INTERNATIONAL JOURNAL
OF
CONSERVATION SCIENCE

ISSN: 2067-533X Volume 9, Issue 3, July-September 2018: 523-536 www.ijcs.uaic.ro

AN EXPLORATION OF DISASTER RISK TO CULTURAL HERITAGE ASSETS: TOWARDS EFFECTIVE CONSERVATION

Dodo MANSIR[1*], Narimah KASIM[1], Indera Syahrul MAT RADZUAN[2]

[1] Universiti Tun Hussein Onn Malaysia, Department of Construction Management, 86400 Parit Raja Batu Pahat, Johor, Malaysia
[2] Universiti Tun Hussein Onn Malaysia, Department of Real Estate Management, 86400 Parit Raja Batu Pahat, Johor, Malaysia

Abstract

Owning to the losses incurred from the occurrence of certain events at Cultural Heritage Sites (CHS's), conservation of its Cultural Heritage (CH) assets is reported to be threatened. The losses while qualifying for disasters to an affected CHS have necessitated proactive measures in the conservation of CH assets (individual and collective) aimed at reducing the risks of their exposure to eventual disasters. Foremost in such measures is the assessment of Disaster Risks (DR) whereby good practice (assessment of DR) conceptualises it (DR) to being a collective interplay of four variables namely: hazards, vulnerability; capacity and exposure. While deeper insights to the manifestation of each variable is deemed to be gained through a technique that investigates each variable in a multi-level approach, researches in the CH domain are yet to fully apply such approach (particularly to all the variables). Therefore, this research examined the four DR variables with a view to explore their multi-level manifestations in the domain of CH conservation. With the aid of a structured questionnaire and by means of conducting a survey, data was collected from 204 respondents at The Historic Commercial and Residential Zone (Old Quarter) of the Core Zone of Malacca CHS in Malaysia. Using IBM SPSS Statistics 23.0, a 5-Step Exploratory Factor Analysis (EFA) was carried out to analyse the inputted data. The achievement of certain threshold requirements by the results of this research indicates the fulfilment of some objectives of EFA. For instance, the reduction of manifest items is evident from the 47 manifest items having factor loadings ≥ 0.6 as against the total of 58 manifest items initially used in the study. Additionally, while the 47 manifest items for all 10 factors retained fulfilled convergent validity (loadings of manifest items ≥ 0.6), the loadings for the rotation of all 10 factors fulfilled discriminant validity (loading ≤ 0.3). These 10 factors retained spread across the four DR variables as follows: hazards (natural and human induced); vulnerability (human, material and management-based); capacity (human, material and management-based); and exposure (heritage values and community assets). The EFA technique used in this research has enabled the multi-levelling of each variable within the sphere of variable-to-factor and then factor-to-manifest item. The implication of the approach to multi-levelling of variables is for gaining deeper insights of DR to CHS conservation. However, it is worthy stating that the manifest items used in this study are bound to vary both within and across CHS's, thus, further studies could embark on a conceptual framework for the assessment of DR that could apply to specific contexts of DR towards the effective conservation of CHS's and its CH assets therein.

***Keywords**: Cultural Heritage Assets; Cultural Heritage Sites; Disaster Risk; Exploratory Factor Analysis; Manifest item; Variable.*

Introduction

Several events have been reported to threaten the conservation of Cultural Heritage Site's (CHS) and its Cultural Heritage (CH) assets therein. Some of such events among others include: landslides and avalanches at the CHS in Upper Svaneti Georgia [1]; floods at CHS's in

---

[*] Corresponding author: mansirdo14@yahoo.com

Portugal and Genoa Italy [2, 3]; climate change at CHS's in Flanders Belgium, Newcastle Australia and Derwent Valley Mills UK [4-6]; and earthquake at CHS's in Byblos City Lebanon, Bam Iran and Kathmandu Nepal [7-10]. While these events may differ (in type) across CHS's, they predominantly impact some effect to CH assets (individual and collective) during and after their occurrence. The works of [8, 11] report some effects of the occurrence of such events at CHS's to include: loss of lives; damage to property; and also significant disruptions to livelihoods and communities. Although there is variability (within and across CHS's) in the occurrence of any such event, resulting effects predominantly bear consequences that are rather negative to the conservation of CH assets (tangible and intangible). The pulling together of the reported events and their resultant effects could be deemed to pass for disasters to CHS's based on its (disaster) definition by [12-14] to being a type of event leading to the disruption of the functioning of a community or a society and resulting to human, material, economic and environmental losses. Therefore, the exposure of a CHS to the occurrence of any such event could indeed threaten the conservation of both tangible and intangible CH assets.

Optimising the effects of events threatening CHS's have necessitated measures in conserving CH assets therein the CHS. Irrespective of the measure however, the ultimate goal of optimisation is to substantially reduce losses to CHS's (its CH assets) exposed to Disaster Risks (DR) (deemed to being the expected outcome of any DR initiative according to [15]). The first and most crucial measure towards the achievement of a successful loss reduction strategy is the assessment of DR [16]. Although this claim was made outside the domain of CH conservation, [17, 18] both stress on the critical importance of the assessment of DR as a prerequisite for the effective conservation of CH. Hence, the importance of the assessment of DR towards effectively conserving CH assets (tangible and intangible) against threats of DR cannot be over-emphasised.

The numerous frameworks for assessing DR across fields is an indication of variability in existing approaches. However, good practice to assessing DR according to [16, 19] is an approach which conceptualises it (DR) to being the collective interplay of the following variables: hazard; vulnerability to the hazard; capacity to anticipate, resist, cope with and recover from the hazards occurrence; and exposure to DR. This concept of DR was pioneered by global platforms such as [13, 15, 20, 21]. Although such concept have been universally applied across fields, authors within the CH conservation domain have also somewhat expressed DR in line with such concept as can be found in [1, 5, 22–26]. This clearly shows that the assessment of DR in the CH conservation domain has indeed become a subject of empirical and conceptual research. Although differing in scope, all of these studies adopted the concept of DR to propose frameworks aimed at reducing DR to CH conservation via assessment.

The assessment of DR is a sequential process whose starting point according to [13, 27] is risk identification. Prior to determining the collective interplay of the variables expressing DR however, the manifestation of each variable should be identified within some specified context as emphasised by [22, 28-30]. This is important owning to the circumstantial variability of the DR variables within and across an exposed environment. Whatever the circumstance, a multi-level approach in the identification of the manifestation of each DR variable is recommended by [15, 20].While [16, 19] claim that such an approach accords deeper insights to the comprehension of the collective interplay of DR variables, only the work of [18] in the CH conservation domain seem to have attempted contextualising the manifestation of the variable 'hazard' on a multi-level (primary and secondary) basis. However, the manifestation of the variables vulnerability, capacity and exposure to DR in this work were given rather less consideration on such multi-levelling. Notable in other available works that assessed DR in the CH conservation domain is an approach contrary to the multi-levelling of variable manifestation. Some works include [5, 17, 18, 24, 31-35]. Impliedly from such, the quest to gaining deeper insights (in the stages succeeding risk identification which are risk analysis and risk evaluation) on all the variables collectively interplaying to express DR in the CH conservation domain stands to be undermined. Since [15] suggests optimising the reduction of DR through inclusive measures, rather than selecting variable(s) to multi-level, all variables need to be accorded appropriate inclusion in whatever proposed measure that seeks to gain deeper insights from investigating the collective variables interplay in the assessment of DR. Therefore, the goal of this research is to examine the four DR variables with a view to explore their multi-level manifestations within the context of CH conservation.

Variables of disaster risk to cultural heritage conservation

The term disaster has evolved to be comprehended as some phenomena which alters or changes prevailing conditions. While such changes are predominantly perceived to being 'for worse' rather than 'for better', the avoidance of disasters rationally speaking is generally a preferred option as against its occurrence. Disasters according to [12-14] is a type of event leading to the disruption of the functioning of a community or a society which results to losses (human, material, economic and environmental among others). Owning to its impacted effects wherever it occurs, the risks of the exposure to disasters (Disaster Risks; DR) have indeed become issues of global concern. Therefore, efforts to conceptualise it (DR) have accorded global acclaim which is evident from its (DR) being a topical issue in global platforms such as [15, 20, 36]. According to [13], DR is a function of the interaction between variables which are: hazards; vulnerability; capacity; and exposure. Since such conceptualisation is universal, the subsequent sub-sections while adopting the explanation of each of these variables will contextualise them as they relate to the conservation of CH.

Hazards

There exist various definitions of the term hazard. According to [13, 15, 20, 26, 37] a hazard is a potentially damaging physical event, phenomenon or human activity. Another definition by [16] portrays a hazard as an event which is a general source of danger. Key in these definitions (among other definitions) is the qualifying of hazard as an event which by extension signifies that it (hazard) occurs. Additionally, the occurrence of a hazard infers that it results to effects bearing negative consequences on an exposed item.

Based on such defining attributes of the term hazard, authors have not only reported various hazards that have occurred in CHS's, but also their accompanying effects to the conservation of CHS's. For instance, [38, 39] reported that tsunami, earthquake and hurricane did not only cause enormous damage to the heritage cities and landscapes in Japan, USA and Indonesia, the hazards had also led to loss of lives, displacement of communities and repercussions even beyond the borders of the heritage cities. They further report that while fires engulf and destroy heritage items, floods leave heritage items submerged. Again, the work of [8] capture some destructions of CHS in Nepal as a result of an earthquake. Moreover, it is reported in [40] that earthquake, rainfall, termite attack, fire outbreak, landslide, have led to the loss of lives and economic damages to CHS's. These reported accompanying effects of hazards (damage, destruct, disrupt, submerge among others) clearly inform of its negative consequence to the conservation of a CHS whenever it occurs.

Vulnerability

Vulnerability has several contextualisation's that is particularly relative to disciplines. For instance, [41] argues that vulnerability in economics can be in terms of decline in income and consumption, whereas in the field of Disaster Management, in terms of human and property losses. Similarly, vulnerability in social works according to [31] is linked to the variability of social and economic indices. These differing contextualisations show the dynamic nature its (vulnerability) meaning. Such dynamism also exists in the evolution of the conceptualisation of the term in the DR domain. As claimed by [19], earlier definitions of vulnerability were predominantly applied to estimating losses and damages to critical infrastructure (such as buildings, pipelines and roads among others) resulting from the occurrence of a hazard of given magnitude. The shortcoming of such a view was its considering DR to being the same for all who were exposed to it. In other words, there was no concept of differential vulnerability. Eventually, this notion was discarded for the obvious reason attributed to [16] that the term vulnerability should not focus on hazards alone but should move towards a better understanding of the processes that generates it (vulnerability) which include a combination of variables that determine the degree to which people's life, property and livelihood is put at risk by events. Hence, a more encompassing interpretation of vulnerability emerged which according to [13, 15, 20] refer to the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. Likewise, [33] defined vulnerability as the measure of the extent to which a community, structure, service or geographical area is likely to be damaged or disrupted on account of its nature or location by the impact of a particular disaster hazard. From these definitions, it becomes clear that the term vulnerability is a derivative relying on the 'condition' or 'state of being' both of which are 'inherent characteristic' of a factor or process that increases the impact of hazards. While such increment of the impact of hazard (due to existing vulnerability) may vary within and across CHS's, it however has adverse effects.

Several factors or processes that have been reported to constitute vulnerabilities to the conservation of CHS's among others include: poor enforcement of legislation [42-46]; imbalanced management [47]; poor infrastructure [48]; loss of trades, local cultural practices and traditions [14, 49-54]; and poor motivation and public engagement [23, 55, 56]. The characteristics qualifying these reported vulnerabilities do not only inform on the negativity in its presence (innate state) also, it could equally increase the effect of any eventuality occurring during the conservation of CHS.

Capacity

Although differing in type or context, the conceptualisation of the term capacity has general appreciating across fields of study. According to [12, 19], capacity is recognised as the assets, resources and skills available within a community, society or organisation that are fundamentally important and used to reduce risks of a disaster. Another definition by [13] refers to capacity as the combination of all the strengths, attributes and resources available within a community, society or organisation to manage and reduce DR. Although used interchangeably with other terms (local resources, coping strategies, coping mechanisms, adaptability and coping ability) capacity constitutes a set of conditions that in essence, offer an antithesis to vulnerability [19]. From these definitions it becomes clear that similar to vulnerability, the term capacity is a derivative relying on the 'state of being' or 'inherent characteristic' of a factor or process.

Several factors or processes that have been reported to constitute capacities to the conservation of CHS's among others include: heritage knowledge [23, 44, 52, 57]; community networking or involvement [58, 59]; efficient infrastructure such as roads, water, electricity, sanitation, telecommunication [60]; training or skill development or specialized workforce [32, 61-64]. The characteristics qualifying these reported capacities do not only inform on the positivity in its presence (innate state), rather unlike vulnerability, it could decrease the effect of any eventuality occurring during the conservation of CHS.

Exposure

Although there exist differences in assets exposed to DR in CHS's, they however are susceptible to the effects (losses) disasters pose. According to [13, 21] exposure refers to people, property, other assets or systems exposed to hazards. Likewise, [5] define exposure as the presence of people, environmental services and resources, infrastructure, socioeconomic or cultural values in CH assets that could be adversely affected by a stress. Also referred to elements at risk by [65], exposure refers to the elements within a given area that have been, or could be, subjected to the impact of a particular hazard. These definitions show that the very presence of items in a given environment (such as CH assets in a CHS) makes them susceptible to the effects of an eventual disaster.

Several authors have reported the assets exposed to DR in a CHS. These include people [3, 33, 66-68]; CH assets [3, 31, 32,]; livelihood [53, 68-71]; businesses and investments [70]; socio-economic activities [67]; the community [12]; water [72]; and supply chain distributions [67]. The items exposed to DR in a CHS from these studies inform that they (the items) are not only tangible (human or material), rather, intangible assets (such as processes and systems).

Methodology

This research uses a multi-faceted approach to data collection. It initially reviewed literature to identify manifestations of each DR variable within the context of CH conservation. Afterwards, a questionnaire is designed (initial version in English but translated to Malay language and Mandarin) to collect data by means of a survey on the effect of the exposure of CH assets to DR from the residents of the Core Zone of Malacca CHS in Malaysia (specifically The Historic Commercial and Residential Zone also called Old Quarter).

Using snow-ball sampling, the researchers identifying respondents having interest in conservation who subsequently recommend other respondents having similar interest [73, 74]. Such sampling design is informed by the recommendations of [23, 25, 75-77], that all recommend obtaining data from those genuinely interested in conservation of CHS's. This is necessary due to contestations and divergent opinions on it (conservation of CHS's) from different stakeholders. From the information obtained in [78], the estimated population at the Core Zone of Malacca CHS in 2006 was 3,720. However, information obtained from Melaka World Heritage Office indicate that there are about 5,000 people living and working in the Core Zone of Malacca CHS as at June 2016. Using a 95% confidence and 5% margin of error from the sample size table of [79], the sample size corresponding to the total population (5,000) for this study is 365. Similarly, the sample size estimation graph by [80] also gives a sample size of approximately 365 for such population.

Using IBM SPSS Statistics 23.0, Exploratory Factor Analysis (EFA) is carried out to analyse the inputted data specifically to examine the structure or relationship between variables and manifest items. This is one among several objectives of conducting an EFA as outlined by [81, 82].

Results and Discussions

Out of the 365 distributed questionnaires, 204 questionnaires were returned (constituting 55.89%). There are several diverging opinions regarding the adequate sample size to use for EFA. While *A.B.A. Costello and J.J.W. Osborne* [81] is of the opinion that sample adequacy should be based on subject to item ratio, *B. Williams et al.* [82] and *J.F. Hair Jr.* et al. [83] proposed that 100 cases and above should be a guiding rule of thumb. Based on such, the 204 cases seem sufficient for this research. After *M. Saunders* et al. [84] posits that what is most worthy of consideration regarding return rates of a data collection tool is the sufficiency of the returned tools to represent the phenomena being studied.

Although there exist several approaches to carrying out an EFA, the 5-step EFA protocol by [82, 85] will be used in this study. The steps are: determining data suitability; extraction of factors; determining the number of factors to retain; selecting the rotational method; and interpretation and labelling. The subsequent sub-sections present and discuss result of this study for each step of the EFA.

Data Suitability

The two tests that assess data suitability to be used for an EFA are the Kaiser–Meyer–Olkin (KMO) and the Bartlett's Test of Sphericity. While the former is used to determine the sampling adequacy, the later establishes the statistical significance for a given data to be considered appropriate for an EFA. Data for this research yielded a KMO of 0.813. This value while considered satisfactory (based on the acceptable 0.5 minimum KMO threshold by [82, 86,] goes to show that the sample used in this research proves sufficient. Furthermore, the results of the Bartlett's Test of Sphericity is significant (p = 0.00 0) which informs that an EFA will be suitable for the data of this research for p < 0.05 as stated by [87].

Extraction of Factors

Factor extraction involves determining the factors that can be used to best represent the interrelationships among the set of variables studied [87]. The several methods of factor extraction according to [81, 88] include: principal component; un-weighted least squares; generalized least squares; maximum likelihood; principal axis factoring; alpha factoring; and image factoring. Irrespective of the method used however, the purpose of the data extraction is to reduce a large number of items (manifests) into meaningful factors [82]. For this study, the Principal Components (PC) method is used. The PC according to [87] is the most commonly used method of factor extraction in conducting an EFA. Results from such extraction yielded a total of 10 factors as depicted in Table 1.

Table 1. Number of factors extracted

Variables		Factors extracted
Independent	Hazard	2
	Vulnerability	3
	Capacity	3
Dependent	Exposure to Disaster Risk	2
Total		**10**

Out of the 10 factors extracted, 2 factors are for the independent variable ‘hazard’, 3 factors are for the independent variable ‘vulnerability’, 3 factors are for the independent variable ‘capacity’ and 2 factors are for the dependent variable ‘exposure’ to DR.

Number of Factors Retained

While the extraction of factors in EFA is one thing, retaining all of them is another. However, the decision to retain a specific number of factors should be based on the factors fulfilling certain criteria. A criteria reported by [82, 89,] is that a manifest must have a minimum loading of 0.6. From the results of the component matrix having a total of 58 manifest items, 47 of them distributed across all 10 factors extracted with each having loading values of 0.60 and above. Results of the component matrix was chosen as against both the pattern and structural matrix because it (the component matrix) not only have seemingly better item distribution across factors but also better factor loadings (≥ 0.6) which signify better convergent validity between items to factor. Another criteria for the retention of a factor in EFA according to [74, 83, 85,] is for a factor to have an Eigenvalue ≥1. All 10 factors extracted have Eigenvalues ≥1 (refer to Table 2). Again, the cumulative percentage of the variance explained is another criteria in retaining a factor in EFA. Although [82] report that no fixed threshold of the cumulative percentage of the variance explained exist (due to disagreements in different disciplines), [90] suggests a minimum value of 50% to be acceptable. Based on such threshold, results of all 4 variables in this study prove satisfactory (hazard, 54.313%; vulnerability, 59.979%; capacity, 51.669%; and exposure, 54.231%. Table 2 illustrates these results.

Adding to the afore-presented criteria’s, the caution by [85, 87, 91] sheds light on the decision to retain factors. They suggest that three or more items should load on a factor for it (the factor) to be retained. Such advice becomes beneficial during later stages of data analysis (Confirmatory Factor Analysis; CFA) because instances could arise whereby a factor (or construct) fails the modelling fitness criteria as a result of low factor loading or high Modification Index among other criteria. As such, re-specifying the model to becoming fit may warrant the deletion of manifest item/items from the factors. However, re-specifying models whose factors have less than 3 manifest items might either not run or may not yield good fitness indices. Based upon all such requirements, all the 10 factors extracted shall be retained.

Table 2. Factors retained

Variables		Factors	Eigenvalue	Variance explained (cumulative)	Manifest items used for survey	Manifest items that passed suppression ≥ 0.6)	Total
Independent	Hazard	1	3.056	43.710	13	6	11
		2	1.681	**54.313**		5	
	Vulnerability	1	2.211	35.418	15	4	13
		2	1.685	48.867		4	
		3	1.479	**59.979**		5	
	Capacity	1	3.684	38.337	16	5	13
		2	1.682	41.275		4	
		3	1.351	**51.669**		4	
Dependent	Exposure	1	3.415	41.145	14	5	10
		2	1.103	**54.231**		5	
Total			**10**		**58**	**47**	

Rotation

After establishing the required number of factors to retain, they (the factors) are rotated to ease interpretation. The two main approaches to factor rotation are orthogonal and oblique [81,85,87]. While the results of the former are uncorrelated, those of the latter are correlated. The use of an oblique rotation to an orthogonal is recommended by [81] since the oblique rotation reproduces an orthogonal solution but not vice versa. Furthermore, the oblique rotation produces more satisfactory results because while an orthogonal rotation produces a rotated component/factor matrix, an oblique rotation produces a pattern, structure and component matrix [89]. This gives variety in the selection of the most optimal results. Hence, the oblique rotation (Direct Oblimin technique specifically) is chosen in this study. Table 3 shows the results of the rotation of the factors extracted and retained.

Table 3. Factor loadings from rotation.

Factors	Cross Factor Loading
	Hazard
1-2 (2-1)	-0.251
	Vulnerability
1-2 (2-1)	0.227
1-3 (3-1)	-0.291
2-3 (3-2)	0.158
	Capacity
1-2 (2-1)	0.204
1-3 (3-1)	0.196
2-3 (3-2)	-0.259
	Exposure
1-2 (2-1)	-0.226

These results show that cross-factor loadings (absolute value) are all less than 0.3 for all DR variables. Although these values indicate 'low' correlation for loading ≤ 0.3 according to [74, 87], these results are satisfactory since they indicate discriminance (rather than convergence) between factors. This means that hardly will any 2 factors under same variable measure the same issue. It is worthy stating that a value of 1.00 was obtained for the cross factor loadings (along the diagonal of the 2×2 and 3×3 matrices in this study) of factors 1-1, 2-2 and 3-3. The reason for such value according to [74] is because any factor is always perfectly correlated with itself.

Interpretation and Labelling

Interpretation and labelling of factors in EFA involves the researcher examining some common theme amongst items of a factor then giving the factor a name [82]. While [89] report that no guideline exist on interpreting results of an EFA, [85] stress that the items to define a factor should share some conceptual pattern of the common factor. Based on such, the naming of each of the 10 factors retained was done through examining some common conceptual theme of the collection of manifest items of every factor. Results of such process is depicted in Table 4.

Table 4. Name of factors

Variables	Items	Theme	Labelled Factors
Hazards	Rising damp on wall and floor; Rainfall (too little or too much); Thunder/lightening; Severe winds; Erosion (water, wind); Humidity	Primary source of event	Natural
	Noise (vehicles, construction work, etc); Fire; Traffic; Urban development; Relocation of community members		Human-induced
Vulnerability	Deficient skills; Poor motivation and public engagement; Conflict (on heritage and development); Neglect/abandonment of heritage property	Negative innate characteristic in	Human
	Scarce material resource; Short water supply (quality and quantity); Poor infrastructure (roads, water, electricity, sanitation, telecommunication); Short supply of First Aid		Material
	Legislation sufficiency; Regulation enforcement; Limited funds/financial resources; Limited communication and Early Warning System; Tourism;		Management-based
Capacity	Training/skill development; Heritage knowledge; Community networking; Self-motivation; Precautious attitude; Raising awareness	Positive innate characteristic in	Human
	Abundant material resource; Abundant water supply (quality and quantity); Efficient infrastructure (roads, water, electricity, telecommunication); Effective First Aid		Material
	Efficient emergency response; Efficient governance/management; Access to information; Stand-by utilities and/or Critical facilities (water, electricity, telecommunication, hospitals, transportation)		Management-based
Exposure	Historical value; Architectural value; Cultural value; Spiritual value; Economic value	Cultural Heritage Items	Heritage Value
	People's lives; People's livelihood; Tangible heritage assets (buildings, artefacts, scripts and other collections); Intangible heritage assets (language, songs, poetry, cultural practices); Businesses (source of income); Natural resources (air, rivers, land, trees, vegetation)		Community Assets

While the naming of each factor is in accordance to the collective theme of the manifest items forming the factors, each variable is within the context of its definition presented in text.

Conclusion

This study embarked on the assessment of DR to CHS conservation based on its conception to being a collective interplay of four variables which are: hazards; vulnerability; capacity; and exposure. Based on existing definitions of each of these variables, their manifestations are contextualised from what obtains in literature on CH conservation studies. In a bid to explore the multi-level manifestations of each variable, an EFA technique (5-step approach) was employed with a view to exploring the multi-level manifestations of the DR variables.

The achievement of certain threshold requirements by the results of this research indicates the fulfilment of some objectives of EFA (among others) reported by [82]. For instance, the reduction of manifest items of this study from 58 to 47 (refer to Table 2). Similarly, the 'convergence' of all manifests of each factor (loadings of factors ≥ 0.6 according to [74]. Likewise, results from the rotation of factors (in Table 3) indicates discriminance between factors of same variable loading ≤ 0.3 according to [74, 87].

The 5-step EFA approach used in this research has enabled the multi-levelling of each variable of DR. Such multi-levelling is within the sphere of variable-to-factor and then factor-to-manifest item in the CH conservation domain. While the variables have been conceptualised to collectively define DR, the manifest items were obtained from literature based on the working definitions of each variable. However, the 10 labelled factors (natural and human induced hazards; human, material and management-based vulnerabilities; human, material and management-based capacities; and the exposure of heritage value and community assets) presented in Table 4 are all conceived from this research. These labelled factors alongside their manifest items will be further used to develop a model to assess DR towards the effective conservation of CHS's and its CH assets therein.

The implication of this research is for gaining deeper insights of DR to CHS conservation (based on the multi-levelling of variables). While such may obtain in sister domains, the earlier articulated issue of the assessment of DR in the CH domain lye in the approach not only in conceptualising DR but adopting strategies that will aid gaining deeper insights. However, it is worthy to state that the manifest items used in this research are bound to vary both within and across CHS's. Thus, further studies could try to embark on a conceptual framework for the assessment of DR that could apply to specific contexts of DR towards the effective conservation of CHS's and its CH assets therein.

Acknowledgement

We thank Melaka World Heritage Office for both granting the permission to conduct this research and also introducing the people who provided data for this study. Additionally, we thank the Malaysian Commonwealth Scholarship and Fellowship Plan (CSFP) and also Nigerian Tertiary Education Fund (TETFund) for funding the Ph. D research which this work is an extract from.

References

[1] A. Alcaraz Tarragüel, B. Krol, C. van Westen, *Analysing the Possible Impact of Landslides and Avalanches on Cultural Heritage in Upper Svaneti, Georgia*, **Journal of Cultural Heritage**, **3**(4), 2012, pp. 453-461.

[2] S.G. Lanza, *Flood Hazard Threat on Cultural Heritage in the Town of Genoa (Italy)*, **Journal of Cultural Heritage**, **4**(3), 2003, pp. 159-167.

[3] R. Boinas, A.S. Guimarães, J.M.P.Q. Delgado, *Rising Damp in Portuguese Cultural Heritage: A Flood Risk Map*, **Structural Survey**, **34**(1), 2016, pp. 43-56.

[4] L. Dupont, V. Van Eetvelde, *Assessing the Potential Impacts of Climate Change on Traditional Landscapes and Their Heritage Values on the Local Level: Case Studies in the Dender Basin in Flanders, Belgium*, **Land Use Policy**, **35**, 2013, pp. 179-191.

[5] G. Forino, J. MacKee, J. von Meding, *A Proposed Assessment Index for Climate Change-Related Risk for Cultural Heritage Protection in Newcastle (Australia)*, **International Journal of Disaster Risk Reduction**, **19,** 2016, pp. 235-248.

[6] A.J. Howard, D. Knight, T. Coulthard, K. Hudson-Edwards, D. Kossoff, S. Malone, *Assessing Riverine Threats to Heritage Assets Posed by Future Climate Change Through a Geomorphological Approach and Predictive Modelling in the Derwent Valley Mills*

WHS, UK, **Journal of Cultural Heritage**, **19**, 2016, pp. 387-394.

[7] A. Fallahi, *Bam Earthquake Reconstruction Assessment: an Interdisciplinary Analytical Study on the Risk Preparedness of Bam and its Cultural Landscape: a World Heritage Property in Danger*, **Structural Survey**, **26**(5), 2008, pp. 387-399.

[8] M. Okamura, N.P. Bhandary, S. Mori, N. Marasini, H. Hazarika, *Report on a Reconnaissance Survey of Damage in Kathmandu Caused by the 2015 Gorkha Nepal Earthquake*, **Soils and Foundations**, **55**(5), 2015, pp. 1015-1029.

[9] F. Parsizadeh, M. Ibrion, M. Mokhtari, H. Lein, F. Nadim, *Bam 2003 Earthquake Disaster: on the Earthquake Risk Perception, Resilience and Earthquake Culture - Cultural Beliefs and Cultural Landscape of Qanats, Gardens of Khorma Trees and Argh-E Bam*, **International Journal of Disaster Risk Reduction**, **14**, 2015, pp. 457-469.

[10] N. Makhoul, C. Navarro, J. Lee, A. Abi-Youness, *Assessment of Seismic Damage to Buildings in Resilient Byblos City*, **International Journal of Disaster Risk Reduction**, **18**, 2016, pp. 12-22.

[11] R. Jigyasu, *Building Capacity for the Disaster Risk Management of Cultural Heritage: Opportunities and Challenges*, proceedings of the **Closing Event of the Celebration of the 40th Anniversary of the World Heritage Convention**, **6–8 November, 2012,** Kyoto International Conference Centre, Kyoto, Japan, 2013, pp. 74-75.

[12] * * *, ADPC, **Community-Based Disaster Risk Management for Local Authorities**, 2006, Thailand.

[13] * * *, UNISDR, **Proposed Updated Terminology on Disaster Risk Reduction**, Paris 2015.

[14] C. Wamsler, E. Brink, *The Urban Domino Effect: a Conceptualization of Cities' Interconnectedness of Risk*, **International Journal of Disaster Resilience in the Built Environment**, **7**(2), 2016, pp. 80-113.

[15] * * *, **Sendai Framework for Disaster Risk Reduction 2015-2030**, UNISDR, Sendai Japan, 2015.

[16] M. Reddy, *An Integrated Model for Disaster Risk Assessment for Local Government in South Africa*, **Ph. D. Thesis**, North West University, 2010.

[17] J.J. Wang, *Flood Risk Maps to Cultural Heritage: Measures and Process*, **Journal of Cultural Heritage**, **16**(2), 2015, pp. 210-220.

[18] M. Ravankhah, M. Schmidt, *Developing Methodology of Disaster Risk Assessment for Cultural Heritage Sites*, **4th International Conference on Building Resilience,** 2014, pp. 13-22.

[19] P. Venton, *Methods Of Enhancing the Sustainability and Scale of Community Based Disaster Risk Management: Findings from International Action Research*, **Ph. D. Thesis**, Cranfield University, 2008.

[20] * * *, **Hyogo Framework for Action 2005-2015**, UNISDR, Hyogo Japan, 2005.

[21] * * *, **Terminology on Disaster Risk Reduction**, UNISDR, 2009.

[22] O. Vileikis, G. Cesaro, M. Santana Quintero, K. van Balen, A. Paolini, A. Vafadari, *Documentation in World Heritage Conservation: Towards Managing and Mitigating Change – the Case Studies of Petra and the Silk Roads*, **Journal of Cultural Heritage Management and Sustainable Development**, **2**(2), 2012, pp. 130-152.

[23] N. Atakul, M.J. Thaheem, A. De Marco, *Risk Management for Sustainable Restoration of Immovable Cultural Heritage, Part 1: PRM Framework*, **Journal of Cultural Heritage Management and Sustainable Development**, **4**(2), 2014, pp. 149-165.

[24] H. Phillips, *The Capacity to Adapt to Climate Change at Heritage Sites - the Development of a Conceptual Framework*, **Environmental Science and Policy**, **47**, 2015, pp. 118-125.

[25] O. Geoff, O. Phil, J. Janaka, R. Jigyasu, *Developing a Model for Building Resilience to Climate Risks for Cultural Heritage*, **Journal of Cultural Heritage Management and Sustainable Development**, **5**(2), 2015, pp. 99-144.

[26] X. Romao, E. Pauperio, N. Pereira, *A Framework for the Simplified Risk Analysis of Cultural Heritage Assets*, **Journal of Cultural Heritage**, **20**, Special Issue, 2016, pp. 696-708.
[27] * * *, **Risk management: Risk assessment techniques**, ISO, 2009.
[28] * * *, **Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning**, Federal Emergency Management Agency, Washington D.C., 2005.
[29] J.A. Stouffer, **Community Risk Assessment. A Guide for Conducting a Community Risk Assessment**, Manningham (Victoria), Australia, 2016.
[30] A. Scolobig, T. Prior, D. Schroter, J. Jorin, A. Patt, *Towards People-Centred Approaches for Effective Disaster Risk Management : Balancing Rhetoric with Reality*, **International Journal of Disaster Risk Reduction, 12**, 2015, pp. 202-212.
[31] R. Jigyasu, **Sustainable Post Disaster Reconstruction Through Integrated Risk Management - The Case of Rural Communities in South Asia**, 2004.
[32] R. Jigyasu, *Towards Developing Methodology for Integrated Risk Management of Cultural Heritage Sites and Their Settings*, in **15th ICOMOS General Assembly and International Symposium: Monuments and Sites in Their Setting - Conserving Cultural Heritage in Changing Townscapes and Landscapes**, 2005.
[33] I.C. Nicu, *Cultural Heritage Assessment and Vulnerability Using Analytic Hierarchy Process and Geographic Information Systems (Valea Oii Catchment, North-Eastern Romania). An Approach to Historical Maps*, **International Journal of Disaster Risk Reduction**, **20**, 2016, pp. 103-111.
[34] M. Andretta, F. Coppola, A. Modelli, N. Santopuoli, L. Seccia, *Proposal for A New Environmental Risk Assessment Methodology in Cultural Heritage Protection*, **Journal of Cultural Heritage**, **23,** 2017, pp. 22-32.
[35] B. Seyedashrafi, M. Ravankhah, S. Weidner, M. Schmidt, *Applying Heritage Impact Assessment to Urban Development: World Heritage Property of Masjed-e Jame of Isfahan in Iran*, **Sustainable Cities and Society**, **31**, 2017, pp. 213-224.
[36] * * *, **Yokohama strategy and plan of action for a safer world**, UNDP, Yokohama Japan, 1994.
[37] M. Stanganelli, *A New Pattern of Risk Management: the Hyogo Framework For Action and Italian Practise*, **Socio-Economic Planning Sciences**, **42**(2), 2008, pp. 92-111.
[38] G. Abungu, *The Convention Today for a Better Future: Emerging Issues on Sustainable Development and Disaster Prevention/Recovery*, **Celebrating 40 Years of the World Heritage Convention**, 2013, pp. 52-56.
[39] S. Yamato, *Disaster Prevention, recovery from disaster with communities*, **40 Years of the World Heritage Convention,** 2013, pp. 71-72.
[40] * * *, *The International Training Course on Disaster Risk Management of Cultural Heritage*, **Protecting Cultural Heritage from Disaster Risks Due to Earthquakes and Floods**, UNESCO, 2015.
[41] S.K. Vatsa, *Risk, Vulnerability, and Asset-Based Approach to Disaster Risk Management*, **International Journal of Sociology and Social Policy, 24**(10-11), 2004, pp. 1-48.
[42] A. Nizamuddin, *Melaka as a World Heritage Site: a Study from the Legal Point of View*, **Jurnal Perspektif Jil**, **3**(1), 2010, pp. 60-77.
[43] L. Armitage, J. Irons, *The Values of Built Heritage*, *Prop. Manag.*, **Property Management**, **31**(3), 2013, pp. 246-259.
[44] W. H. W. Ismail, *Preservation and Recycling of Heritage Buildings in Malacca*, **Procedia - Social and Behavioral Sciences**, **85**, 2013, pp. 574-581.
[45] C. Barrere, *Cultural Heritages: from Official to Informal*, **City, Culture and Society**, **7** (2), 2014, pp. 87-94.
[46] * * *, **Operational Guidelines for the Implementation of the World Heritage**

Convention, UNESCO, Paris, France, 2015.
[47] * * *, **People Centred Approaches to the Conservation of Cultural Heritage: Living Heritage**, ICCROM, Roma, 2013.
[48] S.M. Farid, *Tourism Management in World Heritage Sites and Its Impact on Economic Development in Mali and Ethiopia*, **Procedia - Social and Behavioral Sciences**, **211**, 2015, pp. 595-604.
[49] K. Graham, D.H.R. Spennemann, *State Emergency Service Local Controllers' Attitudes Towards Disaster Planning for Cultural Heritage Resources*, **Disaster Prevention and Management**, **15**(5), 2006, pp. 742-762.
[50] S.N. Harun, *Heritage Building Conservation in Malaysia: Experience and Challenges,* **Procedia Engineering, 20**, 2011, pp. 41-53.
[51] B. Francesco, *The World Heritage Convention in the Post-2015 International Development Agenda*, **Celebrating of the 40th Anniversary of the World Heritage Convention**, 2013, pp. 110-113.
[52] R.N.R. Othman, A. Hamzah, *Interdependency of Cultural Heritage Assets in the Old Quarter, Melaka Heritage City*, **Procedia - Social and Behavioral Sciences**,**105**, 2013, pp. 577-588.
[53] R. Ahmad, **Cultural Landscapes as Heritage in Malaysia: Potentials, Threats, and Current Practices**, Utrecht University, 2013.
[54] T. Claudia, P. Luigi, *A Novel Paradigm to Achieve Sustainable Regeneration in Historical Centres with Cultural Heritage*, **Procedia - Social and Behavioral Sciences**, **223**, 2016, pp. 693-697.
[55] B. von Droste, *Main World Heritage Challenges of the Last 40 Years*, **Celebrating of the 40th Anniversary of the World Heritage Convention**, 2013, pp. 36-37.
[56] S.Y. Said, H. Aksah, E.D. Ismail, *Heritage Conservation and Regeneration of Historic Areas in Malaysia*, **Procedia - Social and Behavioral Sciences**, **105**, 2013, pp. 418-428.
[57] T. Fejerdy, *Sustainable and Sustaining Development: Sustainable Life of Communities and Sustainable Conservation of Cultural Heritage*, **Celebrating of the 40th Anniversary of the World Heritage Convention**, 2013, pp. 87-89.
[58] D. Munjeri, *Balancing The World Heritage Convention Equation in Afric*a, **Celebration of the 40th Anniversary of the World Heritage Convention**, 2013, pp. 38-39.
[59] M. Murzyn-Kupisz, *The Socio-Economic Impact of Built Heritage Projects Conducted by Private Investors*, **Journal of Cultural Heritage**, **14**(2), 2013, pp. 156-162.
[60] U.W. Shafinaz, **Cultural Heritage Conservation and Sustainable Urban Community in Dhaka; Case Study with Mirpur Benarashi Palli & Shakhari Bazaar**, The University of Hong Kong, Ph. D. Thesis, 2012.
[61] Z.A. Akasah, M. Alias, *Application of the Generic Process Modelling in the Preservation of Heritage School Buildings*, **WIT Transactions on The Built Environment**, **109**, 2009, pp. 323-333.
[62] K. Ingunn, *Living with World Heritage*, **Celebrating of the 40th Anniversary of the World Heritage Convention**, 2013, pp. 47-48.
[63] N. Yukio, *Capacity-Building for Enhanced Implementation of the Convention, Communication Activities for Raising Awareness, and Sustainable Development Connecting Conservation and Communities*, **Celebrating of the 40th Anniversary of the World Heritage Convention**, 2013, p. 86.
[64] S.I. Mat Radzuan, N. Fukami, Y. Ahmad, *Cultural Heritage, Incentives System and the Sustainable Community: Lessons from Ogimachi Village, Japan*, **Malaysian Journal of Society and Space**, **10**(1), 2014, pp. 130-146.
[65] * * *, Australian Institute for Disaster Resilience, **National Emergency Risk Assessment Guidelines**, 2nd edition, Melbourne, Australian Government Attorney-General's Department, 2015.

[66] N.F.N. Azhari, E. Mohamed, *Public Perception: Heritage Building Conservation in Kuala Lumpur*, **Procedia - Social and Behavioral Sciences**, **50**, 2012, pp. 271-279.

[67] * * *, **Towards the Post - 2015 Framework for Disaster Risk Reduction Tackling Future Risks, Economic Losses and Exposure**, UNISDR, 2013.

[68] K. David, G. Yetta, F. Agung, H. Sharon, C. Alison, *Land Use Planning for Disaster Risk Reduction and Climate Change Adaptation: Operationalizing Policy and Legislation at Local Levels*, **International Journal of Disaster Resilience in the Built Environment**, **7**(2), 2016, pp.158-172.

[69] L.W. Woon, Y.L. Mui, *Elemental Cost Format for Building Conservation Works in Malaysia*, **Structural Survey**, **28**(5), 2010, pp. 408-419.

[70] K. Sudmeier-Rieux, U. Fra.Paleo, M. Garschagen, M. Estrella, F.G. Renaud, M. Jaboyedoff, *Opportunities, Incentives and Challenges to Risk Sensitive Land Use Planning: Lessons from Nepal, Spain and Vietnam*, **International Journal of Disaster Risk Reduction**, **14**(part 3), 2015, pp. 205-224.

[71] M.J. Revez, D.J. Rodrigues, *Incompatibility Risk Assessment Procedure for the Cleaning of Built Heritage*, **Journal of Cultural Heritage**, **18**, 2016, pp. 219-228.

[72] A. Ahmad, *The Constraints of Tourism Development for a Cultural Heritage Destination: the Case of Kampong Ayer (Water Village) in Brunei Darussalam*, **Tourism Management Perspectives**, **8**, 2013, pp. 106-113.

[73] R. Kumar, **Research Methodology: A Step by Step Guide**, 3rd edition, London, SAGE Publications Inc., 2011.

[74] A. Bhattacherjee, **Social Science Research: Principles, Methods, and Practices**, 2nd edition, Florida, USA, Creative Commons Attribution, 2012.

[75] E. Avrami, R. Mason, M. de la Torre, **Values and Heritage Conservation**, The Getty Conservation Institute, Los Angeles, 2000.

[76] V.T. King, *UNESCO in Melaka: Cultural Politics, Identities and Tourism in a World Heritage Site*, **Leeds East Asia Papers**, **4**, 2012, pp. 1-50.

[77] A.H. Montaser, *An Integrated Participatory Approach in Managing Built Heritage: Case Study Al Salt, Jordan,* **Ph. D. Thesis,** Technical University of Dortmund, 2012.

[78] * * *, **Malaysia, Nomination Dossier: Historic cities of the straights of Malacca**, Kuala Lumpur, Malaysia, 2008.

[79] R.V. Krejcie, D.W. Morgan, *Determining sample size for research activities*, **Educational and Psychological Measurement**, **30**(3), 1970, pp. 607-610.

[80] J.E. Bartlett, J.W. Kotrlik, C.C. Higgins, *Organizational Research: Determining Appropriate Sample Size in Survey Research*, **Information Technology, Learning, and Performance Journal**, **19**(1), 2001, pp. 43-50.

[81] A.B.A. Costello, J.J.W. Osborne, *Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from Your Analysis*, **Practical Assessment Research and Evaluation**, **10**(7), 2005, pp. 1-8.

[82] B. Williams, T. Brown, A. Onsman, *Exploratory Factor Analysis : A Five-Step Guide for Novices*, **Australasian Journal of Paramedicine**, **8**(3), 2012, pp. 1-13.

[83] J.F. Hair Jr, C. William, B.J. Babin, R.E. Anderson, **Multivariate Data Analysis**, 7th edition, England, Pearson Education Limited, 2014.

[84] M. Saunders, P. Lewis, A. Thornhill, **Research Methods for Business Students,** 5th edition, England, Pearson Education Limited, 2009.

[85] D. Suhr, **Exploratory or Confirmatory Factor Analysis ?**, 2003.

[86] A. Field, **Discovering Statistics Using SPSS**, 3rd edition, London, SAGE Publications Inc., 2009.

[87] J. Pallant, **SPSS Survival Manual: a Step by Step Guide to Data Analysis Using SPSS**, 4th edition, Australia, Allen & Unwin, 2011.

[88] B.G. Tabachnick, L.S. Fidell, **Using Multivariate Statistics**, 5th edition, Boston, Pearson

Publication Inc., 2007.

[89] R.L. Fabrigar, T.D. Wegener, C.R. MacCallum, J.E. Strahan, *Evaluating the Use of Exploratory Factor Analysis in Psychological Research*, **Psychological Methods**, **4**(3), 1999, pp. 272-299.

[90] S.A. Beavers, W.L. John, K.J. Richards, W.S. Huck, J.G. Skolits, L.S. Esquiver, *Practical Considerations for Using Exploratory Factor Analysis in Educational Research*, **Practical Assessment, Research and Evaluation**, **18**(6), 2013, pp. 1-13.

[91] A. Zainudin, **SEM Made Simple: A Gentle Approach to Learning Structural Equation Modelling**, Selangor Malaysia, MWPS Rich Publication Sdn. Bhd., 2015.

Received: Octomber 09, 2017
Accepted: August 18, 2018