Role of Management Information Systems in Disaster Management:

An Exploratory Study in Bangladesh

Md. Hasibur Rahman

Submitted in fulfillment of the requirements for the

Degree of

Doctor of Philosophy

Institute of Disaster Management and Vulnerability Studies
University of Dhaka
Bangladesh

October 2023

Declaration by the Researcher

I declare that I am the sole author of the thesis entitled, **'**Role of Management Information Systems in Disaster Management: An Exploratory Study in Bangladesh**'.** To the best of my knowledge, this thesis does not disobey anyone's copyright or violate any proprietary right, and any ideas, techniques, or any other material from the work of other people included in the thesis, published or otherwise, are fully acknowledged with the standard referencing practices.

I also declare that this thesis is my work and all the sources that I have quoted have been indicated and acknowledged through complete references and this dissertation has not been submitted for any other degree at the University of Dhaka or any other institution.

Signature

…………………………
(Md. Hasibur Rahman**)**
Registration: 187/2012-2013
Re-Registration: 45/2017-2018

Certificate from supervisors

In our capacity as Supervisor and Co-Supervisor of the dissertation respectively, we declare that the dissertation titled 'Role of Management Information Systems in Disaster Management: An Exploratory Study in Bangladesh' is an original work of **Md. Hasibur Rahman,** registration no.: 187/2012-2013 and re-registration no.: 45/2017-2018**,** for pursuing Doctor of Philosophy degree. We do hereby state that the dissertation has been conducted by the researcher's own efforts.

We would also like to certify that we have gone through the draft and final version of the thesis. We have found it satisfactory and fully ready to submit through the Institute of Disaster Management and Vulnerability Studies (IDMVS) to the University of Dhaka. The candidate declares that neither this dissertation nor any part of it has been submitted anywhere else for the award of any degree.

We wish him all the best.

Signature

……………………………….
(Dr. Mahbuba Nasreen), Supervisor
Pro-Vice-Chancellor (Academic)
Bangladesh Open University &
Professor& Former Director
Institute of Disaster Management and Vulnerability Studies (IDMVS)
University of Dhaka

Signature

……………………………….
(Dr. Md. Hasibur Rashid), Co-Supervisor
Vice Chancellor
Begum Rokeya University of Rangpur
And
Professor
Management Information Systems (MIS) Department
University of Dhaka

Abstract

The role of Management Information Systems (MIS) in disaster management and determinants of the adoption of MIS-based services for disaster management have not been adequately investigated in the context of Bangladesh yet. This fact leaves a blank space in the knowledge of the application of MIS in disaster management. However, this gap needs to be addressed to align with the government's plans of making use of MIS to fulfill its objectives, such as mitigating and managing disaster events efficiently. Conversely, it's widely recognized that Bangladesh, situated in South Asia, is a country with low elevation, shaped by the deltas of the Ganges, Brahmaputra, and Meghna rivers. This geographical characteristic makes it susceptible to recurrent disasters. Therefore, some extensive changes have taken place, in terms of policy and IT infrastructure development for disaster management, over the last decade in Bangladesh. Sequentially, the need for an integrated MIS system for efficient disaster management as well as proper coordination among different governing bodies and stakeholders is realized more than ever.

While a number of previous studies, which are specific to the Bangladesh context, have focused on disaster management in terms of context-specific solutions, gender inclusion, supply chain, policy, community-based disaster management, ICT integration, and so on, no studies have focused on the application of MIS in disaster management in terms of its roles and adoption by the users. Therefore, the major objective of the present study was to investigate the role of MIS in disaster management in Bangladesh. In this process, this study investigated the elements that impact end-users' acceptance of MIS based services for disaster management. Concurrently, the requirements and users' perceived benefits regarding the integration of MIS in disaster management were also identified.

The study was conducted through a mixed-method approach, consisting of both qualitative and quantitative studies. The qualitative study was conducted to identify the roles of MIS in disaster management by finding the perceived benefits of the use of MIS-based services for disaster management through Key Informants Interviews (KII) and Focus Group Discussions (FGD). The participants of the 12 KIIs where the officials or stakeholders from different disaster management-related organizations, whereas, the

participants in four FGDs were the end-users. Then, the researcher purposively selected the respondents whom at least used MIS-based services for disaster management was surveyed. Also, a total number of 815 respondents was identified as the sample for the quantitative study following purposive sampling. A structured questionnaire was used to collect data for the quantitative study. On the other hand, the semi-structured, checklist with open-ended questions was used for the qualitative study.

The findings from the thematic analysis of KIIs reveal four major roles of MIS services for disaster management that are perceived by stakeholders. The roles are: 1) information access for disaster management, 2) strategic planning in the disaster management process, 3) operational management in disaster events, and 4) disaster risk assessment in disaster events. Similarly, the thematic analysis of FGDs reveals four major roles of MIS services for disaster management that are perceived by end-users. These are 1) affordability in disaster management, 2) connectedness in disaster events, 3) coordination in disaster events and 4) improvement in decision-making ability in disaster events.

In the study, the literature and theory review helped the researcher to formulate a coherent set of hypotheses to identify the factors that influence the end-users in using MIS-based services for disaster management. Also, based on the Technology Adoption Model (TAM) and the Diffusion of Innovation Theory (DOI) model, a conceptual framework was proposed and tested to explain the variation in the actual use of MIS-based services for disaster management. For testing the conceptual framework, the researcher used Partial Least Squares Structural Equation Modeling (PLS-SEM).

The hypotheses testing reveals that except trialability (TR) ($t = 0.948, \beta = 0.130, p > 0.05$), the Perceived usefulness (PU) ($t = 5.139, \beta = 0.601, p < 0.01$), Perceived ease of use (PEoU) ($t = 7.551, \beta = 0.288, p < 0.01$), Behavioural intention (BI) ($t = 11.326, \beta = 0.234, p < 0.05$), Relative advantage (RA) ($t = 9.112, \beta = 0.595, p < 0.05$), Compatibility (Com) ($t = 14.336, \beta = 0.489, p < 0.05$), Complexity (Comx) ($t = 5.962, \beta = -0.188, p < 0.05$), and Observability (Ob) ($t = 4.672, \beta = 0.446, p < 0.05$) factors influence the adoption of MIS based services for disaster management by the end-users in Bangladesh. On the other hand, the structural model analysis tested the fitness of the model, where the R-

squared value for the Actual Use factor was 0.593, which implies that the proposed conceptual model can explain up to 59.3 percent of the variance in the actual use.

The present study provides several significant implications which would help to make use of MIS for disaster management. Knowing the factors influencing the adoption of MIS-based services for disaster management by the users and their perceived benefits will provide a broader knowledge of how to enhance the role of MIS in disaster management in Bangladesh. Other implications include that the providers of MIS-based services for disaster management should develop user-friendly services. Finally, the study is significant as the findings of the study not only provide important knowledge of the influencing factors in adopting MIS-based services for disaster management and the perceived user benefits by using MIS-based services but also no previous study with a similar objective was conducted in Bangladesh to enhance the role of MIS in disaster management. By fulfilling this research gap, this study contributes to the country's objectives regarding Sustainable Development Goals (SDG), particularly, SDG 2 (strengthen capacity for adaptation to climate change), SDG 11 (decrease the economic losses caused by disasters), and SDG 13 (combat climate change and its impacts).

Key Concepts:

Management Information System; Disaster Management; Information System; Information System models; End-users understanding.

Dedication

I would like to dedicate this thesis to my beloved wife, who left us forever, and my parents, my family members. I owe them a debt of gratitude for the inspiration and motivation received from their compassion, courage, and commitment. Thank you!

Acknowledgments

I would like to extend sincere gratitude to many people who supported me throughout the journey of the dissertation. Firstly, I want to thank my supervisor Professor Dr. Mahbuba Nasreen, Director of the Institute of Disaster Management and Vulnerability Studies (IDMVS), University of Dhaka. I am grateful for her invaluable support, guidance, and encouragement to conduct the study.

I am grateful to my co-supervisor Professor Dr. Hasibur Rashid, Department of the Management Information Systems University of Dhaka. Both of them have been great sources of motivation, encouragement, support, and guidance for the last three years while working on this thesis.

I would also like to show my warm-hearted gratitude to all of the respondents for providing valuable responses and keen guidance for this thesis. Without this completion of the thesis would not have been possible.

I also thank the faculty members of the IDMVS for their inspirational advice. I would like to thank my family and friends for their support during my journey on this research and efforts in the completion phase. My heartfelt thanks are also due to Professor Mohammad Moqbul Hossain Bhuiyan and Associate Professor Dr. Rakibul Hoque, Department of Management Information Systems, the University of Dhaka for their enormous assistance in conducting the research.

.

Table of Content

Index

Explanation of Different Chapters of the Thesis **Page No.**

List of Figures

List of Tables

List of Maps and Images

List of Abbreviation

ADPC	Asian Disaster Preparedness Centre
BBS	Bangladesh Bureau of Statistics
BIDS	Bangladesh Institute of Development Studies
BRDC	Bangladesh Rural Development Committee
BWDB	Bangladesh Water Development Board
BRAC	Bangladesh Rural Advancement Committee
BSS	Bangladesh Sangbad Sangstha
CDMP	Comprehensive Disaster Management Program
CEGIS	Centre for Environmental and Geographic Information Services
CVA	Capacity Vulnerability Analysis
CSR	Corporate Social Responsibility
DCI	Direct Calorie Intake
DFID	Department of International Development
DDMC	District Disaster Management Committee
DG	Director General
DMIC	Disaster Management Information Centre
DMB	Disaster Management Bureau
DM&RD	Disaster Management and Relief Division
DRR	Directorate of Relief and Rehabilitation
ERD	Economic Relation Department
EU	European Union
FGD	Focused Group Discussion
FFW	Food for Work
FMC	Flexible Microcredit
FY	Fiscal Year
GCN	Global Compact Network Bangladesh
GDP	Gross Domestic Product
GNP	Gross National Product
GoB	Government of Bangladesh
GR	Gratuitous Relief
HIES	Household Income and Expenditure Survey

HH	Household
ICT	Information Communication Technology
IT	Information Technology
IMDMCC	Inter-Ministerial Disaster Management Coordination Committee
IPCC	Intergovernmental Panel on Climate Change
IFRC	International Federation of Red Cross
KII	Key Informant Interview
MDG	Millenniums Development Goal
MDMC	Municipal Disaster Management Committee
MIS	Management Information Systems
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
MoDM&R	Ministry of Disaster Management and Relief
MoLG	Ministry of Local Government
MoWR	Ministry of Water Resource
NDMAC	National Disaster Management Advisory Committee
NDMC	National Disaster Management Council
NAP WD	National Action Plan for Women Development
NGO	Non-Government Organization
Ob	Observability
OXFAM	Oxford Committee for Famine Relief
PEoU	Perceived Ease of Use
PRA	Participatory Rural Appraisal
SOD	Standing Orders on Disaster
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
UCCDMC	Union City Corporation Disaster Management Committee
UDDIPAN	United Development Initiatives for Program Action
UDMC	Union Disaster Management Committee
UzDMC	Upazila Disaster Management Committee
UDMP	Upazila Disaster Management Plan
UNDP	United Nations Development Program

Chapter 1: Background of the Study

1.1 Introduction

Bangladesh ranks fifth place in the risk index regarding natural disaster occurrence. In the last three decades, the country has suffered from more than 200 natural disasters because of its low-lying geography, monsoons, and overflowing rivers. It has three major rivers, namely: the Ganges, the Brahmaputra, and the Meghna, spanning across the country. Because of being situated on the Ganges Delta and changing geo-climate, often the highly dense population of Bangladesh suffers from frequent disasters that include tropical cyclones and storms (52%), floods (31%), river bank erosion, earthquakes, droughts, salinity, tidal surges, thunderstorms, and landslides. While nearly 68% of Bangladesh is vulnerable to flooding, about 1.7 million hectares of plain areas are susceptible to riverbank erosion. Furthermore, the country falls into an earthquake-prone zone and is trying to develop an effective disaster management system (Nasreen, 2017). Additionally, like many other countries, Bangladesh is negatively affected due to climate changes such as rising global temperatures and rising sea levels (DMRH, 2020). Such climate changes pose substantial challenges to the country's sustained human development by disturbing the poverty reduction, socio-economic condition, and health of the people. As well, the rapid industrial and economic growth is causing environmental pollution, whereas, river bank erosion is causing migration of people toward metropolitan areas. Overall, the four main reasons for natural disasters in the country are geographical location, environmental situation, climate change, and the country's economic development phase.

Disasters, whether natural and/or human-induced, are the major source of risk for and threats to the poor. They often ruin the successes and amassed wealth and property in third-world countries like Bangladesh (Dilley, 2005). As a result, considering the frequent occurrence of natural disasters, the Ministry of Disaster Management and Relief (MoDMR) has designed the revised National Plan for Disaster Management (NPDM), developed from 2010 to 2015. Later NPDM has been revised recently (NPDM 2021-2025), which tends to be highly aligned with the vision 2041 of the

Government of Bangladesh. According to the Perspective Plan 2021-2041, lowering the vulnerabilities regarding natural disasters, disaster readiness, and capacity building for comprehensive disaster management are highly prioritized, especially, considering the high cost and economic loss due to climate change. Focusing on vision 2041, NPDM recommends formulating risk-informed disaster management planning, inclusion as an underlying strategy (e.g., participation of women and men), priority-level action plans (e.g., action plans with varying levels of importance, such as disaster risk governance and allocating resources for enhancing disaster risk reduction and resilience) as well as implementing initiatives for business continuation after a disaster. Also, according to Perspective Plan 2021-2041, which is specifically concerned with protection from climate change, Bangladesh aims to adopt new strategies for environmental management and green growth for safeguarding the socio-economic progress and ensuring sustainable goal achievement regarding disaster management.

Management Information System (MIS) is an information system that assists organizational managers in decision-making in turbulent and dynamic business environments. It provides data for the investigation, assessment, analysis, and visualization of information needed for the execution processes of decision-making. It helps organizations gain maximum benefits by incorporating information systems in the business management processes and people (Majchrzak & Markus, 2012). In short, MIS is an information system that makes, forms, stores, and creates data with the natural data inside and outside the organization. Over the last two decades, MIS, as an information generation tool, has assisted in making critical business decisions. It allows organizational managers to make informed decisions rather than random and disorganized ones. Therefore, the significance of MIS in decision-making can be realized when MIS can facilitate making a reasonable framework to amplify the successful utilization of cutting-edge information approach to management practices. MIS professionals always realized the need for maximum outputs from inputs which is important for organizational benefits.

In organizational settings, MIS-based systems can be of different types according to the types of functions in an organization, such as Business Intelligence System (BIS), Executive Support Systems (ESS), Marketing Information System (MkIS), Sales Force Automation system (SFA), Customer Relationship Management system (CRM), Knowledge Management System (KMS), Human Resources Information System (HRIS), Enterprise Resource Planning system (ERP), Financial Accounting System (FAS), Office Automation Systems (OAS), Supply Chain Management system (SCM), Transaction Processing Systems (TPS), and Decisions Support Systems (DSS). These systems are used as basic or advanced information systems that generate accurate, timely, precise, cost-effective, and reliable information for organization managers and assist them including the directors, executives, and working personnel to make decisions not only for current issues but also for the future operations through pinpointing potential problems that need to be rectified.

In the context of disaster management, MIS helps in the analysis of the unsettling influences in an organization, determines necessary activities, optimizes, and takes timely actions for disaster management. It enables the identification of the processes and sources of hazards during a disaster, evaluation of crisis, management of resources and information in a crisis, and preparation of proper preventive mitigation plans. For disaster management, MIS-based systems include disaster information management systems (DIMS) and early warning systems (EWS). As disaster management (DM) is a knowledge-intensive and time-sensitive task, MIS-based DIMS and EWS tools can be vital for decision-making in disaster management by proving required information and making a complex set of interrelated activities easier. For disaster management, information distribution by using MIS can be crucial for reducing destruction in disasters. As useful decision-making demands suitable, timely, optimum, and relevant information, the role of MIS-based services in disaster-related decision-makings and resource management is important and cannot be overlooked. However, although early warning systems and weather forecasts have improved over the last decades, the use of MIS has not been significant in reducing the vulnerability of people affected by natural disasters.

As a fast-growing economy, Bangladesh has been showing significant progress among other South Asian countries to introduce Information Technology (IT) and implement it in different development sectors including education, agriculture, and environmental management. The ICT Policy 2009 (*National ICT Policy* 2009) the country supports the use of ICT-based disaster warning and management technologies for disaster management. On the other hand, following the disaster management Act 2012, the government has established Disaster Management Information Centre (DMIC) (Rezoane, 2016). Subsequently, the Government of Bangladesh (GoB) has shown keenness to introduce MIS for disaster management in an effective manner. As an example, entities like the National Disaster Management Information Centre (DMIC), Space Research and Remote Sensing Organization (SPARRSO), Bangladesh Meteorological Department (BMD), Flood Forecasting Warning Centre (FFWC), Center for Environmental and Geographic Information Services (CEGIS), and Institute for Water Modeling (IWM) utilize Management Information Systems (MIS) for disaster management within Bangladesh. Also, the government has developed GeoDASH, a geospatial data storing and sharing platform, which allows the Department of Disaster Management (DDM) to host geospatial data regarding various disasters, such as earthquakes, floods, landslides, and dangerous weather conditions.

It is worth mentioning that Bangladesh has achieved great progress in disaster preparedness and mitigation over the last two decades, thereby, decreasing the death toll from hundreds of thousands to hundreds of people during tropical storms. In 2019, the MIS-based early warning systems and government preparedness measures aided in the evacuation of approximately 2 million people before Cyclone Bulbul. Further, the government has realized that the use of MIS-based systems is essential for efficient disaster management. Therefore, as a process of significant reform, the information technology division of the government has been experiencing numerous changes through the digitization of databases, technological innovations, and information frameworks application. However, despite having a good ICT infrastructure in the country, the Ministry of Disaster Management and Relief in Bangladesh is confronting challenges in the application of MIS for disaster preparedness, rescue, security, relief management, end-users understanding, making contingency plans, and making strategic operational and management choices.

While the government and the respective organizations are keen and committed to adopting MIS for disaster management, the role of MIS application in disaster management and influencing factors at the user level are not investigated in any previous studies in the context of Bangladesh. For that, this research aims to conduct a mixed-method study for identifying the roles of MIS applications in disaster management by finding the perceived benefits of using MIS-based services in disaster management as well as the factors that influence the adoption of MIS-based services (e.g., SMS alerts) by the end-users in Bangladesh. This study would ultimately provide broader knowledge on how to enhance the role of MIS in disaster management in Bangladesh.

1.2 Disaster Scenario in Bangladesh

Bangladesh is among the foremost disaster-prone regions around the world. In Bangladesh, around 13 percent of families and 12.64 percent population stay in disaster-prone regions (Islam, 2016). The most frequent natural hazards within the country incorporate geological risks (seismic tremors, tidal waves), hydro-meteorological risks (tidal surges, violent winds, and droughts), and other hazards such as biological hazards including epidemics, recent Covid-19 pandemic, and creepy crawly infestations. The country has 147570 square kilometres of land area from latitudes 20.34º and 26.38º/N and longitudes 88.01º and 92.41º/E with a population of about 158.9 million (BBS, 2018). India surrounds this country in the west, the north, and the east, and the extreme southeast is bounded by another neighbouring Myanmar. Bangladesh stands on the Bay of Bengal situated in its southern part. Bangladesh is exceptionally distinctive from other countries for having an uncommon geographical feature. To its north, the Himalayan range is situated, and the Inlet of Bengal to its south with its channelling towards the Meghna estuary, and India arrive in the west. The combined result of these parts, played by these different geographical highlights, has a considerable impact on the climatic framework in Bangladesh.

Bangladesh stands as one of the world's most densely populated nations. As the population continues to rise and their demands across different sectors grow, there is a noticeable shift in land utilization trends, resulting in a decline in both cultivated and forested areas. With similar geo-climatic circumstances, the Indian sub-continent is susceptible to common natural catastrophes. Though Bangladesh is situated in the same basin, it suffers profuse losses of human and animal life and huge damages to property, trees, and harvests in rampant catastrophe incidences. Bangladesh ranks itself as one of the highest vulnerability indexes to a natural disaster (Khan & Sayem, 2013). The country is experiencing devastating disasters such as floods, drought, tidal surges, flash floods, and cyclones almost every year (Nasreen, 2012). Cyclones and tidal surges are frequent and periodic phenomena in the Bay of Bengal. Generally, from the months of mid-April to mid-June and mid-September to mid-December, cyclone becomes a severe killer. Seventy-five percent of cyclone occurs strictly during spring and autumn. In numerous instances, the cyclone, combined with a tidal surge, impacts the region with a force exceeding 20 feet, posing significant risks to trees, infrastructure, animals, and invaluable human lives within the nation. This also leads to substantial and immeasurable economic damages.

Human-caused disruption in nature is influencing the environment both regionally and worldwide in various harmful manners. In 1991, the cyclone caused the death of about 140,000 people in Bangladesh. The floods, which immersed in 1987 and 1988 sequentially, were amazingly serious and at that point, the floods submerged about 57,000 and 82000 square-kilometre of range of the country individually (ADB, 1991). This importance is demonstrated in this country for different reasons such as expanded drainage congestion, a diminishment of forested land within the watershed, and a reduction of the floodplain region upstream of the delta. Frequently, cyclones and floods result in serious devastation of houses, crops, instructive education, streets, embankments, etc. in Bangladesh (Azad et al., 2019). Global warming and greenhouse effects are likely to cause sea-level rise, which could bring devastating impacts on the deltaic country like Bangladesh.

Bangladesh is extremely prone to heightened occurrences of flooding, heightened moisture stress, and the infiltration of salinity due to shifts in climate patterns. As indicated by a study by Nasreen (2009), the country's most prevalent disasters comprise floods, cyclones, tornados, and riverbank erosion. These events disrupt people's means of living, cause damage to infrastructure, redirect resource allocation, and disrupt economic endeavors and development. It is reported by the CRED Disaster Database, from 1986 to 1995 these 10 years Bangladesh experienced over 93 disasters. Among them, a cyclone took place 40 times, and a flood, 31 times. Earlier in 1970 and 1991, the devastating cyclone took dead tolls of 300,000 lives and 138,000 lives, which are among the most shattering natural disasters in the world (CRED, 2002). During the past 21 cyclones in the Bay of Bengal (Bangladesh and India) took 1.25 million lives (Gayathri et al., 2016). On the other hand, riverbank erosion is a serious issue in Bangladesh. It may be a process, which is generally controlled by river dynamics. Erosion within the coastal districts of Bangladesh is caused generally by several components, such as high storm wind, waves, currents, solid tidal actions, and storm surges (Rahman, 2010).

Frequent natural disasters often lead to heightened poverty levels among coastal populations in the country, causing them to be less of a contribution to the national economy compared to other regions. The cultivation of essential rice varieties like Aus, Boro, and Aman, as well as wheat products, is frequently severely affected by various agro-climatic changes. An excessive increase in monsoon rainfall exacerbates flooding, impacting fish farmers and causing losses. Changes in surface water temperature also have detrimental effects on the shrimp industry.

Conversely, the recurrent cyclonic storm surges, prolonged floods, and droughts make the livestock sector more susceptible. Diseases induced by pathogens such as cholera, malaria, and dengue are also projected to have severe impacts. Moreover, the housing and sanitation infrastructure of those living below the poverty line are frequently affected by these natural disasters, potentially exacerbating food safety issues due to the transportation of contaminants. Consequently, subsistence agriculture and the food security of impoverished populations are at significant risk. These collective effects can deteriorate the broader socio-economic landscape, disproportionately affecting the disadvantaged.

Disaster mitigation encompasses three practical programs: readiness, immediate reaction, and post-disaster growth. In this context, community-based efforts for disaster mitigation tend to be more efficient in resource utilization and self-sufficiency. Thus, it's essential to incorporate adaptive and coping strategies into development initiatives, particularly at the community level, and integrate innovative policies to ensure sustainable development (Rahman, 2010). As the policy landscape shifts in the realm of disaster management, Bangladesh is progressively embracing a holistic societal approach that emphasizes community-based initiatives to a larger degree.

Chandio (2006) pointed out that in a disaster situation, early response is very much important to minimize the casualties and the damage to human lives caused. On Monday, May 25, 2009, Cyclone Aila struck Bangladesh, resulting in significant devastation across the southern regions. This event led to the loss of 190 lives and impacted around 3,935,341 individuals. On November 15, 2007, Cyclone Sidr made landfall in coastal areas. In July 2019, monsoon rains continued to affect a substantial portion of the country, particularly the northern, north-eastern, and south-eastern Divisions. According to the UN Resident Coordinator for Bangladesh, there were 71 reported deaths in 21 Districts, with over 287,000 people being displaced and approximately 4 million individuals affected (ADRC, 2019).

1.3 The use of MIS in Disaster Management

The use of MIS in disaster management started to increase in the 1980s. For example, an MIS-based system like Emergency Management Information System and Reference Index (EMISARI) was developed for disaster management in the 1980s (Rafi et al., 2018). EMISARI enabled coordination during disaster events and to utilize the recorded data on demand. However, at that time such systems were not dynamic, hence, real-time management of resources was not possible. In the 1990s, systems like Disaster Inventory System (DisInventar) (UN, 1994) allowed the collection of data regarding loss and damage as well as disaster effects. Later in the 2000s, an Information Management System for Hurricane disasters (IMASH) was developed for pre- and post-disaster management. Today's DIMSs mostly automated and interoperable and commonly have five major components are:1) database, 2) mitigation, 3) administrative control, 4) response and recovery module, and 5) communication system. They are also actor-centred that are consist of complex socio-technical systems that take into account the perspectives and interests of many stakeholders.

The main reason for adopting MIS in Disaster Management is its ability to make use of information in real-life situations like pre- and post-disaster events (Van De Walle et al., 2014). Various studies present that MIS plays a vital role in socio-economic development as well as disaster management (Duca et al.; Dugdale et al., 2017; Magnusson et al., 2018; Stroeva et al., 2015). Therefore, utilizing MIS for disaster management is crucial for anticipating climate and disaster, warnings of hazards, dissemination of local government, the interest of civil society, and understanding and activity of prevalent in expansion to the components of disaster preparedness and data and communications technology. Also, to advocate the use of MIS in disaster management, UNDP has cited that, 'there is a need for developing a global partnership in cooperation with the private sector to make the benefits of new technologies available (UNDP, 2002). However, MIS itself is not enough as people as a community need to practice to avail the maximum and optimum benefits from the use of MIS in disaster management (Van De Walle et al., 2014). As MIS is the study of human beings, machines, and management (Figure 1.1) where peoples work with the technology in an organization and the relationships among them for better management, integrating users' perceptive into MIS-based disaster management systems can increase the efficiency and creativity of the systems.

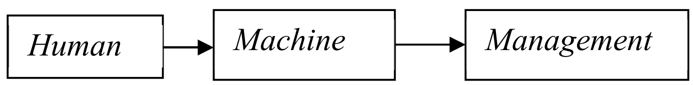


Figure 1.1: Steps of MIS in the context of disaster management.

The application of MIS-based Disaster Information Management Systems (DIMSs) has increased significantly worldwide which allows users to use and spread real-time information during and after disaster events. DIMSs enable users to integrate, mine, and analysis of a large amount of data, thereby, facilitating multi-criteria decision-making. As a result, the scope of using DIMSs is widening, especially for post-disaster management actions which require information-intensive tasks as well as an integrated system to connect relief and donor agencies and dispatch resources efficiently. For pre-disaster management, the use of DIMSs is also crucial as it allows for recording data and creating alerts based on predefined critical information (Nespeca et al., 2020).

Overall, the scope of the application of MIS in disaster management shows in (Figure 1.2). The four areas of application of MIS in disaster management are prevention

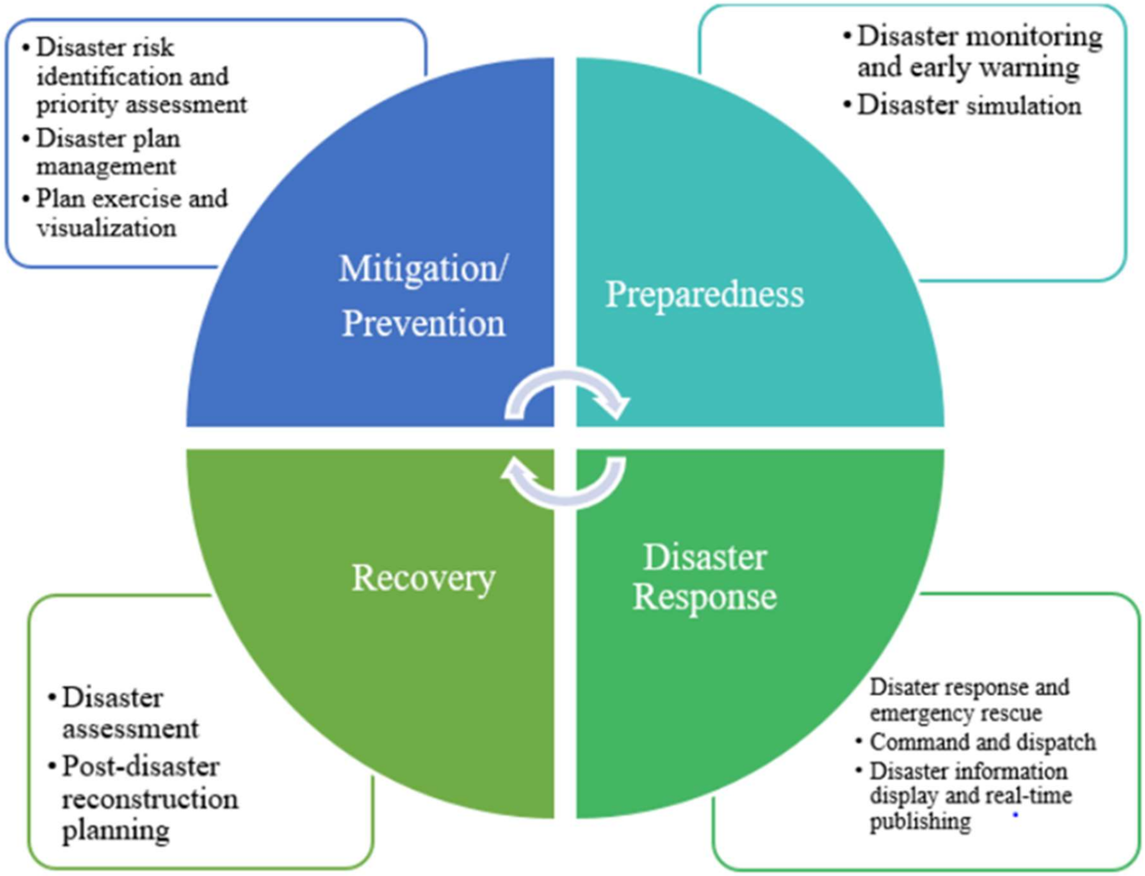


Figure 1.2: Scope of the application of MIS in disaster management (Banisakher et al., 2020).

(e.g., early warning and detection), preparedness (e.g., problem analysis and assessment of scope), response (e.g. response mobilization and damage containment), and recovery phases (e.g. relief and medical care service). The activities of the preparedness phase are planning, organizing, training, equipping, evaluation, and improvement activities (Kadam, 2012) which require related information (Flachberger & Gringinger, 2016). Then, the activities of the response phase are concerned with issues and decisions related to rebuilding important infrastructure.

1.4 Current State of Research on MIS in Disaster Management

DIMSs are used throughout the lifecycle of disaster management, including pre and post-disaster management phases that begin with risk management planning, response, recovery, and rehabilitation. Previous studies show that the application of MIS can significantly minimize such resultant losses that incur from disaster events (Beydoun et al., 2018). For example, using human sensing in disaster management (Ogie et al., 2018) and using big data to visualize, analyze and forecast disasters (Akter & Wamba, 2019). A recent study by Meyer et al. (2022) reports that while there is no specific functional requirement to build a DIMS, key functions of a DIMS include data collection and process, data analysis, and dissemination of information (Meyer et al., 2022). However, the researcher emphasized that the purpose of a specific DIMS should be clearly defined according to the area of use for disaster management. On the other hand, when it comes to the application of the most recent and destructive technologies, the study by Munawar et al. (2022) highlighted the potential scopes of IoT, AI, and Bigdata integration in MIS for disaster management (Munawar et al., 2022).

The number of studies on the use of MIS in disaster management is increasing, especially focusing DIMSs. These studies focus on different aspects of DIMSs, such as review studies, system design, and user adoption. Rafi et al. (2018) conducted a review study on 19 automated DIMS to compare the designs used in DIMSs in different countries and found that DIMSs have two essential components, which are database inventory and communication infrastructure (Rafi et al., 2018). They also reported that the application of DIMS has increased significantly since 2004 in different countries, yet only a few of the proposed DIMS have been empirically tested during real disaster events.

When it comes to focusing on the design and development process, Nespeca et al. (2020) proposed an actor-centred perspective which is important for analyzing information management practice during a disaster in terms of self-organization and the ability to support coordinated self-organization (Nespeca et al., 2020). In another study by Nussbaumer et al. (2019), an open-source decisions support system named S-HELP was built by following an ethics-by-design approach for the integration of a large number of modules, such as situation module, information management module, action module, knowledge management module, learning management module, communication module, GIS module, social module, and weather module (Nussbaumer et al., 2019). The system showed potential usefulness and applicability for large and cross-border disasters.

Then, when it comes to user adoption of MIS-based tools and information for disaster management, Gulatee et al. (2020) have identified the key factors at an individual level which are: perceived usefulness, perceived ease of use, individual it, knowledge, and social influence (Gulatee et al., 2020). At the organizational level, the key factors that influence the adoption of DIMS are organizational IT infrastructure, organizational IT readiness, IT interoperability, financial resources, and the decision-making process. Further, they have found that social norms and culture were found to be the significant context-specific determinants for the adoption of MIS tools for disaster management. Moreover, the study by Lee et al. (2011) also reports that user satisfaction and expected group value have a direct influence on the use intention of DIMS, whereas, perceived task support influences the use intention of DIMS indirectly through user satisfaction (Lee et al., 2011).

1.5 Disaster Management System in Bangladesh

Currently, Bangladesh has a workable disaster management system that entails following a set of mechanisms and procedures. At the national level, government activities in disaster management are very active. The government engages several ministries and agencies to play a vital role in the overall disaster management system. It is an effective and efficient system that the country has taken many initiatives until today and attained substantial positive results. This progress attained may be categorized in two ways mainly: (1) “the institutional framework”, and (2) “the legal and policy framework”. Ministry of Disaster Management and Relief (MoDMR), through developing a comprehensive model, is focusing on institutionalization and professionalizing disaster management systems.

In terms of chronological advancements, the Ministry of Disaster Management and Relief (MoDMR) was established in 1972 which focuses on the comprehensive disaster risk reduction concept. MoDMR is responsible for coordinating national disaster management activities for all government and private organizations. It allocates national disaster management activities through prioritizing risk reduction as a part of the disaster management system. Then the Standing Orders on Disaster (SoD), introduced in 1997 was revised two more times: in 2010 and 2019 with a more holistic and multifaceted approach. The SoD is designed to guide the disaster management activities in Bangladesh as well as allocate different roles for different actors from central to local levels. Figure 1.3 shows that National Disaster Management Council (NDMC) is the head of the Disaster Management Regulative Framework which works closely with the National Disaster Management Advisory Committee (NDMAC), MoDMR, and the Inter-Ministerial Disaster Management Coordination Committee (IMDMCC). NDMAC includes a member of parliaments, experts, academia, NGOs, Civil Society Organizations, and relevant others to implement different activities planned through the plans, policies, and regulatory frameworks.

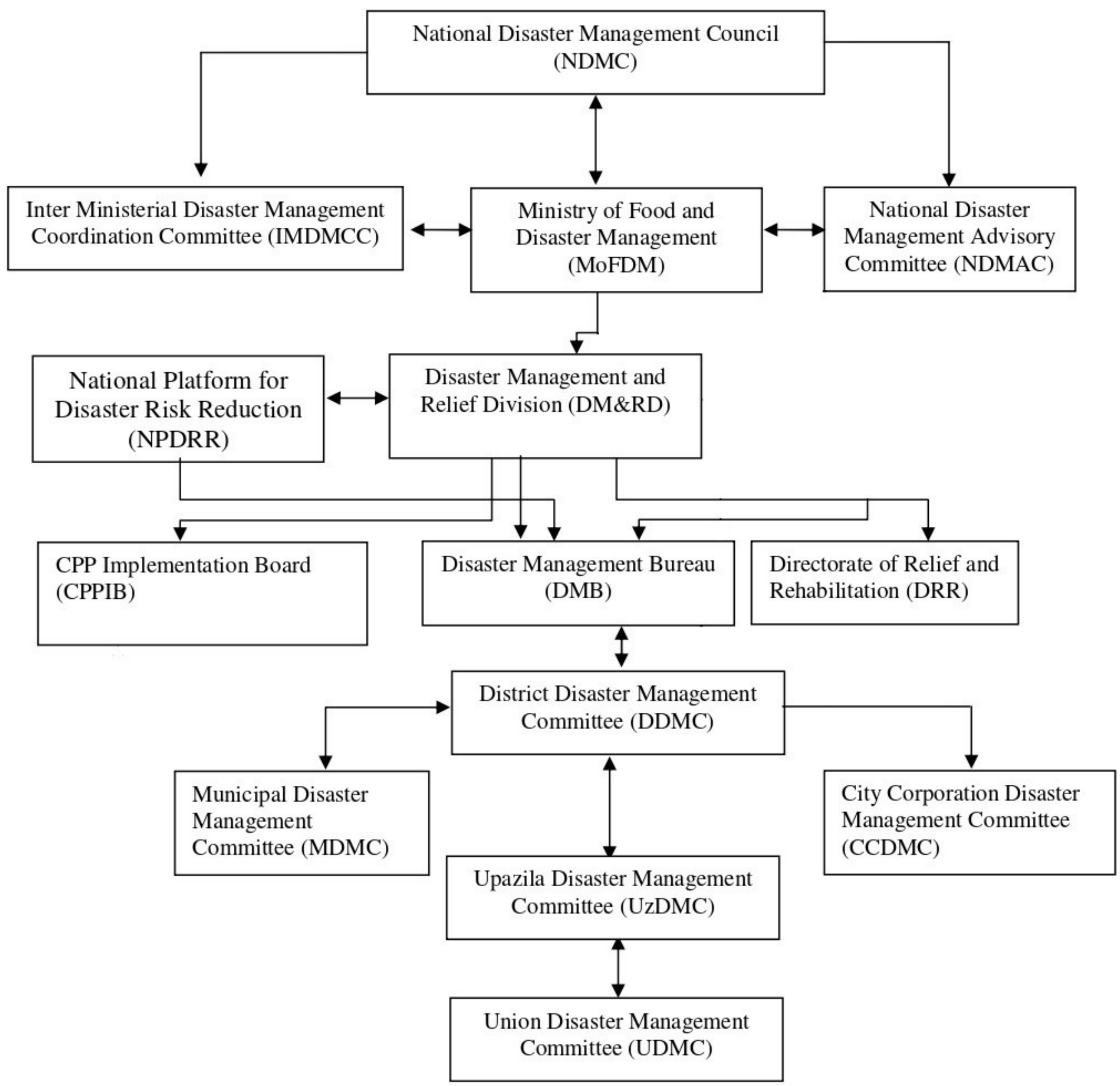


Figure 1.3: The top Disaster Management Institutions in Bangladesh (MoDMR, 2010)

On the other hand, in 1991, the country had begun its disaster preparedness efforts which later led the country to formulate a comprehensive plan, namely National Plan for Disaster Management (NPDM) 2010–2015 in 2010. Subsequently, the National Disaster Management Act 2012 (NDPA) was introduced which guides the disaster management process at various national and sub-national levels. In Bangladesh, disaster management committees are available at the national, district, Upazila, city corporation, Pourashava, and union levels to coordinate disaster management activities within their respective areas of jurisdiction. Figure 1.3 shows that the active disaster management institutions at the sub-national levels are: District Disaster Management Committee (DDMC), Upazila Disaster Management Committee (UzDMC), Union Disaster Management Committee (UDMC), Pourashava Disaster Management Committee (PDMC), and City Corporation Disaster Management Committee (CCDMC). These five disaster management institutions at the sub-national levels closely work with Disaster Management Bureau (DMB) which is headed by Disaster Management and Relief Division (DM&RD). Additionally, over the years, NGOs have flourished and virtually grown into a mass movement in Bangladesh. The country has one of the world's largest presence of NGOs (e.g., OXFAM, CARE, Concern, and Action Aid including the local NGOs BRAC, BDPC, and CNRS) that are involved in post-disaster response and rehabilitation operations. Currently, a wide range of community-based disaster preparedness activities is being implemented by NGOs as a part of risk reduction.

In the present day, the Government of Bangladesh envisions minimizing the impact of both natural and human-caused disasters on its population. This includes the establishment of an efficient emergency response system aimed at reducing the losses incurred due to such disasters. To achieve this goal, the country employs a structured approach that provides guidance to various organizations and personnel engaged in disaster risk reduction and emergency response management. Figure 1.3 illustrates the Disaster Management Planning Framework, which directs disaster management committees at both national and sub-national levels to execute specific plans tailored to the management of particular hazards (e.g., Earthquake Management Plan, Cyclone Management Plan, etc.). Another noteworthy initiative in Bangladesh is the Cyclone Preparedness Program (CPP), which serves to disseminate timely alerts and guidance to coastal communities in anticipation of impending cyclones. The CPP, an all-inclusive famous volunteer organization of Bangladesh, which combines volunteerism and communication technology, was set up in 1972, after the annihilating Bhola cyclone. The CPP was the initiative of the father of the Nation Bangabandhu Sheikh Mujibur Rahman. “Mujib Killa”, was named by the people of disaster-prone areas to Bangabandhu as he instructed them to build this high plinth to protect people and livestock (Nasreen, 2021). Nowadays, that organization has been rebuilt and restored through training, MIS technology updates (e.g., wireless network), and expansion of the areas per the changing cyclone route.

On the other hand, Bangladesh's ICT Policy 2009 advocated for using ICT-based disaster warning and management technologies to protect its citizens from natural disasters (*National ICT Policy* 2009). So far, ICT has played significant roles and brought a paradigm shift in disaster management unlike traditional disaster response and relief practice in Bangladesh. Moreover, because there exists a good ICT infrastructure and increases in accessibility and connectivity in Bangladesh, there is a need for using advanced MIS-based tools for effective DRR, After the government introduced the National Disaster Management Act 2012, the Department of Disaster Management (DDM) was established which is responsible to implement the activities of the MoDMR. DDM is the most important organ or instrument within the field to actualize and facilitate various shapes of disaster management activities. It uses several MIS tools such as cyclone shelter database information for efficient response, interactive voice response service to send up-to-date messages, ICT Humanitarian emergency platform to coordinate and support emergency communications, and early warning systems to forecast and broadcast information regarding floods and cyclones. These tools collect data from the Global Integrated Observing System (GIOS), Global Data Processing and Forecasting System (GDPFS), and Global Telecommunication System (GTS).

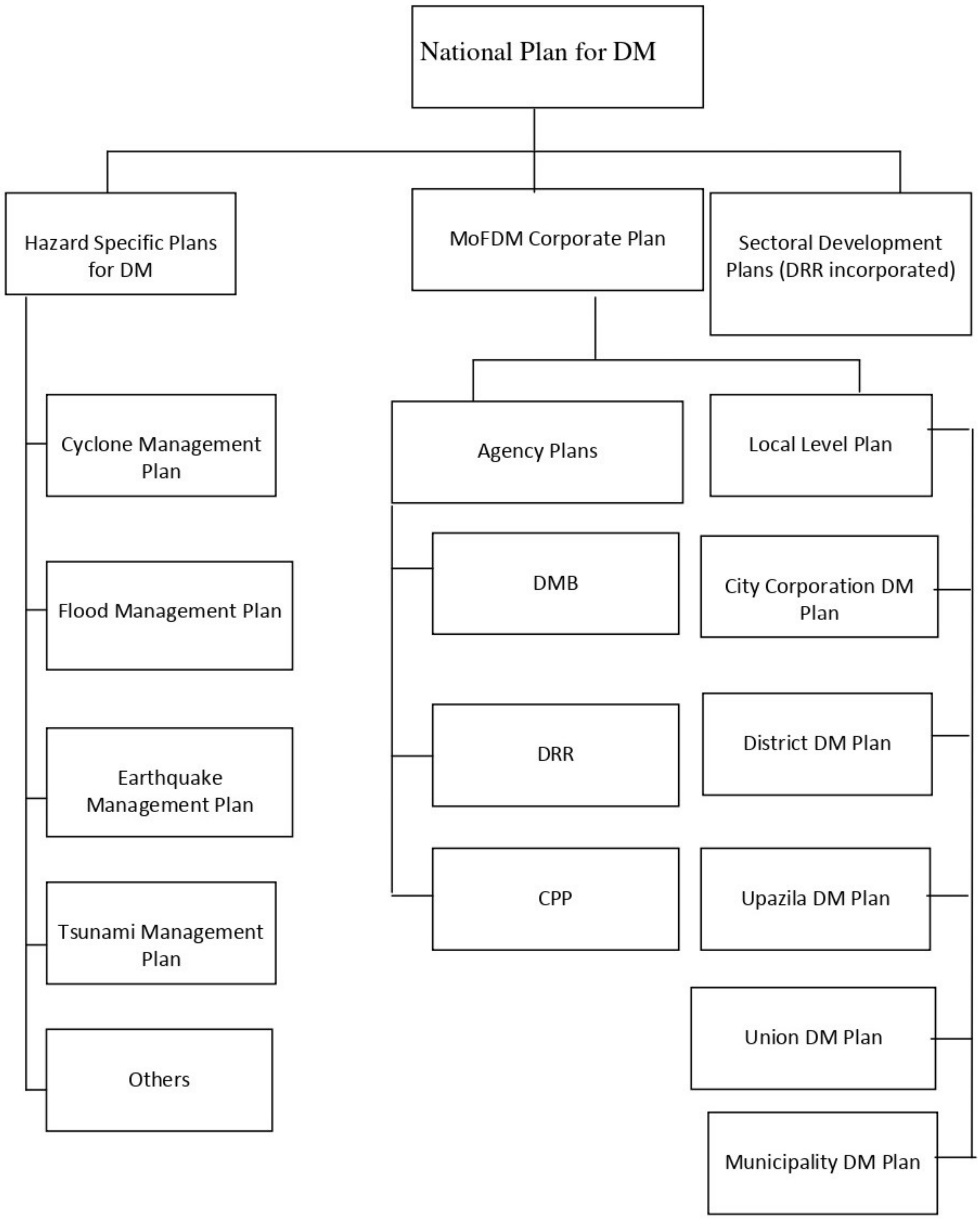


Figure 1.4: Disaster Management Planning Framework (MoDMR, 2010)

Besides, organizations such as National Disaster Management Information Centre (DMIC), Space Research and Remote Sensing Organization (SPARRSO), and the Center for Environmental and Geographic Information Services (CEGIS) can generate time-sensitive information based on MIS tools and the data from different sources for early warning through various mediums (e.g., radio, television, voice call, SMS). In addition, Flood Forecasting Warning Centre (FFWC) and Bangladesh Meteorological Department (BMD) use early warning systems for forecasting floods and cyclones for disaster management (NIPORT/ICF, 2020). Overall, MIS tools in combination with the internet, GIS-based systems, Remote Sensing, and satellite observation and communication can play crucial roles in disaster mitigation and risk reduction in Bangladesh.

1.6 The National Plans and Policies for Disaster Management

Currently, Bangladesh officially adopts the UN Sendai Framework for Disaster Risk Reduction (SFDRR, 2016-2030), necessitating extensive collaboration among agencies. Additionally, within the National Plan for Disaster Management (NPDM, 2010-2015; 2016-2020, 2021-2025), the focus has been on executing projects aimed at medium and long-term disaster management. These projects encompass disaster risk reduction and prevention, enhancing emergency response capabilities, and enhancing disaster recovery and reconstruction efforts. On a different note, various donors, including the World Bank, Asian Development Bank, UNDP, and others, have primarily focused on supporting disaster risk mitigation through infrastructure development (e.g., riverbank erosion countermeasures, coastal embankment rehabilitation). They have also undertaken water management and maintenance initiatives involving public participation, as well as bolstering organizational capacities. However, these efforts have not yet extended to establishing a comprehensive disaster risk management framework in Bangladesh (DRMEP, 2017).

Besides, institutional structures and a fitting chain of command have been built up and suitable training is given to the disaster managers at different levels to guarantee facilitated and fast reactions at all levels. Other than the development of inter-community arrangements are guaranteed for the sharing of resources amid emergencies. In this handle, perceiving the reality that awareness almost vulnerabilities is fundamental for actuating a mindset of disaster prevention, mitigation, and preparedness among individuals, this project starts a community-based awareness era campaign as a portion of its general disaster change management strategy. In arrange to plan a successful and holistic campaign, a steering committee for mass media campaigns is constituted with due representation of specialists from individual ministries and offices. The committee to define a campaign strategy pointed at changing people groups' discernment of natural hazards and counsel the agencies and experts related to advertising and media to instill a culture of security against natural hazards (MoDMR, 2016-2020).

Apart from the utilization of print and electronic media, it is proposed to utilize places with high open visibility such as hospitals, schools, railroad stations, transport terminals, post workplaces, commercial complexes, and district offices to create individuals mindful of their vulnerabilities and advance creation of a secure living environment. Slogans and messages, for this reason, are created occasionally and communicated to the concerned ministries and agencies for printing and spread. Other than that, the mass media campaign makes a difference to construct the information, state of mind, and abilities of the individuals in vulnerability reduction and sustainable hazard management measures. Provision of essential support and assistance to the communities by the way of exchanging resource data, micro-management of emergency response, specialized crisis reaction teams, and sharing of the disaster-related database is done when required to guarantee satisfactory preparedness at all levels for persistent observing and assessment to be carried out.

1.7 Integrating MIS in Disaster Management System

Management Information Systems (MIS) hold considerable potential in facilitating accurate, timely decision-making within disaster management. Through the analysis of real-time conditions utilizing various information systems within the global disaster management framework, MIS aids in making appropriate decisions at the precise time and location. The effectiveness of service-oriented entities relies significantly on information provision, immediate responsiveness, and maintaining effective communication with beneficiaries, thereby fostering their loyalty to the service provider. MIS functions as a structured procedure. In today's highly competitive business environment, the service sector can gain a competitive edge by effectively managing data, conducting data analysis, and swiftly arriving at decisions through MIS. This capability empowers managers to expedite the decision-making process. ‘People who are responsible for disaster management need timely, relevant, and correct information (Van De Walle et al., 2014). MIS as an information management system can provide outputs that are reliable, timely, and accurate to support decisions making. Success in disaster management can be greatly achieved using information services and instant response.

According to Davis (1989), "An integrated users-machine system for providing information to support operations, management and decision-making functions in an organization. The system utilizes computerized and manual procedures; models for analysis, planning, control, and decision making; and a database." In this regard, MIS can play a significant role in taking the right decisions at the right time and right place by analyzing the immediate situations in disaster management with the help of different information available in an integrated system. Using MIS, data can be condensed and filtered until it becomes information for use in decision-making at various levels nationally and organizationally. MIS can be a systematized process in disaster management. Using MIS, with the help of geographic information systems, global positioning systems, remote sensing technology, database management, big data analysis, and internet connectivity, quick decision-making is possible in real-time (Van De Walle et al., 2014).

Also, an information system alone does not do computer processing. Instead, it requires a management system that can deliver the necessary information in a timely fashion at a reasonable cost. There are different phases in disaster management, such as the pre-disaster phase (consisting of the prevention phase, mitigation phase, and preparedness phase), during disaster phase (consisting of response phases), and the post-disaster phase (consisting of the response phase, recovery phase, and development phase) (Figure 1.5). In each of these phases, MIS can particularly and effectively play significant roles in disaster management, such as the mitigation phase, information on the past and present changes in geographical information can be used for identifying floodplain areas near rivers. For the preparedness phase, websites can be created to alert people and guide them in taking precautions for forthcoming disaster events. For response phases, MIS can help in disaster management by managing coordination in providing sustenance (e.g., food, water), shelters, and medical assistance by rescuers. Similarly, for recovery phases, MIS can help in the reconstruction of infrastructures. In this way, the integration of MIS in disaster management can be crucial and useful in every step of emergencies.

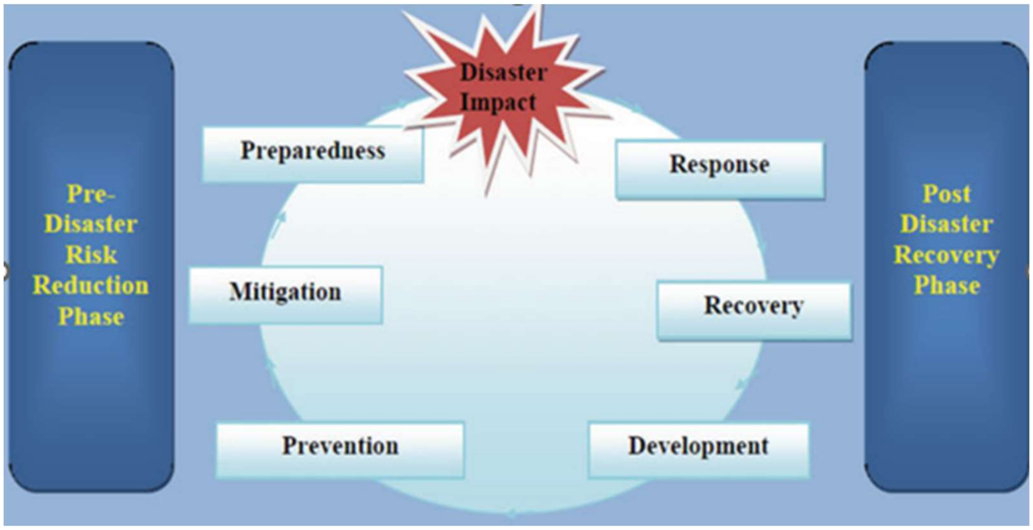


Figure 1.5: MIS in different phases in disaster management (Basu et al., 2019)

1.8 Problem Statement

In the Bangladesh context, there are several studies regarding disaster management. For instance, the study by Alam and Ray-Bennett (2021) focused on context-specific solutions to improve the effectiveness of disaster risk in Bangladesh (Alam & Ray-Bennett, 2021). On the other hand, Hasan et al. (2019) reviewed the disaster management policy in Bangladesh from the perspective of gender inclusion (Hasan et al., 2019). In another study, Shareef et al. (2019) investigated the effectiveness of the emergency supply chain during disaster management (Shareef et al., 2019). Also, Ahmed (2019) in his study critically reviewed and evaluated the National Plan for Disaster Management (NPDM 2016–2020) of Bangladesh (Ahmed, 2019). Then Azad et al. (2019) studied the scope and advantages of decentralized and community-based disaster management to minimize the risk of disaster in Bangladesh (Azad et al., 2019). Similarly, Mohibbullah et al. (2021) empirically studied the benefits and roles of local social networks at the bottom of the country's administrative levels as well as institutional collaboration for sustainable disaster management in Bangladesh (Mohibbullah et al., 2021). Additionally, Moroto et al. (2018) studied to identify the significant factor that can determent the preference of NGOs' project locations for disaster management (Moroto et al., 2018). However, none of these studies have focused in the area of application of MIS for disaster management in Bangladesh.

So far, ICT has played significant roles and brought a paradigm shift in disaster management unlike traditional disaster response and relief practice in Bangladesh. Also, the government is committed to deploying state-of-the-art digital technologies for disaster management. To make this progress better, there is a need for using advanced MIS-based tools for effective DRR, especially, because there exists a good ICT infrastructure and an increase in accessibility and connectivity in Bangladesh. While the MIS application is reported to be useful for disaster management in Bangladesh, however the real-time MIS practices in disaster management are not significant yet. Additionally, the early warning system of the meteorological department has been improved over the last decade in Bangladesh but the use of MIS in alerting and preparing the community people of vulnerable areas is almost non-existent. For that, it is important to know which factors influence the adoption of MIS-based services by the end-users.

The adoption and use of MIS depend on a few factors, such as the perceived usefulness, complexity, affordability, and end-users' knowledge and experience of MIS services. However, no previous studies in the Bangladesh context have investigated which factors influence the adoption of MIS-based services for disaster management by the end-users and what role MIS plays in disaster management in Bangladesh. A previous study by Md Hassan (2015) investigated the role of ICT in the natural disaster management of Bangladesh, however, their study did not focus on the MIS, especially on the use of any theoretical framework to explain the significant factors that influence MIS-based service adoption for disaster management (Md Hassan, 2015). Hence, there is a research gap which is necessary to fill to increase the adoption of MIS-based services for disaster management and enhance the role of MIS-based services in disaster prevention, mitigation and management.

1.9 Scope of the study

This study focuses on identifying the roles of MIS applications in disaster management and the factors that influence the adoption of MIS-based services by the end-users in Bangladesh. The study entails conducting a literature review, data collection and data analysis for thematic analysis and testing a conceptual framework. The study followed a mixed method approach which is a combination of both qualitative and quantitative analyses. The data was collected from 12 Key Informant Interviews (KII) and

4 Focus Group Discussions (FGD) for qualitative analysis and from 815 end-users for quantitative analysis. The end-users as participants were from nine districts which are detailed in the data collection sub-section below (Map 1). The study also entails proposing a conceptual framework based on the Technology Adoption Model (TAM) and the Diffusion of Innovation Theory (DOI) model and testing the conceptual framework using Partial Least Squares Structural Equation Modeling (PLS-SEM).

1.10 Selection of Study Area

The study area was chosen according to mobile phone and internet users in the districts. The chosen nine districts were: Dhaka, Narayangonj, Munshigonj, Kishorgonj, Gopalgonj, Jashore, Kushtia, Chattogram, and Coxs' bazar. The districts were chosen by categorizing the divisions having development in ICT sector. The target audience for survey were selected such that they had access to mobile phone. The highest mobile phone users were in the division of Dhaka (78.41%), following Chattogram (76.3%) and Khulna (69.35%) (BBS, 2022). The amount of internet users was also similar, Dhaka (48.09%), Chattogram (47.96%) and Khulna (31.49%) (BBS, 2022). Selecting the areas were crucial for determining response to disaster management in areas with proper broadcast coverage. Flood, cyclone, drought and river bank erosion are common in these areas. Early warning broadcasts can have a huge impact in these areas during disaster season. Most of the disasters occur during the season of monsoon (ADPC, 2008).

1.11 Research Objectives

The general objectives of the research are to investigate the role of management information systems in disaster management in Bangladesh. In this process, the study was conducted with specific objectives to ultimately enhance the adoption and role of MIS-based services for disaster management in Bangladesh. The specific objectives are:

1. To identify the perceived benefits that might influence the adoption of MIS-based services for disaster management.
2. To find the factors influencing the adoption of Management Information Systems (MIS) based services for disaster management by the end-users in Bangladesh.

1.12 Significance of the study

Bangladesh stands as the seventh most impacted nation by natural disasters within the past two decades. As highlighted in the Global Climate Risk Index 2019, Bangladesh holds the seventh spot among countries greatly affected by extreme climatic events from 1998 onward. The increasing prevalence of these climate-related occurrences is a pressing concern, leading to significant adverse socio-economic outcomes for affected communities. This situation poses a considerable challenge to the nation's socio-economic advancement and overall development prospects. Consequently, Bangladesh is striving to mitigate the impact of recurrent natural disasters with its limited resources. However, given these resource constraints, more effective results can be achieved through the integration of Management Information Systems (MIS). Therefore, Bangladesh aims to enhance its climate change resilience by incorporating MIS into its disaster management practices.

However, the current literature review reveals a research gap in that there is no previous study in the context of Bangladesh that has focused on identifying the roles of MIS applications in disaster management and the factors that influence the adoption of MIS-based services by the end-users in Bangladesh. Therefore, the researcher of this study is committed to conducting this study to minimize this research gap that can consequently contribute to enhancing the adoption and role of MIS-based services for disaster management in Bangladesh.

Further, with the vision of Digital Bangladesh, it is expected that Bangladesh can adopt information technology, such as MIS, as extensively as possible in the field of disaster management. In this process, the Ministry of Disaster Management has taken various vital steps in implementing information technology in disaster management to ensure that the country can sustain itself in difficult situations, such as a natural disasters. For that, the use of MIS tools for disaster management is certainly an innovative intervention, which can make disaster preparedness easier and more effective. The finding of this study will contribute to the sustainability of disaster management by understanding the role of MIS in disaster management better.

Bangladesh has already experienced a number of building collapse tragedies. Even though the magnitudes of these types of disasters were not as great as the one of the Rana Plaza disaster, they also took a toll on humanity. During the review of daily newspaper articles on building collapses, we have found a number of incidents occurring in the last decade in Dhaka. Among those, on June 9, 2004, one three storied building collapsed in old Dhaka city where 19 people died and 11 were seriously injured. Another one was a garment factory; a nine-story building collapsed in Savar on April 11, 2005, killing 64 people working there (Biswas et al., 2015).

Moreover, as climate change is becoming a major problem in contemporary times and turning Bangladesh into one of its worst exposed countries of the world, especially in socio-economic aspects, extensive research for Sustainable Development Goals (SDGs) must be taken into consideration. The findings of this study will contribute to achieving SDG goal 2 (strengthen capacity for adaptation to climate change), SDG goal 11 (decrease the economic losses caused by disasters), and SDG goal 13 (combat climate change and its impacts) by helping in planning Disaster risk reduction (DRR) program which is essential for sustainable social and economic development.

Organization of the Thesis

Chapter 1: Background of the study

The introductory chapter of the present study provides an overall schema of this research. In this process, the overall depiction regarding the necessary actions and reasons for the survey of the research has been fairly expressed. It includes information as to which methodological approaches are chosen to apply and their relevant background information based on the review of relevant national and international literature. Besides, a presentation on different organizational involvements in disaster management concerning information management is also given. In brief, this chapter expresses the research design, study area and population, research method, field data collection, and data analysis. The significance of the study with explanations has also been discussed.

Chapter 2: Review of Literature

This chapter searches and presents information on subjects relevant to the topic of Management Information Systems (MIS) in Disaster Management considering Bangladesh's context. This chapter starts with making important criticism of MIS followed by literature related to information on disaster preparedness, mitigation, and management. In this regard, the literature review chapter discusses the management information systems-based processes and prevention mechanisms used in disaster management in Bangladesh and develops multiple themes such as disaster early warning, real-time management, and post-disaster management. This section also extends the research focus of rapid response after giving attention to the history of the disaster response, including the inception of the different government organizations and NGOs. Finally, this section concludes with a review of disaster references to floods, river erosion, and earthquakes citing the relevance to the historical perspectives, and relief response strategies integrated with management information systems in Bangladesh.

Chapter 3: Conceptual Framework

Chapter three emphasizes making hypotheses based on the literature review to investigate the factors that influence the adoption of management information technology for disaster management in Bangladesh. Considering the researcher's interest to find the influencing factors in adopting MIS-based services for disasters in Bangladesh, this chapter gives a comprehensive detail of the technology acceptance and end-users' understanding of information technology.

Chapter 4: Methodology and Research Design

Chapter 4 delves into the methodology, a fundamental philosophy guiding the research. It offers a concise rationale for the chosen methodology within each model, clarifying its pertinence to the research topic and its potential implications for Management Information Systems (MIS) and disaster management. The study employs a mixed-method approach, encompassing both qualitative and quantitative research methods. To execute the quantitative research, latent constructs within a proposed model were assessed using items primarily sourced from previous studies. These items were suitably adapted to align with the study's context. Initially, a structured questionnaire was formulated, with responses obtained through a 5-point Likert scale. The study aimed to include a sample population that could potentially represent the entire demographic of Bangladesh. Through the convenience sampling method, face-to-face survey interactions were conducted, facilitated by trained field investigators and administrative personnel.

Chapter 5: Research Findings

Chapter five presents the findings carefully and methodically points out the areas of concurrence between the qualitative and quantitative dimensions, and also any areas of contradiction and new issues encountered. After finding a few demographical results obtained from analyzing data using the Statistical Package for the Social Science (SPSS) researcher emphasize path analysis using Partial Least Square (PLS) regression for quantitative analysis to meetup the hypotheses discussed in the conceptual framework earlier. The outcomes of the survey were presented including the discussion on the scope for future research on the topic of management information technology and disaster management. Finally, this chapter presents recommendations based on the feedback from the disaster-vulnerable communities and specific responses provided by the respondents of a qualitative study.

Chapter 6: Results and Discussion

This chapter summarizes the findings of the data analysis and discusses the qualitative and quantitative findings. Discusses have been done from the focus group results and proceeded to the quantitative data collection. As a part of the mixed method approach data were collected through qualitative and quantitative phases. Researchers emphasize path analysis from the both Technology Adoption Model (TAM) and Diffusion of Innovation Theory (DOI) models by using Partial Least Square (PLS) regression for quantitative analysis to meet-up the hypotheses.

Chapter 7: Conclusion

This chapter summarizes the total exploration of this research and its outcome and implications. It includes how the author of this study identified the research gap and followed an appropriate theory to investigate the factors in adopting Management Information Systems (MIS) based services in disaster management in Bangladesh. Concurrently, the requirements and users' perceptions regarding the integration of MIS in disaster management were also identified. Finally, based on the findings, this chapter also concisely reiterates the importance of understanding or adopting the specific problems in the areas of MIS practices by the end-users in disaster management in Bangladesh, and how this thesis can give guidance to the readers to develop strategies for integrating information management system within disaster management procedures.

Chapter 2: Review of Literature

2.1 Introduction

Based on the review of previous research, this paper focuses on the management of both risks and consequences of the disaster and audits both show and past prevention and readiness measures taken in disaster-prone ranges in expectation of the known hazards, which are frequently alluded to as pre-disaster measures and long-term rehabilitation. However, it must be mentioned here that interrelated literature discussing the need for collaboration among different disaster management organizations and research institutions is scant. The moment one too included recovery and development of a governmental plan and policy (GoB National Plan 2010-15). It appears that practices of MIS in the disaster sector have yet to implement properly in Bangladesh. This study is the first of its kind in Bangladesh and can be used as guidelines for similar studies for future researchers. A review of the literature of this research has indicated that the government policy has influenced information technology-based disaster management through national strategy centrally and strengthening the institutional activities. There are different driving elements in the management data system, for case: technological development in all segments lets modern managers obtain required selective information for complex assignments and decisions.

2.2 Review of Literature

Before the 1970s, globally, civilian usage of ICT in Disaster Management was limited to a few numbers in educational institutions and government, and large companies (Levius et al., 2017). In the 1970s a computer revolution took place in the world with the invention of microprocessors. This microprocessor device made the computer faster and lighter. Its improved computing capability, storing capacity at an individual level and organizational level. Real-time emergency data, program and project planning, and decision support systems were added to the operational activities of computer and technological platforms. Nevertheless, this computing facility and availability were very delayed and confined to a particular scope. After that in the 1980s, this computerization and technological application become more popular and available for a common purpose. In the late 1980s, the desktop computer becomes a more popular and powerful instrument. With a network system added to the computer, desktops become portable with more maturity and a wide range of possibilities. Large organizations and individuals could use those technologies.

Stephenson and Anderson stated reading the development and possible medium-term future of information technology (IT) in disaster management in 1997 in Disasters and the Information Technology Revolution review. A major change regarding emergency global information access and networking occurred recently time. In that review, a set of key technologies were focused on and discussed those innovations to instruct disaster planning, preparedness, disaster controlling, and further disaster research for more than 10 years. It is also stated operational, and organizational implications would take place in disaster management study (Drabek, 2018).

In a disaster situation, as a preparedness measure, it is undoubtedly believed that early and timely warning facilitates people to take preparation to evacuate and go to the shelter in time which helps to save lives, reduce the loss, and to recover the damage (Dahou et al., 2012). An effective warning system requires to have better and more successful coordination among warning providers and logistic providers for warning information, people, and community for increasing awareness regarding hazard preparedness and disaster management. It is noteworthy that the warning system works as a system combination among various technologies, tools, components, etc. than only a single technology or machine. This system has the function to identify, detect and assess the risk of the hazards. It also involves identifying accurately the vulnerability of the community and people who are at risk, and finally, communicating information about the risk to the vulnerable people in time so that the people can be alert to avoid and lessen the adverse magnitudes. This final component emphasizes the significance of education and raising awareness in the disaster-prone community and people with the expectation that they can take action to face unavoidable hazards (Samarajiva, 2005).

Local communities, particularly those who are the most susceptible are important to stakeholders who implement proper and in-time warning systems for them to face the disaster. Their input into the framework plan and their capacity to reply eventually decide the degree of chance related to normal dangers. Communities ought to be mindful of risks and potential adverse impacts to which they are exposed and be able to require particular activities to play down the risk of misfortune or harm (Bronfman et al., 2016). Such as, the geographic area of a community is a fundamental determinant within the determination of catastrophes on which the framework ought to center the then community instruction. For example, coastal communities require more education and preparedness to face a possible tsunami. A community living beside a mountain requires more education about the landslide and their early warning system. Local governments ought to have significant information on the hazard to which their communities are uncovered. They have to be effectively included within the plan and maintenance of early warning frameworks and get information collected to be able to prompt, educated, or lock in the neighborhood populace in a way that increases their security and diminishes the potential misfortune of assets on that the community depends (Van De Walle et al., 2014).

A disaster is characterized as a catastrophic incident, calamity, or severe event that impacts a region or community due to natural or human-induced factors, accidents, or negligence. Such occurrences result in significant loss of life, suffering, property damage, environmental degradation, or a combination thereof, surpassing the capacity of the affected community. Disasters can stem from both natural and human causes. While studies often distinguish between natural and human-induced disasters, these categories are essentially artificial. All disasters fundamentally arise from human actions, influenced by decisions regarding where and how people live (Redmond, 2005). The location and condition of the structures in which individuals reside play a critical role in determining the vulnerability of both individuals and communities, affecting their accessibility to disaster response and aid provided by emergency organizations.

The risk of landslides increases as the demand for land prompts the establishment of new settlements on steep hillsides, a perilous endeavor that often leads to fatalities. According to Jones (1992), the threat posed by landslides is somewhat overshadowed due to their localized and intermittent impacts, with their causative factors often attributed to other hazards like earthquakes and heavy rainfall (Jones, 1992). Both internal and external circumstances entail potential risks to human lives. Anticipating future catastrophes compels the recognition of necessities, urgencies, and perceived effectiveness of disaster management, public policy, and government funding. Disaster managers must identify tools capable of gauging the equilibrium or disequilibrium within the environment. Should a significant disequilibrium exist without appropriate interventions to rectify it in a timely manner, the consequences can prove fatal to individuals, communities, countries, and even the environment. These tools serve to assess the repercussions of disasters on local and national economies.National governments in their respective countries are capable of approaches and systems that provide early warning for the expansion of specialized frameworks for the planning of convenient and compelling hazard warning systems (Gaillard, 2010). There must be an assurance that disaster warnings are coordinated towards the vulnerable populations through planning all-encompassing disaster response systems that address the particular needs of the targeted populace. The arrangement of back to local communities and local governments to create operational capabilities is a basic work to decipher early warning information into risk minimization improvement.

Local organizations are vital to connecting international capabilities to the specific needs of specific countries and in encouraging compelling early caution practices among adjoining countries. International bodies ought to give back for national early warning exercises and cultivate the trade of information and information between individual countries (Carrão et al., 2016). Therefore, the private segment encompasses a different part to play in early warning, counting creating early warning capabilities in their claim organizations. On the other hand, the private divisions have better preparation to implement ICT-based solutions. The private sectors include a huge undiscovered potential to assist give gifted management within the frame of technical labour, expertise, or gifts of merchandise or management (in-kind and cash), particularly for the communication, dispersal, and reaction components of early warning.

For disaster events, the media continuously plays an imperative part in progressing the disaster awareness of the common population and in dispersing early warnings. For illustration, social media as a potential asset spread critical news and rules some time recently, amid and after disaster events (Porto de Albuquerque et al., 2015). The media can be the basic interface between giving the warning to the common people. The logical community includes a basic role in giving technical input to help governments in creating early caution systems. Their ability is basic to examining the communities of the dangers confronted by natural disasters, supporting the plan of scientific and systematic observing and warning managements, cultivating information trade, interpreting scientific or technical data into clear messages, and dispersing justifiable notices to those at hazard. Essentially, nowadays, social media information is broadly utilized for disaster management and data dispersal (Xiao et al., 2015).

Application of information technologies in crisis management still long way to go. It may be a while yet before the real suggestions of these advances are clear. Within the cases and figures given here, all ought to be mindful of the dangers both of overestimating shorter-term impacts, and of thinking little of longer-term results. In general, it appears very likely that a few significant changes will happen within the aptitudes, the hierarchical plan, the management styles, and the learning forms of crisis arranging and management (Bhanumurthy & Sharma, 2019). Numerous of the conceivable results are as it was ambiguously seen, and numerous could appear exceptionally further to numerous readers at the display, particularly those in countries where this innovation has not yet penetrated. In any case, IT prospects ought to be given much closer consideration presently in arranging large-scale relief ventures and within the choice and plan of formal instruction programs for the next era of proficient crisis directors around the world (Kapucu & Naim, 2016).

Another study on the role of ICTs in Disaster Management found that efficient disaster response requires quick access to reliable and accurate data and the capacity to assess analyze and integrate information from varied sources (Van De Walle et al., 2014). ICT can aid in reducing the impacts of acute climate-related events (Haworth et al., 2015). The noteworthiness of the community in compelling disaster management is contended whereas recognizing the critical part of governments, epistemic communities, donors, businesses, and NGOs. Most of the time, ICT applications are financed remotely raising authorities approximately assist reliance and sustainability. For this case, the development of modern remote innovations, meeting of broadcast communications, computing, and multi-media; multi-stakeholder associations, and the utilization of FOSS by socially disapproved ICT-savvy experts are empowering more prominent standardization and interoperability, more information accessibility, more prominent reach at lower costs, and to a few degrees straightforwardness and responsibility of disaster asset allocation and conveyance (Bennett et al., 2016).

Decision Support Systems (DSS) are one sort of MIS, which is very useful when a large number of images need to be integrated and used in a collaborative environment (Collen & McCray, 2015). However, these systems require critical issues for the underlying computing infrastructure. Firstly, it must accomplish tall execution. The information, such as social media and estimating information is utilized to bolster successful decision-making amid natural hazards, comes in streams, and must be handled in a real-time mould. Moreover, since most of this information is dispersed over distinctive offices and companies and with diverse designs, resolutions, and semantics, it takes a generally long time to distinguish, handle, and consistently coordinated these heterogeneous datasets. Secondly, it must be adaptable. As tens to hundreds of computers are required for the physical show reenactments to run in some hours to deliver high-resolution comes about and bolsters the related decision-making process utilizing multi-sourced information once such an occasion is identified. After the crisis, the computing assets ought to be discharged and recovered by other science, application, and instruction reason in some minutes without or with small human intercession. Thirdly, it should be resilient. In times of basic circumstance, framework disappointments may happen since the unfavourable environmental conditions, such as physical harm, control blackouts, surges, etc. Subsequently, the enormous information capacity, recreation, investigation, and transmission management must be able to function amid such antagonistic conditions (Musaev et al., 2013).

While using internet connectivity for information dissemination in disaster-affected areas, the foremost critical deterrent hindering far-reaching Internet usage in disaster management is the extending gap among people who may have financial, language, and cultural limitations. Without coordination between decision-makers and an easy flow of consistent and reliable information among all included, successful likelihood planning and emergency response are at risk (Putnam, 2002).

Disaster managers face many challenges but the MIS as a management tool in this field seems to work even though, in real-time data management, previous and present data management, tempers flare from all sides. MIS can play a vital role but due to inter-relation between GO and NGO could make the lacking of a program successful. There are frequently misconstrued faults depending on the point within the cycle at which their community or agency appears to be stuck. The quality of the emergency manager must, subsequently, come from inside.

A crisis manager is anticipated to act proficiently, i.e., a person with specialized knowledge equipped with extraordinary capacities and the control to act. This happens numerous times indeed when his or her career field has however to be respected as a calling and when the required strengthening has however to be given. A disaster manager may be a devoted person who distinguishes the risks confronting his or her community from different viewpoints, a few within the private division and numerous more from the public sector. He or she utilizes his or her education, training, and experience (knowledge, abilities, and abilities) as the agents of and for alter taking put around family, friends, and co-workers. Regularly with few assets and supporters, the emergency manager is confronted with the assignments related to shaping an effective and successful organization with a comprehensive management arrangement to confront the hazards in his or her community. The arrangement must incorporate activities in mitigation and prevention to incorporate hazard identification and the assessment of risk. It too must address what arrangements must be made for events that cannot be avoided. This incorporates supervising the preparing and preparing of others who may render help as well as conducting drills and works out to center on coordination and communications among responders. Once an occasion happens, the disaster manager gets to be a coach and liaison between agencies and governmental organizations.

2.3 MIS in the Disaster Management Plans and Policies in Bangladesh

Research conducted on media, perception, and disaster-related behaviour in Bangladesh found that early and in time, easily comprehended warning language and warning systems through various tools could lessen death of lives, and loss of property from catastrophic disasters. With the ability of the Disaster Management Act, 2012 article 19, based on NPDM **(**2010-2015, revised in 2016-2020, 2021-2025)) and Standing

Orders on Disaster (SoD), 1997; revised in 2010 & 2019) Disaster Management Policy of Bangladesh has been developed.

The finding of Another research done by the Forum for Development, Journalism and Communication Studies showed that an innovative warning system developed by authority, which is easily understandable can save lives, assets, and nature. The study also recommended that the process increase awareness and confidence among the people and inspire self-rescue, which also reduces the death toll (Ullah, 2003).

The telephone warning system is very much popular in disaster preparedness all over the world (Sorensen, 2000). It has multiple beneficial features such as it serves quicker, more accurate information. However, the telephonic warning system has two barriers (a) Telephone line access in many areas is still not satisfactory – particularly in coastal areas and rural. Though an increase in telephone usage there are also several areas which are developed of this service. (b) The other barrier is congestion of lines immediately before a disaster, during, and post-disaster. The network telephone flops severely and hampers its service.

2.4 Preparedness of Disaster management in Bangladesh

Cyclone Preparedness Program (CPP) in Bangladesh is one of the pioneering initiatives in South Asia, inaugurated by Bangabandhu Sheikh Mujibur Rahman in 1972, immediately after the independence. Currently, the CPP is jointly operated by the Government and the Bangladesh Red Crescent Society in collaboration with the International Federation of Red Cross and Red Crescent Society (IFRC). CPP has been recognized as the most successful cyclone preparedness activity in the globe. Cyclone preparedness program maintains a radio communication network, which is vastly covered in this country. This network has combined both HF and VHF radio covering high risky zones in Bangladesh.

Besides radio communication support, the telecommunication network used in Cyclone Preparedness Program has three elements:

a. **High Frequency (HF)** transceiver radios are situated in Dhaka for the transmission of cyclone information. These centers transmit local information to Dhaka headquarters about its movement, progress and so.

b. **Very High Frequency (VHF)** transceivers are field station systems, which collect local information from HF stations and send it to the sub-station at the union level.

c. **Transistor radios** are operational for receiving meteorological and climate updates in the village, along with cyclone warning signals and bulletins transmitted by Bangladesh Radio. Additionally, these radios provide regular coverage of abnormal weather conditions, particularly during cyclones or periods of low atmospheric pressure.

The entire cyclone preparedness program has been enriched with training and awareness programs among people and volunteers working locality, from the very beginning the volunteers are trained with an elementary training course conducted by the CPP personnel. In light of the CPP program, foundation training is organized for three days for volunteers in different forms. This training covers dissemination, evacuation, sheltering, rescue and evacuation, first aid, and relief operations. The training program is for volunteers important that will create public awareness. This training program encompasses cyclone drills, demonstrations, performing stage plays, films, videos, leaflets, posters, booklets, TV-Radio programs, etc.

The newly invented communication tools can be used effectively if these tools serve sound warning systems. For better and ultimate results, it is very important to utilize emerging technologies. Lack of training and efficient users the application of these technologies goes in vain. Besides machines, drivers of the machine are necessary. The flood warning system is very good and modern, the authority cannot enjoy the benefit of these systems due to a lack of proper and expert users. In time people cannot access the forecast system to convey the warning signal. Currently, the flood forecasting and warning center are using an end-to-end review strategy in three pilot areas. This strategy indicates that the effective utilization of new technologies is very good.

2.5. Community activity in Disaster Management

Community activity is vaster than individual efforts in the case of disaster management. Collective efforts lessen the degree of damage and loss. This concerted endeavor is possible only when the communication system works properly among the surrounding communities. Proper and quick information transmission contributes to less hazardous results. If the information is disrupted by disaster disparity exists among the other communities because of less development of communication infrastructure. Communication disparity exists in Bangladesh that impedes the development of the disaster management process. This disparity exists not only in the country but also among the groups, communities, and other interested authorities (Yodmani & Hollister, 2001). This discrimination is highly found in Asian countries. As scientific and technological development reaches all communities, disaster managers are now more enthusiastic to use those state of art innovations related to disasters for accurate and real-time information, knowledge sharing, and faster decision-making. Still, disaster managers have to depend on traditional and outdated mediums of communication. Here low communication infrastructure is a constraint to better communication. It is considered wise to combine new and old-fashioned communication tools at national, regional, and local levels.

2.6 ADPC in MIS-based Disaster Management

To modernize the system of disaster management Asian Disaster Preparedness Center (ADPC) started working with regional countries. Bangladesh and Sri Lanka are two countries situated in and within the ocean. Like other coastal countries, these two countries are more hazard-prone areas in the world. Bangladesh and Sri Lanka intended to collaborate to get rid of natural hazards due to their geographical location. Many RCC member countries such as Bangladesh, Cambodia, India, Indonesia, Iran, Maldives, Lao PDR, Nepal, Pakistan, Malaysia, Philippines, Sri Lanka, etc. have either already integrated DRR into the school curriculum or are in process of completing the integration or are initiating (ADPC, 2008). In April 2015, both countries responded positively to collaborating for receiving support so that they could increase national early warning capability and make strengthen. ADPC also extended its activities in the Maldives. The main purpose of ADPC activities is expanding and spreading emergency warning and communication systems through mutually founded projects. Afterward, with UNDP funds and consultancy, ADPC evaluated risk assessment and training with the relevant state's top authority. With the help of satellite images and GIS, ADPC conducted a survey and arranged national training and workshop on risk identification and assessment. The basis of the pilot survey and training programs ADPC used various modelling tools to facilitate faster results. Recently, in 2021 Secretary of MoDMR, Bangladesh has been elected as Chairperson of ADPC, which would provide Bangladesh much more rooms to develop an MIS system in disaster management.

2.7 The role of the MIS in Disaster Management

Management Information Systems of an organization play a role like the heart of the body (Eppler & Mengis, 2004). The MIS process starts with collecting data from an appropriate source, verification of the data, processing that data, and formulating reliable information to make decisions, plan, and serve the specified purpose. This process is similar to the blood circulation of humans and the activity of the human heart. The processed information serves the need of individual, group, and management activities. MIS in disaster management also collects accurate and appropriate data from reliable sources and; a process that data and represents a usable form of data so that disaster managers can make the proper, timely decision for the betterment of the community. MIS performs critical and crucial analysis and assessment of data regarding the events of man-made and/or natural hazards. This information comprises spatial and non-spatial but affects the disasters (Chou et al., 2014).

Management Information Systems (MIS) guarantee that fitting data is collected from different sources, and at that point prepared and send in advance to all the poor goals. The system is anticipated to fulfill the information needs of a person, a bunch of people, and the management functionaries: the supervisors and beat management. For illustration, MIS for Disaster Administration System employments basic examination and appraisal of the suggestions of the event of natural or man-made hazards require information comprising of both spatial and non-spatial related to variables affecting the hazards.

Management Information Systems can play a role to identify the process by which hazards become dangerous and perils and the natural resources indicators of socioeconomic environment that are liked with that process, planning that is also related to preventive measures or steps, and finally, assess the damage and losses resulting from disaster with the help of GIS. Satellite Remote Sensing (SRS) and GIS are playing a vital role in disaster management in the modern technology era. With the help of these states of art technology related to earth surface database management, data storage, data mining, and data analysis have become easier and more effective. Using those technology calculations and output become precise and accurate and disaster managers can serve prompt service. It also serves real-time information. When internet service is added to a disaster database, MIS becomes more powerful with this dimension of data dissemination, open and free access to the database, and real-time data circulation. Internet connectivity provides pace to satellite remote sensing and GIS. As result, disaster data become faster, and planning, implementing, maintaining, and controlling activities become.

While using MIS technology requires a wide range of images and maps for analysis of data on disasters and hazards. These images and maps provide elementary location data. These also focus on the hazards and possible disasters with thematic support maps. These maps also contain geological features, drainage, landforms, tectonic features, land cover and soils, and land use. Information regarding geographical maps identifies earth materials and geological hazards these maps provide information such as geological maps helping to identify the earth materials, geological hazards (e.g., volcanic eruptions, seismic landslides, etc.), and river courses. Whereas, the geomorphology maps create an integrated image surface of the land and its potential hazards like fold, erosion, landslides, subsidence, etc. These digital images make us understand a wide spread of geomorphologic processes regarding human interferences and the associated risk with development activities. In the same way, soil maps describe the changes and variances of land characteristics. Likewise, the soil maps illustrate the diversity and alterations in soil attributes. Another instrument known as specialized educational maps accompanied by supplementary data facilitates location-specific forecasts, such as predictions about landslides, mass erosion, monitoring soil-related disease outbreaks, and more. These maps also serve to offer insights into drainage patterns, instances of waterlogging, erosion vulnerability, and the potential for salinization.

2.8 The Status of the MIS in Disaster Management in Bangladesh.

The Government of Bangladesh has committed to embracing the need for disaster management in its NPDM 2010–2015. Numerous of these needs are revised through the NPDM archive. The United Countries Office for Venture Services (UNOPS), an operational arm of the United Nations, has been helping the Government of Bangladesh in executing these needs (UNOPS, 2016). In a post-review evaluation, UNOPS has expounded its part in these executions, which are presented briefly below:

To address Hyogo Framework for Action (UN, 2005-2015), UNOPS has made a difference in GoB by creating a "project management data framework to screen and report on key program accomplishments and guided the advancement or survey of key Disaster management policies," including the NDMP 2010–2015 (UNOPS, 2016). With the assistance of UNOPS the GoB has defined more than 550 union-level community risk reduction action plans that defend 15–20 million individuals who are casualties of disasters (consistent with HFA 2). "Ten inquire about ventures dissecting the effect of climate alter have been executed and a climate alters library and Site built up, as well as a regulation component that predicts climate and surges impact" (UNOPS, 2016). UNOPS has a dynamic part in shaping and propelling the Catastrophe Administration Data Center and risk data network, which is anticipated to cover 150 million individuals in 64 districts and 230 Upazilas (sub-districts).

Consistent with HFA 5 (reinforcing disaster preparedness), UNOPS gave early recuperation specialized support to GoB in 2007 to address the harm caused by two extreme floods and Cyclone Sidr, which influenced about 9 million individuals. This technical support included 200 circumstance reports on floods and Sidr, which were broadly scattered and circulated among national and international organizations. Also, according to FEMA, developed countries manage disaster management systems in a way that depends on and collaborates with numerous agencies for effective disaster management. There exists a large national network, which is comprised of the sub-networks that incorporate national organizations (e.g., FEMA), local and regional level emergency management agencies, and as well as the initial response agencies (e.g., fire departments, police departments), and search and rescue units, and nonprofit organizations e.g., the Red Cross (Waugh Jr & Streib, 2006).

Presently, the MoDMR has led the formulation of the NPDM 2016-2020 blueprint. This plan draws from various national and international frameworks, including Vision 2021's emphasis on safeguarding against climate change and environmental impacts, as well as promoting ecological advancement. It also incorporates the Bangladesh Climate Change Strategic Action Plan (BCCSAP), which prioritizes adaptation and disaster risk reduction with a focus on poverty alleviation and acknowledges the interconnectedness between climate change and disasters. Moreover, the Paris Climate Change Agreement offers Bangladesh the prospect of embracing a sustainable trajectory by investing in renewable energy. Additionally, the Sustainable Development Goals (SDGs) are seamlessly woven into the objectives, aspirations, and undertakings of NPDM 2016-2020, serving as a guiding framework tailored to the unique context of Bangladesh.

2.9 Summary of the chapter:

This chapter discussed the literature of articles, books related to disasters, and the link between MIS and disaster and management. In this connection, an effort has been made to develop the conceptual framework of Management information systems about disaster management, and its spectrum with MIS strategy. The existing policy of disaster management and the current perspective of disaster management have been reviewed. This chapter also covered the review of preparedness of disaster management in Bangladesh, community activity in disaster management, organizational activity in disaster management, the role of the MIS in disaster management, and the status of the MIS in disaster management in Bangladesh.

Chapter 3: Conceptual Framework

3.1 Introduction

This chapter gives specific attention to the conceptual framework formed based on the researcher's synthesis of the literature to identify the factors influencing the adoption of IT-enabled services for disaster management by the end-users in Bangladesh. To develop a conceptual framework for the present research, it was essential to review some relevant theories. The review was supportive to a form the theoretical basis of the present research. The development of a conceptual framework works as a link between the previous knowledge of other researchers and the observations of the researcher of this study on the adoption of IT-enabled services. The conceptual framework of the present study is based on the theoretical models namely, the Technology Acceptance Model (TAM) (Davis, 1989) and the Diffusion of Innovation (DOI) model (Rogers, 2010). While the TAM model helps us to understand the preference of the end-users in choosing between the existing technologies available, the DOI model helps us to understand how and why a new technology spreads among the end users and identify the underlying reasons.

Following the development of the conceptual framework, the author proposes eight hypotheses in this chapter and justifies the hypotheses based on previous studies in the literature. Regarding conceptual framework, McGaghie et al. (2001) cited it as setting the stage for the presentation of the particular research question that drives the investigation being reported based on the problem statement. The problem statement of a thesis presents the context and the issues that caused the researcher to conduct the study. Therefore, it is necessary to study the research problems and intuitive questions based on a conceptual framework that contains information on academic principles and integrity. Before developing the conceptual framework, some pertinent discussions are given below in section 3.2.

3.2 Concept of Management Information System

Management Information Systems (MIS) is a planned process of providing previous, present and projection information relating to interrelated operations and external intelligence (Raymond McLeod, 2004). It represents data such as the organization's process, operating procedures, internal controls and audit preparation, which the management uses to make effective and efficient decisions (Stoneburner et al., 2002). MIS supports the planning, control and operational functions of an organization by furnishing uniform information in the proper time frame to help the process of decision-making (Beaven, 2012). The three components, namely management, information, and system, are discussed below to understand MIS in detail:

***Management*:** In the words of Beets et al. (1994), Management is a distinct process consisting of planning, organizing actuating and controlling performed to determine and accomplish the objectives by the use of people and resources (Beets et al., 1994). Management refers to the tasks from the planning of setting tactics, strategies, and goals and selecting the best course of action to attain those objectives, staffing for completion of those actions, leading and directing human resources by motivating them and finally controlling overall activities by taking necessary corrective actions.

***Information*:** Information is a fact and figure that is a process for standard form so that quick decision-making can help in completing proper decisions. Information is also regarded as knowledge, which derives individuals to use those facts for effective functionalities of components engaged in an organization. Data are facts that are used in a decision-making process and usually are taken from the historical records that are recorded and filled without direct intent to retrieve for decision-making. According to Davenport and Beers (1995), Information comprises data that has been retrieved, processed, or utilized for informational purposes, analysis, intervention, discussions, or as a foundation for predicting or making decisions pertaining to any business entity. In MIS, data and information may differ, however, disaster management does make any differentiation, data must be distinguished from information and the distinction is clear and important for the present purpose.

***System*:** A system is an integrated process working with other related components for a common destination. The system can also be referred to as a set of elements joined together for a common objective (Aldrich & Whetten, 1981). MIS can encompass various elements of disaster-related data to facilitate both immediate and long-term decision-making. This system is comprised of subsystems that contribute to a larger whole. In this context, the organization functions as the overarching system, while its divisions, units, and capacities constitute the subsystems. The underlying principle of MIS is to enhance organizational productivity by fostering seamless information exchange among operational subsystems. The concept of MIS has gained traction over the past two decades. It has been described in several manners, also referred to as Information System, Information and Decision System, and computer-based Decision System. The MIS framework enables organizations to capture, process, and systematically manage their business activities and transactions. While MIS has emerged as a recent field, its application within disaster management is relatively less prevalent compared to other business and social science domains. Nevertheless, it plays a pivotal role in disaster management by disseminating alerts, enabling real-time disaster response, and facilitating post-disaster recovery efforts.

Each process in MIS involves the decision-making process as a basic task and pre-requisite. The task of MIS is to facilitate to decide on planning, organizing and controlling activities in an organization. Similarly, the decision-making process is also required in the disaster management process. Figure 3.1 below shows the general steps of MIS involved in the context of disaster management. The first step, which is disaster database preparedness, involves the digitization of databases through ensuring and developing IT frameworks application, IT readiness, and IT interoperability. At the same time, the data are collected from different government sources such as National Disaster Management Council and other related sources like Global Integrated Observing System, Global Data Processing and Forecasting System, and Global Telecommunication System. As well as, the collected data are subjected to data verification and authentication based on predefined rules and criteria. The second step, the intervention of MIS, entails the application of a management information system (MIS), which receives disaster-specific data and generates important information which is used in step 3, planning and decision-making. Then, in step 4, information dissemination based on planning and decision-making minimizes the loss of lives and property.

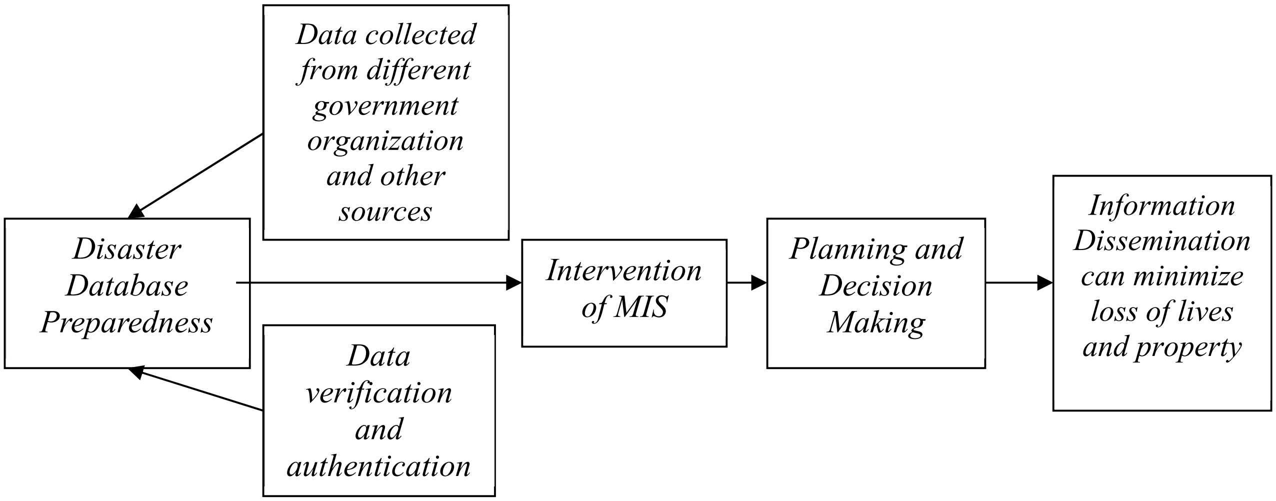


Figure 3.1 General steps of MIS in the context of disaster management

3.3 Theoretical Background

This conceptual framework is drawn on the Technology Adoption Model (TAM) (Gangwar et al., 2015; Wallace & Sheetz, 2014; Xu et al., 2017) and the Diffusion of Innovation Theory (DOI) (Cheng et al., 2004; Olsson et al., 2016; Rogers, 2002, 2010) because of the following reasons. First, the factors taken from theories are widely accepted. Second, many studies used theories to identify the factors (e.g., perceived usefulness, relative advantage and behavioural intention) that influence the Adoption of Technology (AoT); however, the influence of the above-mentioned factors has not tested on the adoption of MIS for the prevention and management to disaster. It can be anticipated that the factors taken from TAM and DOI would contribute to identifying the influencing factors. The TAM and DOI models are discussed below. Both these two theories are relevant for understanding how perceived usefulness (PU), relative advantage (RA) and behavioural intention (BI) can hypothetically influence the adoption of MIS for the prevention and management of disaster.

3.3.1 Technology Adoption Model (TAM)

Initially proposed by Davis (1989), Technology Adoption Model (TAM) is the most extensively used model in the area of Information Systems (IS) for understating the factors that influence the adoption when presented with new technology. Davis proposed TAM to understand why an individual accepts or rejects new technology. Mainly two beliefs are associated with TAM, known as perceived ease of use (PEoU) and perceived usefulness (PU) (Gangwar et al., 2015). TAM helps in identifying how internal beliefs and intentions are affected by external factors such as PU. The behavioural intention regarding new technology is both positively and negatively associated with the perceived usefulness and perceived ease of use.

Although new technologies offer many updated features and convenience, it is challenging for both academicians and practitioners to understand which particular features would contribute most to user acceptance. Therefore, TAM was developed based on the fact that external stimuli such as design features affect the beliefs and attitudes regarding using the system. The TAM model can forecast the individual adoption and application of new technology, thus widely used in health IT, e-Commerce and telecommunication IT (Zeng et al., 2018). By comparison, the TAM model has been broadly applied and tested in North American countries than the Asian countries. Until today, in the context of the adoption of MIS for disaster management, no significant study has been found that has applied TAM.

3.3.2 Diffusion of Innovation Theory (DOI)

Diffusion of Innovation Theory (DOI), developed by (Rogers, 2002), - states the different aspects of technology adoption. These aspects are known as the relative advantage (RA), compatibility (Comp), complexity (Comx), trialability (Ta) and observability (Ob) (Ashrafzadeh & Sayadian, 2015). While the relative advantage is the degree to which a new technology is perceived better than any other obtainable technology, compatibility is the degree of consistency regarding the need and previous experience of users that is important to understand how a new technology function. The complexity aspect is the degree to which a new technology is perceived as relatively difficult to learn and apply. The trialability refers to the degree to which a new technology is available for experiment and interacts with before adopting it. Finally, the observability is the result of using a technology that is noticeable to its users. DOI is found to be very useful in studying the users' adoption of new technology and different conclusions are found in different contexts. DOI has been used in the areas of healthcare IT, telecommunication IT and e-Commerce. DOI uses a scientific way that involves the communicative and psychological aspects of technology adoption.

3.4 Conceptual framework and Development of Hypotheses

The conceptual framework (Figure 3.2) incorporates factors from both the TAM and DOI models. As shown in Figure 3.2, the conceptual framework explains the possible users' acceptance of technology. Based on the conceptual framework, the authors proposed eight hypotheses which are justified below in the light of existing literature.

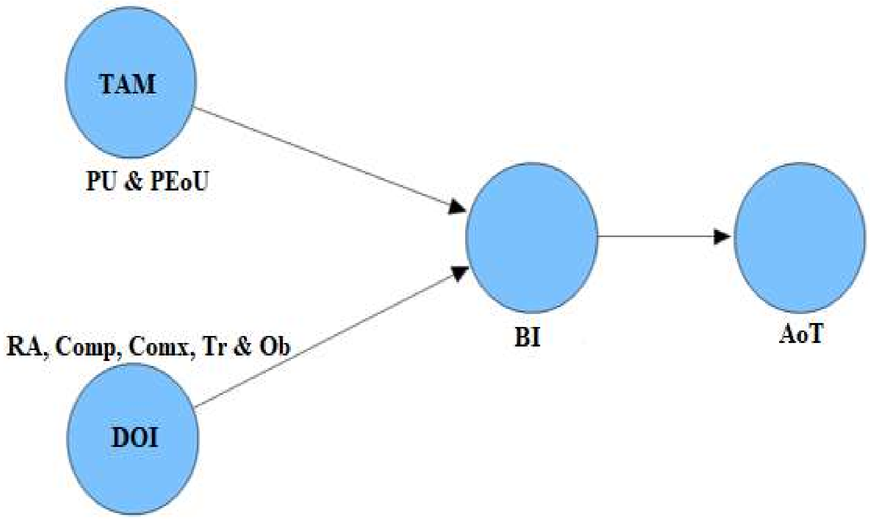


Figure 3.2: The basis of conceptual framework based on TAM (Factors: PU & PEoU) and DOI (Factors: RA, Comp, Comx, Tr & Ob) models.

Perceived usefulness (PU)

According to Davis (1989), Perceived usefulness (PU) is suggested as the degree to which an individual believes that using a particular system would enhance his or her job performance (Davis, 1989). PU implies that users are more likely to use a technology-based service that adds value (e.g., efficiency and time savings) for them. The Information System literature shows a positive relationship between PU and behavioural intention. For example, PU is found to be an influencing factor in the adoption of technology such as e-text, e-learning and assistive technology (Hamid et al., 2016). Further, the study by Almaiah (2018) has highlighted that PU is a significant determinant of the behavioural intention of technologies such as e-commerce, online banking, mobile payment service health information system and so on (Almaiah, 2018). On the other hand, the recent studies by Seo and Lee (2021) and Puriwat and Tripopsakul (2021) also found that PU is a significant determinant of behavioural intention to use technology (Puriwat & Tripopsakul, 2021; Seo & Lee, 2021). Therefore, the author proposes the following hypothesis (Figure 3.3). It can determine an individual's attitude towards using technology. Therefore, the author proposes the following hypothesis.

Hypothesis 1: Perceived usefulness significantly influences the behavioural intention in using MIS in disaster management.

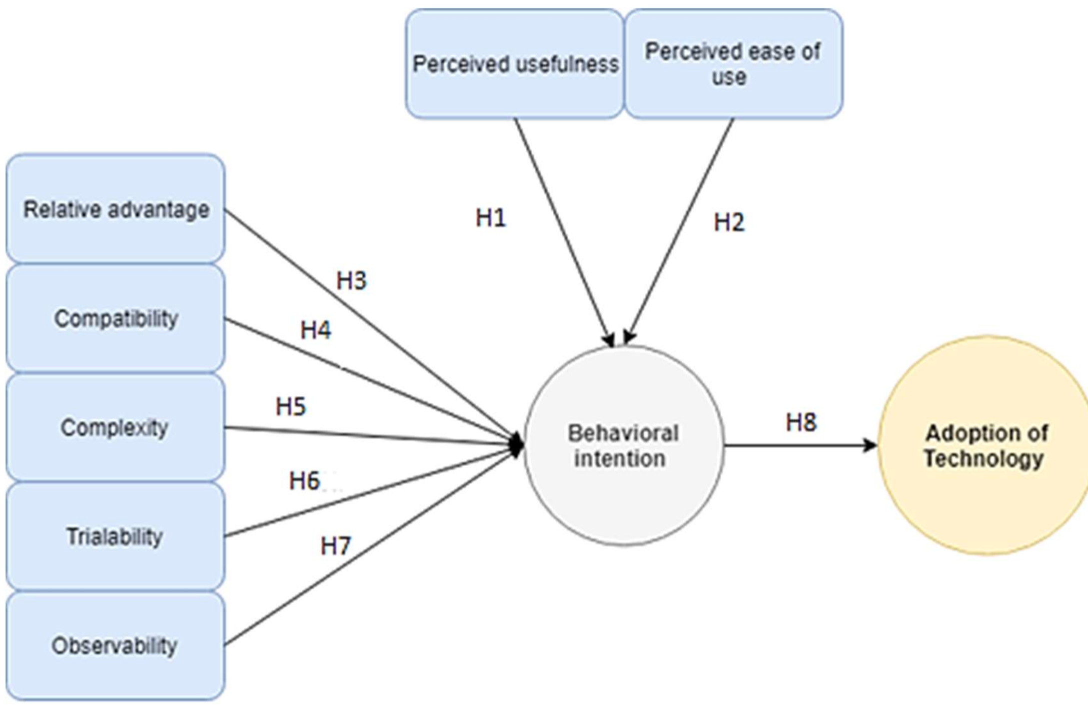


Figure 3.3: Conceptual model forming the basis of hypotheses

Perceived ease of use (PEoU)

Perceived Ease of Use is defined by Davis (1989) as the degree to which a person believes that using technology will be free from effort. It is the belief held by an individual based on the amount of effort needed to use any particular technology (Fred D. Davis, 1989). It creates confidence among individual users that this factor will not make difficulties or the users will not require excessive effort when using a particular technology (Effendy et al., 2021). Further, PEoU implies that technology is easy to know, learn and apply. Therefore, it is regarded as a significant determinate not only for the adoption of any new technology but also for the long-term use of that technology. Researchers believe that the PEoU increases the likelihood of the technology being used (Yang et al., 2021). For example, PEoU is found to be an influencing factor in online learning (Chiu & Wang, 2008). Likewise, recent studies by Effendy et al. (2021) and Yang et al. (2021) reported that PEoU significantly affects the behavioural intention of technology of users. Therefore, the author proposes the following hypothesis.

Hypothesis 2: Perceived ease of use significantly influences the behavioural intention of using MIS in disaster management.

Relative advantage (RA)

According to Rogers (2002), relative advantage is the degree to which a technology is perceived as superior to an existing technology it replaces (Rogers, 2002). RA is measured based on the terms of cost, convenience, satisfaction, and social factors including the perceived advantages such as motivation and value. It implies that users may conclusively find a new technology more beneficial, both economically and socially, than similar ones, Hence, they will intend to use the technology. Additionally, RA relates to the extent to which technology enhances efficiency, economic benefits, and value. The lack of benefits and value regarding adopting new technology can lead to a lack of perceived RA (Yatigammana et al., 2013). The studies by Ooi et al. (2011) and Lin et al. (2020) show that RA has a significant influence on behavioural intention to use technology (Lin et al., 2020; Ooi et al., 2011). Also, the recent study by Mombeuil and Uhde (2021) confirms that RA is a significant determinant of behavioural intention to use new technology. Therefore, the author proposes the hypothesis below (Mombeuil & Uhde, 2021).

Hypothesis 3: Relative advantage significantly influences the behavioural intention in using MIS in disaster management.

Compatibility (Comp)

Compatibility is the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 2002). It measures the degree to which a new technology-based service has consistency with the past and needs as well as aligns with the personal value and experience of individual users. It generally determines whether a user will accept a new technology if he effortlessly understands the operating process and application. If a user perceives new technology as highly compatible, then can he use the technology more effectively which leads to swift adoption (Chatterjee et al., 2021). High compatibility leads to a higher chance of technology adoption (Olsson et al., 2016). For example, according to Tornatzky and Klein (1982) in the context of the adoption of innovations in education, compatibility is one of the most significant factors. Previous studies reported a positive relationship between compatibility and behavioural intention to new technologies (Suebtimrat & Vonguai, 2021). Further, the significant influence of compatibility is revealed in the recent study by Jilani et al. (2022). Therefore, we propose the following hypothesis.

Hypothesis 4: Compatibility significantly influences the behavioural intention in using MIS in disaster management.

Complexity (Comx)

Complexity is the amount of difficulty perceived by an individual user in adopting new technology. This factor is similar to TAM's perceived ease of use in terms of the fact that users swiftly adopt new technology if it does not require new skills and understanding with high effort. Thus, it works as an important precursor for influencing behavioural intention. For example, according to AlBar and Hoque (2017), complexity is negatively related to the adoption of new technology (AlBar & Hoque, 2017). Previous studies reported that the complexity of the innovation makes it less likely it is to be adopted (Touray, 2015). As well as, the study by Al-Zoubi et al. (2019) confirms the significant influence of complexity on behavioural intention (Al-Zoubi et al., 2019). In addition, the negative relationship between complexity and behavioural intention was revealed in the study by Lee et al. (2011). Therefore, the author proposes the following hypothesis.

Hypothesis 5: Complexity significantly but negatively influences the behavioural intention of using MIS in disaster management.

Trialability (Tr)

Trialability factor states that whether the users get the scope to use a new technology for testing its usefulness can determine the adoption of that technology. It allows the users to lower their possible perceived risk resulting from using a new technology before adopting it. If the results of the use of new technology show improvement, trialability reduces prospective users' uncertainty about the new technology and creates favourable sentiments among users about it. For that reason, according to Sallehudin et al. (2015), organizations find it significant to examine a new technology on a limited scale in advance of adopting that technology in practice at a large scale (Sallehudin et al., 2015). Moreover, the recent study by Alhasan et al. (2022) has found that trialability significantly influences behavioural intention. Also, another recent study by Jilani et al. (2022) shows that trialability is a significant determinant of behavioural intention in new technology adoption. Therefore, the author proposes the following hypothesis (Alhasan et al., 2022; Jilani et al., 2022).

Hypothesis 6: Trialability significantly influences the behavioural intention in using MIS in disaster management.

Observability (Ob)

Observability is the degree to which the usefulness of a new technology is noticeable to its users. It refers to how much visible the outcomes of new technology are to users. It emphasizes the fact that the benefits of using any new technology as outcomes need to be noticeable for the adoption of that technology. Users adopt new technology if they can easily see the positive effective of it, where the rate of adoption is positively related to observability. As a result, it is presumed that the more observability the users have, the quicker the adoption will be. For example, according to AlBar **(**2017), observability has a positive effect on the adoption of any new technology (AlBar & Hoque, 2017). Also, previous studies reveal that observability significantly influences behavioural intention in using new technology (Lin et al., 2020). Besides, a recent study by Mehta (2022) shows that observability has a significant influence on behavioural intention (Kim & Mehta, 2022). Therefore, the author proposes the following hypothesis.

Hypothesis 7: Observability significantly influences the behavioural intention in using MIS in disaster management.

Behavioural intention (BI)

Behavioural intention (BI) is referred to an individual's subjective possibility that he or she would participate in a certain behaviour. It is a user's willingness to adopt new technology because of its usefulness to its user. It is a proximate and highly predictive factor that influences the adoption of Technology (Mun et al., 2006). Thus, a user's potential behavioural intention toward using a new technology depends on their view that the technology is useful. BI is found to be a major influencing factor in using value-added services The relationship between BI and the adoption of Technology (AoT) has always been a significant issue in IS research (Kuo & Yen, 2009). Previous studies have revealed the significant influence of BI on the adoption of technology. For example, the study by Mailizar et al. (2020) shows that BI significantly affects the actual use or adoption of technology (Mailizar et al., 2020). Additionally, the study by Ghio et al. (2021) confirms the significant influence of BI on the adoption of technology (Ghio et al., 2021). Therefore, the author proposes the following hypothesis.

Hypothesis 8: Behavioural intention significantly influences the adoption of Technology (MIS) in disaster management.

3.5. Conclusion

The conceptual framework that is proposed in this research is important, especially in terms of providing a starting point for analyzing the factors that influence end-user adoption of MIS in the context of disaster management. The factors in the conceptual framework have been selected based on TAM and DOI models. Understanding the influence of these factors along with proper organizational policies can ensure the application of MIS in disaster prevention and management through assessing and developing effective preparedness systems.

Chapter 4: Methodology and Research Design

4.1 Introduction:

According to the proposed hypotheses in this research, the methodology chapter has been designed for developing a research plan, sampling techniques, choosing the sampling population, questionnaire design, data collection, and data interpretation for this research. Research methodology is one of the most important elements of any research on which many scholars have explored their observations. According to Ishak and Alias (2005), it involves a systematic process and constructive data analysis for finding insights or solutions to a problem (Ishak & Alias, 2005). This systematic process includes method selection, guideline formulation, and theoretical analysis, following a research approach that fits the best study and research objectives, and research tools. This chapter orderly presents the steps of methodology development, research approach, design process, questionnaire design, data collection and ethical approval process and the final summary of this chapter.

4.2 Methodology Development:

The present study, the research follows the positivist approach based on ontological and epistemological perspectives. Nevertheless, firstly, it is the objective of this study to formulate a conceptual framework based on testable proposed hypotheses following chapter three. In the context of the Information System, a study is classified under the positivist approach when proposed hypotheses are tested and inference is drawn about the subject being studied from the sample to population based on the data analysis and research findings (Orlikowski & Baroudi, 1991). For this study, the inference is going to be drawn based on the impact of perceived usefulness, perceived ease of use, relative advantage, compatibility, complexity, trialability, and observability on behavioural intention for the adoption of Technology in the Bangladesh context, which is relevant to the positivist approach.

Secondly, it is important that research findings should be replicable which indicates that the researcher and reality are separate, and there involve fewer biases in the study (Creswell & Zhang, 2009). In this regard, the positivist approach allows for generating and replicating the study that involves a literature survey, bias reduction, pre-test survey, building and establishing measurement, and data collection for data analysis, structural model validation and result interpretation.

Thirdly, the research adopted a mixed method approach following both quantitative and qualitative processes, as the process of a qualitative study that involves the application of statistical methods to test hypotheses, evaluation of research constructs and relationships among the selected variables, the ontological and epistemological perspectives of positivist approach align with the steps followed in a quantitative study (Walsham, 1995). In this process, a quantitative survey approach has been preferred for this study. However, this study also has a qualitative part that involves conducting in-depth interviews of respondents and focuses on group discussion for the identification of variables. Besides, the qualitative study focuses on the experiences of the people involved, and attempt to understand the reasons behind certain behaviour description.

Justification for Mixed Method:

Both the qualitative and quantitative study parts are complementary to each other when integrated for triangulation. Triangulation is a technique that increases the credibility and validity of the results. It is a way of finding answers to the research questions by following more than one method (Heale & Forbes, 2013). Therefore, as a part of the triangulation process, this study follows mixed method **(**using qualitative and quantitative in combination) research which will also increase the breadth and depth of the researcher's understanding of the factors influencing the MIS adoption regarding disaster management by bringing out more comprehensive knowledge (Wisdom et al., 2012).

Qualitative Method:

Qualitative method is a scientific way of observation and reflection based on non-numerical data collected by the means of unstructured or semi-structured data collection techniques, such as interviews and focus group discussions. Qualitative study is exploratory in nature that helps in seeking an in-depth understanding of the topic of interest and identifying the variables initially. The qualitative approach is involved not only with the cause and effect of the event but also with insight and understanding of the issue; therefore, inquiry is a continuous process because multiple clarifications are necessary which are based on individual perspectives and contexts. In the qualitative study, instead of testing hypotheses, theories emerge as the data is recorded. It is a process of bringing order, structure and meaning to the mass of collected data (Marshall & Rossman, 1990). Qualitative method involved finding a relationship between categories and themes of data seeking to increase the understanding of the phenomenon (Strauss & Corbin, 1990).

Quantitative Method:

Quantitative method has multiple benefits for a researcher. For example, a quantitative study involves hypotheses formulation and empirical investigation to find out whether the researcher's assumptions are valid or not. It also involves reliability and validity tests on observable phenomena. Thus, the quantitative method allows greater generalization of the results. Quantitative method is easily reproducible and easy to measure without human emotions and perceptions. According to Jayaratne and Stewart (1995), quantitative method minimizes the biases in the findings of a study by applying mathematical and statistical calculations that help to conduct a study objectively (Jayaratne & Stewart, 1995). Besides, this method allows making an empirical inference based on collective information given by a large number and different types of respondents.

4.3 Research Design:

The study is cross-sectional in nature that has used a structured questionnaire for collecting data. The data collection methods incorporated in this study have been linked with the socio-economic condition in Bangladesh, where a schematic design is established for developing disaster management strategies. As this research is based on a mixed method approach where qualitative and quantitative parts are used for collecting data, the data collection techniques also involve a literature review, secondary data source analysis, interviewing the key informants or key stakeholders and focus group discussion with the local people for the qualitative part. The researcher designs the quantitive part by involving large-scale data collection using a structured questionnaire.

The first stage involves a qualitative part with a broad literature review, secondary data analysis, interviewing and focus group discussion (Figure 4.1). The literature review gathers as much as possible relevant information on the existing model, theories and case studies on the application of MIS in disaster management. However, the main objective of the broad literature review was to identify the factors or variables that influence the adoption of MIS for disaster management and identify the related scopes and problems. After that, the research proposes a conceptual framework based on theories of technology adoption. Then, the researcher also formulates the research objectives, questions, constructs and hypothesis. Then again, the research finishes the first stage by developing a sampling frame.

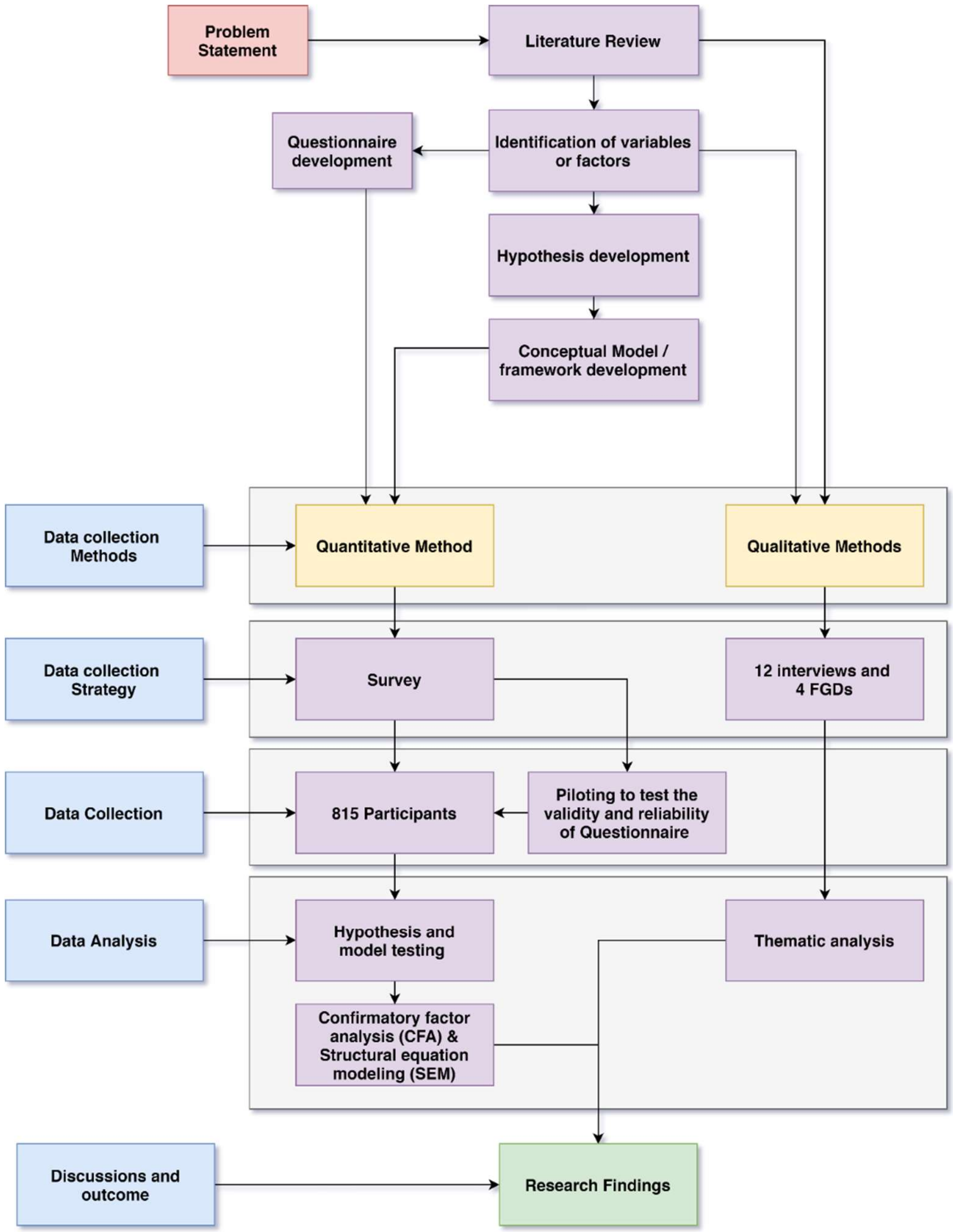


Figure 4.1: Research Process Diagram

In stage two, the researcher develops the instrument for data collection for the pre-test survey, pilot study and full-scale survey. This stage also involves testing of questionnaire's reliability and validity before a full-scale survey. In stage three, the research uses statistics for data analysis that includes confirmatory factor analysis (CFA) and hypothesis testing using partial least squares-based structural equation modelling

(PLS-SEM) (Harrington, 2009; Ullman & Bentler, 2012). Finally, the third stage ends with data and results in interoperation and thesis writing.

4.4. Sampling:

According to Teddlie and Yu (2007), sampling is a technique of selecting samples or subset units from a specific population of interest to conduct a study (Teddlie & Yu, 2007). The population in this study is the disaster-affected people living in areas of the country in different communities. Those people have used different kinds of technologies before, during, or after disaster events and ICT for preparing for disaster events and management. Almost every year devastating water logging takes place in Bhobodoho Water Logging in Jashore, Bangladesh keeps at least one million people under water for years. Due to hydrological complexities, the problem, caused by structural interventions funded by ADB and USAID, remains unresolved (Environmental Justice Atlas). The selected areas were different disaster-prone districts in Bangladesh including Bhobodoho Upazila of Jashore district as a water-logged area for data collection as cross-matching of selected data. Overall, nine districts (Dhaka, Narayangonj, Munshigonj, Kishorgonj, Gopalgonj, Jashore, Kushtia, Chattogram, and Coxs' bazar) were selected across Bangladesh for data collection. These districts were selected because they are commonly disaster-affected districts. The researcher also visited different disaster management organizations to interview the key informants.

The sample techniques depend on the research design. Some of the names of sampling techniques are snow-ball sampling, cluster sampling, purposive sampling or judgment sampling and convenience sampling. All the sample techniques can be divided into two types, namely probability sampling and non-probability sampling. For this study, purposive sampling or judgment sampling is chosen according to the purpose of the study which is exploratory in nature in the Bangladesh context. Purposive sampling or judgment sampling is a type of non-probability sampling that allows a researcher to include as much variation or homogeneity in the population sample as a researcher wants. The technique includes selecting individuals on purpose from a large chosen population based on the researcher's judgment that considers the purpose of the study. As purposive sampling permits a researcher to choose the samples that he or she deems as the best representative of the population concerning the subject to be studied. Thus, purposive sampling assists in justifying the generalization of the study findings (Sharma & Ravindran, 2017).

4.5 Sample Size and Instrument Design:

Sample size depends on the availability of economic resources (Krishnamurthi & Raj, 1988). According to Hair et al. (2012), a minimum size of 500 respondents is recommended for a conceptual framework that contains more than seven latent variables (Hair et al., 2012). On the other hand, according to Ullman and Bentler (2012), the sample size should follow the ratio of c:q, where c is the number of Constructs (c) and Question (q) is the number of items related to the constructs in the conceptual framework. For this study, the c is 8 and q is 31, therefore, the sample size should be a minimum of 248 (8 multiplied by 31). Later, with a target of surveying 850 respondents, the researcher ended up surveying 815 respondents. The researcher purposively selected the respondents who at least used IT-based MIS services before, or during, or after any disaster event.

Finally, as the author has followed the partial least squares-based structural equation modelling (PLS-SEM) technique for testing the conceptual framework, the author has followed the 'inverse square root method' to test if the sample size was enough (Vojvodic & Hitz, 2019). The 'Inverse square root method' was proposed by Kock and Hadaya (2018), which is specific to PLS-SEM (Kock & Hadaya, 2018). The formula is shown below, where, N = minimum required number of samples, 2.486 is the sum of the values for $Z_{.95}$ and $Z_{.8}$in Z score tables based on normal bell-shaped distribution, $|\beta|_{min}$is the lowest path coefficient value. As per Table 5.16, the path coefficient trialability is 0.130, which is the lowest in the table. The calculation shows that the minimum required sample size is 366 (rounding up to 365.69). Therefore, the minimum number of 815 respondents in this study was fairly above the minimum required sample size of 366.

$$N > \left(\frac{2.486}{|\beta|_{min}}\right)^2$$

$$N > \left(\frac{2.486}{0.130}\right)^2$$

$$N > 365.69$$

Source: Sample size techniques (Kock & Hadaya, 2018)

A structured questionnaire was used to collect data for quantitative study. On the other hand, semi-structured and open-ended questions were used for qualitative study. In this study, the instrument for data collection includes a literature review, in-depth interview, focus group discussion (FGD), and structured questionnaire. For qualitative study, twelve Key Informant Interviews (KII) and four Focus Group Discussions (FGD) were conducted on different disaster management organizations following purposive sampling. The author conducted three KIIs from four organizations, which were: MoDM&R, UNDP, SPARSO Bangladesh, IFRC Bangladesh, German Red Cross Bangladesh, CordAid, MoDM&R-CDMP Phase-II, OXFAM Bangladesh¸ ActionAid, a2i, Islamic Relief Bangladesh and Asian Disaster Preparedness Centre, Bangladesh & Bangkok.

The selection criteria for participants in KII were: 1) five years of job experience and 2) having a managerial or above position in their respective organizations. Also, there were four participants in each FGD, where the participants were the end-users who used IT services at least once for disaster management. Each FGD lasted for 30 minutes and the author probed the participants with various questions related to MIS's roles in disaster management.

4.6 Stakeholders' Mapping:

The participants as stakeholder and their mapping according to their roles in disaster management are shown in table 4.5.1 below. The researcher has selected 12 KIIs as participants where each 2 KIIs from the 12 KIIs belong to six types of stakeholder groups in the second column in the table. The column 3, 4, and 5 respectively map their level of interest, level of influence, and roles. This stakeholder mapping in the table allows identifying the stakeholders' roles involved during disaster management. Analyze stakeholders: For each stakeholder, mapping analyze their needs, scopes, expectations, and potential impact in disaster management. The mapping involves conducting surveys, interviews, or focus groups with stakeholders.

Types of participants	Stakeholder Groups	Level of Interest	Level of Influence	Needs/scopes/expectations
KII	Government agencies	High	High	Access to resources, reliefs, and funding, clear communication channels
KII	Local and national NGOs	High	High	Access to funding and resources, effective coordination
End-users	Local communities and residents	High	Low	Timely and accurate information, access to resources and support
KII	Private sector companies	High	Low	Access to funding and resources, coordination with stakeholders
KII	Media organizations	High	Low	Timely and accurate information, access to government officials
KII	International organizations	Low	High	Coordination with stakeholders, access to resources and funding

Table 4.5.1: Stakeholders' Mapping

It is important to follow the five steps below for instrument design:

Step 1: Specify the Domain of Constructs

The objective of this step is to obtain a lucid meaning of the constructs in the conceptual model (Williams & Lewis, 2005). In this regard, to explore the role of MIS in disaster management it is important to conduct an extensive literature review and Construct definitions used in the conceptual framework below (Table 4.5.2).

Construct	Definition	Reference
Perceived usefulness	The extent to which users believe that using a particular system would enhance their job performance.	(Davis, 1989; Puriwat & Tripopsakul, 2021; Seo & Lee, 2021)
Perceived ease of use	The extent to which users believe that using a particular system would be free from effort.	(Davis, 1989; Effendy et al., 2021; Yang et al., 2021)
Relative advantage	The extent to which new technology is perceived better than others.	(Lin et al., 2020; Mombeuil & Uhde, 2021; Rogers, 2002)

Compatibility	The degree to which an innovation is perceived as relatively difficult to understand and use.	(Alam & Ray-Bennett, 2021; Rogers, 2002; Suebtimrat & Vonguai, 2021)
Complexity	The amount of difficulty perceived by an individual user in adopting new technology.	(Al-Zoubi et al., 2019; AlBar & Hoque, 2017; Rogers, 2002)
Trialability	Trialability factor states that whether the users get the scope to use a new technology for testing its usefulness can determine the adoption of that technology.	(Alhasan et al., 2022; Jilani et al., 2022; Rogers, 2002)
Observability	The observability factor emphasizes the fact that the benefits of using any new technology as outcomes need to be noticeable for the adoption of that technology.	(Fred D. Davis, 1989; Iskandar et al., 2020; Kim & Mehta, 2022)
Behavioural intention	Users' subjective possibility that they would participate in a certain behaviour.	(Ghio et al., 2021; Mailizar et al., 2020; Rogers, 2002)

Table 4.5.2: Construct definitions used in the conceptual framework

Step 2: Identifying items for the Constructs

After acquiring a clear understanding of the concepts and definitions of the constructs, it is important to identify the items for all the constructs to measure. The items are selected for the previous studies in the existing literature based on the fact that how much those items have contributed to the previous studies and how much those items are relevant to this study currently. Following the study of the items adopted for this study by has provided in (Table 4.2) below (Carter et al., 2022; Lin et al., 2020). The table shows the related items adopted for the constructs in the conceptual framework.

Construct	Items
Perceived usefulness (PU)	1. The technology **(**MIS) based information and instruction enable me to take necessary actions. 2. The provided information and instructions are valuable. 3. The provided information and instructions are effective. 4. The provided information and instructions are required for life-saving and damage minimization.

	5. The provided information and instructions are useful.
Perceived ease of use (PEoU)	1. The way to get technology **(**MIS) based information and instructions is easy to follow. 2. The way to get information and instructions is clear. 3. The way to get information and instructions is through flexibility to interact. 4. The way to get information and instructions is understandable. 5. The way to get information and instructions does not need special skills.
Relative advantage (RA)	1. Enhance my ability to get necessary information and instructions. 2. Enhance my efficiency to get necessary information and instructions. 3. Lessen difficulty to get necessary information and instructions. 4. Easier to get the necessary information and instructions. 5. Easier to cooperate or interact with.
Compatibility (Comp)	1. Fits my need to get the necessary information and instructions to cope with disaster situations. 2. Match the way I want to interact. 3. Fits the demand of the situation. 4. Compatible with the way I want to receive information and instructions. 5. Compatible with the existing system
Complexity (Comx)	1. The difficulty in using technology **(**MIS) based information and instructions would prevent me from using it. 2. It is important to get necessary devices or gadgets easily for getting technology (MIS) based information and instructions.
Trialability (Tr)	1. It is important to have the opportunity to try technology (MIS) based information and instructions in disaster events first. 2. It is important to have a satisfactory trial use of technology (MIS) based information and instructions in a disaster event.

Observability (Ob)	1. The benefits of using MIS for providing information and instructions in disaster events are observable 2. The results of using MIS for providing information and instructions in disaster events are apparent.
Behavioural intention (BI)	1. Like using the technology (MIS) based on information and instructions regarding disaster events and management. 2. Like to take action accordingly. 3. Like disseminating the information obtained. 4. Like to follow the instructions obtained. 3. Like interacting with the instructions or information provider.

Table 4.5.3: List of related items adopted for the constructs in the conceptual framework

Step 3: Pre-Test Survey

The objective of the pre-test survey is to increase the validity of the selected items of the constructs in the conceptual framework. The pre-test survey is recommended to conduct with people who are experts on the subject to be studied. In this study, the IT users involved were the academics of the MIS department at Dhaka University in Bangladesh. The academics were asked for rating the items from 1 (Strongly Irrelevant) to 5 (Strongly Relevant) to measure the relevance between items and constructs. Further, the academics were also asked for examining each definition of the construct to identify whether was appropriate or not.

As a part of the pre-test survey, 25 respondents were approached with the developed questionnaire. Some rewording was done according to the suggestions provided by the respondents. When testing the internal consistency, it was found good, with the Cronbach's Coefficient Alpha value for the pre-test survey being 0.77, which is greater than the recommended value of 0.70 (Litwin & Fink, 1995).

Step 4: Addressing the Common Method Bias

The presence of common method bias can result in inaccuracies in measurement. This bias is characterized as 'the misleading variability that arises from the measurement method itself rather than from the constructs the measurements are intended to depict' (Podsakoff et al., 2003). To avoid common method bias, various scale types, reverse coding, and semantic scaling instead of the most commonly used Likert scale are applied.

In this study, the reverse coding technique was followed to have the respondent's attention on the questions and make them answer carefully instead of answering automatically.

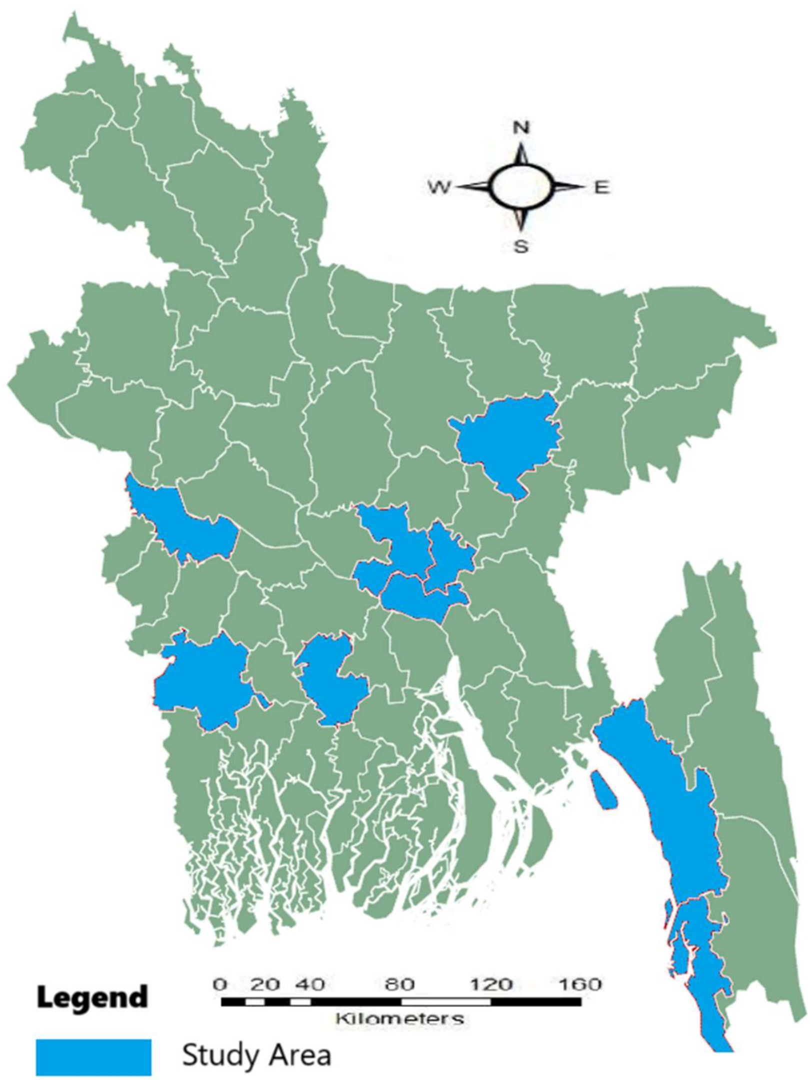
Step 5: Pilot Study

To further strengthen the content validity, a pilot study has been conducted. In this process, the researcher used multiple formats of survey questions for avoiding the common method bias. The hard copy of the different formats of questionnaires was distributed to 50 respondents from the University of Dhaka. The researcher met the respondents in person, consulted, and also supported them to answer the questions in case they face any difficulty or ambiguity in understanding the questionnaire. In this step, it was found that the respondents were able to understand the contents of the questionnaire clearly. The average time in completing a questionnaire was 23 minutes. After finishing the pilot study, the researcher modified eight items and three items were reworded to remove ambiguity. Finally, the specific changes and modifications have made the questionnaire ready to conduct the actual study.

4.6 Data Collection:

Under the methodology process, a purposive method was carried out in the study of the different areas to identify the exact population to draw a representative sample. The respondents were selected from the University of Dhaka, Savar, Mawya ghat, Narayangonj, Munshigonj, Kishorgonj, Tungibari in Gopalgonj district, Meherpur upazila in Kushtia district, Chattogram and Coxs' bazar districts of Bangladesh and Bhobodoho upazila of Jashore district a total of 850 respondents was identified as the population of the study. For qualitative study, 12 interviews and 4 Focus Group Discussions (FGD) were also conducted on different disaster management organizations. following purposive sampling.

The respondents were selected randomly from those over 16 years of age. The questionnaire surveyed IT users of the location. Inside each community, an attempt has taken to get a great, statistically sound test of views. It is inconceivable to distinguish and meet all influenced community individuals, in this manner, a test of 10 people was distinguished from a given list of people from each FGD. However, not one or the other of the tests constitutes strict likelihood tests of the population of each community since accessibility and openness for interviews are imperative limitations. Much care has been taken to maintain a strategic distance from people with solid views impacting both the genuine examining as well as the meet handle of other individuals. The researcher got a response from 815 respondents, among these only 782 surveys were eligible for data analysis after the data preparation process.



Map 1: Map of Study Location

(Legend: Dhaka, Narayangonj, Munshigonj, Kishorgonj, Gopalgonj, Jashore, Kushtia, Chattogram, and Coxs' bazar)

4.8 Reflective and Formative Construct Specification:

In this step, considering the latent variables, the researcher established hierarchical component models (HCMs) to test the conceptual framework using Partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2012). The HCM has two layers

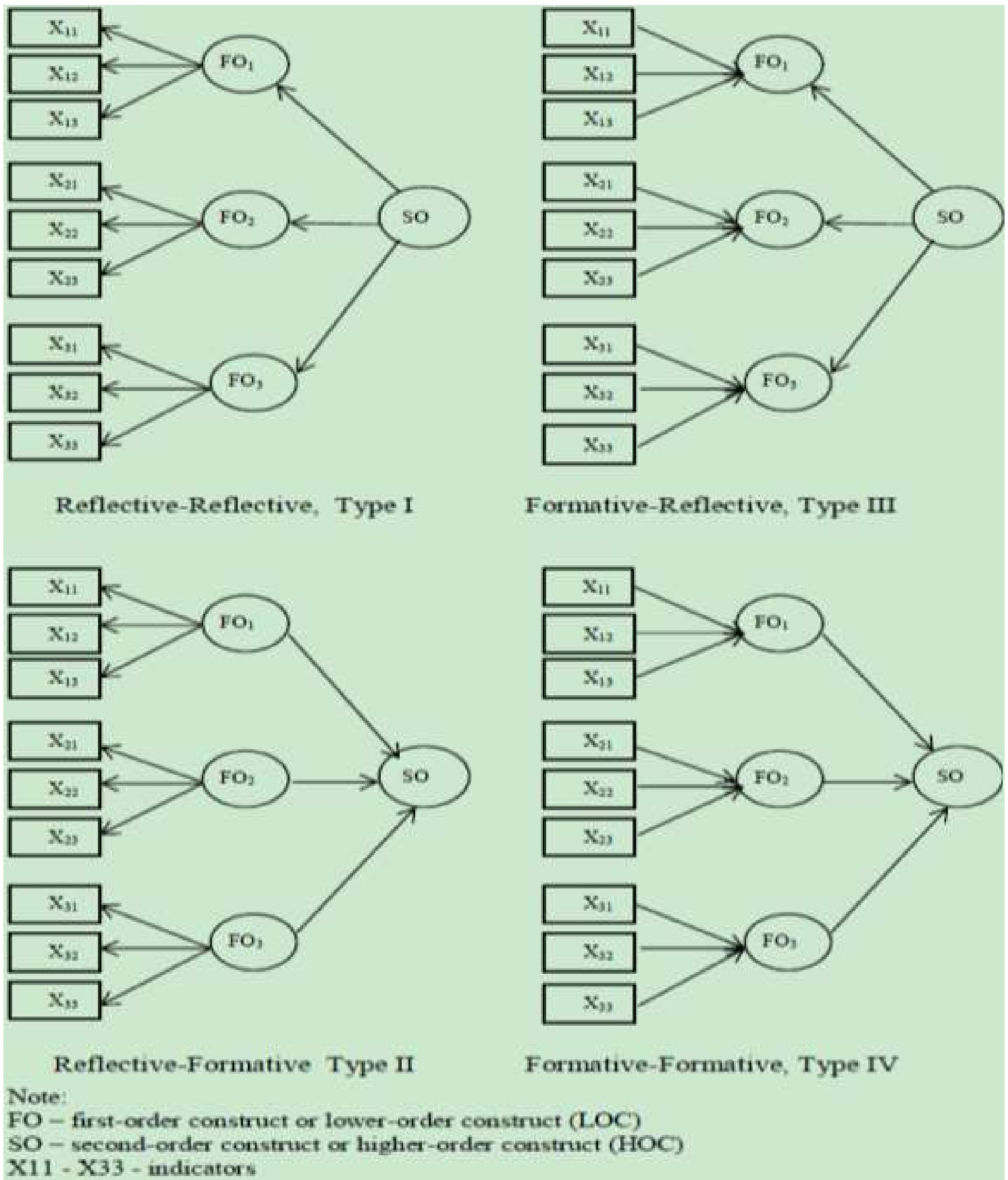


Figure 4.2**:** Hierarchical Component Models. Source:(Becker et al., 2012)

called first-order and second-order. The relationships among the first-order variable are either reflective or formative in nature. In a reflective nature, the causality of factors flows from the latent variable to the indicators, whereas, in a formative nature, the causality of factors flows from items to a construct (Figure 4.2).

To develop a conceptual model, it is crucial to identify the reflective and formative nature of the model to avoid poor designing of the relationships among the constructs that can lead to obtaining wrong research findings. Besides, the selection of reliability and validity test techniques depends on the understanding of whether the conceptual framework is reflective or formative in nature (Diamantopoulos, 2006). According to Hair et al. (2012), the Category II- Reflective-Formative model is very frequently used in the domain of MIS. In this study, the Category II- Reflective-Formative model is used for testing the conceptual framework, where all the constructs are formative second-order in nature (i.e., arrows indicate from constructs to items) and all the items are reflective first-order factors as in nature.

4.9 Analytical Framework:

In the qualitative study, the author used thematic analysis based on the data from KIIs and FGDs. The thematic analysis allows the identification and reporting of repeated patterns of information extracted from data (Kiger & Varpio, 2020). In thematic analysis, the information is extracted through the processes of coding and constructing themes. For hypotheses testing in the quantitative study, SPSS v23 **(**Statistical Package for the Social Sciences) was used. Then for testing the conceptual framework, the partial least squares-based structural equation modelling (PLS-SEM) technique was used using Smart-PLS 3.0 tool. PLS-SEM is a multivariate statistical technique that allows the estimation of the cause-effect relationships between the latent variables as well as estimates how much a conceptual framework can explain the dependent constructs in terms of variance (Kono & Sato, 2022). The advantages of PLS-SEM include its ability to estimate very complex models and its requirement for a small sample size. PLS-SEM is often used across different management disciplines, including organization research Sosik et al. (2009) and strategic management Hair et al. (2012).

4.10 Researcher's Ethics:

This research has been conducted based on the ethics guidelines of the Human Research Ethics Committee, of the University of Dhaka. The Ethical Review Policy of the

Institute of Disaster Management and Vulnerability Studies (IDMVS) has also been followed.

4.11 Summary:

This chapter presents a detailed discussion of the methodology development process followed by this study. At first, the influence of the epistemological and ontological perspectives was discussed regarding the methodology development process. Besides, it has also discussed and justified why the positivist approach was chosen. The justification of research design, type, methodology and sampling techniques were discussed in this chapter. In this study, the researcher has chosen to follow the mixed method approach: quantitative method or qualitative methods. This is because either the quantitative method or the qualitative method alone cannot adequately fulfill the gaps in the understanding of the problem to be addressed. The mixed method helped in enriching insights into the specific research questions that might not be completely understood when following a single method (i.e., a quantitative or a qualitative method). The mixed method can provide both complementary and contradictory results. If the results from the mixed method are complementary, then the finding becomes strong, and if contradictory, then the study finding could lead to a new direction for further future study. Besides, the mixed method, if the findings are complementary, helps in the additional explanation and generalization of the study findings. The next chapter details the findings and analysis of the study.

Chapter 5: Research Findings

5.1 Introduction

This chapter represents the data preparation and analysis processes. To investigate the factors influencing the adoption of Management Information Systems (MIS) based services for disaster management by the end-users, the findings from both the qualitative and quantitative studies are presented in this chapter. The qualitative data have been discussed here based on KIIs (stakeholders) and FGDs (end-users). The data preparation and analysis for quantitative study required three major steps: namely, (l) missing data analysis, (2) normality analysis, and (3) biasness testing. In the data analysis part, the chapter presents the reliability testing of the questionnaire and validity testing of the proposed model and details of data analysis before hypothesis testing by smart Partial Least Square (PLS) regression. These relationships between constructs/factors are explored. The major uniqueness of PLS regression is to preserve the irregularity of the relationship between predictors and dependent variables, whereas these other techniques treat them symmetrically. In this chapter, the findings from three sources, namely: (a) Quantitative findings from the survey questionnaire, (b) Qualitative findings from interviews with those engaged in disaster response and (c) the researcher focused the quantitative survey from the findings of qualitative data. In many cases, precise quotes extracted from the group discussions and in-depth interviews are included. Here the researcher`s responsibility is to comment on how the qualitative findings help to elaborate on the quantitative results (Creswell & Zhang, 2009). Further, this chapter details the demographic information of the participants of the study. It should be mentioned that gender-specific data (i.e., male and female-headed household-wise data) are presented in this section. The demographic information in this chapter focuses on:

1. Personal details of the respondents
2. General understanding of IT users
3. Presenting adaptation strategies practiced by the community
4. Presenting issues that indicate its adaptation

5.1.1 Demographic information

The demographic data analysis shows that the author initially approached 850 respondents **(**IT users) and interviewed 12 KIIs and conducted 4 FGDs. Finally, a total number of 815 respondents were identified as the population of the study. The demographic information includes socio-demographic information of the respondents such as age, sex, educational level, income and major occupation of the respondents. This study investigated multiple descriptive variables to identify the relationships and their patterns among all those variables. The descriptive statistics include the representation of graphs and tables of the population that participated. Once the data was collected and classified, different statistical techniques were applied to conduct the descriptive analysis. These techniques were measuring the total number, mean, and standard deviation.

5.1.1.1 Gender Ratio

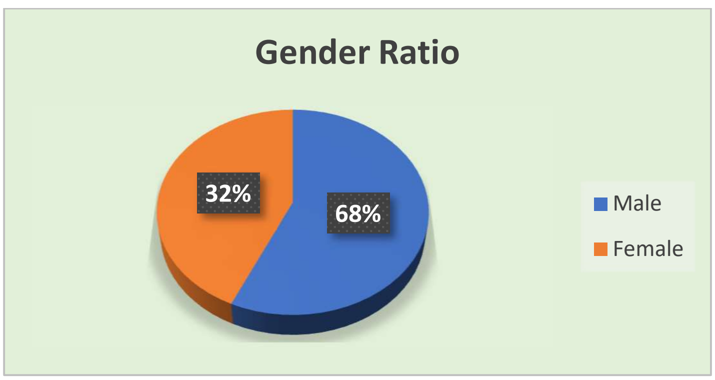


Figure 5.1.1: Gender ratio

As is shown in Figure 5.1.1 the gender ratio where the ratio between male and female respondents was thirty-two percent and sixty-eight percent respectively.

5.1.1.2 Age of Respondents

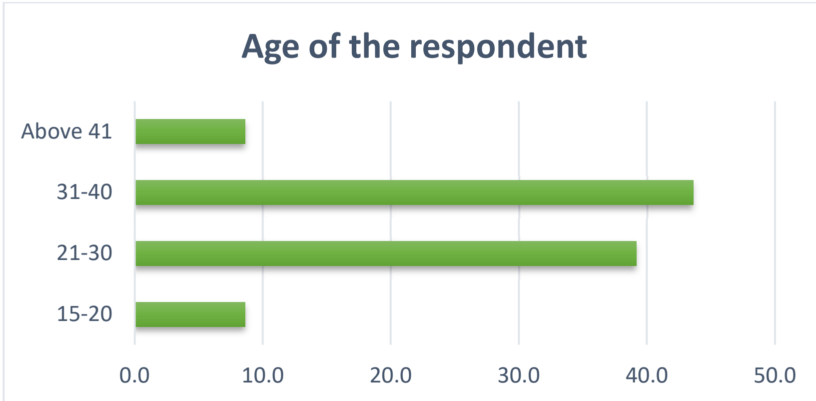


Figure 5.1.2: Age of the respondents

As is apparent in Figure 5.1.2, the respondents were grouped into three categories of age range which are 15-20, 21-30, 31-40 and above 41 respectively. From the above figure, we can see that 8.6 percent of the respondents belong to the age group of 15 to 20 years and the age group of people above 41 years of age. There are only about forty-four percent (43.6%) of the respondents belong to the age group of 31-40 years old, whereas, 39.2 percent of the respondents belong to the age group of 21-30 years old. Age range is significant for understanding IT-based disaster management. The minimum, maximum. and the mean age of the respondents was 19,63 and 34.4.

5.1.1.3 Respondents' income

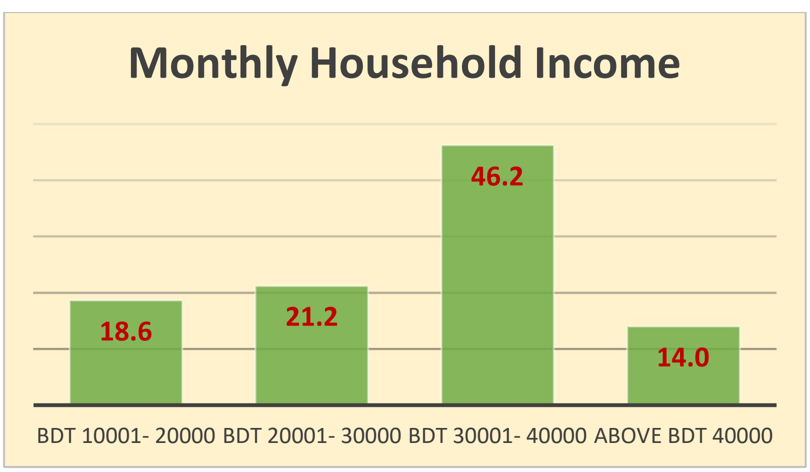


Figure 5.1.3: Income Distribution

Figure 5.1.3 shows that most of the respondents about forty-six percent (46.2%) have a monthly income of between 30001-40000 taka. And 18.6%, 21.2%, and 14% of the respondents have a monthly income between 10001–20000-taka, 20001-30000 taka and above 40000 taka respectively. The minimum, maximum. and the mean income of the respondents was about 13,000, 70,000 and 30,000.

5.1.1.4 Respondents' Education

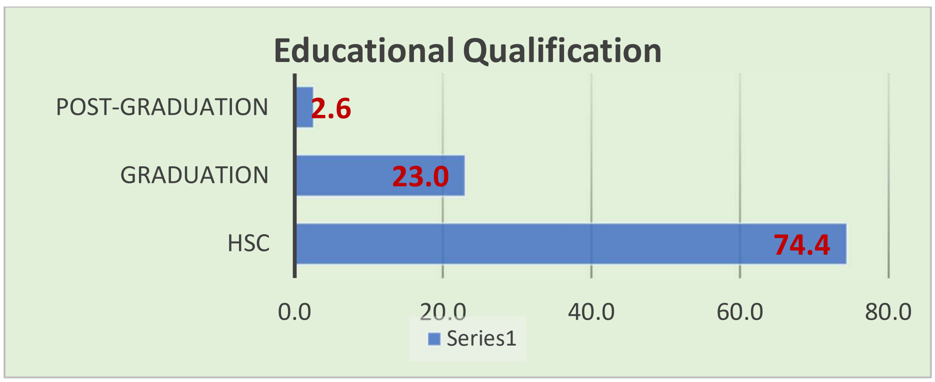


Figure 5.1.4: Education Distribution

Figure 5.1.4 depicts the distribution of educational qualifications of the respondents. It shows that 2.6% of the respondents had a post-graduation degree and twenty-three percent of the respondents had a graduation degree. The graph also shows the education level of most of the respondents about seventy-four percent (74.4%) are completed a Higher Secondary School certificate. Educational qualification is significant to understand IT-based disaster management.

5.1.1.5 Employment status

Figure 5.1.5: Employment status

Figure 5.1.8 shows that 73% of the respondents were employed whether in a job or service while 27% of the respondents were unemployed.

5.1.1.6 Distribution of participants from each district

Table 5.1.1 below shows the respondents' distribution according to their respective districts. It shows that Dhaka (31.8%) has the highest number of respondents followed by Narayangonj (16.4%). On the other hand, Gopalgonj has a lower number of respondents.

Districts	**Number**	**Percentage**
Dhaka	259	31.8%
Narayangonj	134	16.4%
Munshigonj	46	5.6%
Kishorgonj	54	6.6%
Gopalgonj	40	4.9%
Jashore	84	10.3%
Kushtia	68	8.3%
Chattogram	83	10.2%
Coxs' Bazar	47	5.8%
Total	815	100%

Table 5.1.1: Respondents' distribution according to their respective districts

5.1.1.7 Respondents' distribution of IT knowledge, awareness, and uses

Table 5.1.2 shows the respondents' preference and distribution of IT knowledge, awareness, and uses. It was found that ninety-seven percent of the respondents use a cell phone. It is a positive sign for using SMS or voice mail-based disaster warnings and disaster management can be practiced. Also, about eighty-two (82%) receive SMS alerts for preparation before the disaster as since 2019 MoDMR is providing a 'Weather Forecast' on disasters through a specific mobile hotline number 1090. A text message service to warn people of disasters, including floods and cyclones has also been introduced. And about (18%) are not aware of the hotline number (1090) for weather news. Besides, data shows that only forty-one percent of the respondents know about ICT-based disaster management.

IT knowledge, awareness, and uses	Yes	No
Distribution of cell phone use	97%	3%
Reception of SMS alerts for disaster warning	82%	18%
Respondent's awareness about the weather news hotline	86%	14%
Awareness of ICT-based disaster management	59%	41%
The ratio of ICT-based disaster warnings from GoB/NGOs	38%	62%
Internet browsing facility on a mobile	58%	42%
Using weather news/disaster warning news on the internet	39%	61%
Respondents' perception about using ICT for disaster warning	73%	27%
Respondent's perception of the cost of using ICT for disaster warning	34%	66%

Table 5.1.2: Respondents' distribution of IT knowledge, awareness, and uses

Table 5.1.2 also shows that only thirty-eight of the respondents received ICT-based disaster warnings from either the GoB or different NGOs. Further, it has been learned that fifty-eight percent of the respondents have a mobile that can be used for internet use. As well as, only thirty-nine percent of the respondent use the internet either from PC or mobile to obtain weather or disaster warning news. Moreover, the data shows that seventy-three percent of the respondents think ICT can minimize the loss of lives and property damage if used for disaster warnings. In addition, sixty-six percent of the respondents think it is expensive to collect information on disasters using ICT.

5.1.1.8 Medium of getting disaster warning

It has been revealed that television is the most available media about forty-two percent are getting disaster warnings. Eighteen percent of the respondents reported that they are also informed by the announcement from the masjid. About fifteen percent of the respondents receive mobile SMS alerts and 9.8% of the respondents receive a warning from NGO. Moreover, 2.4% and 4.4% of the respondents receive alerts from the local authorities and voice all from relatives (Figure 5.1.6).

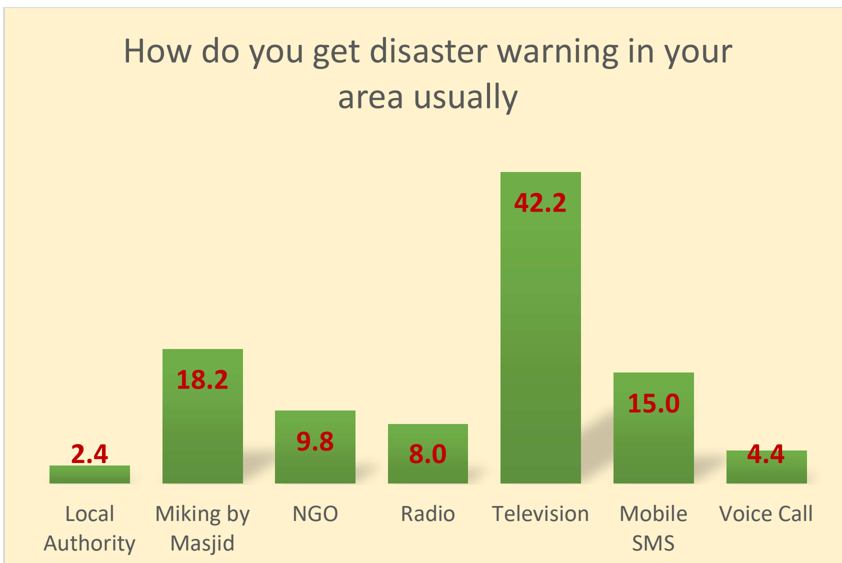


Figure 5.1.6: Frequencies of the mediums of getting disaster warning

5.1.1.9 Types of information based on ICT

Figure 5.1.7 shows that sixty-two percent of the respondents prefer to receive an early warning from ICT-based disaster management services whereas thirty-three percent of the respondents prefer receiving social counselling. On the other hand, only 5 percent of the respondents prefer to receive news about health safety.

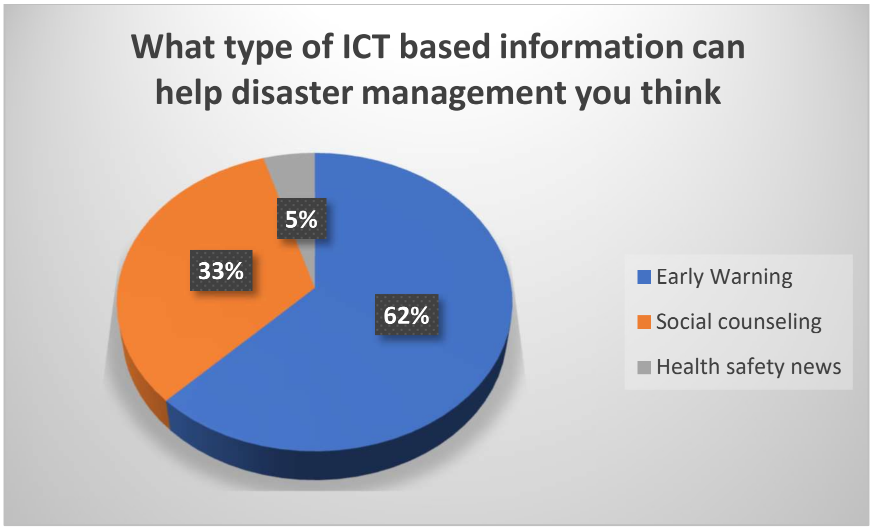


Figure 5.1.7: Types of information based on ICT

5.1.1.10 Effectiveness of IT for early warning in disaster

The data presents the ratios of the different answers that the respondents gave when asked whether IT-based services are effective in providing an early warning before a disaster. Seventy-five percent of the respondents think that IT-based early warning is effective whereas fifteen of the respondents think the opposite. On the other hand, nine of the respondents neither agreed nor disagreed with the statement that IT-based early warnings are effective. A negligible percentage (1%) of the respondents strongly believe that IT-based early warning is not effective (Figure 5.1.8).

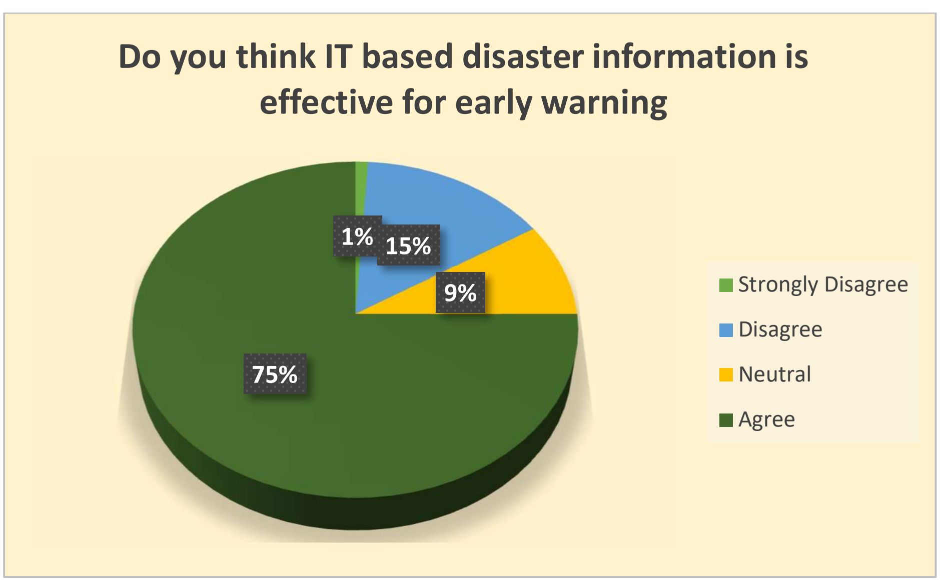


Figure 5.1.8: Effectiveness of IT for early warning in disaster

5.1.1.11 Risk reduction by IT-based disaster management

The data shows the percentages of the various responses that the respondents gave when asked whether IT-based disaster management can reduce the risk of disaster. Seventy-three percent of the respondents think that IT-based disaster management can reduce the risk of disaster whereas nineteen percent of the respondents think the opposite. On the other hand, 6 percent of the respondents neither agreed nor disagreed with the statement that IT-based disaster management can reduce the risk of disaster. Also, a minor (only 1%) percentage of the respondents strongly believe that IT-based disaster management cannot reduce the risk of disaster (Figure 5.1.9).

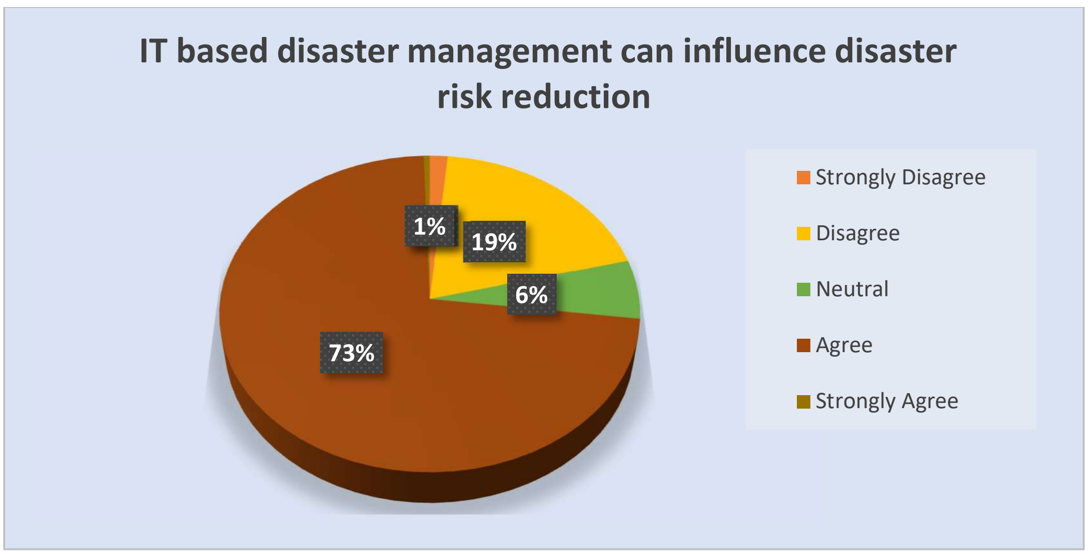


Figure 5.1.9: Risk reduction by IT-based disaster management

5.2 Qualitative data analysis

The researcher has conducted 12KIIs where the participants were the stakeholders and 4 FGDs where the participants were end-users to identify the roles of MIS in disaster management. For qualitative analysis, thematic analysis was chosen which entails coding based on the data collected from KIIs and FGDs. The thematic analysis technique has seven steps for identifying, analyzing, and reporting common categories of topics or issues in qualitative data. The steps are: 1) reading the data to highlight important texts,2) developing topic-wise categories, 3) generating codes, 4) generating themes by assigning codes to the major categories, 5) reviewing themes,6) defining themes, and 7) results presentation. When a number of codes meaningfully belong to a category, a theme is created. While creating themes, the researcher ensures that they are characterized by significant attributes for reviewing the themes step. The thematic analysis reveals eight themes in total where four from KIIs and four from FGDs. The four themes from KIIs are: 1) information access, 2) strategic planning, 3) operational management, and 4) disaster risk assessment. Similarly, four themes from FGDs are 1) affordability, 2) connectedness, 3) coordination and 4) decision-making. These themes are presented below which help the author to identify the role of MIS in disaster management.

5.2.1 Information Access

The ability to retrieve and use information from various sources is referred to as information access. This can include retrieving information from databases created based on different sources. It is critical because it involves the organization in such a way that users can easily find and use the information they require. In the context of disaster management, previous studies by Sakurai and Murayama (2019) and Karimiziarani et al. (2022) reported that information access is important for disaster management (Karimiziarani et al., 2022; Sakurai & Murayama, 2019). The author quotes the following statements from the respondents below that show that MIS plays role in disaster management by providing information access.

From KII respondents:

> "…MIS can help to gather a significant amount of time-sensitive and knowledge-intensive data from different sources and organizations. Therefore, MIS can provide access to real-time data and information, hence allows information sharing easier, which is necessary to create situational awareness. The sources of data for MIS systems include sensors, surveillance systems, and even social media platforms as well as government, non-government and private organizations. These

organizations are both national and international bodies for disaster management.”

“... Access to information is important for choosing different response options as well as identifying the trends and patterns in the data. Without MIS, we could not generate enough data to support these tasks. On the other hand, the introduction of MIS helps in mapping, data and information sharing which are important for measuring damages, listing resources, and tracking progress in actions to be taken for disaster management. Besides, MIS is needed for solid knowledge of geographical distribution which is important for designing proper disaster relief projects. Overall, using MIS can play a vital role in disaster data management that enables access to significant information for everyone.”

“... For disaster management, MIS contributes in providing access to information to all levels of employees, from top-level directors to managers to end-level workers, which is significant for facilitating communication among each other for decision making as well as to address the challenges of disaster management. However, it is important to remember that incorrect or unauthentic information can cause great damage in the process of disaster management.”

Thematic code	Determining factor
Information Access	MIS infrastructure

Table 5.2: Information access and determining factor

5.2.2 Strategic Planning

Organizations use strategic planning to set priorities and resources and ensure the creation of a long-term plan for the organization that outlines its goals and objectives, as well as the steps necessary to achieve them. The information generated from the integration of MIS is important to create a plan to guide the organization toward its objectives. MIS can facilitate the implementation of strategic planning in an organization. For disaster management, strategic planning entails developing a long-term plan for responding to and recovering from disasters. This type of planning is important because it helps to ensure that an organization is prepared to deal with the aftermath of a disaster and has the resources and capabilities to respond effectively. In disaster management, strategic planning typically entails conducting a thorough risk assessment to identify potential hazards and vulnerabilities, followed by developing a plan outlining the steps that will be taken to mitigate or reduce those risks (Ahmed, 2013; Ranaei Kordshouli, 2015). How MIS facilitates the implementation of strategic planning in disaster management is manifested in the quotes of the statements of the respondents below.

From KII respondents:

> "... As information is important for strategic management of disaster management, MIS plays crucial roles by providing information using which we formulate strategic plans in disaster management. Further MIS allows the modelling and simulation of damages from disaster events which is useful for making strategic planning beforehand. Efficient strategic planning can minimize the cost of disaster management as well as streamline the recovery and reconstruction efforts."

> "... MIS enables strategic planning by taking data-driven decisions that can help reduce the risk of costly errors and ensure that response efforts are effective based on up-to-date information available from partnering with different institutions. Also, the implementation of strategic planning for disaster management involves fuzzy and inter-dependent nature of disaster management activities, where the roles of MIS are indispensable."

> "... A functional MIS system can make it much easier and faster capacity building to generate reports, budgets, and analyze issues on time, which all are part of strategic planning for disaster management. MIS also contributes to disaster management by managing human resources in our organization."

Thematic code	Determining factor
Strategic Planning	MIS infrastructure

Table 5.3: Strategic planning and determining factor

5.2.3 Operational Management

The process of managing and directing an organization's day-to-day operations is known as operational management. The management of business procedures to achieve the utmost level of efficiency within an organization. It is an important aspect of management because it helps to ensure that the organization's goals and objectives are met. In disaster management, operational management refers to the processes and activities that occur during the disaster response phase. This step typically follows the immediate response to a disaster and includes tasks such as coordinating resource deployment, establishing and maintaining communication channels and managing overall response efforts. Previous studies show that operational management is a critical component of disaster management because it helps to ensure that response efforts are well-organized and effective (Galindo et al., 2018; Yan & Pedraza-Martinez, 2019). The author quotes the following statements from the respondents below.

From KII respondents:

> "… MIS supports online documentation, communication and coordination which is essential for operational control and management during disaster management. As effective disaster management involves intricate and interrelated activities Using MIS is important to oversee and follow up the operational management both on departmental and organizational levels during disaster management. Besides, MIS allows stakeholders such as NGOs to support disaster operation management plans energetically. Overall, operational management includes planning, organizing, and controlling various resources and processes in an organization including information sharing and communication which all are enhanced by MIS."

> ".. MIS plays a critical role in disaster operation management by providing the tools and information required for effective disaster planning, response, and recovery. In disaster management, most of the key tasks that are

typically associated with operational management are facilitated by the integration of MIS."

"… MISs that monitor GIS environment to provide information to managers and aid them in decision making for operational management that involves systematic resource planning and management. MIS also helps to understand quantity and magnitude of previous hazards records and distribute resources and workload and facilitate communication between related departments which is necessary during operational management during disaster management."

"… We have to comply with various disaster management programs and bodies such as World Food Program (WFP), Disaster Management Bureau (DMB), UN Strategy for Disaster Reduction (UNISDR) and the Asian Disaster Preparedness Centre (ADPC). For that, the integration of MIS is extremely important, if fact, it is not possible to run disaster management operations according to those disaster management programs and bodies. Additionally, MIS is important for interoperability, information sharing and feedback which are the parts of operational management."

Thematic code	Determining factor
Operational Management	MIS infrastructure

Table 5.4: Operational management and determining factor

5.2.4 Disaster Risk Assessment

A disaster risk assessment is the process of identifying and evaluating a community's or region's potential risks and vulnerabilities to natural disasters. This type of assessment typically entails gathering and analyzing data on a variety of factors, including the likelihood of a disaster occurring, the potential impact of a disaster on the community, and the available resources and capabilities for responding to and recovering from a disaster. Therefore, MIS has significantly a potential scope in the process of disaster risk assessment. Previous studies also highlight that disaster risk assessment is an important tool for disaster management because it provides critical information that can be used to develop effective disaster response and recovery strategies (Bernal et al., 2017; Tsai & Chen, 2010). The author quotes the following relevant statements from the respondents below.

From KII respondents:

> "... Risk management is a continuous process of disaster management. In this regard, MIS integration is important for hazard identification, hazard exposure, and hazard forecast. All these steps are also necessary for risk assessment, risk analysis, risk prevention and. Risk management. All these steps need the collection and analysis of data which is made possible by integrating MIS. On the other hand, using MIS-generated data, we can create risk-grade specific alerts and conduct awareness campaigning."

> "… Using early warning indicators of MIS, we can identify hazards and risks as well as the related environmental and socioeconomic parameters involved. Additionally, MIS helps us to determine specific hazards for tsunami, cyclones, flood, and earthquakes as well as visualization of different scenarios of hazards."

Thematic code	Determining factor
Disaster Risk Assessment	MIS infrastructure

Table 5.5: Disaster risk assessment and determining factor

5.2.5 Affordability

A user's ability to pay for the services is referred to as affordability. In disaster management, it refers to individuals', households', and communities' ability to pay for the services such as information required to prepare for, respond to, and recover from disasters. It can include things like emergency shelters, supplies, temporary housing, and medical care. It is frequently a deciding factor, and it can influence the decisions that individuals and households make. MIS-based services can provide information, instructions or other assistance to individuals and communities in order to make disaster management more affordable (Wallace & Sheetz, 2014; Zagorecki et al., 2013). This can help to ensure that everyone, regardless of financial situation, has the resources they need to prepare for and respond to disasters. The author quotes the following statements from the respondents below.

From FGD respondents:

> "… we receive alert information which is a type of communication used in disaster management to notify people about a future or ongoing disaster. We receive an alert for free via a variety of channels, including radio, television, social media, and mobile phone alerts. It helps us to get timely and accurate information about the disaster, such as its location, the type of hazard involved, and potential impacts and consequences. Such timely information assists us in taking appropriate action to protect ourselves and their property, as well as prepare for the disaster's potential effects."

> "... MIS-based services have improved this communication by voice and SMS in a disaster event. However, in a real-time situation, where I need to search for disaster information or disaster warning etc. I would prefer receiving information of early warning straight away on my cell phone without spending any money. Otherwise, it may take me to the warning center for queries."

Thematic code	**Determining factor**
Affordability	Access to MIS Services

Table 5.6: Affordability and determining factor

5.2.6 Connectedness

In disaster management, connectedness refers to the degree to which individuals, organizations, and communities are interconnected and capable of communicating and sharing information with one another. This is useful in disaster situations because it ensures that people have access to the information and resources they need to prepare for, respond to, and recover from disasters. In the event of a disaster, if people are connected, they may be able to quickly and easily share important information and resources, such as emergency supplies and shelter. Furthermore, a previous study reported that connectedness can aid in the collaboration of communities involved in disaster management, hence, potentially improving the overall response to a disaster (O'Sullivan et al., 2013). It can help to identify the location of a disaster such as a cyclone as a moving target at any moment and also create significant value in disaster events. The author quotes the following statements from the respondents below.

From FGD respondents:

> “...MIS based services such as SMS alerts before and during disaster management enable poor and disempowered citizens to be connected to time-critical information. Such services can provide information on the spot and save lives or damages due to disaster.”
>
> “… During disaster events, my main concern is to ensure ready adequate information of the changing situation. It is essential as the moving people do not realize the criticality of reaching the goods on time. This system will make my situation much easier by providing connectedness timely.”
>
> “… the MIS service gives us a sense of connectedness that can help to build resilience and improve the effectiveness of disaster management efforts. Communication is an essential component of disaster management because it allows for the coordination of response efforts, the dissemination of information and guidance to the public, and the maintenance of situational awareness. Effective communication in disaster situations can help to save lives, reduce the overall impact of the disaster, and facilitate the recovery process. It is critical to have MIS-based communication service that can be used to share information quickly and effectively in disaster management utilizing technologies, such as mobile phone alerts.”

Thematic code	Determining factor
Connectedness	Access to MIS Services

Table 5.7: Connectedness and determining factor

5.2.7 Coordination

Coordination is an essential component of disaster management because it ensures that the various organizations and agencies involved in disaster response work effectively together. It is critical in disaster situations because it ensures that available resources and capabilities are used in the most efficient and effective manner possible. This may entail coordinating the activities of various organizations and agencies, such as emergency responders, public health officials, and disaster relief organizations, to ensure that they are all working toward the same goal. Coordination can also entail coordinating the distribution of resources, such as emergency supplies and personnel, to ensure that they are distributed in the most effective manner to meet the goals and requirements during disaster management. The respective studies by Prizzia (2008) and Abramson et al. (2007) also suggest that coordination is important in disaster management operations (Abramson et al., 2007; Prizzia, 2008). The author quotes the following statements from the respondents below.

From FGD respondents:

> "... As you know disaster management operation is comprised of several functions, such as providing instructions and information about a situation timely as well as in real-time. All these functions need coordination. I have communicated with several organizations for some recent disaster information, and finally, I coordinate by physically visiting different disaster management organizations."

> "... MIS-based service allows knowing the safe locations during disaster events. This can include coordinating the deployment of resources such as personnel, equipment, and supplies, as well as coordinating information and guidance communication to people. As a chairman of the village, using MIS services I can forward instructions and sufficient information to coordinate with shelter providers and efficiently distribute human resources and manage relief inventory. During an emergency, I can coordinate by visiting locations and victims."

Thematic code	Determining factor
Coordination	Access to MIS Services

Table 5.8: Coordination and determining factor

5.2.8 Decision-making ability

Decision-making is an essential component of disaster management because it requires making difficult and complex decisions in the face of uncertainty and time constraints. Decision-makers in disaster situations may face a variety of challenges, including limited information, competing priorities, and complex trade-offs. For that, the application of MIS-based services may enable us to use tools and techniques such as decision trees, cost-benefit analysis, and scenario planning to assist decision-makers in evaluating the potential consequences of various options and selecting the best course of action. Overall, effective decision-making is critical for ensuring that disaster management efforts are effective and efficient, as well as for minimizing the impact of disasters on individuals, communities, and the environment.

MIS-based services can contribute to improving decision-making ability in disaster events. Previous studies show MIS services enable in taking decisions for disaster management (Mathew, 2005). Besides MIS can be used to enhance the efficiency of decision-making in disaster events. The author quotes the following statements from the respondents below.

From FGD respondents:

> "... Using MIS, we gain access to critical information. Therefore, MIS services make us feel empowered in times of confusion due to emergency situations which are important for decision-making. Because, MIS assists us to use information technology to support and improve decision-making, operations, and management in organizations."

> "… In the context of disaster management, MIS services can be used to support decision-making by providing relevant and timely information to us, such as real-time data on the location and severity of a disaster, the availability of resources, and the status of response and recovery efforts."

"... Disaster preparedness information from the government/non-governmental organizations first have to come to the end users the helping them to be safe and take safety precautions. Ultimately, it takes helps in taking a crucial decision in a disaster event. I can then carefully monitor if the safety measures are taken. For that, real-time data collection, data missing, disaster data analysis, data dissemination etc. are needed to establish strong cooperation between top-down and bottom-up. There should be a one-stop service, such as a unique website to float analyzed data/information for participants'/end-users understanding. There should be a digital platform to gather all data/information for end-users access."

Thematic code	**Determining factor**
Decision-making ability	Access to MIS Services

Table 5.9: Decision-making ability and determining factor

5.3 Quantitative data analysis

This research applies a survey to identify DOI and TAM attributes and demographic variables that impact behavioural intention to adopt the role of MIS in disaster when MIS in disaster management will be available.

5.3.1 Data Preparation

In the missing data analysis step-1, the Missing Completely at Random (MCAR) technique is applied which is important to find the missing values. Although, it is unlikely that there is any missing data since the researcher collected the data by standing before the respondents, thus they could not skip any current question before moving to the next question. In step-2, the data normality is tested by applying the skewness and kurtosis techniques. These tests are used to define the data sets in relation to their normal distribution. In other words, normality looks for the skewness in the distribution by identifying the high or low ranks that happened by a small number of respondents. In step-3, the common biases in a method can happen because of a method's characteristic effects. In other words, the biasness can happen due to multiple external factors such as the way in which the questions were developed.

5.3.2 Missing Data Analysis

Missing data is a challenge to the researchers as it impairs the empirical data analysis by causing biasness in the study. Therefore, the concern of missing data is more important than the sample size. The issue of missing data causes inaccessibility in an analysis of other valid data. To find the data missing completely at Random (MCAR), at first, we created two groups of respondents and then using the T-test, the mean-variance on age, sex, and other key variables is analyzed to test if the two groups differ on any variable in the method. The module known as "Missing Value Analysis" (MVA) in the statistical package SPSS was used for the t-test to identify the missing values. Figure 5.2 below shows the overall summary of the missing values. Since the researcher collected the data through the face-to-face interview process, thus they could not skip any current question before moving to the next question.

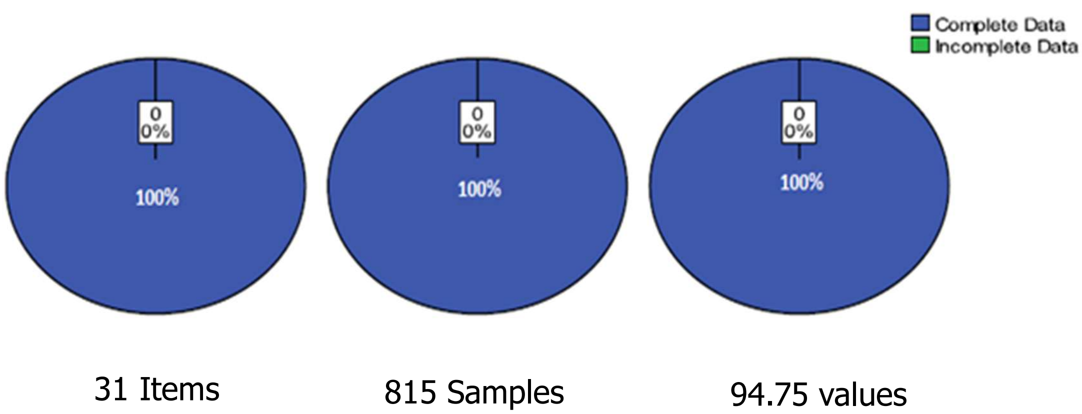


Figure 5.2: Summary of the missing values

5.3.3 Normality Analysis

After the test of missing data, the sample data was further tested for normality test. The normality in the sample data determines whether the data is disseminated across the sample without extreme points by a few responders that can change the result that is not factual. The normal distribution refers to the symmetric curve which has two parts: (1) general mean value, and (2) variance. As the data size increases, the distribution goes closer to the normal distribution. The normality is accomplished by 'outliner' the dataset. Before normality analysis, the researchers ensure that the coding of the data is executed correctly to identify the prejudice of the respondents that is known as ‘outliner’. The outliner is the bad data in the study that is very different from the rest of the data in the data sample. The research executed the multivariable taste to identify the outliners. After that, the outliners are contrasted with the standard data which are arbitrarily determined.

According to Hair et al. (2012), the investigation of skewness and kurtosis in the sample data is required to find the normality. When the data distribution is skewed to the left, it is symbolized as optimistic and if the data is skewed to the right side, it is symbolized as unenthusiastic. The skewness influences the statistical means, and kurtosis influences the statistical variance and covariance. Table 5.3.1 below represents the skewness and kurtosis values of 31 variables. For showing the evidence of more normality, the research further tested the normality of multivariate normality in Table 5.3.2 below, where it was found that composite variables were above 0.05 which indicates that the data distribution was normal.

Normality Test

Variable	Skewness	Kurtosis
PU1	-14.66	15.80
PU2	-12.82	6.41
PU3	-7.64	3.35
PU4	-11.40	2.23
PU5	-12.60	2.65
PEoU1	-10.90	8.54
PEoU2	-09.18	3.35
PEoU3	-11.25	3.10
PEoU4	-15.25	12.16
PEoU5	-10.41	12.14
BI1	-17.12	24.67
BI2	-17.11	7.85
BI3	-14.62	25.64
BI4	-18.10	5.50
BI5	-16.95	23.97
RA1	-15.85	21.35
RA2	-10.58	-0.64
RA3	-13.10	0.65
RA4	-9.56	12.05
RA5	-10.04	-1.02
Com1	-9.54	-4.75
Com2	-8.98	1.64

Com3	-7.93	3.25
Com4	-11.56	8.64
Com5	-9.22	1.52
Comx1	-10.37	9.83
Comx2	-8.81	7.29
Tr1	-7.98	13.35
Tr2	-9.83	10.42
Ob1	-10.03	8.21
Ob2	-12.16	12.25

Table 5.3.1: Normality Test Standard error of skewness=0.081 and standard error of kurtosis=0.172 (Park, 2015)

Normality of composite variables

Variable	Skewness	Kurtosis
Perceived usefulness (PU)	-0.323	-1.172
Perceived ease of use (PEoU)	-2.242	-2.567
Behavioural intention (BI)	-0.164	-0.889
Relative advantage (RA)	0.862	0.487
Compatibility (Com)	0.126	-0.543
Complexity (Comx)	0.089	-0.711
Trialability (Tr)	-0.183	-1.115
Observability (Ob)	-1.255	-0.821

Table 5.3.2: Normality of composite variables after transformation

5.3.4 Biasness testing

Biasness testing involves finding whether the variance happens because of measurement techniques used, such as the hypotheses formed to measure the characteristics. To test the biasness, the exploratory factor analysis (EFA) is conducted. The result shows that there are 12 factors that interpret around sixty-five percent (65%) of the model. The factors explain 23% of the variance which is less than 50%. Therefore, it can be said that the result is not likely to be affected by common biasness (Table 5.3.3).

Common Method Bias Test-Total Variance Explained

Initial Eigenvalue	Extraction Sums of Squared Loadings

Component	Total	Variance	Cumulative	Total	Variance	Cumulative
1	21.35	24.66	24.12	21.16	24.94	24.97
2	8.40	9.65	34.32	8.34	9.38	34.49
3	5.49	6.16	40.61	5.74	6.56	40.36
4	3.26	3.89	44.48	3.49	3.23	44.89
5	2.66	3.66	48.36	2.16	3.82	48.67
6	2.76	3.47	51.16	2.82	3.28	51.35
7	1.79	2.39	53.31	1.74	2.85	53.58
8	1.94	1.46	55.94	1.61	1.35	55.76
9	1.58	1.67	57.26	1.63	1.15	57.58
10	1.85	1.68	58.17	1.75	1.45	58.56
11	1.52	1.20	60.26	1.97	1.65	60.10
12	1.71	1.16	61.35	1.56	1.56	61.35

Table 5.3.3: Common Method Bias Test-Total Variance Explained (Fuller, *et al*., 2016)

5.4 Tools and technique

Once the data preparation steps are complete, it implies that the data is ready for optimal data mining. For the data analysis, SPSS (Statistical Package for the Social Sciences) and Smart-PLS 3.0 have been used. The version SPSS 23 was used for convenience and availability. SPSS helped to find frequency distributions as presented in the descriptive analysis in the previous chapter. On the other hand, Smart-PLS 3.0 was used for identifying the influence of the factors, as well as for measuring reliability and validity by applying the structural equation modelling (SEM) technique. Eventually, SEM lets the researcher learn whether the conceptual framework is valid.

5.5 Reliability Coefficient of the questionnaire

The reliability coefficient of the questionnaire was tested using SPSS. Tables 5.5.1 and 5.5.2 show the reliability coefficient of the questionnaire and the significance of the reliability test respectively. The Cronbach’s Alpha coefficient of the questionnaire is 0.750 which is greater than the recommended value of 0.70 (Litwin & Fink, 1995). On the other hand, the significance of the reliability shows a 99% confidence interval.

Reliability coefficient of the questionnaire

Reliability Statistics

Cronbach's Alpha	No. of Items	Number of responses
0.750	31	815

Table 5.5.1: The reliability coefficient of questionnaire (Peterson & Kim, 2013)

Significance of the reliability test

ANOVA						
		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig**
Between People		2125.455	389	5.056		
Within People	**Between Items**	842.236	41	21.016	16.612	.000
	Residual	20493.910	15950	1.275		
	Total	21234.146	15000	1.325		
Total		23059.601	17399	1.416		
Grand Mean = 3.19						

Table 5.5.2: The significance of the reliability test (Taherdoost, 2016)

5.6 Reliability Discussion of Each Dimension

In this step, the internal reliability of the items was evaluated with a total reliability scale. Table 5.6 presents the reliability coefficient for each dimension where Cronbach's Alpha for all dimensions was above the recommended value of 0.70. Besides, the T-Squared values support Cronbach's Alpha values of each dimension.

Reliability discussion of each dimension

Variables	**No. of Items**	**Cronbach's Alpha (α)**	**T-Squared**	**F**	**Sig**
Perceived usefulness (PU)	5	0.854	43.976	7.158	.000
Perceived ease of use (PEoU)	5	0.826	60.784	20.071	.000
Behavioural intention (BI)	5	0.728	42.989	10.553	.000

Relative advantage (RA)	5	0.773	72.148	23.864	.000
Compatibility (Com)	5	0.713	141.36	46.69	.000
Complexity (Comx)	2	0.757	146.54	48.47	.000
Trialability (Tr)	2	0.769	46.836	15.456	.000
Observability (Ob)	2	0.719	10.238	5.087	.000

Table 5.6: Reliability discussion of each dimension

5.7 Understanding perceived usefulness to behavioural intention

There were 5 items for the perceived usefulness variable. All the respondents were requested to rate their degree of agreement or disagreement on each statement related to specific items. The Five-Point Likert scale was used to rate each statement. The range of degree of agreement of disagreement was from -1 for strongly disagree to 5 for strongly agree. Table 5.7.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above 3, which indicates that most of the respondents on average agree with each statement. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'perceived usefulness affects the behavioural intention in technology adoption for disaster management'. It is important for the respondents that the technology-enabled services enable them to take necessary steps at the right time and provide them with valuable, effective and useful information to minimize damage and save lives.

Descriptive understanding of Perceived usefulness

Perceived usefulness (PU)	**Mean**	**Median**	**Std. Deviation**
Enable to take necessary actions	3.64	4.00	1.136
The provided information and instructions are valuable	3.40	4.00	1.157
The provided information and instructions are effective	3.39	4.00	1.121

The provided information and instructions are useful	3.32	3.00	1.064
Important for live-saving and damage minimization	3.43	3.00	1.056

Table 5.7.1: Descriptive understanding of Perceived usefulness

The multicollinearity test can provide the VIF value which indicates the degree of correlation between one independent variable and the other independent variables in a model. In the multicollinearity test, it was found that (Table 5.4.2) the variance inflation factors (VIF) were less than 5 (Becker et al. (2015) described that VIF< 5 is acceptable) and the tolerance values are less than 1, which indicates that there exits collinearity among all the items. From table 5.7.2, it is clear that effectiveness (r=0.542, p<0.0001) and usefulness (r=0.509, p<0.0001) are significantly correlated to the fact of enabling the respondents for taking necessary steps during disaster events. On the other hand, the perceived usefulness (r=0.698, p<0.0001) and importance in minimizing damages (r=0.556, p<0.0001) are highly correlated to the effectiveness of the information and instructions provided.

Correlation and multicollinearity test of Perceived usefulness

Item	PU1	PU2	PU3	PU4	PU5	Tolerance	VIF
PU1	1	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.450	2.224
PU2	0.214	1	< 0.0001	0.276	< 0.0001	0.706	1.417
PU3	**0.542**	0.143	1	< 0.0001	< 0.0001	0.333	3.004
PU4	**0.509**	0.178	**0.698**	1	< 0.0001	0.353	2.836
PU5	0.429	0.055	**0.556**	0.487	1	0.432	2.312

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.7.2: Correlation and multicollinearity test of Perceived usefulness

5.8 Understanding perceived ease of use to behavioural intention

There were 5 items for the perceived ease of use variable. Table 5.8.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above 3, which indicates that most of the respondents on average agree with each statement. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'perceived ease of use affects the behavioural intention in technology adoption for disaster management'. Especially, the respondents emphasized that the technology-enables services have provided clear information. It is important for the respondents that the technology-enabled services information and instruction which is easy to follow and understandable and do not need special skill.

Descriptive understanding of Perceived ease of use

Perceived ease of use (PEoU)	Mean	Median	Std. Deviation
Easy to follow	3.22	3.00	1.229
The way to get information and instructions is clear	3.98	3.00	1.262
The way to get information and instructions is flexible	3.79	3.00	1.142
The way to get information and instructions is understandable	3.76	3.00	0.996
Does not need special skill	3.50	3.00	1.257

Table 5.8.1: Descriptive understanding of Perceived ease of use

In the multicollinearity test, it was found that (Table 5.8.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that all the items are correlated. From Table 5.8.2, it is apparent that the clarity of the information ($r=0.651$, $p<0.0001$) and understandability ($r=0.592$, $p<0.0001$) are highly correlated to the easiness of the information and instruction to follow. Also, the analysis shows that need flexibility ($r=0.696$, $p<0.0001$) is highly correlated to the fact of not needing any special skill.

Correlation and multicollinearity test of Perceived ease of use

Items	PEoU1	PEoU2	PEoU3	PEoU4	PEoU5	Tolerance	VIF
PEoU1	1	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.292	3.425
PEoU2	**0.651**	1	< 0.0001	< 0.0001	< 0.0001	0.293	3.408
PEoU3	0.393	0.143	1	< 0.0001	< 0.0001	0.239	4.191
PEoU4	**0.592**	0.178	0.418	1	< 0.0001	0.470	2.127
PEoU5	0.329	0.055	**0.696**	0.487	1	0.182	2.810

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.8.2: Correlation and multicollinearity test of Perceived ease of use

5.9 Understanding behavioural intention to the adoption of Technology

There were 5 items for the behavioural intention variable. Table 5.9.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean values for all items were above 3, which indicates that most of the respondents on average agree with each statement. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'behavioural intention influences the technology adoption for disaster management'. It is highly important to note that the likeness of the respondents increases the likelihood to adopt the technology.

Descriptive understanding of Behavioural intention

Behavioural intention (BI)	Mean	Median	Std. Deviation
Like using technology (MIS) based information	4.26	4.00	1.226
Like to take action accordingly	3.50	3.00	1.318
Disseminating the information	3.49	3.00	1.174
Like to follow the instructions	3.33	4.00	1.416

Like interacting with the instructions or information provider	3.29	3.00	1.135

Table 5.9.1: Descriptive understanding of Behavioural intention

In the multicollinearity test, it was found that **(**Table 5.9.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that all the items are correlated. From Table 5.9.2, the likeness to follow the instructions **(**r=0.617, p<0.0001) is highly correlated to the likeness to use the technology **(**MIS) based information in disaster events.

Correlation and multicollinearity test of Behavioural intention

Items	BI1	BI2	BI3	BI4	BI5	Tolerance	VIF
BI1	1	0.212	< 0.0001	< 0.0001	0.000	0.698	1.432
BI2	-0.062	1	< 0.0001	< 0.0001	< 0.0001	0.712	1.408
BI3	0.242	0.250	1	0.261	< 0.0001	0.433	2.309
BI4	0.217	0.258	**0.617**	1	0.040	0.761	1.315
BI 5	0.174	0.214	0.056	0.103	1	0.471	2.121

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.9.2: Correlation and multicollinearity test of Behavioural intention

5.10 Understanding the relative advantage of behavioural intention

There were 5 items for the relative advantage variable. Table 5.10.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above 3, which indicates that most of the respondents on average agree on each statement, mostly with the fact of less difficult to get necessary information and instructions. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'relative advantage influences the behavioural intention in technology adoption'. It is important for the respondents if the new technology-enabled services offer relative advantages over the existing system in terms of enhancing ability, efficiency and easier cooperation.

Descriptive understanding of Relative advantage

Relative advantage (RA)	**Mean**	**Median**	**Std. Deviation**
Enhance ability to get necessary information and instructions	3.28	3.00	1.123
Enhance efficiency to get necessary information and instructions	3.23	3.00	1.021
Lessen difficulty to get necessary information and instructions	3.93	4.00	0.879
Easier to get the necessary information and instructions	3.20	3.00	1.088
Easier to cooperate or interact	3.93	3.00	1.979

Table 5.10.1: Descriptive understanding of Relative advantage

In the multicollinearity test, it was found that **(**Table 5.10.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that all the items are correlated. From table 5.10.2, it was found that the fact of having less difficulty is highly correlated with the facts of easiness in getting (information r=0.636, p<0.0001), enhanced ability (r=0.598, p<0.0001), (efficiency r=0.525, p<0.0001) for the respondents to perceive relative advantage.

Correlation and multicollinearity test of Relative advantage

Items	**RA1**	**RA2**	**RA3**	**RA4**	**RA5**	**Tolerance**	**VIF**
RA1	1	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.281	3.574
RA2	0.325	1	< 0.0001	< 0.0001	< 0.0001	0.579	1.726

RA3	**0.598**	0.525	1	< 0.0001	< 0.0001	0.291	3.448
RA4	0.238	0.378	**0.636**	1	< 0.0001	0.336	2.979
RA5	0.315	0.248	0.351	0.391	1	0.129	2.604

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.10.2: Correlation and multicollinearity test of Relative advantage (Alin, 2010)

5.11 Understanding compatibility to behavioural intention

There were 5 items for the compatibility variable. Table 5.11.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above 3, mostly the demand of the situation (mean=3.99), which indicates that most of the respondents on average agree on each statement. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'compatibility influences the behavioural intention in technology adoption for disaster management'. It is important for the respondents that if the technology-enabled services are supposed to be compatible with the existing system and the users need the necessary and useful information to cope with the situation.

Descriptive understanding of Compatibility

Compatibility (Com)	Mean	Median	Std. Deviation
Get the necessary information and instructions to cope	3.59	3.00	1.048
Match the way I want to interact	3.15	3.00	0.877
Fits the demand of the situation	3.99	4.00	1.009
Compatible with the way I want to receive information	3.14	3.00	1.246
Compatible with the existing system	3.16	3.00	1.081

Table 5.11.1: Descriptive understanding of Compatibility

In the multicollinearity test, it was found that (Table 5.11.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that all the items are correlated. From (table 5.8.2), it was found that fact of compatibility of the information (received r=0.509, p<0.0001), and demand of the situation (r=0.542, p<0.0001) are highly correlated with the facts of getting necessary information that can help the respondents to cope with the situation in disaster events. On the other hand, the compatibility of the existing system is not correlated to the (r=0.074, p<0.0001) demand of the situation, which means that in the time necessary the respondents are ready to use new technology even if that is not compatible with the existing system.

Correlation and multicollinearity test of Compatibility

Items	Com1	Com2	Com3	Com4	Com5	Tolerance	VIF
Com1	1	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.145	2.159
Com2	0.214	1	< 0.0001	0.189	0.047	0.664	1.505
Com3	**0.542**	0.454	1	0.104	0.137	0.675	1.481
Com4	**0.509**	0.066	0.081	1	0.001	0.678	1.475
Com5	0.429	0.099	0.074	0.165	1	0.711	1.406

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.11.2: Correlation and multicollinearity test of Compatibility

5.12 Understanding complexity ease of use to behavioural intention

There were two items for the complexity usefulness variable. Table 5.12.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above 3, which indicates that most of the respondents on average agree with each statement. From the table, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that ‘complexity negatively affects the behavioural intention in technology adoption’. It is important for the respondents that the technology-enabled services should not be complex that can prevent them from using technology before, during and after the disaster events.

Descriptive understanding of Complexity

Complexity (Comx)	Mean	Median	Std. Deviation
The difficulty prevents me from using it.	3.19	3.00	1.145
It is important to get necessary devices or gadgets easily	3.26	3.00	1.086

Table 5.12.1: Descriptive understanding of Complexity

In the multicollinearity test, it was found that (Table 5.12.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that all the items are correlated. From Table 5.12.2, it can be inferred that the fact of difficulty (r=0.425, p<0.0001) in using technology-enabled services is correlated to the fact of getting necessary devices or gadgets to avail of technology-enabled services easily.

Correlation and multicollinearity test of Complexity

Items	Comx1	Comx2	Tolerance	VIF
Comx1	1	<0.0001	0.483	2.071
Comx2	0.425	1	0.521	1.922

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.12.2: Correlation and multicollinearity test of Complexity

5.13 Understanding trialability ease of use to behavioural intention

There were 2 items for the trialability variable. Table 5.13.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was less than 3, which indicates that most of the respondents on average disagree with each statement. From the table, it can be seen that the respondents demonstrated disagreement with the statement on each item that indicates that ‘trialability does not affect the behavioural intention in technology adoption for disaster management’. It is not important for the respondents if the technology-enabled services are trialled first to change their behavioural intention.

Descriptive understanding of Trialability

Trialability (Tr)	Mean	Median	Std. Deviation
It is important to have the opportunity to try first	2.80	3.00	1.349
It is important to have a satisfactory trial use	1.92	2.00	1.201

Table 5.13.1: Descriptive understanding of Trialability

In the multicollinearity test, it was found that (Table 5.13.2) the VIF was more than 5 but the tolerance values are very close to 1, which indicates that a satisfactory trial (use r=0.282, p=0.119) is not correlated with the opportunity to try a technology-enabled service first.

Correlation and multicollinearity test of Trialability

Items	Tr1	Tr2	Tolerance	VIF
Tr1	1	0.119	0.905	6.419
Tr2	0.282	1	0.997	5.674

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.13.2: Correlation and multicollinearity test of Trialability

5.14 Understanding observability ease of use to behavioural intention

There were 2 items for the observability variable. Table 5.14.1 below shows the values of mean, median and standard deviation based on the degree of agreement or disagreement by respondents. The mean value for all items was above three, which indicates that most of the respondents on average agree with each statement. From the data, it can be seen that the respondents demonstrated a high level of agreement with the statement on each item that indicates that 'observability affects the behavioural intention in technology adoption for disaster management'. It is important for the respondents that if the benefits and results of technology-enabled services are obvious before changing their behavioural intention to adopt the technology.

Descriptive understanding of Observability

Observability (Ob)	Mean	Median	Std. Deviation
The benefits need to be observable	3.13	3.00	1.316
The results need to be apparent	3.97	4.00	1.300

Table 5.14.1: Descriptive understanding of Observability

In the multicollinearity test, it was found that (Table 5.14.2) the VIF was less than 5 and the tolerance values are less than 1, which indicates that there exists collinearity among all the items. From Table 5.14.2, it can be inferred that the benefits of the technology-enabled services (Ob1) (r=0.439, < 0.0001) correlated to the fact that the result of the service is noticeable enough (Ob2).

Correlation and multicollinearity test of Observability

Items	Ob1	Ob2	Tolerance	VIF
Ob1	1	< 0.0001	0.664	3.506
Ob2	**0. 439**	1	0.728	2.593

Note: Bold values indicate significance at alpha=0.05 level, differing from 0. The correlation values are displayed in the lower diagonal, while the corresponding P values are shown in the upper diagonal.

Table 5.14.2: Correlation and multicollinearity test of Observability

5.15 Exploratory Factor Analysis

The eligibility of the exploratory factor analysis is determined by Bartlett's test of Sphericity and the Kaiser-Meyer-Olkin (KMO) measures to find the adequacy suitability of the data. The Bartlett's test of Sphericity (Chi-Square= 5829.646; with significance = 0.000) and KMO value (0.793) were within the recommended range required for data analysis as Kaiser (1974) recommends the KMO value to be greater than 0.6. Table 5.15.1 shows the results of Bartlett's test of Sphericity and the Kaiser-Meyer-Olkin (KMO) measures. On the other hand, Table 5.15.1 shows the average variance extracted (AVE) values of the constructs hypothesized. Since all the constructs have a higher square root of AVE values **(bold values**) than other constructs' coefficients, it can be confidently claimed that the conceptual framework is valid.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.793
Bartlett's Test of Sphericity	Approx. Chi-Square	5829.646
	Df	810
	Sig.	.000

Table 5.15.1: The KMO and Bartlett's Test (KMO value greater than 0.6 is significant (Ali et al., 2012).

The Discriminant analysis

	Perceived usefulness	**Perceived ease of use**	**Behavioural intention**	**Relative advantage**	**Compatibility**	**Complexity**	**Trialability**	**Observability**
Perceived usefulness	**0.4712**							
Perceived ease of use	0.3924	**0.7956**						
Behavioural intention	0.0835	-0.0914	**0.7685**					
Relative advantage	0.0765	0.2144	0.0417	**0.5964**				
Compatibility	0.0052	0.1076	-0.0851	0.0509	**0.5857**			
Complexity	-0.0612	-0.0652	0.5982	0.0436	-0.1117	**0.7232**		
Trialability	0.2787	0.1612	0.0467	0.0162	-0.0486	0.0584	**0.6821**	
Observability	0.4380	0.6704	-0.1646	0.2344	0.1281	-0.1438	0.0884	**0.8424**

Note: Diagonal elements are square roots of the average variance extracted **(**AVE)**(bold**).

Table 5.15.2: The Discriminant analysis (Li et al., 2013)

5.16 Hypothesis Testing

Finally, after analyzing the data for normality, multicollinearity, tolerance and exploratory factor analysis, Structural Equation Modelling (SEM) was used to examine the relationship between the independent and dependent variables (Figure 5.3). The SEM result indicated a significant model (R^2 = 0.593) and seven out of eight independent variables are significantly related to the user's behavioural intention. For the relationship between behavioural intention and the adoption of technology, the R^2 value is 0.595, which means that all the independent variables can explain about 59.5% variance in the adoption of MIS-based service use for disaster management. The R^2 value of 0.595 shows that the conceptual framework has a good model fit.

Besides, based on the *t*-statistics and *p*-values, hypotheses testing shows (Table 5.16) among these eight hypotheses, only the trialability (TR) related hypothesis is rejected (p-value >0.05, T-value < 1.96). On the other hand, the hypotheses about Perceived usefulness (PU) Perceived ease of use (PEoU), Relative advantage (RA), Compatibility (Com), Complexity (Comx), Observability (Ob) and Behavioural intention (BI) were accepted as their respective (p-values and t-values) were less than .05 and more than 1.96 respectively (Table 5.16).

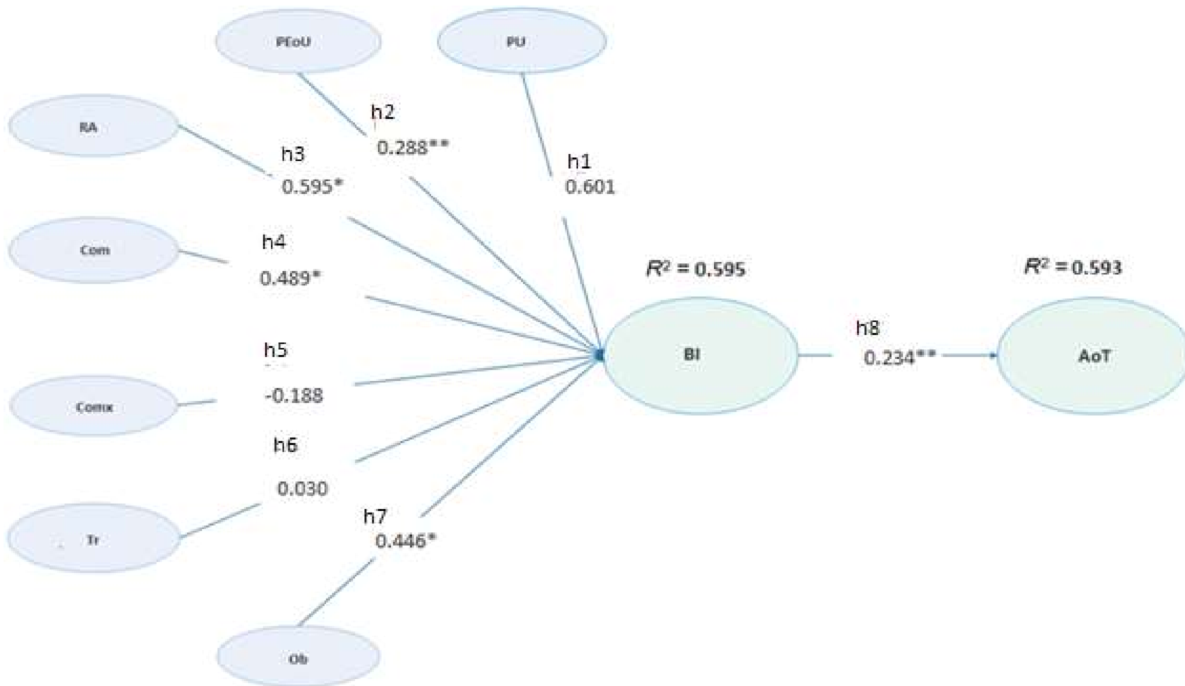


Figure 5.3: Path Analysis using Smart PLS **(**using SmartPLS 3.0)

Hypothesis Testing

Path between			**Hypothesis**	**Regression Coefficient (β)**	**T-value**	**P-value**	**Comments**
Perceived usefulness (PU)	>	Behavioural intention	H_1	0.601	5.139	P < .05	Accept
Perceived ease of use (PEoU)	>	Behavioural intention	H_2	0.288**	7.551	P < .01	Accept
Relative advantage (RA)	>	Behavioural intention	H_3	0.595*	9.112	P < .05	Accept
Compatibility (Com)	>	Behavioural intention	H_4	0.489*	14.336	P < .05	Accept
Complexity (Comx)	>	Behavioural intention	H_5	-0.188	5.962	P < .05	Accept
Trialability (Tr)	>	Behavioural intention	H_6	0.030	0.948	P > .05	Reject
Observability (Ob)	>	Behavioural intention	H_7	0.446*	4.672	P < .05	Accept

Behavioural intention (BI)	>	Adoption of Technology	H_8	0.234**	11.326	P < .01	Accept

Table 5.16: Hypothesis Testing. (** P < .01, * P < .05)

5.17 Summary

After finishing the steps of data preparation, multicollinearity, tolerance and Exploratory Factor Analysis, the partial least squares (PLS) structural equation modelling (SEM) was conducted and applied using Smart PLS software. This chapter described the details of each step involved in the data preparation and analysis and hypothesis testing. The results show the evaluation of the proposed conceptual framework in the rural setting in Bangladesh. This chapter clarifies the detailed results of data analysis with regard to the related existing knowledge discussed in the data management and hypothesis chapter.

Chapter 6: Result and Discussion

This chapter contains the discussions and implications of the qualitative data collected (interviews & focus groups) and quantitative (survey) phase. After the analysis of demographic data, findings researcher emphasized developing a path analysis using Smart PLS according to the hypothesis of the research. In this section, the discussions proceed to the quantitative data collected from the survey.

6.1 Qualitative finding discussion

Overall, the interview respondents and the focus group study revealed that affordable communication in disaster events, connectedness in disaster events, coordination in disaster events, and improvement in decision-making ability in disaster events are the major benefits that are perceived by the end-users when using MIS-based services for disaster management.

6.1.1 Information Access for disaster management

For effective disaster management, access to accurate and timely information is essential. This data can be used to evaluate the current situation, identify potential hazards and risks, and create appropriate response and recovery plans. It can also aid in the coordination of the efforts of various agencies and organizations involved in disaster response, as well as in communicating with the public about the situation and the actions being taken. Several approaches can be taken to ensure that people have access to the information they require during a disaster. One strategy is to integrate MIS for disaster management. This can help ensure that information is generated and analyzed at the right time. Finally, it is critical to integrate MIS for disaster management as it can guide involve community leaders and organizations in information dissemination to the people who need it the most.

The findings from the KIIs reveal that information access disaster management is crucial for effective disaster management. Regarding the role of MIS in disaster management, they suggest that MIS can be used to track and monitor potential hazards to generate critical information, as well as evaluate the risks they pose to a community. Then the important information can also be used to monitor the readiness and availability of emergency resources such as shelters, medical supplies, and first responders. An MIS can assist a disaster manager in obtaining important information for identifying potential vulnerabilities and taking steps to reduce the risks of harm during a disaster by providing this information. The study findings by Zlatanova and Fabbri (2009) inform this finding.

6.1.2 Strategic planning for disaster management

Strategic planning is an essential component of disaster management. It entails creating a long-term plan that outlines a disaster management program's goals and objectives, as well as the strategies and actions that will be taken to achieve those goals. Strategic planning assists in ensuring that disaster management efforts are coordinated and effective, as well as aligned with the community's overall goals and priorities. Overall, strategic planning aims to ensure that disaster management efforts are well-coordinated, effective, and aligned with community needs and priorities. Communities can better prepare for and respond to disasters by taking a strategic approach to disaster management, reducing the risks of harm to people and property.

The KII participants inform that the MIS integration has enabled them to formulate strategic planning for disaster management according to the goals and objectives that reflect the communities' priorities and need by being able to identify and assess the hazards and risks that are most likely to have an impact on the community. The previous studies by Abid et al. (2021) and Loghmani et al. (2022) support this finding (Abid et al., 2021; Loghmani et al., 2022).

6.1.3 Operational management for disaster management

Disaster management relies heavily on operational management. It is responsible for the time-to-time coordination and implementation of the disaster management plan's strategies and actions. It is also concerned with the practical, on-the-ground implementation of disaster management activities, which are typically carried out by first responders and emergency responders. In this regard, MIS can facilitate the coordination of emergency resources, such as shelters, medical supplies, and first responders. Besides, MIS integration allows monitoring of the progress of the disaster and its effects, in addition, to providing decision-makers assistance and timely and accurate information.

The thematic analysis of the KIIs in this study reveals MIS is important for management in disaster management to ensure that disaster response efforts are coordinated, effective, and aligned with the disaster management plan's overall goals and objectives. Findings from previous studies also align with the finding (Akter & Wamba, 2019; Sakurai & Murayama, 2019).

6.1.4 Disaster risk assessment for disaster management

A disaster risk assessment is a process used to identify and evaluate the potential risks and hazards that an organization or community may face from natural or man-made disasters. This assessment typically involves a thorough analysis of the potential hazards and vulnerabilities in a given area, as well as the potential impacts and consequences of those hazards. The goal of a disaster risk assessment is to provide decision-makers with the information they need to develop effective strategies for mitigating and reducing the risks of disasters. This information can be used to identify the most vulnerable areas or populations and to develop emergency response plans and other measures that can help to protect people and property in the event of a disaster.

Findings from the KIIs reveal that disaster risk assessments are an important part of disaster management and emergency planning, and are typically conducted by governmental organizations, and other entities with responsibility for public safety. The respondents opined that disaster risk assessments can provide information that can be used to develop strategies for mitigating the risks and impacts of natural disasters, as well as to identify the steps that must be taken to prepare for and respond to disasters. The study findings by Lin (2018) and Van Westen (2013) also support this finding of this study (Lin, 2018; Van Westen, 2013).

6.1.5 Affordable communication in disaster events

Interview respondents in FGDs identified communication with concerned people and authorities using MIS was very important for disaster management. The findings suggest the affordability of free alerts such as SMS or voice communication fulfills the basic need of decision-making in disaster management. MIS-based alerts are important in disaster management because they can warn people about impending dangers and allow them to take the necessary precautions to protect themselves and their loved ones.

An alert could, for example, warn of an impending hurricane, provide the storm's expected path and intensity, and advise people to evacuate to a safe location. MIS-based alerts can be distributed via a variety of channels, including the news media, social media, and emergency alert systems. Timely SMS alerts can help people make informed decisions and reduce the risk of harm during a disaster by providing timely and accurate information. Overall, MIS-based alerts can provide critical information about the nature of the disaster, its potential consequences, and the steps people can take to stay safe.

Usually, disaster management is a critical situation; therefore, the workforce must communicate well. In addition, these survey results also support that more than 40% of survey respondents' perceptions that MIS deployment can facilitate communication for disaster management. This finding of communication supports Akter and Wamba (2019) who advocate building communication for disaster management. Additionally, the study by Mahmud et al. (2012) in the Bangladesh context and the study by Rajendran and Shankaran (2021) support this finding of this study (Mahmud et al., 2012; Rajendran & Shankaran, 2021).

6.1.6 Connectedness in disaster events

In disaster management, connectedness is referred the degree to which individuals, communities, and organizations are interconnected and can support one another during disaster events. By integrating MIS, a high degree of connectedness can facilitate the flow of information, resources, and support among various parties, allowing for a more effective disaster response. In this way, vulnerable people and communities can better prepare for and respond to disasters by lowering the risk of harm to them and their property. This study found that MIS-based services for disaster management have a profound affordance in creating connectedness. Also, among survey respondents, around 70% suggested connectedness during a disaster event is crucial. MIS has built-in GPS, sensors, and audio-visual functionalities. This property of mobile phones provides an enhanced means of communication. For example, mobile GPS allows connecting the right authority. This connectedness is important for disaster management with limited resources.

A previous study by Adepoju et al. (2021) shows that connectedness is significant for disaster management and resiliency (Adepoju et al., 2021). Besides, Zhang et al. (2017) have a similar view and suggested that MIS-based services enable people to provide ubiquitous services for users (Zhang et al., 2017). MIS-supported connectedness is also appropriate for village people because of its cost-effectiveness.

6.1.7 Coordination in disaster events

Successful disaster response requires effective coordination. In disaster events, it is required to ensure the effective collaboration and communication of various organizations and agencies involved in disaster response and management. Also, timely coordination can help to reduce duplication of efforts, reduce confusion and chaos, and ensure that affected communities needs are met. The integration of MIS can help in the accomplishment of coordination in disaster events using a variety of tools and technologies, such as disaster management software, communication systems, and mapping tools. Overall, disaster event coordination is critical for ensuring a successful disaster response and meeting the needs of affected communities in a timely and effective manner.

The FGD respondents in this study expressed that MIS-based service helped them previously coordinate to get through difficult times. The studies by Tomaszewski (2020) and Rathore et al. (2014) reported improved coordination and improved disaster management ability due to the use of MIS-based services (Rathod et al., 2014; Tomaszewski, 2020). As the latest mobile phones are equipped with a myriad of sensors, cameras, and microphones; this feature of mobile phones can also assist in organizing the operation of disaster management to offer location-aware services, reducing process loss and helping with resource management.

6.1.8 Improvement in decision-making ability in disaster events

The ability of individuals and organizations to make timely, effective, and informed decisions during a disaster situation is referred to as disaster decision-making ability. This entails analyzing the situation, considering the available options, and making an appropriate and effective decision in addressing the needs of the affected community. Effective decision-making during disaster events is critical to ensuring a successful response. It reduces confusion and chaos while also ensuring that appropriate action is taken promptly. This can help to mitigate the disaster's impact and ensure that affected communities needs are met in a timely and effective manner. Enhanced communication and information flow enhance collaboration among stakeholders, which is crucial in the improvement of decision-making ability in disaster events.

The significance of decision-making ability in disaster events has also been acknowledged in a recent study by Melendez-Landaverde (2019). They further highlighted that recent internet-based technologies, social networking tools, and mobile technologies allow the disaster management government bodies or authorities to connect, interact and create experiences on an unprecedented scale based on having real-time information. Therefore, MIS as suggested by the interview and focus group respondents helps in the improvement of decision-making ability in disaster events by breaking down boundaries such as team-level barriers and organizational boundaries. The analysis of data from FGDs shows that the respondents experienced improved decision-making ability by using MIS-based services during disaster events. This finding is also supported by Ratajczak et al. (2017), who noted the importance of mobile applications for collaborative scheduling and monitoring of decision-making in a critical situation (Ratajczak et al., 2017).

6.2 Quantitative finding discussion

The study applied the factors derived from DOI and TAM models to determine and investigate the factors influencing the adoption of MIS-based services for disaster management by the end-users in Bangladesh. The study merged the basic DOI and TAM to form a conceptual framework. The hypotheses posited in this research are substantiated by empirical evidence, aligning with previous studies' conclusions. The findings show that Perceived usefulness (PU) and Perceived ease of use (PEoU) are the most significant factors influencing MIS-based services for disaster management. These two factors can influence a user's decision to implement a disaster management information system. A person is more likely to adopt an information system if they believe it will be useful and simple to use. However, if a person believes that using a specific information system will be ineffective or difficult to use, they are less likely to adopt it. The finding about PE in this study aligns with the finding by Boontarig (2016). The recent study by Kavota et al. (2020) also supports the findings regarding PU and PEoU in this study (Kavota et al., 2020). However, the results of this study indicate that Trialability (Tr) is not significant in explaining the adoption of MIS-based services for disaster management by the end-users in Bangladesh. One of the possible reasons might be the lack of knowledge among the rural users about other users' experiences and perceptions which also help them in forming the performance and effort expectancy.

On the other hand, this study shows, Relative advantage (RA) is significant in explaining the adoption of MIS-based services for disaster management by the end-users. RA is measured in terms of improved efficiency, increased productivity, and enhanced capabilities, from which users can determine whether a technology is worth using by understanding its potential benefits and advantages. The study of Mugeni et al. (2020) also conforms to the result that RA is a strong and significant determinant of the adoption of information technology-based services (Mugeni et al., 2020). Also, the hypothesis about Compatibility (Com) was found as supported which is obvious in the Bangladesh context as if the service medium is not compatible with the device available to the users and then it is unlikely to be adopted by the users. Compatibility enables the integration and use of various technological solutions, which can improve efficiency and productivity. This can help them communicate and exchange data with each other consistently and reliably. Regarding compatibility, the recent study by Zaman et al. (2021) also had a similar finding (Zaman et al., 2021).

Additionally, the results of this study also confirm that the factors of Observability (Ob) are significant. Further, the study findings by Al Bar (2017), Barišić (2018), and Byomire (2015) also support these findings as they conclude that Ob was found significant and had the most explanatory power on the actual use MIS based services (AlBar & Hoque, 2017; Barišić et al., 2018; Byomire & Maiga, 2015). The findings of this study, which demonstrate the influence of Ob on mHealth services usage, are consistent with the substantial backing provided by relevant research in the realm of technology adoption and utilization within the information system literature.

As well as, complexity (Comx) was been considered an important MIS-based service. It plays an important role in ITC adoption. Technologies that are difficult to use or necessitate extensive training and expertise can be a barrier to adoption because they are perceived as too complicated by some users, hence negatively influencing user adoption. Furthermore, technologies that necessitate significant changes to existing processes or systems may be perceived as complex and thus slower to be adopted. In this study, Comx showed significant influence on MIS-based services for disaster management. The study by Akter et al. (2013) found a significant positive influence of Comx in users' BI and actual usage of MIS-based technology services (Akter et al., 2013). Moreover, this result aligns with the existing study in which Comx had a significant impact on the MIS-based service adoption, usage, and continuance of usage (Al-Zoubi et al., 2019). Finally, this study also confirms that Behavioural intention (BI) has a positive influence on the use of MIS-based services, which is consistent with the studies by Mailizar et al. (2020) and Ghio et al. (2021). Similarly, this finding is consistent with the findings of a study by Mahmud et al. (2012) on process management, where BI showed a significant impact on users' continuance use of MIS services.

To investigate the impact of MIS on organizations, Al-Ahmad et al. found that more organized the MIS of a section, higher their performance and efficiency (Al-Ahmad & Alnajjar, 2009). This also signifies the importance of MIS in the role of high valued organizations. When tackling COVID-19 pandemic, interactive technologies proved to be beneficial for both students and teachers (Camilleri & Camilleri, 2022). Camilleri et al. (2022) proposes that the PU of remote learning technologies positively influences attitudes and intentions, with attitudes acting as a mediator between perceived usefulness and usage intentions It can also be said that technology helped overcome some troubles of a disaster. MIS facilitates the collection, processing, and dissemination of information, thereby contributing to the perceived convenience, trustworthiness, and efficacy of information acquisition, which are key dimensions affecting consumer choices (Choudhury & Karahanna, 2008). Choudhury and Karahanna (2008) emphasizes understanding consumer intent to adopt these channels across purchase stages, highlighting the multi-dimensional nature of RA.

6.3 Summary

The role of MIS service for disaster management should focus on the Perceived usefulness (PU) Perceived ease of use (PEoU), Relative advantage (RA), Compatibility (Com), Complexity (Comx), Observability (Ob), and Behavioural intention (BI) factors that might influence the adoption of MIS based services for disaster management by the end-users in Bangladesh. As well as the providers should also find ways how to increase the roles of using MIS in disaster management, such as 1) information access for disaster management, 2) strategic planning for disaster management, 3) operational management for disaster management, 4) disaster risk assessment for disaster management, 5) affordability in disaster management, 6) connectedness in disaster events, 7) coordination in disaster events, and 8) improve decision-making ability in disaster events. Focusing on these factors and perceived benefits will enhance the adoption and role of MIS-based services for disaster management in Bangladesh, thereby contributing to the vision of Digital Bangladesh.

Overall, MIS tools in combination with the internet, GIS-based systems, Remote Sensing, and satellite observation and communication can play crucial roles in disaster mitigation and risk reduction in Bangladesh. When internet service is added to a disaster database, MIS becomes more powerful with this dimension of data dissemination, open and free access to the database, and real-time data circulation. Internet connectivity provides pace to satellite remote sensing and GIS. As result, disaster data become faster, and planning, implementing, maintaining, and controlling activities become relatively easier for end-users.

Chapter 7: Conclusion

Bangladesh has been developing communication and information technologies very vigorously. Besides, the development of communication technologies, the application can play a vital role in different phases of disaster management. When following the technology-based approaches, new challenges for disaster management need to understand/adopted by the end-users of the local community and the ease of use will make the challenges positive. This research started by understanding the current research gap in Bangladesh which was to understand and enhance the roles of MIS in disaster management by finding the perceived benefits of the use of MIS and by identifying and understanding the factors influencing the adoption of Management Information Systems (MIS) based services for disaster management by the end-users. Besides, it was important to know what benefits of using MIS-based services motivate the users in using MIS-based services for disaster management to enhance the role of MIS in disaster management in Bangladesh. It was found that the major benefits that are perceived by the end-users when using MIS-based services for disaster management are, 1) affordable communication in disaster events, 2) connectedness in disaster events, 3) coordination in disaster events and 4) improvement in decision making ability in disaster events. In contrast, when seeking opinions from the key informants as stakeholders, it was found that MIS plays significant roles in disaster management in Bangladesh thought contributing to information access, strategic planning, operational management and disaster risk assessment for disaster management.

On the other hand, the study has crafted and authenticated a theoretical framework grounded in the DOI and TAM models to comprehend the pivotal determinants driving the adoption of MIS-based services for disaster management in Bangladesh. The results indicate that factors such as Perceived Usefulness (PU), Perceived Ease of Use (PEoU), Observability (Ob), Relative Advantage (RA), Compatibility (Com), Complexity (Comx), and Behavioral Intention (BI) significantly shape the adoption of MIS-based services for disaster management in Bangladesh. However, Trialability (TR) was not observed to hold significant explanatory power in the context of MIS-based services adoption for disaster management in Bangladesh. This observation diverges from existing literature, yet it may be attributed to the limited availability of MIS-based services that involve users in a trial phase. In the broader context of Bangladesh, this finding aligns with the emphasis on cost-effectiveness of MIS-based services. In the socio-economic landscape of Bangladesh, the affordability of MIS-based services is crucial for their efficient and timely utilization.

The application of MIS-based services in different phases of disaster management is a new challenge for the disaster management community. However, the overall findings may enhance the adoption and role of MIS-based services for disaster management in Bangladesh, thereby contributing to the shaping of appropriate policies for designing and implementing MIS-based services effectively for disaster management. The effective communication linkage between emergency operations centers, broadcasting systems, front-line responders, and affected communities is critical in the aftermath of a disaster. The communication linkage is necessary for: assessing damage and need; collecting information on supplies and other resources; coordinating rescue and relief activities; accounting for missing people; and motivating public, political, and institutional responses. There should be a unique digital platform for data dissemination for end-users understanding and easy accessibility.

This study is significant as the research presents a tested and validated conceptual formwork for the first time based on strong theoretical models namely DOI and TAM models to identify the factors influencing the adoption of MIS-based services for disaster management. The research has considered the main challenges in disaster management and how MIS-based services can facilitate this process. To my knowledge, for the first time, this research considers interpersonal and instructional components to study significant factors influencing MIS-based services adoption for disaster management in Bangladesh. The research results of this study will not only address the call by government and development agencies for the digitization of Bangladesh but also enhance our understanding of MIS capabilities in disaster management and the roles of MIS-based services in disaster management. The smooth practices of MIS depend on a few factors, such as the management, affordability, and end-users understanding of improving the practices of MIS.

7.1 Possible practical contribution of this study

This dissertation presents a comprehensive integration of conceptual framework and methodology for research in Management Information Systems (MIS). The need for a more comprehensive conceptual framework was resulting from a review of past research frameworks. An early warning system is one of the major factors for the risk reduction of any disaster. Currently, the finding would be useful for The Bangladesh Meteorological Department (BMD) which uses MIS to issue warnings regarding disaster events. Also, The Bangladesh Red Crescent Society (BDRCS) can be benefited from the findings that have run a joint project with the GoB regarding an early warning system to protect millions of people residing in low-lying coastal areas. On the other hand, the Department of Disaster Management (DDM) run by the Ministry of Disaster Management can notice these study findings when developing MIS services regarding disaster management.

Overall, in Bangladesh, all these multi-agency disaster management bodies would require collaboration among geographically distributed public and private organizations to enable a rapid and effective response to an unexpected event by providing MIS-based service to the users. As the current disaster management systems cannot often cope with the complexity and uncertainty, the understanding of the factors influencing the adoption of Management Information Systems (MIS) based services for disaster management by the end-users will contribute practically by designing and providing MIS-based services. Furthermore, this study will practically contribute to achieving the SDG goal2 (strengthen capacity for adaptation to climate change), SDG goal11 (Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels), and SDG goal13 (combat climate change and its impacts). National Plan for Disaster Management (NPDM) 2021-2025 is designed to be highly aligned with vision 2041. According to the Perspective Plan 2021-2041, lowering the vulnerabilities regarding natural disasters, disaster readiness, and capacity building comprehensive disaster management is highly prioritized, especially, considering the high cost and economic loss due to climate change. Focusing on vision 2041, NPDM recommends formulating risk-informed disaster management planning, inclusion as an underlying strategy (e.g., participation of women and men), priority-level action plans (e.g., disaster risk governance and investing in disaster risk reduction for resilience) as well as implementing initiatives for business continuation after the disaster. Also, according to Perspective Plan 2021-2041, which is specifically concerned with protection from climate change, Bangladesh will adopt new strategies for environmental management and green growth for safeguarding the socio-economic progress and ensuring sustainable goal achievement regarding disaster management.

Furthermore, the practical insights derived from the empirical results offer valuable recommendations with implications for the formulation, conceptualization, and establishment of MIS-based services dedicated to disaster management in Bangladesh. It is advisable for MIS service providers to concentrate on the identified perceived advantages and influential aspects from this study to optimally utilize the government's constrained resources. Additionally, users should be furnished with adequate assistance for utilizing MIS-based services, encompassing training, informational resources, and human support, in order to bolster the effectiveness of MIS in disaster management efforts.

7.2 Theoretical contribution of this study

In this study, data was collected to test and validate a conceptual framework based on DOI and TAM models. In this process, the researcher has been able to use the existing theories and body of knowledge (BoK) to provide MIS-based services for disaster management. Initial findings suggest that the convergence of DOI and TAM models can better explain the user of MIS-based service in disaster management in Bangladesh, which is a contribution to both theories as well as in a new context. Therefore, the study adds additional knowledge to the MIS research by offering a theoretical framework for the adoption and usage of MIS-based services in disaster management. Consequently, the synthesis of the conceptual model, which can explain up to 59.3% of the variances in the Actual Use, based on DOI and TAM models has helped us to theoretically conceptualize the use of MIS-based services for disaster management in a broader way. Additionally, the study makes a contribution to the field of MIS by employing DOI and TAM models to elucidate the adoption and utilization of MIS-based services in the context of disaster management. Ultimately, this research enhances the MIS literature by highlighting the preeminent determinants impacting the adoption and utilization of such services for disaster management. This insight empowers policymakers and service providers to cultivate a more effective role for MIS in disaster management, all the while giving due regard to the pivotal factors that drive adoption and usage. In the Bangladesh context, this study concludes with a strong theoretical basis that Bangladeshi technology users are more perceived benefit-oriented, thereby there is a need to emphasize the associated perceived benefit. The combination of DOI and TAM models in this study is theoretically significant as rather than simply taking into account how perceived benefit, it also takes into account how other significant factors (e.g., Relative Advantage, Compatibility, Complexity) might interplay with a perceived benefit when affecting behavioural intention to technology adoption. Overall, this study theoretically contributes to enriching the adoption of MIS, specifically in end-user's understanding of the Bangladesh context and in the area of disaster management.

7.3 Limitations and future research directions

Owing to the distinctive regional focus (rural areas) of the sample and the cross-sectional nature of this study, certain constraints influence the findings. Primarily, the sampling method employed and the rural context of the selected samples raise questions regarding the applicability of the findings to broader urban populations. However, considering the diversity in demographics and socio-economic status among the sample drawn from the covered regions, it can be contended that the chosen sample adequately represents the entire elderly population of Bangladesh. Additionally, a notable limitation of this study is that the formulated hypotheses were exclusively derived from the perspective of end users, omitting insights from service providers. However, this limitation could serve as a basis for a subsequent study, in which the researcher proposes to investigate how service providers and organizations incorporate users' perceived concerns (such as complexity and compatibility) and address these aspects when adopting MIS-based services for disaster management.

Hence, to provide a broader perspective on the theoretical framework, an expansion of this study could encompass additional age demographics within the Bangladeshi populace. For instance, including younger individuals who tend to be more adept and discerning in their technology usage could yield distinct outcomes in future investigations. Secondly, the cross-sectional nature of the study could not offer a comparative view of the contingent and causality impact of the users' experience level before and after the adoption and usage of Health Services. As the perception and familiarity of the users change over time, a longitudinal study can yield more comprehensive findings. To uncover a causal relationship among the specified factors, longitudinal data could be used in future studies. Furthermore, this study is not free from the limitations concerning interview-based research, such as respondent selection bias and researcher bias in the process of data collection and analysis.

7.4 Recommendations for future research

Management Information System (MIS) is applicable in many sectors, especially in sustainable development, climate change, and disaster management. Future research could examine MIS's impact on other areas of disaster management, especially in real-time disaster management and at an organizational level. In addition, more work should be conducted to understand the impact of organizational management culture on MIS-based service development. Also, the future study should consider age and gender as the mediating factors for hypotheses such as perceived benefits, trialability, and complexity to either confirm the finding of this study or obtain a new finding. Moreover, how and how much the existing management approach deter or supports the identified model constructs should also be studied. Future research may similarly find the roles of MIS adoption in different improvement phases and during the implementation process for MIS-based service provision for disaster management. Similarly, further study also needs to understand the complete influence of these benefits perceived by the users within the research domain and thus provide the basis for an extension of this study.

References

Abid, S. K., Sulaiman, N., Chan, S. W., Nazir, U., Abid, M., Han, H., Ariza-Montes, A., & Vega-Muñoz, A. (2021). Toward an Integrated Disaster Management Approach: How Artificial Intelligence Can Boost Disaster Management. Sustainability, 13(22), 12560. https://doi.org/10.3390/su132212560

Abramson, M., Chao, W., Macker, J., Mittu, R., & Dc, N. R. L. W. (2007). Coordination in Disaster Management and Response: A Unified Approach. DTIC. https://apps.dtic.mil/sti/citations/ADA638067

ADB. (1991). Asian Development Bank.

Adepoju, O. E., Han, D., Chae, M., Smith, K. L., Gilbert, L., Choudhury, S., & Woodard, L. (2021). Health Disparities and Climate Change: The Intersection of Three Disaster Events on Vulnerable Communities in Houston, Texas. International Journal of Environmental Research and Public Health, 19(1), 35. https://doi.org/10.3390/ijerph19010035

ADPC, A. D. P. C. (2008). Integrating Disaster Risk Reduction into School Curriculum. In.

ADRC. (2019). Asian Conference on Disaster Reduction 2019.

Ahmed, I. (2019). The national plan for disaster management of Bangladesh: Gap between production and promulgation. International Journal of Disaster Risk Reduction, 37, 101179. https://doi.org/10.1016/j.ijdrr.2019.101179

Ahmed, Z. (2013). Disaster risks and disaster management policies and practices in Pakistan: A critical analysis of Disaster Management Act 2010 of Pakistan. International Journal of Disaster Risk Reduction, 4, 15-20. https://doi.org/10.1016/j.ijdrr.2013.03.003

Ajzen, I. (1991). The theory of planned behavior. Organizational behavior and human decision processes, 50(2), 179-211.

Akter, S., Ray, P., & D'Ambra, J. (2013). Continuance of mHealth services at the bottom of the pyramid: the roles of service quality and trust. Electronic Markets, 23, 29-47.

Akter, S., & Wamba, S. F. (2019). Big data and disaster management: a systematic review and agenda for future research. Annals of Operations Research, 283, 939-959.

Al-Ahmad, N., & Alnajjar, F. J. (2009). The impact of management information systems on organizations performance: field study at Jordanian universities. Review of Business Research, 9(2), 127-137.

Al-Zoubi, R., Morales, P., & Reggio, P. H. (2019). Structural insights into CB1 receptor biased signaling. International journal of molecular sciences, 20(8), 1837.

Alam, E., & Ray-Bennett, N. S. (2021). Disaster risk governance for district-level landslide risk management in Bangladesh. International Journal of Disaster Risk Reduction, 59, 102220. https://doi.org/10.1016/j.ijdrr.2021.102220

AlBar, A. M., & Hoque, M. R. (2017). Factors affecting cloud ERP adoption in Saudi Arabia: An empirical study. Information Development, 35(1), 150-164. https://doi.org/10.1177/0266666917735677

Aldrich, H., & Whetten, D. (1981). Organization Sets, Action Sets, and Networks: Making the Most of Simplicity. ResearchGate, 385-408. https://www.researchgate.net/publication/245024261_Organization_Sets_Action_Sets_and_Networks_Making_the_Most_of_Simplicity

Alhasan, A., Audah, L., Ibrahim, I., Al-Sharaa, A., Al-Ogaili, A. S., & M. Mohammed, J. (2022). A case-study to examine doctors' intentions to use IoT healthcare devices in Iraq during COVID-19 pandemic. International Journal of Pervasive Computing and Communications, 18(5), 527-547.

Ali, S. B., Mahdi, A., & Malihe, J. (2012). The effect of employees' performance appraisal procedure on their intrinsic motivation. International Journal of Academic Research in Business and Social Sciences, 2(12), 161.

Alin, A. (2010). Multicollinearity. WIREs Computational Statistics, 2(3), 370-374. https://doi.org/10.1002/wics.84

Almaiah, M. A. (2018). Acceptance and Usage of a Mobile Information System Services in University of Jordan. Education and Information Technologies, 23(5), 1873-1895. https://eric.ed.gov/?id=EJ1189145

Armstrong, G., Kotler, P., & Da Silva, G. (2006). Marketing: An Introduction: An Asian Perspective. Pearson/Prentice Hall.

Ashrafzadeh, A., & Sayadian, S. (2015). University instructors' concerns and perceptions of technology integration. Computers in Human Behavior, 49, 62-73. https://doi.org/10.1016/j.chb.2015.01.071

Azad, M., Uddin, M., Zaman, S., & Ashraf, M. A. (2019). Community-based Disaster Management and Its Salient Features: A Policy Approach to People-centred Risk Reduction in Bangladesh. Asia-Pacific Journal of Rural Development. https://www.semanticscholar.org/paper/Community-based-Disaster-Management-and-Its-Salient-Azad-Uddin/71e1219d32bc4562bb482981bbbc4ce079eae90b

Banisakher, M., Omar, M., Hong, S., & Adams, J. (2020). A Human Centric Approach to Data Fusion in Post-Disaster Management. Journal of Business and Management Sciences, 8(1), 12-20. https://doi.org/10.12691/jbms-8-1-3

Barišić, A., Amaral, V., & Goulão, M. (2018). Usability driven DSL development with USE-ME. Computer Languages, Systems & Structures, 51, 118-157.

Basu, S., Roy, S., & Dasbit, S. (2019). Reliable Post Disaster Services over Smartphone Based DTN: An End-to-End Framework. https://doi.org/10.1007/978-981-13-6573-7

BBS. (2018). Bangladesh bureau of statistics (BBS). Statistics and Informatics Division, Ministry of Planning www. bbs. gov. bd.(Accessed 9 November 2019).

BBS, B. B. O. S. (2022). Population and Housing Census 2022.

Beaven, D. F. (2012). PROCESSING MANAGEMENT INFORMATION (United States Patent No. US 8,095,413 B1). U. S. Patent.

Becker, J.-M., Klein, K., & Wetzels, M. (2012). Hierarchical latent variable models in PLS-SEM: guidelines for using reflective-formative type models. Long range planning, 45(5-6), 359-394.

Becker, J.-M., Ringle, C. M., Sarstedt, M., & Völckner, F. (2015). How collinearity affects mixture regression results. Marketing Letters, 26, 643-659.

Beets, P. N., Terry, T. A., & Manz, J. (1994). Management systems for sustainable productivity. Impacts of forest harvesting on long-term site productivity, 219-246.

Bennett, D. M., Phillips, B. D., & Davis, E. (2016). The future of accessibility in disaster conditions: How wireless technologies will transform the life cycle of emergency management. DigitalCommons@UNO, 87, 122. https://digitalcommons.unomaha.edu/pubadfacpub/83

Bernal, G., Salgado-Gálvez, M. A., Zuloaga, D., Tristancho, J., González, D., & Cardona, O. (2017). Integration of Probabilistic and Multi-Hazard Risk Assessment Within Urban Development Planning and Emergency Preparedness and Response: Application to Manizales, Colombia. International Journal of Disaster Risk Science. https://www.semanticscholar.org/paper/Integration-of-Probabilistic-and-Multi-Hazard-Risk-Bernal-Salgado-G%C3%A1lvez/6fd4e0832db387a4c9da88d3c7f0e845cd8e4d0b

Beydoun, G., Dascalu, S., Dominey-Howes, D., & Sheehan, A. (2018). Disaster management and information systems: Insights to emerging challenges. Information Systems Frontiers, 20, 649-652.

Bhanumurthy, V., & Sharma, V. K. (2019, 2019). Integration of multiple technologies in web environment for developing an efficient framework for emergency management.

Biswas, A., Rahman, A., Mashreky, S. R., Humaira, T., & Dalal, K. (2015). Rescue and Emergency Management of a Man-Made Disaster: Lesson Learnt from a Collapse Factory Building, Bangladesh. Scientific World Journal, 2015. https://doi.org/10.1155/2015/136434

Boontarig, W. (2016, 2016). Effect of personality factors on attitude towards the adoption of health information via online social networking.

Bronfman, N., Cisternas, P., López-Vázquez, E., & Cifuentes, L. (2016). Trust and risk perception of natural hazards: implications for risk preparedness in Chile. Natural Hazards, 81. https://doi.org/10.1007/s11069-015-2080-4

Byomire, G., & Maiga, G. (2015, 2015). A model for mobile phone adoption in maternal healthcare.

Camilleri, M. A., & Camilleri, A. C. (2022). The acceptance of learning management systems and video conferencing technologies: Lessons learned from COVID-19. Technology, Knowledge and Learning, 27(4), 1311-1333.

Carrão, H., Naumann, G., & Barbosa, P. (2016). Mapping global patterns of drought risk: An empirical framework based on sub-national estimates of hazard, exposure and vulnerability. Global Environmental Change, 39, 108-124. https://doi.org/10.1016/j.gloenvcha.2016.04.012

Carter, B., Reitzel, L., Chen, T., Woodard, L., & Obasi, E. (2022). Engaging the Houston Community in Research: An Early Case Study of a Community Engagement Core in the University of Houston's HEALTH Center for Addictions Research and Cancer Prevention. Health Behavior and Policy Review, 9, 1017-1036. https://doi.org/10.14485/HBPR.9.5.2

Chandio, R. A. (2006). Economic growth, financial liberalisation and poverty reduction of Pakistan (1970-2000).

Chatterjee, S., Rana, N. P., Khorana, S., Mikalef, P., & Sharma, A. (2021). Assessing Organizational Users' Intentions and Behavior to AI Integrated CRM Systems: a Meta-UTAUT Approach. Information Systems Frontiers, 1-15. https://doi.org/10.1007/s10796-021-10181-1

Cheng, J. M. S., Kao, L. L. Y., & Lin, J. Y.-C. (2004). An investigation of the diffusion of online games in Taiwan: An application of Rogers' diffusion of innovation theory. Journal of American Academy of Business, 5(1/2), 439-445.

Chiu, C.-M., & Wang, E. T. G. (2008). Understanding Web-based learning continuance intention: The role of subjective task value. Information & management, 45(3), 194-201.

Chou, C.-H., Zahedi, F. M., & Zhao, H. (2014). Ontology-Based Evaluation of Natural Disaster Management Websites: A Multistakeholder Perspective. MIS Quarterly, 38(4), 997-1016. https://misq.umn.edu/ontology-based-evaluation-of-natural-disaster-management-websites-a-multistakeholder-perspective.html

Choudhury, V., & Karahanna, E. (2008). The Relative Advantage of Electronic Channels: A Multidimensional View. MIS Quarterly, 32(1), 179-200. https://doi.org/10.2307/25148833

Collen, M., & McCray, A. (2015). Decision Support Systems (DSS). https://doi.org/10.1007/978-1-4471-6732-7_17

CRED. (2002). Centre for Research on the Epidemiology of Disasters

Creswell, J. W., & Zhang, W. (2009). The application of mixed methods designs to trauma research. Journal of Traumatic Stress: Official publication of the international society for traumatic stress studies, 22(6), 612-621.

Dahou, K., Kibuka-Musoke, D., Ngo, B., & Pavarini, F. (2012). Climate challenges to Africa, a call for action. OECD Journal: General Papers, 2010(4), 7-112.

Davenport, T. H., & Beers, M. C. (1995). Managing Information about Processes. Journal of Management Information Systems, 12(1), 57-80. https://doi.org/10.1080/07421222.1995.11518070

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology on JSTOR. In (Vol. 13, pp. 319-340). MIS Quarterly.

Diamantopoulos, A. (2006). The error term in formative measurement models: interpretation and modeling implications. Journal of modelling in management, 1(1), 7-17.

Dilley, M. (2005). Natural disaster hotspots: a global risk analysis (Vol. 5). World Bank Publications.

DMRH. (2020). Disaster Management Reference Handbook (2020) - Bangladesh. In CFE-DMHA (Ed.).

Drabek, T. E. (2018). Community processes: coordination. Handbook of disaster research, 521-549.

DRMEP. (2017). Disaster Risk Management Enhancement Project (DRMEP) - BD-P91 | Countries & Regions | JICA. In.

Duca, G., Hajiyev, A., & Serotila, I. (2018). Evolving Science Management Paradigm for the Benefit of Socio-Economic.

Dugdale, J., Gonzalez, J., & Turoff, M. (2017). Introduction to Communication and Information Systems Technology for Crisis and Disaster Management Minitrack.

Effendy, F., Hurriyati, R., & Hendrayati, H. (2021). Perceived Usefulness, Perceived Ease of Use, and Social Influence: Intention to Use e-Wallet. Atlantis Press. https://doi.org/10.2991/aebmr.k.210831.060

Eppler, M. J., & Mengis, J. (2004). The Concept of Information Overload: A Review of Literature from Organization Science, Accounting, Marketing, MIS, and Related Disciplines. Information Society, 20(5), 325-344. https://doi.org/10.1080/01972240490507974

Flachberger, C., & Gringinger, E. (2016, 2016). Decision Support for Networked Crisis & Disaster Management-A Comparison with the Air Traffic Management Domain.

Fred D. Davis, R. P. B., Paul R. Warshaw. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models on JSTOR. 35(08), 982-1003. https://www.jstor.org/stable/2632151

Gaillard, J. C. (2010). Vulnerability, capacity and resilience: Perspectives for climate and development policy. Journal of International Development, 22(2), 218-232. https://ideas.repec.org/a/wly/jintdv/v22y2010i2p218-232.html

Galindo, G., Yie, R. D., Ditta, A., Ruiz, M., & Varela, A. (2018). Gender difference in publication among recent OR/MS sci-entific publications in top journals. Revista ESPACIOS, 39(47). https://www.revistaespacios.com/a18v39n47/18394720.html

Gangwar, H., Date, H., & Ramaswamy, R. (2015). Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. Journal of Enterprise Information Management, 28(1), 107-130. https://doi.org/10.1108/JEIM-08-2013-0065

Gayathri, R., Murty, P. L. N., Bhaskaran, P. K., & Srinivasa Kumar, T. (2016). A numerical study of hypothetical storm surge and coastal inundation for AILA cyclone in the Bay of Bengal. Environmental Fluid Mechanics, 16, 429-452.

Ghio, D., Lawes-Wickwar, S., Tang, M. Y., Epton, T., Howlett, N., Jenkinson, E., Stanescu, S., Westbrook, J., Kassianos, A. P., & Watson, D. (2021). What influences people's responses to public health messages for managing risks and preventing infectious diseases? A rapid systematic review of the evidence and recommendations. BMJ open, 11(11), e048750.

Gulatee, Y., Yuan, Q., Gasco-Hernandez, M., Gil-Garcia, J. R., Sutherland-Mitzner, M., & Pardo, T. A. (2020). Technology adoption for emergency preparedness and response in rural areas: identifying the main determinants. In ICEGOV '20: Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance (pp. 469-476). Association for Computing Machinery. https://doi.org/10.1145/3428502.3428574

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2012). Partial least squares: the better approach to structural equation modeling? Long range planning, 45(5-6), 312-319.

Hamid, A. A., Razak, F. Z. A., Bakar, A. A., & Abdullah, W. S. W. (2016). The Effects of Perceived Usefulness and Perceived Ease of Use on Continuance Intention to Use E-Government. Procedia Economics and Finance, 35, 644-649. https://doi.org/10.1016/S2212-5671(16)00079-4

Harrington, D. (2009). Confirmatory factor analysis. Oxford university press.

Hasan, M., Nasreen, M., & Chowdhury, M. A. (2019). Gender-inclusive disaster management policy in Bangladesh: A content analysis of national and international regulatory frameworks. International Journal of Disaster Risk Reduction, 41, 101324. https://doi.org/10.1016/j.ijdrr.2019.101324

Haworth, B., Bruce, E., & Middleton, P. (2015). Emerging technologies for risk reduction: Assessing the potential use of social media and VGI for increasing community engagement. Australian Journal of Emergency Management, 30(3), 36-41. https://research-repository.uwa.edu.au/en/publications/emerging-technologies-for-risk-reduction-assessing-the-potential-

Heale, R., & Forbes, D. (2013). Understanding triangulation in research. Evidence Based Nursing, 16(4), 98-98. https://doi.org/10.1136/eb-2013-101494

Ishak, I. S., & Alias, R. A. (2005). Designing a strategic information system planning methodology For Malaysian institutes of higher learning (ISP-IPTA). Universiti Teknologi Malaysia Skudai, Malaysia.

Iskandar, M., Hartoyo, H., & Hermadi, I. (2020). Analysis of factors affecting behavioral intention and use of behavioral of mobile banking using unified theory of acceptance and use of technology 2 model approach. International Review of Management and Marketing, 10(2), 41.

Islam, M. R. (2016). Bangladesh Disaster-related Statistics 2020.

Jayaratne, T. E., & Stewart, A. J. (1995). Quantitative and qualitative methods in the social sciences: Feminist issues and practical strategies. Debates and issues in feminist research and pedagogy, 217-234.

Jilani, M. M. A. K., Moniruzzaman, M., Dey, M., Alam, E., & Uddin, M. A. (2022). Strengthening the trialability for the intention to use of mHealth apps amidst pandemic: a cross-sectional study. International Journal of Environmental Research and Public Health, 19(5), 2752.

Jones, D. K. C. (1992). Landslide hazard assessment in the context of development. Geohazards: Natural and man-made, 117-141.

Kadam, S. (2012). Application of ICT in Disaster Management with Emphasis on Indian Subcontinent. IUP Journal of Information Technology, 8(1), 48.

Kapucu, Q. H., & Naim. (2016). Information Communication Technology Utilization for Effective Emergency Management Networks. Public Management Review, 18(3), 323-348. https://ideas.repec.org/a/taf/pubmgr/v18y2016i3p323-348.html

Karimiziarani, M., Jafarzadegan, K., Abbaszadeh, P., Shao, W., & Moradkhani, H. (2022). Hazard risk awareness and disaster management: Extracting the information content of twitter data. Sustainable Cities and Society, 77, 103577.

Kavota, J. K., Kamdjoug, J. R. K., & Wamba, S. F. (2020). Social media and disaster management: Case of the north and south Kivu regions in the Democratic Republic of the Congo. International Journal of Information Management, 52, 102068. https://doi.org/10.1016/j.ijinfomgt.2020.102068

Khan, M. A. U., & Sayem, M. A. (2013). Understanding recovery of small enterprises from natural disaster. Environmental Hazards, 12(3-4), 218-239.

Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. Medical Teacher, 42(8), 846-854. https://doi.org/10.1080/0142159X.2020.1755030

Kim, J. W., & Mehta, P. G. (2022). Duality for Nonlinear Filtering I: Observability. arXiv preprint arXiv:2208.06586.

Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. Information Systems Journal, 28(1), 227-261.

Kono, S., & Sato, M. (2022). The potentials of partial least squares structural equation modeling (PLS-SEM) in leisure research. Journal of Leisure Research, 1-21. https://doi.org/10.1080/00222216.2022.2066492

Krishnamurthi, L., & Raj, S. P. (1988). A model of brand choice and purchase quantity price sensitivities. Marketing Science, 7(1), 1-20.

Kuo, Y.-F., & Yen, S.-N. (2009). Towards an understanding of the behavioral intention to use 3G mobile value-added services. Computers in Human Behavior, 25(1), 103-110. https://doi.org/10.1016/j.chb.2008.07.007

Laudon, K. C., & Laudon, J. P. (2004). Management information systems: Managing the digital firm. Pearson Educación.

Lee, J., Bharosa, N., Yang, J., Janssen, M., & Rao, H. R. (2011). Group value and intention to use — A study of multi-agency disaster management information systems for public safety. Decision Support Systems, 50(2), 404-414. https://doi.org/10.1016/j.dss.2010.10.002

Levius, S., Safa, M., & Weeks, K. (2017). Research note for use of information and communication technology to support comprehensive disaster management in the Caribbean countries. Journal of Information Technology Case and Application Research, 19(2), 113-120. https://doi.org/10.1080/15228053.2017.1333362

Li, Y., Tan, C.-H., & Yang, X. (2013). It is all about what we have: A discriminant analysis of organizations' decision to adopt open source software. Decision Support Systems, 56, 56-62. https://doi.org/10.1016/j.dss.2013.05.006

Lin, L. (2018). Integrating a national risk assessment into a disaster risk management system: Process and practice. International Journal of Disaster Risk Reduction, 27, 625-631.

Lin, W. R., Lin, C.-Y., & Ding, Y.-H. (2020). Factors Affecting the Behavioral Intention to Adopt Mobile Payment: An Empirical Study in Taiwan. Mathematics, 8(10), 1851. https://doi.org/10.3390/math8101851

Litwin, M. S., & Fink, A. (1995). How to measure survey reliability and validity (Vol. 7). Sage.

Loghmani, M., Tootooni, M. M., & Sharifian, S. (2022). Risk assessment of trace element accumulation in two species of edible commercial fish Scomberoides commersonnianus *and Cynoglossus arel from the northern waters of the Oman Sea. Marine Pollution Bulletin, 174, 113201.*

Magnusson, M., Nyberg, L., & Wik, M. (2018). Information systems for disaster management training: investigating user needs with a design science research approach. Proceedings ISCRAM2018.

Mahmud, I., Akter, J., & Rawshon, S. (2012). SMS based Disaster Alert System in Developing Countries: a Usability Analysis. EXCEL. http://dspace.daffodilvarsity.edu.bd:8080/handle/20.500.11948/3288

Mailizar, A., Abdulsalam, M., & Suci, B. (2020). Secondary school mathematics teachers' views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia. Eurasia Journal of Mathematics, Science & Technology Education, 1-9.

Majchrzak, A., & Markus, M. L. (2012). Technology affordances and constraints in management information systems (MIS). Encyclopedia of Management Theory,(Ed: E. Kessler), Sage Publications, Forthcoming.

Marshall, C., & Rossman, G. (1990). Designing qualitative research.(p111) Newbury Park. In: Sage Publications.

Mathew, D. (2005). Information technology and public health management of disasters--a model for South Asian countries. Prehospital and Disaster Medicine, 20(1), 54-60. https://doi.org/10.1017/s1049023x00002156

Mathwick, C., Malhotra, N., & Rigdon, E. (2001). Experiential value: conceptualization, measurement and application in the catalog and Internet shopping environment☆. Journal of retailing, 77(1), 39-56.

McGaghie, W. C., Bordage, G., & Shea, J. A. (2001). Problem statement, conceptual framework, and research question. Academic Medicine, 76(9), 923-924. https://doi.org/10.1097/00001888-200109000-00021

Md Hassan, A. A. (2015). Role of ICT in natural disaster management of Bangladesh.

Melendez-Landaverde, E. R. W., Micha; Verkade, Jan. (2019). Exploring protective decision-making in the context of impact-based flood warnings. Journal of Flood Risk Management.

Meyer, M. A., Alexander-Hawk, M., Purdum, J. C., Yelle, H., Vick, J., Rodriguez, A., Romero, S., & Taylor, K. A. (2022). Resilience in Recovery? Understanding the Extent, Structure, and Operations of Nonprofits Meant to Address Disaster Survivors' Unmet Needs. Nonprofit and Voluntary Sector Quarterly, 08997640221138265.

MoDMR. (2010). National Plan for Disaster Management

MoDMR. (2016-2020). National Plan for Disaster Management. Government of Bangladesh

Mohibbullah, M., Gain, A. K., & Ahsan, M. N. (2021). Examining local institutional networks for sustainable disaster management: Empirical evidence from the South-West coastal areas in Bangladesh. Environmental Science & Policy, 124, 433-440. https://doi.org/10.1016/j.envsci.2021.07.016

Mombeuil, C., & Uhde, H. (2021). Relative convenience, relative advantage, perceived security, perceived privacy, and continuous use intention of China's WeChat Pay: A mixed-method two-phase design study. Journal of Retailing and Consumer Services, 59, 102384.

Moroto, H., Sakamoto, M., & Ahmed, T. (2018). Possible factors influencing NGOs' project locations for disaster management in Bangladesh. International Journal of Disaster Risk Reduction, 27, 248-264. https://doi.org/10.1016/j.ijdrr.2017.10.011

Mugeni, G. B., Omieno, K., Wabwoba, F., Karume, S. M., Mabele, L., & Otanga, D. (2020). Determinants for the Adoption of Internet of Things (IoT) for Flood and Drought Disaster Management in Kenya. ISJ Theoretical & Applied Science, 09 (89), 342-354.

Mun, Y. Y., Jackson, J. D., Park, J. S., & Probst, J. C. (2006). Understanding information technology acceptance by individual professionals: Toward an integrative view. Information & management, 43(3), 350-363.

Munawar, H. S., Mojtahedi, M., Hammad, A. W. A., Kouzani, A., & Mahmud, M. A. P. (2022). Disruptive technologies as a solution for disaster risk management: A review. Science of the Total Environment, 806(Pt), 3. https://doi.org/10.1016/j.scitotenv.2021.151351

Musaev, A., Wang, D., & Pu, C. (2013, 2014). LITMUS: Landslide detection by integrating multiple sources.

Nasreen, M. (2009). Disasters and disaster research: A case study of floods in Bangladesh. Understanding the global environment, 265-287.

Nasreen, M. (2012). Women and girls: Vulnerable or resilient. Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Dhaka-1000.

Nasreen, M. (2017). Bangladesh National Conservation Strategy.

Nasreen, M. (2021). Fifty years of disaster risk governance in Bangladesh. Daily Star. https://www.thedailystar.net/supplements/celebrating-50-years-bangladesh/news/fifty-years-disaster-risk-governance-bangladesh-2067109

National ICT Policy (2009).

Nespeca, V., Comes, T., Meesters, K., & Brazier, F. (2020). Towards coordinated self-organization: An actor-centered framework for the design of disaster management information systems. International Journal of Disaster Risk Reduction, 51. https://doi.org/10.1016/j.ijdrr.2020.101887

NIPORT/ICF. (2020). Bangladesh Demographic and Health Survey 2017-18. https://www.dhsprogram.com/pubs/pdf/FR344/FR344.pdf

Nussbaumer, A., Pope, A., & Neville, K. (2019). A framework for applying ethics-by-design to decision support systems for emergency management. Information Systems Journal, 33(1), 34-55. https://doi.org/10.1111/isj.12350

O'Sullivan, T. L., Kuziemsky, C. E., Toal-Sullivan, D., & Corneil, W. (2013). Unraveling the complexities of disaster management: a framework for critical social infrastructure to promote population health and resilience. Social Science & Medicine (1982), 93, 238-246. https://doi.org/10.1016/j.socscimed.2012.07.040

Ogie, R. I., Rho, J. C., & Clarke, R. J. (2018, 2018). Artificial intelligence in disaster risk communication: A systematic literature review.

Olsson, A., Skovdahl, K., & Engström, M. (2016). Using diffusion of innovation theory to describe perceptions of a passive positioning alarm among persons with mild dementia: a repeated interview study. BMC Geriatrics, 16, 3. https://doi.org/10.1186/s12877-016-0183-8

Ooi, K.-B., Sim, J.-J., Yew, K.-T., & Lin, B. (2011). Exploring factors influencing consumers' behavioral intention to adopt broadband in Malaysia. Computers in Human Behavior, 27(3), 1168-1178.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. Information systems research, 2(1), 1-28.

Park, H. M. (2015). Univariate analysis and normality test using SAS, Stata, and SPSS.

Peterson, R. A., & Kim, Y. (2013). On the relationship between coefficient alpha and composite reliability. Journal of applied psychology, 98(1), 194.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of applied psychology, 88(5), 879.

Porto de Albuquerque, J., Herfort, B., Brenning, A., & Zipf, A. (2015). A geographic approach for combining social media and authoritative data towards identifying useful information for disaster management. Taylor & Francis. https://eprints.gla.ac.uk/256090

Prizzia, R. (2008). The role of coordination in disaster management. In. Taylor and Francis.

Puriwat, W., & Tripopsakul, S. (2021). Explaining an adoption and continuance intention to use contactless payment technologies: during the COVID-19 pandemic. Emerging Science Journal, 5(1), 85-95.

Putnam, L. (2002). By choice or by chance: How the internet is used to prepare for, manage, and share information about emergencies. First Monday.

Rafi, M. M., Aziz, T., & Lodi, S. H. (2018). A comparative study of disaster management information systems. Online Information Review, 42(6), 971-988.

Rahman, M. R. (2010). Impact of riverbank erosion hazard in the Jamuna floodplain areas in Bangladesh. Journal of Science Foundation, 8(1-2), 55-65.

Rajendran, L., & Shankaran, S. (2021, 2021). ICT enabled early warning dissemination system for disaster management.

Ranaei Kordshouli, H. (2015). A framework for the formulation of disaster management strategic plans at national and regional levels. Disaster Prevention and Management Knowledge (quarterly), 5(1), 30-42.

Ratajczak, J., Schimanski, C. P., Marcher, C., Riedl, M., & Matt, D. T. (2017, 2017). Mobile application for collaborative scheduling and monitoring of construction works according to lean construction methods.

Rathod, U., Hudnurkar, M., & Jakhar, S. (2014). Factors affecting collaboration in supply chain: a literature review. Procedia-Social and Behavioral Sciences, 133, 189-202.

Raymond McLeod, G. S. (2004). Management Information Systems (9th ed.). Pearson/Prentice Hall.

Redmond, A. D. (2005). Needs assessment of humanitarian crises. Bmj, 330(7503), 1320-1322.

Rezoane, Q. A. (2016). A Study on Disaster Management Policy of Bangladesh: Institutional Capacity Enhancement. Unpublished master's thesis). North South University.

Rogers, E. M. (2002). Diffusion of preventive innovations. Addictive behaviors, 27(6), 989-993.

Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

Sakurai, M., & Murayama, Y. (2019). Information technologies and disaster management–Benefits and issues. Progress in Disaster Science, 2, 100012.

Sallehudin, H., Razak, R. C., & Ismail, M. (2015). Factors influencing cloud computing adoption in the public sector: an empirical analysis. Journal of Entrepreneurship and Business, 3(2), 30-45.

Samarajiva, R. (2005). Policy commentary: mobilizing information and communications technologies for effective disaster warning: lessons from the 2004 tsunami. New Media & Society, 7(6), 731-747.

Seo, K. H., & Lee, J. H. (2021). The emergence of service robots at restaurants: Integrating trust, perceived risk, and satisfaction. Sustainability, 13(8), 4431.

Shareef, M. A., Dwivedi, Y. K., Mahmud, R., Wright, A., Rahman, M. M., Kizgin, H., & Rana, N. P. (2019). Disaster management in Bangladesh: developing an effective emergency supply chain network. Annals of Operations Research, 283, 1463-1487.

Sharma, S., & Ravindran, B. (2017). Online multi-task learning using active sampling.

Sorensen, J. H. (2000). Hazard warning systems: Review of 20 years of progress. Natural hazards review, 1(2), 119-125.

Sosik, J. J., Kahai, S. S., & Piovoso, M. J. (2009). Silver bullet or voodoo statistics? A primer for using the partial least squares data analytic technique in group and organization research. Group & Organization Management, 34(1), 5-36.

Stoneburner, G., Goguen, A., & Feringa, A. (2002). Risk management guide for information technology systems. Nist special publication, 800(30), 800-830.

Strauss, A., & Corbin, J. (1990). Basics of qualitative research. Sage publications.

Stroeva, O., Lyapina, I. R., Konobeeva, E. E., & Konobeeva, O. E. (2015). Effectiveness of management of innovative activities in regional socio-economic systems.

Suebtimrat, P., & Vonguai, R. (2021). An investigation of behavioral intention towards QR Code payment in Bangkok, Thailand. The Journal of Asian Finance, Economics and Business, 8(1), 939-950.

Taherdoost, H. (2016). Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. How to test the validation of a questionnaire/survey in a research (August 10, 2016).

Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. Journal of mixed methods research, 1(1), 77-100.

Tomaszewski, B. (2020). Geographic information systems (GIS) for disaster management. Routledge.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. IEEE Transactions on engineering management(1), 28-45.

Touray, A. (2015). Sustainable solutions for last mile Internet access in developing countries: critical success factors. Jyväskylä studies in computing(214).

Tsai, C.-H., & Chen, C.-W. (2010). An earthquake disaster management mechanism based on risk assessment information for the tourism industry-a case study from the island of Taiwan. Tourism Management, 31(4), 470-481. https://doi.org/10.1016/j.tourman.2009.05.008

Ullah, M. S. (2003). The role of dialect specific radio warnings in saving lives during cyclonic disaster in Bangladesh. Turning the tide on disasters towards sustainable development, World Disaster Reduction Campaign.

Ullman, J. B., & Bentler, P. M. (2012). Structural equation modeling. Handbook of Psychology, Second Edition, 2.

UN. (1994). DesInventar In: https://www.desinventar.net.

UN. (2005-2015). Hyogo Framework for Action 2005-2015 (HFA). In. Kobe, Hyogo, Japan: ISDR. International Strategy for Disaster Reduction.

UNDP. (2002). Millenium Development Goals (MDGs) . Goals, targets and indicators.

UNOPS. (2016). IMPACT Sustainability Report 2016- UNOPS.

Van De Walle, B., Turoff, M., & Hiltz, S. R. (2014). Information systems for emergency management (Vol. 16). Routledge.

Van Westen, C. J. (2013). Remote sensing and GIS for natural hazards assessment and disaster risk management. Treatise on geomorphology, 3(15), 259-298.

Vojvodic, M., & Hitz, C. (2019). Governance team leadership and business user participation: organizational practices for innovative customer engagement in data compliance project. Central European Business Review, 8(2), 15-45.

Wallace, L. G., & Sheetz, S. D. (2014). The adoption of software measures: A technology acceptance model (TAM) perspective. Information & management, 51(2), 249-259.

Walsham, G. (1995). Interpretive case studies in IS research: nature and method. European Journal of information systems, 4(2), 74-81.

Waugh Jr, W. L., & Streib, G. (2006). Collaboration and leadership for effective emergency management. Public administration review, 66, 131-140.

Williams, W., & Lewis, D. (2005). Convergent interviewing: a tool for strategic investigation. Strategic Change, 14(4), 219.

Wisdom, J. P., Cavaleri, M. A., Onwuegbuzie, A. J., & Green, C. A. (2012). Methodological reporting in qualitative, quantitative, and mixed methods health services research articles. Health services research, 47(2), 721-745.

Xiao, Y., Huang, Q., & Wu, K. (2015). Understanding social media data for disaster management. Natural Hazards, 79, 1663-1679.

Xu, X., Thong, J. Y. L., & Tam, K. Y. (2017). Winning back technology disadopters: testing a technology readoption model in the context of mobile internet services. Journal of Management Information Systems, 34(1), 102-140.

Yan, L., & Pedraza-Martinez, A. J. (2019). Social media for disaster management: Operational value of the social conversation. Production and Operations Management, 28(10), 2514-2532.

Yang, M., Mamun, A. A., Mohiuddin, M., Nawi, N. C., & Zainol, N. R. (2021). Cashless transactions: A study on intention and adoption of e-wallets. Sustainability, 13(2), 831.

Yatigammana, M., Johar, M., & Gunawardhana, C. (2013). Impact of Innovations attributes on e-learning acceptance among Sri Lankan postgraduate students.

Yodmani, S., & Hollister, D. (2001, 2001). Disasters and communication technology: Perspectives from Asia.

Zagorecki, A. T., Johnson, D. E. A., & Ristvej, J. (2013). Data mining and machine learning in the context of disaster and crisis management. International Journal of Emergency Management, 9(4), 351-365.

Zaman, U., Zahid, H., Habibullah, M. S., & Din, B. H. (2021). Adoption of big data analytics (BDA) technologies in disaster management: a decomposed theory of planned behavior (DTPB) approach. Cogent Business & Management, 8(1), 1880253.

Zeng, F., Chan, H. K., Pawar, K., & Aickelin, U. (2018). FACTORS AFFECTING THE ADOPTION OF INFORMATION TECHNOLOGY IN SUPPLY CHAIN IN THE DYNAMIC ECONOMY: A REVIEW OF 2000 TO 2017. on Logistics (ISL 2018) Big Data Enabled Supply Chain Innovations.

Zhang, X., Han, X., Dang, Y., Meng, F., Guo, X., & Lin, J. (2017). User acceptance of mobile health services from users' perspectives: The role of self-efficacy and response-efficacy in technology acceptance. Informatics for Health and Social Care, 42(2), 194-206.

Zlatanova, S., & Fabbri, A. G. (2009). Geo-ICT for risk and disaster management. Geospatial Technology and the Role of location in Science, 239-266.

Appendix

Glossary

Adaptation: Adaptation as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm.

Attitude: The beliefs, feelings, and attitudes toward an object or concept which are consistently favorable or unfavorable to a person (Armstrong et al., 2006)**.**Performance attitude refers to the extent to which a individual has a favorable or unfavorable assessment or evaluation of the actions in question (Ajzen, 1991).

Perceived Ease of Use: The degree to which a individual believes that it will be effortless to use a given program (Davis, 1989).

Perceived Usefulness: Perceived usefulness as the degree to which a person considers a particular program to improve the output of his or her job (Mathwick et al., 2001)

Perceived behavioural control: It refers to the perceived ease or difficulty of acting and is presumed to represent past experience as well as expected barriers and impediments **(Ajzen, 1991)**.

IS: Information systems can be classified by the specific organizational function they serve as well as by the organizational level. Based on the organizational level, business functions, and business processes that information systems support, they are classified into four major types of Systems: Transaction Management System, Management Information System, Decision-Support System, and Executive Support System (Laudon & Laudon, 2004).

Management: In the words of Terry; “Management is a distinct process consisting of planning, organizing actuating and controlling performed to determine and accomplish the objectives by the use of people and resources” (Beets et al., 1994).

Perceived Ease of Use: The degree to which a individual believes that it will be effortless to use a given program (Davis, 1989).

Perceived Usefulness: Perceived usefulness as the degree to which a person considers a particular program to improve the output of his or her job (Mathwick et al., 2001)

Perceived behavioural control: It refers to the perceived ease or difficulty of acting and is presumed to represent past experience as well as expected barriers and impediments (Ajzen, 1991).

System: System is an integrated process working with other related components for a common destination. The system can also be referred to “as a set of elements joined together for a common objective” (Aldrich & Whetten, 1981).

UP: Union Parishad, elected local government institution comprising several villages.

Upazila: Is a sub-district comprising several unions.

Role of Information Systems in Disaster Management
(Data Collection Tools)
Socio Economic Information

Serial Number: Date of the survey:
Name of the Location:

1.	Name of the Respondent:		
2.	E-mail of the Respondent:	Response	Code
3.	Gender	Male	1
		Female	2
4.	Age of the Respondent	15-20 Y	1
		21-30 Y	2
		31-40 Y	3
		Above 40 Y	4
5.	Educational Qualification of the Respondent	Below S.S.C	1
		S.S.C	2
		H.S.C	3
		Graduate and above	4
5.	Occupation of the Respondent	Student	1
		Service	2
		Business	3
		Other (Specify)	4
6.	Income	(Below 10,000)	1
		(10-20 thousand)	2
		(21-30 thousand)	3
		(31-40 thousand)	4
7.	Number of Family members	(2-4)	1
		(5-7)	2
		(8-10)	3
8.	Which media is most effectively using for disaster warning? Such as:	Radio	1
		TV	2
		Mobile	3
		Locally Miking	4
11.	Do you usually receive any ICT based disaster warning before any disaster by any GOB/NGO?	Yes	1
		No	2
12.	Do you receive any SMS about early warning of disaster in your cell phone?	Yes	1
		No	2
13.	Is there any Internet browsing facility in your Personal Computer (PC)?	Yes	1
		No	2
14.	Do you have internet facility in your mobile?	Yes	1
		No	2
15.	Do you browse weather news/disaster warning news by your mobile/PC as often?	Yes	1
		No	2
16.	Do you think Disaster Information can minimize the loss of lives/ property damage?	Yes	1
		No	2
17.		Yes	1

	Do you think IT based disaster management information collection is expensive?	No	2
18.	Do you know about ICT based disaster management?	Yes	1
		No	2
19.	Was there any TV/Newspaper was in Shelter?:	Yes	1
		No	2
20.	Do you know about hotline number **(**1090) about weather news?	Yes	1
		No	2

Role of Information Systems in Disaster Management
(Data Collection Tools)
Use of Information Technology

Serial Number: Date of the survey:
Name of the Location:

1.	Name of the Respondent:		
2.	E-mail of the Respondent:	Response	Code
3.	Gender	Male	1
		Female	2
4.	Age of the Respondent	15-20 Y	1
		21-30 Y	2
		31-40 Y	3
		Above 40 Y	4
5.	Educational Qualification of the Respondent	S.S.C	1
		H.S.C	2
		Graduate	3
		Post Graduate	4
		PhD	5
5.	Occupation of the Respondent	Student	1
		Service	2
		Business	3
		Other (Specify)	4
6.	Types of Residence	Permanente	1
		Tenant	2
8.	Do you know about ICT based disaster management?	Yes	1
		No	2
9.	How do you get disaster warning in your area usually?	By local authority	1
		Miking by Masjid	2
		NGO	3
		By Radio	4
		By Television	5
		Mobile SMS	6
		Voice Mail	7
10.	Which media is most effectively using for disaster warning? Such as:	Radio	1
		TV	2
		Mobile	3
		Other	4
11.	Do you usually receive any ICT based disaster warning before any disaster by any GOB/NGO?	Yes	1
		No	2
12.	Do you receive any SMS about early warning of disaster in your cell phone?	Yes	1
		No	2
13.	Is there any Internet browsing facility in your Personal Computer (PC)?	Yes	1
		No	2
14.	Do you have internet facility in your mobile?	Yes	1

		No	2
15.	Do you browse weather news/disaster warning news by your mobile/PC as often?	Yes	1
		No	2
16.	Do you think disaster warning through ICT can minimize loss of lives and property damage?	Yes	1
		No	2
17.	Do you think IT based disaster management information collection is expensive?	Yes	1
		No	2
18.	In which year you have first received IT based disaster related information? such as:	Last 5 years	1
		Last year	2
		This year	3
		Never	4
19.	What type of ICT based information can help disaster management you think? such as:	Early Warning	1
		Social counseling	2
		Health safety news	3
		Other	4
20.	Do you know about hotline number (1090) about weather news?	Yes	1
		No	2

Observational Note:---

Questionnaire
Research Topic: Role of Management information systems in disaster management: an exploratory study in Bangladesh.

Management information systems theory that model how users can be benefited in disaster management. The model of questionnaire usuallyexpress the viewpoint about technology acceptance from users aspects and organizational coordination.This is my PhD research questionnaire. Please return as soon as possible. Cooperate please, thanks. Md. Hasibur Rahman.

Answering Scale:
1. *Strongly Disagree*
2. *Disagree*
3. *Neutral*
4. *Agree*
5. *StronglyAgree*

Name : ....Name of University/ Department ....

Age...................... Gender: M/F …….. Student/Service ………………. Service Length ....

Type of Organization/ Company : ....] Mobile No ....Signature ....

Sl.No.	Subjects	Please circle your answer				
Perceived usefulness (PU)of technology-based services in disaster events						
1.	The technology-based information and instructions need to enable me to take necessary actions.	1	2	3	4	5
2.	The provided information and instructions need to be valuable.	1	2	3	4	5
3.	The provided information and instructions need to be effective.	1	2	3	4	5
4.	The provided information and instructions need to be useful for live saving and damage minimization.	1	2	3	4	5
5.	The way to get technology **(**MIS) based information and instructions need to be easy to follow.	1	2	3	4	5
Perceived ease of use (PEoU) of the technology-based services in disaster events		1	2	3	4	5
1.	The way to get information and instructions need to be clear.	1	2	3	4	5
2.	The way to get information and instructions need to be flexible to interact with.	1	2	3	4	5
3.	The way to get information and instructions need to be understandable.	1	2	3	4	5
4.	The way to get information and instructions should not need special skill.	1	2	3	4	5

5.	The provided information and instructions are useful.	1	2	3	4	5
Behavioural intention(BI)of technology-based services in disaster events						
1.	Likeliness to use the technology-based information and instructions is important for adopting technology-based services.	1	2	3	4	5
2.	Likeliness to taking action accordingly is important for adopting technology-based services.	1	2	3	4	5
3.	Likeliness to disseminate the information obtained is important for adopting technology-based services.	1	2	3	4	5
4.	Likeliness to follow the instructions obtained is important for adopting technology-based services.	1	2	3	4	5
5.	Likeliness to interact with the instructions or information provider is important for adopting technology-based services.	1	2	3	4	5
Relative advantage (RA)of technology-based services in disaster events						
1.	It is important that technology-based services enhance my ability to get necessary information and instructions.	1	2	3	4	5
2.	It is important that technology-based services enhance my efficiency to get necessary information and instructions.	1	2	3	4	5
3.	It is important that technology-based services lessen difficulty to get necessary information and instructions.	1	2	3	4	5
4.	It is important that technology-based services make it easier to get necessary information and instructions.	1	2	3	4	5
5.	It is important that technology-based services make it easier to cooperate or interact.	1	2	3	4	5
Compatibility (Comp)of technology-based services in disaster events						
1.	It is important that technology-based services fit to my need to get necessary information and instructions to cope with disaster situation.	1	2	3	4	5
2.	It is important that technology-based services match with the way I want to interact.	1	2	3	4	5

3.	It is important that technology-based services fit to the demand of the situation.	1	2	3	4	5
4.	It is important that technology-based services are compatible with the way I want to receive information and instructions.	1	2	3	4	5
5.	It is important that technology-based services are compatible with the existing system.	1	2	3	4	5
Complexity(Comx)of technology-based services in disaster events						
1.	The difficulty in using technology **(**MIS) based information and instructions would prevent me from using it.	1	2	3	4	5
2.	It is important to get necessary devices or gadgets easily for getting technology **(**MIS) based information and instructions.	1	2	3	4	5
Trialability (Tr)of technology-based services in disaster events						
1.	It is important to have the opportunity to try technology **(**MIS) based information and instructions in disaster event first.	1	2	3	4	5
2.	It is important to have a satisfactorily trial of technology **(**MIS) based information and instructions in disaster event.	1	2	3	4	5
Observability(Ob)of technology-based services in disaster events						
1.	The benefits of using technology-based services for providing information and instructions in disaster event need to be observable	1	2	3	4	5
2.	The results of using technology-based services for providing information and instructions in disaster event need to be apparent.	1	2	3	4	5

Questionnaire in Bangla
Research Topic: Role of Management information systems in disaster management: an exploratory study in Bangladesh.

Management information systems theory that model how users can be benefited in disaster management. The model of questionnaire usuallyexpress the viewpoint about technology acceptance from users aspects and organizational coordination.This is my PhD research questionnaire. Please return as soon as possible. Cooperate please, thanks. Md. Hasibur Rahman.

Answering Scale:
1. *Strongly Disagree*
2. *Disagree*
3. *Neutral*
4. *Agree*
5. *StronglyAgree*

Name : ....Name of University/ Department ....

Age...................... Gender: M/F …….. Student/Service ………………. Service Length ....

Type of Organization/ Company : ....] Mobile No ....Signature

নং.	বিষয়	আপনার উত্তরের নাম্বারের বৃত্ত ভরাট করুন				
দুর্যোগসময়কালীন প্রযুক্তি-নির্ভর সেবার অনুভূত উপযোগিতা						
১.	প্রযুক্তি-নিভৃর তথ্য ও নির্দেশাবলীআমাকে প্রয়োজনীয় কার্যকলাপের আভাস দিবে	১	২	৩	৪	৫
২.	প্রদত্ত তথ্য ও নির্দেশাবলী মুল্যবান হতে হবে	১	২	৩	৪	৫
৩.	প্রদত্ত তথ্য ও নির্দেশাবলী ফলপ্রসূ হতে হবে	১	২	৩	৪	৫
৪.	প্রদত্ত তথ্য ও নির্দেশাবলী জীবন রক্ষাকারী ও ক্ষতির পরিমাণ কমাতে সক্ষম হবে	১	২	৩	৪	৫
৫.	তথ্য ও নির্দেশাবলীর প্রাপ্যতা সহজলভ্য হতে হবে	১	২	৩	৪	৫
দুর্যোগসময়কালীন প্রযুক্তি-নির্ভর সেবার সহজ ব্যবহার		১	২	৩	৪	৫
১.	তথ্য ও নির্দেশাবলী পাওয়ার পদ্ধতি স্পষ্ট হতে হবে	১	২	৩	৪	৫
২.	তথ্য ও নির্দেশাবলী পাওয়ার পদ্ধতি সহজে ব্যবহারযোগ্য হতে হবে	১	২	৩	৪	৫
৩.	তথ্য ও নির্দেশাবলী পাওয়ার পদ্ধতি বোধগম্য হতে হবে	১	২	৩	৪	৫
৪.	তথ্য ও নির্দেশাবলী পাওয়ার পদ্ধতি ব্যবহারে কোনো উচ্চতর দক্ষতার প্রয়োজন হবেনা	১	২	৩	৪	৫
৫.	প্রদত্ত তথ্য ও নির্দেশাবলী পাওয়ার পদ্ধতি দুর্যোগ ব্যবস্থাপ্নয় কার্যকারী হতে হবে	১	২	৩	৪	৫
দুর্যোগসময়কালীন প্রযুক্তি-নির্ভর সেবার আচরণগত উদ্দেশ্য						
১.	তথ্য প্রযুক্তি সম্পর্কিত নির্দেশাবলী দুর্যোগসম্পর্কিত সেবা প্রদানে গুরুত্বপূর্ণ সম্ভাবনা প্রকাশ করে	১	২	৩	৪	৫

২.	প্রযুক্তি সম্পর্কিত সেবা প্রদানে গুরুত্বপূর্ণ সম্ভাবনা প্রকাশে নির্দিষ্ট কর্তৃপক্ষ ধারাবাহিকভাবে কার্য বাস্তবায়ন করা	১	২	৩	৪	৫
৩.	দুর্যোগ ব্যবস্থাপনায় প্রযুক্তি সম্পর্কিত সেবা গুরুত্বপূর্ণ সম্ভাবনা প্রকাশে প্রাপ্ত তথ্য সাধারন জনগনে সম্প্রচারকরা	১	২	৩	৪	৫
৪.	প্রাপ্ত নির্দেশাবলী অনুসরণ করা প্রযুক্তি সম্পর্কিত সেবা প্রদানে গুরুত্বপূর্ণ সম্ভাবনা প্রকাশে সহায়ক	১	২	৩	৪	৫
৫.	তথ্য প্রযুক্তিভিত্তিক সেবার নির্দেশাবলী সর্ম্পকে সরবরাহকারীর সাথে আলাপচারিতা গুরুত্বপূর্ণ	১	২	৩	৪	৫
দুর্যোগের ঘটনায় প্রযুক্তি ভিত্তিক সেবার আপেক্ষিক সুবিধা						
১.	তথ্য প্রযুক্তিভিত্তিক সেবাগুলির প্রয়োজনীয়তা এবং নির্দেশাবলী পাওয়ার জন্য সেবার সুবিধা বাড়ানো গুরুত্বপূর্ণ।	১	২	৩	৪	৫
২.	প্রযুক্তি ভিত্তিক সেবাগুলি প্রয়োজনীয় তথ্য এবং নির্দেশাবলী পাওয়ার জন্য জনগনের দক্ষতা বাড়ানো গুরুত্বপূর্ণ	১	২	৩	৪	৫
৩.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি প্রয়োজনীয় তথ্য এবং নির্দেশাবলী পেতে অসুবিধা কমিয়ে দেয়	১	২	৩	৪	৫
৪.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি দুর্যোগ ব্যবস্থাপনার জন্য প্রয়োজনীয় তথ্য এবং নির্দেশাবলী পাওয়া সহজ করে তোলে	১	২	৩	৪	৫
৫.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি সহযোগিতা বা ইন্টারঅ্যাক্ট করতে সহজ করে তোলে	১	২	৩	৪	৫
দুর্যোগের ঘটনাসমূহে প্রযুক্তি নির্ভর সেবাগুলির সামঞ্জস্য						
১.	প্রযুক্তি-ভিত্তিক সেবাগুলি দুর্যোগ পরিস্থিতি মোকাবিলার জন্য প্রয়োজনীয় তথ্য এবং নির্দেশনা পাওয়ার জন্য আমার প্রয়োজনীয়তার সাথে খাপ খায় এটি গুরুত্বপূর্ণ।	১	২	৩	৪	৫
২.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি দুর্যোগ ব্যবস্থাপনার জন্য ইন্টারেক্ট করার উপায়ের সাথে মেলে।	১	২	৩	৪	৫
৩.	প্রযুক্তি-ভিত্তিক সেবা পরিস্থিতির চাহিদা অনুযায়ী উপযুক্ত তা গুরুত্বপূর্ণ।	১	২	৩	৪	৫
৪.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি দুর্যোগ ব্যবস্থাপনার জন্য তথ্য এবং নির্দেশাবলী পাওয়ার পদ্ধতির সাথে সামঞ্জস্যপূর্ণ।	১	২	৩	৪	৫
৫.	এটি গুরুত্বপূর্ণ যে প্রযুক্তি-ভিত্তিক সেবাগুলি বিদ্যমান সিস্টেমের সাথে সামঞ্জস্যপূর্ণ।	১	২	৩	৪	৫
দুর্যোগ ঘটনাসমূহে প্রযুক্তি ভিত্তিক সেবাগুলির জটিলতা						
১.	প্রযুক্তি ভিত্তিক তথ্য এবং নির্দেশাবলী ব্যবহাওে অসুবিধা দুর্যোগ পরিচালনার জন্য ব্যবহার থেকে বিরত থাকবে।	১	২	৩	৪	৫

২.	প্রযুক্তি ভিত্তিক তথ্য এবং নির্দেশাবলী পাওয়ার জন্য সহজেই প্রয়োজনীয় ডিভাইস বা গ্যাজেটগুলি পাওয়া গুরুত্বপূর্ণ।	১	২	৩	৪	৫
দুর্যোগের ঘটনাসমূহে প্রযুক্তিনির্ভর সেবাগুলির প্রচেষ্টা						
১.	প্রথমে দুর্যোগের ঘটনায় প্রযুক্তি ভিত্তিক তথ্য এবং নির্দেশাবলীর চেষ্টা করার সুযোগ পাওয়া গুরুত্বপূর্ণ।	১	২	৩	৪	৫
২.	প্রযুক্তি ভিত্তিক তথ্য এবং বিপর্যয় ঘঁনার বিষয়ে নির্দেশাবলীর এশটি সনোতাষজনকভাবে বিচার হওয়া গুরুত্বপূর্ণ।	১	২	৩	৪	৫
দুর্যোগের ঘটনানমূহে প্রযুক্তি নির্ভর সেবাগুলির পর্যবেক্ষণ						
১.	দুর্যোগের ঘটনায় তথ্য এবং নির্দেশাবলী সরবরাহের জন্য প্রযুক্তি-ভিত্তিক সেবাগুলি ব্যবহারের সুবিধাগুলি পর্যবেক্ষণযোগ্য হওয়া দরকার	১	২	৩	৪	৫
২.	দুর্যোগের ঘটনায় তথ্য এবং নির্দেশাবলী সরবরাহের জন্য প্রযুক্তি-ভিত্তিক সেবাগুলি ব্যবহারের ফলাফলগুলি স্পষ্ট হওয়া দরকার।	১	২	৩	৪	৫

Interview theme

(for qualitative analysis)

Title of the thesis: **Role of Information Systems in Disaster Management: An Exploratory Study in Bangladesh**

Understanding the process of information/data collection/dissemination about disaster management of your organization:

1. What is the current state of the disaster management and coordination of Information Systems in your organization?
2. When (in which year) your organization started IT based disaster related information dissemination?
3. How does your organization take part before a disaster?
4. How does your organization operate during a disaster?
5. How does your organization operate after a disaster?
6. What was the nature of operation of your IT based disaster management (information sharing/dissemination)?
7. Where there any response by the community? If yes, (Facebook/Twitter/ sharing)
8. What kinds of data have you collected from the disaster affected areas? (Lives/asset loss by assessment form) was it used? (Why/Why Not?)
9. Do you think IT based information dissemination on disaster is expensive? (Yes/No) (If Yes) Why?
10. Does your organization share disaster information with stakeholder\community groups/NGO?
11. How did you share information with the affected areas by (SMS/E-mail/Voice-mail/Radio/TV/IVR etc.)?
12. Do you think Information Technology based disaster management is feasible for your organization and the stakeholders?
13. Is there any dedicated website provided by your organization in consequent of disaster warning?
14. Who do you give access to your data/information? (Everybody/members only/Facebook/Linkedin/Twitter etc.)

15. In case of power shutdown, how do you provide your IT services to the affected community?

16. Who are more benefited by the available ICT used by **(**Management/ Community)?

17. What types of information is valued at community level? **(**TV news/SMS/Voice mail/E-mail/etc)

18. Do you think IT based disaster management can minimize live loss and property damage? If yes, How?

19. Does your organization maintain Information linkage/sharing with other emergency management organization?

20. Does your organization get any feedback from the stakeholder's level? **(**Yes/No.) **(**If yes comments)

21. Is there any Flood Risk Assessment Mapping information/data in your website?

22. Is there any relief distribution assessment information/data in your website?

23. Is there any loss and damage assessment information/data in your website?

24. Is there any specific disaster data/information collected by your organization for the different vulnerable community, such as: **(**Fishermen//Farmer/Day Labour/Service holder/ Businessmen etc.)?

25. Is there any disaster resilience activity related information/data in your website? Such as **(**Community Resilience/

Social Resilience/Structural –Engineering Resilience/ Psychological counseling etc.)

Recommendations for further development of Information systems Based Disaster Management in Bangladesh:--- ------------------ -- ---

Matrix of the Research:

Sl. No.	Name of Organization	Activities	Name of Linkage Organization
01	MoDM&R	Web Portal E-Learning, Micro zonation map, Health crisis management, IVR system, SMS etc.	It has been observer from the website of MoDM&R that4W Database, DMIC Portal, Cyclone shelter DB, Union Fact sheet, Inundation Map, CDMP Risk Management Information, AusAid, DFID, European Union, Norwegian Embassy, Sida, UNDP, CDMP Old Website
02	UNDP	Disaster Risk Reduction, Crisis Prevention and Recovery	UNDP's work is organized into four geographic regions. Africa, Arab States, Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean
03	SPARSO Bangladesh	Effective and peaceful application of Space & Geo-information Technology (GIT) for sustainable development and human safety, security for benefits.	SPARSO Bangladesh linkages with ACRS, AP-RSAF, AIT, APSCO, AP-MCSTA, CIDA, CSSTE-AP, ESA, FAO, ISRO, IOGOOS, JAXA, JICA, ISNET, ICUN, NASA, OIC, RESAP, COMSTECH, SAARC, SMRC, SUPARCO, USAID, UN-ESCAP, UNDP, UNFPA, UN/OOSA, UNFPA
04	IFRC Bangladesh	(IFRC) is the world's largest humanitarian organization, providing assistance without discrimination as to nationality, race, religious beliefs, class or political opinions. IFRC carries out relief operations to assist victims of disasters, and combines this with development work to strengthen the capacities of its member National Societies.	Press contacts, Press releases, Video newsroom Annual Report 2014 World Disasters Report 2015, Appeals, Information Volunteering in emergencies Volunteering policy, Volunteers stay safe Learning, education and training, Internships
05	OXFAM Bangladesh .	Use a combination of rights-based sustainable development programs, public education, campaigns, advocacy, and humanitarian assistance in disasters and conflicts.	The name “Oxfam” comes from the Oxford Committee for Famine Relief, founded in Britain in 1942Oxfam is an international confederation of 18 organizations working together with partners and local communities in more than 90 countries.
06	MoDM&R-CDMP Phase-II:	Database, DMIC Portal, Cyclone shelter DB, Union Fact sheet, Inundation Map, CDMP Risk Management Information, AusAid, DFID, European Union, Norwegian	Media Monitoring Report, ICT Skill Training, Procurement/EOI/RFP, Learning and Development, CRA

		Embassy, Sida, UNDP, CDMP Old Website,	
07	German Red Cross	Early warning system (flood forecasting analysis, cyclone forecasting analysis). Mainly forecast by BMD and analysis by our organization, Beneficiary data collection through smart phone and Weighted average for filtering.	Mobile message and phone call with involvement local committee. Track analysis and flood level analysis and also disseminate messages, cash transfer.
08	CordAid	Cordaid's commitment to climate justice is expressed in our advocacy work with Caritas Internationalis and CIDSE, which has been campaigning for an ambitious, fair, and binding international agreement on climate since 2009.	SMS and phone call with involvement local committee. How many people affected, Loss and damage scenario
09	ActionAid	1990 ActionAid was working in over 30 countries. In Bangladesh we started IT based disaster management from last decades.	SMS and phone call with involvement local committee
10	a2i	We work to make free access to Information (a2i) Programme for everybody. Though this program we focused on Disaster right now but has a plan to ICT based innovation in Disaster area.	Reducing Time, Cost and number of Visit of service providers in receiving services from CPP Disaster information dissemination to village level during cyclone will take as a pilot project soon
11	Islamic Relief Bangladesh	IRB is connected with national warning centres especially with FFWC and BMD only to have warning messages of flood and cyclone. Connecting we have Rapid Emergency Response Team those are also connected through SMS and emergency SOS messages through online, cell phone network	Yes there had numbers of benefits for community although it's very tough job to accomplish since the community peoples were properly acquainted with IT based relief operation and even to read emergency SMS.
12	Asian Disaster Preparedness Centre, Bangladesh	This is agency of ADPC Thailand. Each agency is using its own system and send their information to the Office of Water Management under the Prime Minister Office as the central command.	As ADPC is focusing on disaster preparedness, sometimes community response.

Image 1: GPS points of Kashabpur, Jashore

Image 2: Group Discussion with the teachers of Bhobodhoho College, Jashore