A FRAMEWORK FOR CRITICAL INFRASTRUCTURE MANAGEMENT WITH THE FOCUS ON DISASTERS: CASE STUDY APPROACH

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Degree of Master of Philosophy

Department of Civil Engineering

University of Moratuwa

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DECLARATION

I would like to declare that this work is my own research proposal and this proposal does not include without acknowledgment of any material which have previously published or submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and believe it does not comprise of any material previously published or written by another person except where the acknowledgment is made in the text.

Signature: Date:

UOM Verified Signature

.....10.10.2022.....

P.L.A.I. Shehara

I have supervised the research study of the above mentioned candidate

Signature of the Supervisor(s): Date:

UOM Verified Signature

20/10/2022

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Dr. C.S.A. Siriwardana

ABSTRACT

The significance of Critical Infrastructure and the important focus to enhance their level of resilience capacity is defined by the Sendai Framework for Disaster Risk Reduction developed for 2015-2030. Furthermore, Goal 9 defined by the Sustainable Development Goals calls for creating resilient infrastructure and enhancing their capacity level. Accordingly, the resilience enhancement of the Critical Infrastructure can be delivered by elements of Multi-Hazard Early Warning, which is a strategical concept of Disaster Risk Reduction mechanism. This strategical integration to resilience enhancement can be more effective with the novel technological implementation of Early Warning dissemination. In the research study, main concern is towards development of a strategical resilience assessment framework for Critical Infrastructure management in Sri Lanka. Along the focused research scope, the Transportation Infrastructure sector was focused on framework development. Transportation sector has a wide concern in which their performance on operation depends highly on the level of capability of adapting and recovering from a disaster incident.

From the global level developed frameworks, the Australian Critical Infrastructure Resilience Strategy was identified as the basis for the resilience framework development. Based on this framework the integration of community, organizational and technical infrastructure resilience aspects were identified as the key basis. From the initial literature review, the parameter identification was undertaken and initial parameter selection was undertaken. Here, the community resilience aspects were determined through field survey in which overall 393 responses were collected. The organizational resilience aspects were determined through telephone interviewing in which 1004 responses were collected. The technical infrastructure resilience aspects were determined using field studies and focus group meetings. The identified parameter from the literature review and the initial literature survey was categorized and filtered under the expert opinion survey. For the quantification of the resilience capacity, the quantification of each of indicator aspects were considered. Here, the Analytical Hierarchical Process was applied to capture the weights for the each

identified parameter through expertise determination. Through this, the relationships among each variable aspects were considered for the determination of resilience level. With this, the applicability was determined using a case study in Amaragedara South Grama Niladari division in Bulathsinhala Divisional Secretariat division. The key summary output of the framework implication in regional level aspects can be incorporated into the planning stage of the Disaster Management system in the country.

Key Words: Critical Infrastructure (CI), Natural hazards, Resilience, Transportation sector, Multi-Hazard Early Warning (MHEW)

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P.L.A.I. Shehara

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Abbreviation	Description
AASHTO	American Association of State Highway and Transportation Officials
AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
CABARET	Capacity Building in Asia for Resilience EducaTion
CCA	Climate Change Adaptation
CI	Critical Infrastructure
CI	Consistency Index
CIP	Critical Infrastructure Protection
CIR	Critical Infrastructure Resilience
CLD	Causal Loop Diagrams
CoBRA	Community Based Resilience Analysis
CR	Consistency Ratio
CRITIC	CRiteria Importance Through Inter-criteria Correlation
DEWN	Disaster and Emergency Warning Network
DM	Disaster Management
DMC	Disaster Management Centre
DOM	Department of Meteorology
DRR	Disaster Risk Reduction
DS	Divisional Secretariate
ELECTRE	Elimination and choice expressing the reality

EOP	Emergency Operation Procedures
ESCAP	Economic and Social Commission for Asia and Pacific
EW	Early Warning
FEMA	Federal Emergency Management Authority
FHWA	Federal HighWay Administration
FL	Florida
GIS	Geographic Information System
GN	Grama Niladari
GRS	Geo-synthetic Reinforced Soil
MAUT	Multi-Attribute Utility Theory
MCDM	Multi-Criteria Decision Making
MHEW	Multi-Hazard Early Warning
NBRO	National Building Research Organization
NGO	Non-Government Organizations
NIPP	National Infrastructure Protection Plan
OECD	Organization for Economic Co-operation and Development
PDNA	Post Disaster Need Assessment
PPD	Presidential Policy Directive
PTWC	Pacific Tsunami Warning Centre
RDA	Road Development Authority
RI	Random Consistency Index
SDG	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction

SLP	Sri Lanka Police
SMART	Simple Multi-Attribute Ranking Technique
SMS	Short Message Service
SNA	Social Network Analysis
SOP	Standard Operation Procedures
UNDRR	United Nations office for Disaster Risk Reduction
US	United States
USAID	United States Agency for International Development
USD	United States Dollars
WSM	Weighted Sum Model