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A Proposed Criteria Matrix for Decision Analysis of Post-Disaster Temporary Accommodation Units

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Abstract

Disasters caused by natural hazards or socio-political crises pose widespread damage on built environment resulted with loss of housing. To meet accommodation needs of disaster victims, temporary accommodation units are a common solution not only to bridge the gap until permanent housing are ready to use but also to provide physical and psychological rehabilitation. As post-disaster accommodation units are absolutely diversified from the housing production in usual conditions with respect to necessity of prompt readiness and instant as well as extensive response, the management of provision, design and construction of them require rapid and organizational evaluation.

In an ideal disaster management process, it is critical to define decision criteria of temporary accommodation units in 'preparedness' period to achieve a rational decision-making process in limited time of 'reconstruction' and 'recovery' phase. In literature, there are several studies on decision criteria of temporary accommodation units, yet they generally concentrate on a particular feature. The aim of this study is to generate an extensive and holistic decision criteria matrix to guide decision makers in evaluation of post-disaster temporary accommodation units.

Key words: Temporary accommodation units, decision criteria matrix, disaster management

1. Introduction

According to unstable social, political and economic conditions and natural disasters, there is a dramatic increase in number of disasters, hence disaster-exposed population. However, the main issue is not emphasizing on natural hazards nor directly disasters themselves, the main issue is trying to plan or mitigate disasters. Taking into consideration of planning or mitigating disasters, 'disaster management' comes into prominence in the context.

Disaster management mainly aims to avoid or to reduce risk to human beings' life and to any livelihood systems affecting human beings [1]. Even though neutralizing all unfortunate consequences of disasters is impossible, reducing impacts of disasters is focused with an effective disaster management [2]. To reach an effective disaster management, phasing is applied to diminish conflicts between the role takers [3]. IFRC displays phases of disaster management into three major titles as preparedness, response and recovery [4]. Considering post-disaster accommodation types, Quarantelli categorizes them into four as 'emergency sheltering', 'temporary sheltering', 'temporary housing' and 'permanent housing' [5]. However, it is possible to define 'temporary shelters' and 'temporary housing' under the title of 'temporary accommodation' [6].

Basically, post-disaster temporary accommodation is introduced as units accommodating disaster exposed society within an urban context including services such as education, health etc. [7]. Since

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the continuation of daily lives of disaster impacted society in former residences is impossible, providing temporary accommodation is an urgent intervention until the accomplishment of permanent housing [8]. In other words, temporary accommodation units bridge the gap until permanent housing are ready to use, indeed they provide physical and psychological rehabilitation.

Considering the significance of temporary accommodation units and their absolute difference from the housing production in usual conditions with respect to necessity of prompt readiness and instant as well as extensive response, this study aims to generate an extensive decision criteria matrix of post-disaster temporary accommodation units in 'preparedness' period to achieve a rational decision-making process in 'reconstruction' and 'recovery' phases.

2. Materials and Method

2.1. Decision-Making Process of Post-Disaster Temporary Accommodation Units

True stories display that premeditation in post-disaster decisions are either insufficient or totally absent that decisions are promptly made due to chaos following disaster [9]. Accordingly, decision making following a disaster is more complex than decision-making in ordinary conditions due to being torn between contradictory issues [10]. Carrying responsibility of disaster victims, decision-making process of temporary accommodation units is approached with two main bodies: relief-oriented and development-oriented objectives. While relief-oriented body aims to reduce or prevent loss of lives with short-term humanitarian assistance, development-oriented body defines its frames as long-term assistance with respect to economic, social and physical structures [10]. In this segmented structure of disaster management, decision making and taking action are squeezed between two main contradictory approaches: short-term necessities and long-term requirements.

Table 1 Contradictory factors of successful shelter design (Adapted from [11])

Contradictory factors of temporary accommodation units	
Safety	Cost
Lifespan	Timeliness
Size	Number to be built
Comfort	Materials availability
Privacy	Maintenance and upgrade
Liability of implementing organization	Equity with host population
Donor expectations	Capacity to implement
	Cultural appropriateness
	Construction skills

Taking into consideration of this dichotomy, despite the variability on needs and strategies of temporary accommodation units throughout time, IFRC/RCS defines 'a successful shelter design' which balances the contradictory factors shown in Table 1[11].

Consequently, to handle with the complexity of the problem, one of the most implemented management method for temporary accommodation is 'top-down' approaches following impactful disasters [8]. However, top-down approaches cause several potential problems such as generation of standardized components and units which ignore unique local needs of different occupants [8].

In fact, the reason to apply prefabricated, mass-produced and standardized temporary accommodation units is caused by the necessity of rapid and extensive response [12].

Considering all, ad hoc decision-making processes instead of pre-disaster strategic planning, by governments and non-governmental organizations, following a disaster is resulted with detrimental problems on accommodation unit designs [13].

2.2. Decision Criteria of Building Design

Starting from the contribution of Vitruvius on history of architecture, the definition of criteria and sub-criteria have always been contradictive terms differentiating with respect to era, technology, culture and the society [14]. According to the work of Vitruvius, 'de Architectura', architecture must exhibit three qualities, firmitas, utilitas and venustas as stability, utility and aesthetics. Without these three qualities, an architectural object is lacking, in other words these three are declared as parameters bringing a structure into completion. In this manner, Design Quality Assessment (DQI) as a design assessment framework is presented. This framework, which is called as 'a modern-day interpretation of the Vitruvian work', evaluates the design quality under three main titles which are 'Function', 'Build Quality' and 'Impact' [15].

In common perspective, architects, with an extensive design team, deal with design problem among design objectives, thus the most appropriate design solution is reached. The key design objectives of buildings is presented as shown in Figure 2 [16].

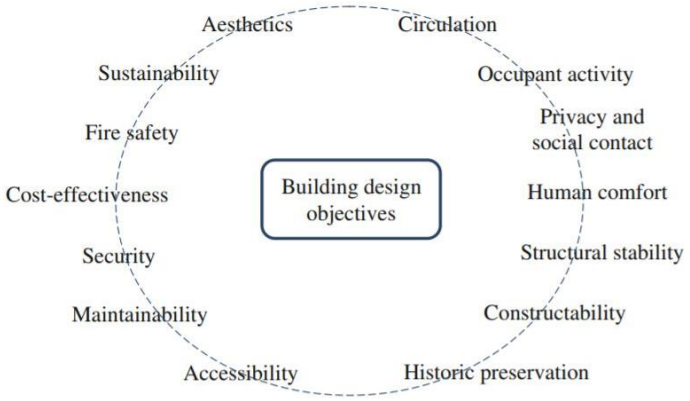

Figure 1 Design Objectives of Architects [16]

2.3. Criteria of Temporary Accommodation Units

Elaborating on housing function, UN-Habitat alleges that "Adequate housing must provide more than four wall and a roof.", indeed it should meet with the following criteria: (1) Security of tenure, (2) Availability of services, materials, facilities and infrastructure, (3) Affordability, (4) Habitability, (5) Accessibility, (6) Location and (7) Cultural adequacy [17]. However, the generation process of post-disaster temporary housing units is different from houses constructed in usual conditions due to specific policies of recovery and reconstruction phases of crisis

management [18]. Accordingly, design objectives of post-disaster temporary accommodation units are also interpreted as different compared to housing units built in ordinary conditions. Further, considering the provision, design and construction of post-disaster temporary accommodation units, there isn't any common applied parameters accepted by decision-makers as guidelines, though many contributions have reached in literature.

In order to reach a design of an innovative temporary unit, Asefi & Sirus propose a unit system aiming to achieve four main goals which are; (1) foldability, ease of and prompt assembly and ease of transportation, (2) expansion and flexibility, (3) compactibility and ease of assembly and durability of structural and covering elements and (4) good visual appearance [19].

On the other hand, according to the statements of Songür, there are five main objectives to consider in generation of temporary housing units which are (1) Mounting time, (2) Stability of the structural system, (3) Reusability of the unit, (4) Meeting the needs of the user and (5) Safety of the unit [20].

Table 2 Guidelines for Disaster Relief Shelters

Environmental factors	
	Climate variations
	Recycling, upgrading and disposal
	Hygienic (water & air)
Economic factors	
	Type of shelters – cost
	Lifetime
	Livelihood
Technical Factors	
	Easy to erect and dismantle
	Materials and insulations
	Classification of hazards and performance
	Physical and psychological effects
Socio-cultural factors	
	Cultural difference
	Dignity and security
	Communication

As a far-reaching approach for accommodation following disasters, Bashawri, Garrity, & Moodley presents factors affecting temporary accommodation units as shown in Table 2 [21].

According to a competition organized by NYC Office of Emergency Management in 2008, named as 'What If New York City Design Competition for Post-Disaster Provisional Housing' displays a set of criteria for post-disaster provisional housing [22].Criteria of the competition, displayed in Table 3**Table 3**, seeks dwelling solutions for recovery period of a catastrophic coastal storm for New York City.

To summarize, there are several contributions on criteria of post-disaster temporary accommodation units from various courses. However, as mentioned contributions present they either approach units from a certain point of view such as sustainability, economy etc., or do not include entire necessary criteria which shed a light on decision-making process of post-disaster temporary accommodation units.

Table 3 Criteria of "What if NYC?" competition (Adapted from [22])

Criteria	Goals
Density	Maximize number of housing units per land area
Rapid Development	Provide units ready to be occupied as soon as possible
Site Flexibility	Maximize the ability to be accommodate as many different sites as possible
Unit Flexibility	Maximize the ability to accommodate as many variable household types and sizes as possible
Reusability	Maximize the potential for reuse of the structures either for future disasters or other purposes
Livability	Maximize the strength, utility, convenience, and comfort of the dwellings
Accessibility	Allow access for people who have limited mobility
Security	Make public space defensible and help people feel safe
Sustainability	Reduce energy costs and the carbon foot- print of the dwellings
Identity	Maximize the ability of New Yorkers to feel a sense of identity and even pride in where they live
Cost Efficiency	Maximize the best value for investment

2.4. Research Approach – Decision Analysis of Post-Disaster Temporary Accommodation Units

Decision-making is one of the inevitable session of architectural design process since the responsibility of architects is to convert the design problem into a well-structured quest for the given input variables such as location, climate and culture within a certain time. Indeed, decision-making in catastrophes make the situation even more complicated due to the necessity of prompt response. As a result, applied methods for the decision-making process of post-disaster temporary accommodation units are insufficient or result with detrimental problems not only to society but also to environment and economy.

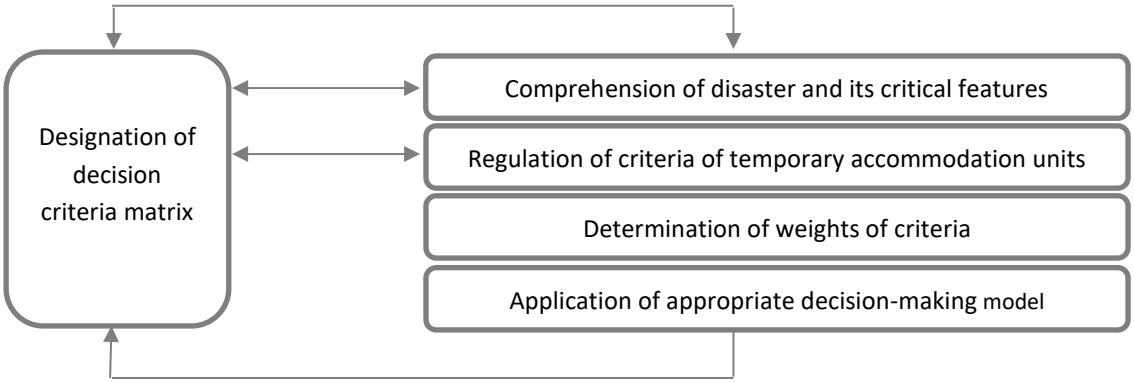

Figure 2 Proposed path-way for the evaluation of temporary accommodation units

As designing and constructing units against several disasters have always been difficult due to their unpredictability, the emphasis is now on "the more predictable and manageable disasters like earthquakes, fires, hurricanes, landslides and floods, and increasingly, to … threats from pollution, crime and poverty" [23]. However, there should also be a path-way even for unpredictable disasters to provide a livelihood environment for disaster victims.

Regardless of the predictability of disaster, Figure 3 presents the proposed methodology of this paper, which is projected on four-phased process, for evaluation of post-disaster temporary accommodation units.

As a part of the strategic disaster management methodology, there is a continuous activity as the designation of decision criteria matrix contributing four phases by leading or directing designers and decision-makers as a guideline in case of a disaster-relief.

Apart from the designation of decision criteria matrix process, the decision-making process of temporary accommodation units starts just after the moment of disaster with comprehension of disaster and its critical features and followed by the regulation of criteria of temporary accommodation units that enables decision-makers to apply a contextual path rather than implementing same decision-tree and parameters to each disaster. Afterwards, weights of parameters are determined and finally an appropriate method is chosen to reach the most rational temporary accommodation alternative.

3. Results

3.1. Designation of Decision Criteria Matrix for Temporary Accommodation Units

Although decision-makers are obliged to reach necessary parameters to evaluate post-disaster temporary accommodation units following a disaster, limited time directs them to make their decisions either with undesignated necessary parameters or with the lack of conscious of multiple parameters resulted with chaos. Thus, the proposed decision analysis pathway aims not only to prevent mentioned problems due to prompt response but also to design a comprehensive criteria matrix to lead decision-makers in case of a disaster. The criteria matrix for temporary accommodation units, which can also be implied as a decision tree, is generated considering contributions on criteria of temporary accommodation units from various courses, so that this study brings studies either from a certain perspective or do not approach the topic with an extensive manner under the same roof and proposes a holistic criteria matrix, as shown in Table 3. Further, by utilizing criteria and sub-criteria in Table 3, temporary accommodation indexes of alternatives are achieved as shown in Figure 4.

Although the criteria matrix aims to present an extensive approach, as needs of affected communities and environmental conditions evolve and change in time, it is possible to modify the decision-tree during each phase of disaster management. In other words, the establishment of this ever-growing decision-tree can be reconsidered and reformulated according to the existing situation of the disaster by decision-makers or designers as each disaster inevitably have its own necessities.

Table 4 Criteria and Sub-Criteria for Temporary Accommodation Units

	Criteria for Temporary Accommodation Units	**Sub-criteria for Temporary Accommodation Units**	**Reference(s)**
Economic			
	C_1. Production Cost	I_1. Cost of Structural Elements	[8] [11] [12] [21] [24] [25]
		I_2. Cost of Non-Structural Elements	
	C_2. Implementation Cost	I_3. Cost of Human Power	*
		I_4. Cost of Material/Device Power	*
	C_3. Transportation cost		[13] [26]
	C_4. Reusability Cost		**
	C_5. Maintenance Cost		**
Architectural			
	C_6. Social & Psychological Properties	I_5. Safety / Security	[13] [21] [25] [27]
		I_6. Appropriateness to Culture	[8] [21] [27] [28]
		I_7. Availability of Participation	[8] [29] [30]
	C_7. Physical Properties	I_8. Adequate Area of Unit	[27] [31]
		I_9. Packed Dimension of Unit / Ease of Transportation & Storage	[13] [19] [27] [32]
		I_{10}. Weight of Unit	[19] [21] [27] [32]
		I_{11}. Flexibility of Units/ Modularity	[19] [27] [33] [34] [35]
		I_{12}. Climate Convenience	[13] [21] [25] [31]
		I_{13}. Durability to Potential Disasters	[8] [36] [37]
	C_8. Timing Properties	I_{14}. Mounting / Demounting Time	[8] [19] [21] [38]
		I_{15}. Lifespan of Unit	[13] [21] [25]
Environmental			
	C_9. CO_2 Emission	I_{16}. CO_2 Emission of Production	[21]
		I_{17}. CO_2 Emission of Implementation	[21]
		I_{18}. CO_2 Emission of Transportation	[21]
	C_{10}. Standing Properties on Soil	I_{19}. Permanent Touched Area to Soil	[39]
		I_{20}. Temporary Touched Area to Soil	[39]
	C_{11}. Reconfiguration of the Product/ Future Use	I_{21}. Reusability	[25] [33] [34] [40]
		I_{22}. Upgradability	[8] [21] [31] [33]
		I_{23}. Recyclability	[21] [25] [33] [40]

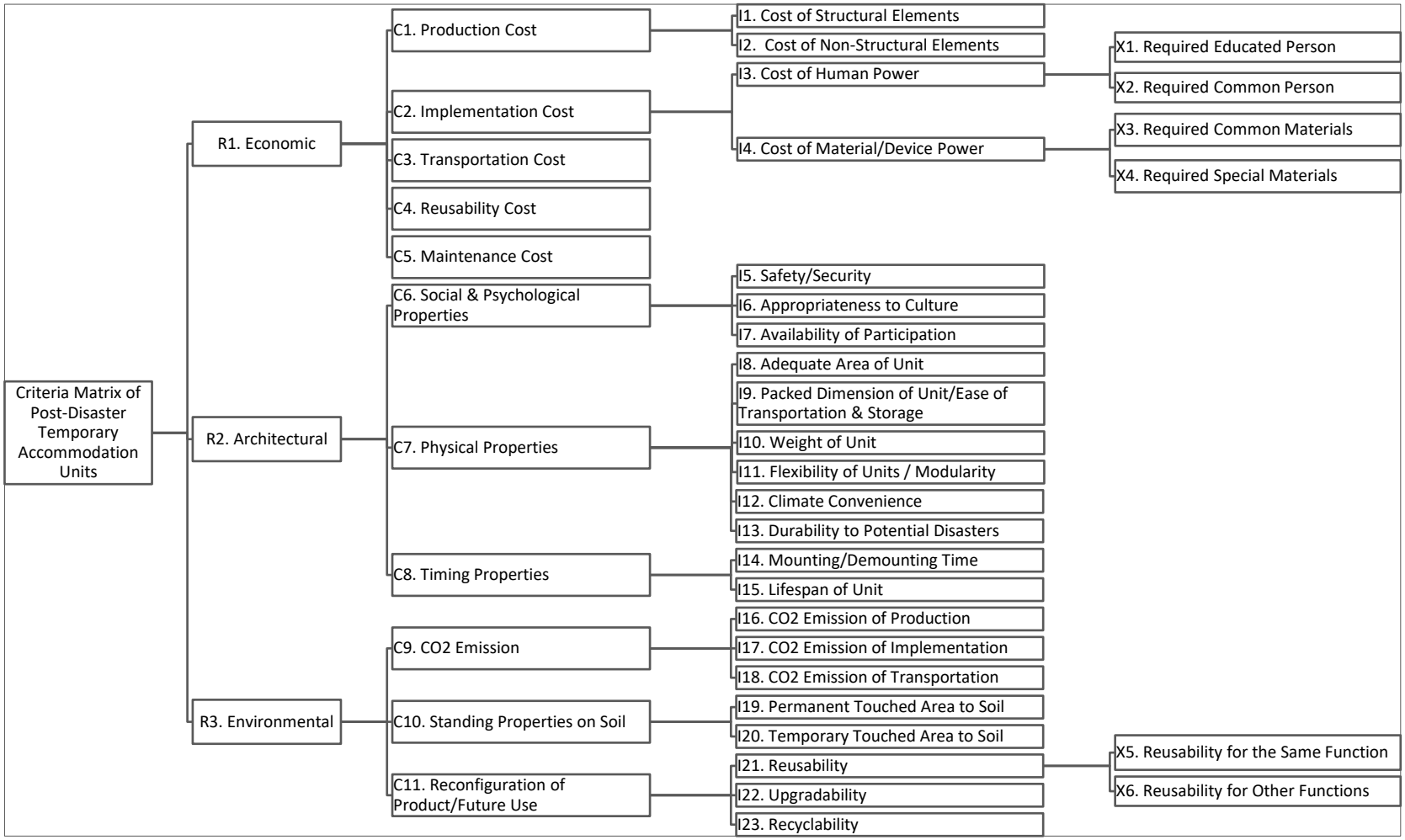

Figure 3 Criteria Matrix of Post-Disaster Temporary Accommodation Units

4. Discussion

As a part of the proposed strategic disaster management methodology for the evaluation of post-disaster temporary accommodation units, the proposed criteria matrix aims to be a basis matrix. Although such a comprehensive matrix includes each criterion, applying it for each disaster as it is may be a misapplication since each disaster has its own critical features with respect to the contextualism principle. Thus, although the generation of basis criteria matrix of temporary accommodation units is a guide for authorities in decision-making process, a detailed investigation of diverse disaster types can be carried out so that decision-makers can apply different criteria matrices for different disaster types.

Conclusion

Temporary accommodation units are a crucial solution applied by authorities not only to provide a physical accommodation but also to provide psychological rehabilitation. Accordingly, not to respond with inadequate information in reconstruction and recovery period in limited time, 'preparedness' period is crucial in an ideal disaster management. To conclude, considering the critical role of temporary accommodation units, this study aims to generate a basis criteria matrix for them in the 'preparedness' period, directing not only decision-makers to an organizational evaluation process but also designers to carry out their design process accordingly.

(*) Criterion mentioned according to the published properties of commercial temporary accommodation units.
(**) Criterion added by authors of this study.

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