✓		
	Difficulties in data processing and analysis	•Implementing rapid and automated data mining and visualisation tools in SM	✓		SM Companies
	Low level of credibility of data	•Strategic use of social media features	✓		Individuals
		•Raising awareness of official accounts	✓		Organisations
		•Development of methods to verify social media information	✓		SM Companies
	Lack of data ownership	•Comprehensive policy development to enable the secure use of social media	✓		Organisations
•Raising awareness of official accounts		✓			
•Protect data privacy of individuals/victims		✓		SM Companies	
Social	Spread of misinformation and disinformation	•Development of methods to verify social media information	✓		SM Companies
		•Management of myths and misinformation in social media	✓		
		•Raising awareness of official accounts	✓		Organisations
		•Delivering consistent, factual, and official information	✓		Individual
		•Strategic use of social media features	✓		
	Insufficient human resources to manage social media use	•Partnerships and alliances to adopt social media for emergency management	✓		Organisation
		•Implementing rapid and automated data mining and visualisation tools in SM	✓		SM companies
	Lack of trust in information and authorities	•Delivering consistent, factual, and official information	✓		Organisations
		•Proactive engagement with the community using social media	✓		
		•Open and honest communication	✓		
		•Raising awareness of official accounts		✓	
	Disparities in social media use across different social groups	•Proactive engagement with the community using social media		✓	Organisations
	Language Barriers	•Strategic use of social media features		✓	Individuals
		•Strategic use of social media features		✓	Individuals
	Miscommunication between victims and responders	•Proactive engagement with the community using social media		✓	Organisations
•Use of a social media plan for critical response phase				✓	
Difficulties in learning social media platforms	•Adopting social media use guidelines		✓	Organisations	
Different levels of community expectations	•Proactive engagement with the community using social media		✓	Organisations	
	•Revolutionising crisis intervention skills for digital environments		✓		
Resistant to change by organisations	•Partnerships and alliances to adopt social media for emergency management		✓	Organisations	
	•Comprehensive policy development to enable the secure use of social media		✓		
Technology	Problems with internet connectivity during emergencies	•Use of a social media plan for critical response phase		✓	Organisations
		•Proactive engagement with the community using social media		✓	
	Difficulties in identifying and clearing bottlenecks	•Use of a social media plan for critical response phase		✓	
•Partnerships and alliances to adopt social media for emergency management			✓		
Legal	Policy breaches and privacy violation issues	•Comprehensive policy development to enable the secure use of social media		✓	Organisations
		•Adopting social media use guidelines		✓	
		•Protect data privacy of individuals/victims		✓	SM Companies

Figure 7. Conceptual model for classification of key challenges with existing strategies.

As shown in Figure 7, some strategies directly contribute to overcoming challenges in each category. For instance, the challenge of ‘difficulties in information accuracy and verification’ can be directly addressed by developing methods to verify social media information. However, some strategies only have indirect or partial contributions to overcoming particular challenges. For example, proactive engagement with the community using social media will only reach part of the digitally divided population. The digital divide refers to the inaccessibility of internet services in some areas but can also be a choice made by some individuals who decide not to engage with technology or refuse digital literacy, as discussed in Section 3.2.2. The strategy of ‘proactive engagement with the community using social media’ is only relevant to such individuals, leaving fully inaccessible people with no direct strategy. Similar consequences can be observed with the challenge of ‘disparities in social media use across different social groups’. Furthermore, the use of social media plans in the critical response phase is only relevant to alternative actions that officials and

authorities can take. Emergency managers can plan alternative or traditional methods of communication if there are connectivity problems during emergencies. Yet, the original challenge remains unsolved or partially solved. It was observed that out of all the proposed 15 strategies, none of them directly address the issues of social and geographical disparities, the digital divide, and internet connectivity problems during emergencies, as evident in the developed conceptual model. Therefore, it is suggested that future research should prioritise exploring and providing practical strategies/solutions to overcome these challenges. Conversely, the most prominent challenges identified include the spread of misinformation and disinformation, insufficient human resources to manage social media use, lack of trust in information and authorities, and poor information quality. These challenges have a considerable number of direct strategies to overcome them, indicating the satisfactory level of attention given in previous studies to highly cited challenges. Implementing these strategies in the context of DM requires combined contributions from organisations, individuals, and SM companies.

4. Conclusions

This study reported findings from a systematic literature review that aimed to identify key challenges and possible strategies for the use of SM in DM. This review included 72 papers from journals and conferences written in English and published before November 2023. The findings suggest that researchers are increasingly becoming interested in using SM as a DM tool. Scholars from countries such as the United States, Australia, Germany, China, and the United Kingdom made a significant contribution to the literature on the use of SM in DM. Overall, Twitter was the predominant SM platform used in DM, appearing in 55% of the papers, followed by Facebook at 24%. SM was used to manage a wide range of disasters, but the most significant disasters that appeared in the literature were hurricanes (25%), pandemics (16%), floods (15%), earthquakes (13%), and bushfires (11%). The content review of the papers identified 18 challenges to SM use in DM, classified and integrated into a classification under four categories: data, technology, social, and legal. The ways in which these challenges could be overcome were discussed later in this study concerning three community sectors: organisations, individuals, and SM companies. A total of 15 strategies were discovered, and a conceptual model was also developed in this study.

The conceptual model provides a readily available point of reference for both the challenges and strategies to the use of SM in DM. Having identified and conceptualised the strategies in an efficient and socially inclusive manner, this study significantly contributes to social sustainability. Specifically, the strategies identified under the social category address some socioeconomic challenges of inequity and injustice within the community. Additionally, the conceptual model aids in encouraging industry practitioners to understand the prevailing challenges and direct strategies towards the optimal use of SM. In addition, this study broadens the current knowledge on SM use in DM, associated with challenges and strategies that are essential for the successful utilisation of SM into the DM context. Finally, the findings of this study serve as a valuable reference for both scholars and professionals who want to further explore SM use in DM practices and procedures.

In facilitating the insufficiently explored area of SM use in DM, this study suggests an empirical verification of the theoretical challenges and strategies. More specifically, most of the challenges and strategies were grounded in the views of researchers, which requires more verification in the form of empirical studies such as case studies. Therefore, future researchers are recommended to conduct such studies to further ensure the useability between the challenges and strategies presented in this study. Furthermore, it was noticed that the current research landscape is more dominant in developed countries such as the United States, Australia, and the United Kingdom. Conversely, developing and disaster-prone countries such as Bangladesh and the Philippines are noticeably absent in the reviewed literature. Therefore, future research should explore the challenges and possible strategies to the use of SM in DM, across wider nations and cultures, to be more literate within the research focus. A unique set of challenges and strategies may be discovered from such

studies, broadening the current state of the art within the context. In addition, the use of SM in different socio-demographic groups in DM is under-researched within the literature. Instead, more generic attention has been given to social communities. In the context of challenges and strategies, it is crucial to examine different socio-demographic groups such as people with a low socioeconomic status, older/isolated people, minor populations, and people with disabilities, as they may face unique sets of challenges based on their conditions, and therefore, a special type of strategy is required to overcome them.

Despite the significant contributions, the authors acknowledge the limitations of this study. Only two prominent databases were employed in this study to conduct the systematic literature review. As a result, this study might not refer to all the available literature in the research focus. Still, it is impossible to consider all the publications within a single review. Further, the researchers also acknowledge the possible subjective judgments on selecting the most pertinent papers. Even though the authors used some strategies to minimise the possible individual bias such as regular discussions, the full exclusion of such subjective judgments is not possible. However, significant contributions made by this study to the contexts of SM and DM are inevitable, as this study is one of the evolving studies that presents a categorised set of challenges and strategies for the use of SM in DM.

Author Contributions: Conceptualisation, K.S., M.N., S.S. and S.P.; methodology, K.S., M.N., S.S. and S.P.; software, M.N.; formal analysis, K.S. and M.N.; investigation, K.S. and M.N.; resources, K.S.; data curation, M.N.; writing—original draft preparation, K.S. and M.N.; writing—review and editing, S.S. and S.P.; visualisation, K.S. and M.N.; supervision, S.S. and S.P.; funding acquisition, K.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data supporting the findings in this study can be accessed through <https://www.scopus.com/> and <https://www.webofscience.com/> (accessed on 22 November 2023).

Conflicts of Interest: The authors declare no conflicts of interest.

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