Risk Assessment on Community-Based Post-Disaster Housing Reconstruction Project

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Abstract

Risk management method has been acknowledged to be an important factor to achieve the project objectives in the construction industry. However, its implementation on community-based post-disaster housing reconstruction is hardly found. Accordingly, the objective of this paper is to assess high risk events that affect time completion of community-based post-disaster housing reconstruction project (CPHRP). Three most recent and most severe areas affected by earthquake and tsunami in Indonesia were chosen as case study locations: Aceh (2004), Yogyakarta (2006) and West Sumatra (2009). Questionnaire survey was selected as data collection method and emailed to respondents to assess the probability of occurrence of particular event and its impact on time completion. The response rate was considered as very satisfactory (79%) with sixty five questionnaires were categorized as valid. Result shows that twenty events can be categorised as high risk and are mostly originated from government.

Keywords

Risk assessment, community-based, housing reconstruction

Introduction

Indonesia is one of the most prone countries in the world. Guha-Sapir et al. (2012) reported that Indonesia together with China, the United States, the Philippines and India, are the top 5 countries that are most frequently hit by natural disasters in recent 10 years. The most common types of disaster in Indonesia during this period are floods and earthquakes. Floods and earthquakes respectively contribute to 42% and 26% of total numbers of natural disaster. Although in the last ten years earthquakes only occupied 26% of total number of natural disasters, the death toll and economic damages it caused compare to total impacts are almost 98% (175,341 fatalities) and 89% (US$10.76 billion) respectively (EM-DAT, 2013). Since the majority of victims in earthquakes are killed by their own collapsed houses, it implies that earthquakes have destroyed many houses and, as consequences, massive housing reconstruction is needed.

Housing reconstruction is probably the most important activity in reconstruction project. It is highly needed by the beneficiaries after the relief period. As a result, delivering a high quality house that can satisfy beneficiaries' expectation is key factor of successful reconstruction programme. However, experiences have shown that the housing reconstruction project was not an easy task and face a lot of problems (ACARP, 2007 and World Vision, 2008). One option of procurement method that can achieve high satisfaction among survivors is by implementing a community-based post-disaster housing reconstruction project (CPHRP). Nevertheless, this programme is not free from risks that can delay housing delivery, increase construction cost, reduce quality, in which at the end can create dissatisfaction. To deal with the risks, risk management method which have been acknowledge to have positive contribution in achieving project objectives in construction project needs to be conducted.

Considering that whole stage of housing reconstruction project and risk management are very broad area, this paper concentrates on the pre-construction stage of CPHRP and assess the high risk events that affected the project's time completion. The other reason to focus upon the pre-construction phase of a CPHRP is because this phase is identified as one of the most important phases which contributes immensely towards the success of CPHRP. Accordingly, the objective of this paper is to assess high risk events that affect the time completion of CPHRP.

Literature review

Earthquake impacts in housing sector

Located in the juncture of four tectonic plates, Indonesia is frequently hit by earthquake. In recent years, the occurrences of large earthquakes have increased significantly. EM-DAT (2013) records that earthquakes occurrence in Indonesia increase from 14 times in the period of 1980-1989 to 39 times in the period of 2000-2009. In addition, particularly after the 9.0 Richter Scale giant earthquake in Aceh at the end of 2004, USGS (2010) notifies that 38 large earthquakes have taken place compared with only 12 earthquakes between 1992 and 2004. Some of the devastated earthquakes during this period are the 6.3 Richter Scale Yogyakarta earthquake in 2006 and the 7.6 Richter Scale West Sumatra earthquake in 2009.

These three devastating earthquakes have created considerable losses to Indonesian communities. Summary of the fatalities, economic losses and number of houses heavily damaged are given in Table 1. Housing is the most affected sector by earthquakes. In Aceh, losses in the housing sector were over 30% of total damage and loss assessment (BRR and partners, 2006). While in Yogyakarta and West Sumatra, the total losses were highly dominated by the housing sector- 53% and 74% of the total losses respectively (Bappenas et al., 2006 and BNPB et al., 2009). These figures indicate the severity of damage caused by earthquake in the housing sector, thus massive housing reconstruction programmes have been conducted in those affected areas.

Table 1. Number of fatalities, economic losses and housing damage due to earthquakes in Aceh and Nias, Yogyakarta and Central Java, and West Sumatra

No.	Disaster location	Fatalities	Economic losses (US$)	Housing destroyed/ heavily damage
1.	Aceh and Nias, 2004 and 2005	127,720	4.9 billion	139,195
2.	Yogyakarta and Central Java, 2006	5,716	3.1 billion	250,000
3.	West Sumatra, 2009	1,117	2.3 billion	115,000

(source: BNPB et al., 2009; BRR, 2009; Bappenas et al., 2006; JRF, 2010)

Providing good quality housing that can withstand the future disaster and achieving high level of beneficiaries' satisfaction are the ultimate goals in post-disaster housing reconstruction. However, this simple goal is not easy to achieve. Many problems have hampered the success of post-disaster housing reconstruction projects, and often found to be the most challenging sector of entire reconstruction programme.

Community-based approach in housing reconstruction

There are several approaches available in post-disaster housing reconstruction (Jha et al., 2010, da Silva, 2010) and one of them is community-based method. Before discussing further about community-based approach, first it is important to define the definition of community itself and into what extent a programme can be called as community-based. It was based on the fact that many organisations involved in post-disaster housing reconstruction often labelled their programme as community-based, without really understand how it should be done (Davidson, et al, 2007; Dercon and Kusumawijaya, 2007). In the context of post-disaster housing reconstruction, Ophiyandri et al. (2012) define community as a group of beneficiaries for housing reconstruction in which their houses are affected by a disaster. Further, Ophiyandri et al. (2010) suggest that from five level of community participation proposed by Davidson et al. (2007) (namely: manipulate, inform, consult, collaborate, and empower in which the last category community have more power to control reconstruction project), to be name as community-based method, the level of participation of community should be at least at the level of collaboration. In this level, community has significant amount of power to control their own housing reconstruction project.

The implementation of community-based approach in disaster affected areas has been proven as a key success factor in housing reconstruction project (Fallahi, 2007, Lawther, 2009). This method can provide many advantages, both physical and psychological. In construction management perspective, this method can ensure that the traditional objectives (time, cost and quality) in construction project can be met, and as a result it achieves high satisfaction among beneficiaries. In psychological perspective, it can rebuild the social capital, ease trauma and create pride among survivors (Ophiyandri et al., 2012). Despite its advantages, this method is still far from problems (Davidson, *et al*., 2007; Dercon and Kusumawijaya, 2007, Jha et al., 2010; MacRae and Hodgkin, 2011). The problems that exist in CPHRP can obstruct the project in achieving its objective. A problem is basically negative event or a risk that needs to be identified, assessed, and controlled.

Risk Management

Risk is combination of the probability of an event and its consequence (PD ISO/IEC Guide 73:2002) and is generally used only when there is at least the possibility of negative consequences. Although risk is often associated with negative impact, Hillson (2002) states that risk can also bring positive consequences on project objectives. In this context, risk is defined as an event that can bring negative impact on housing-reconstruction project in achieving its objectives.

Inevitably post-disaster housing reconstruction can be classified as a construction project. The construction project carries more risks and uncertainties compared to other industries such as the manufacturing industry (Hlaing *et al.,* 2008;). Because the post-disaster situation is more complex than a normal situation, the risk for post-disaster housing reconstruction projects is higher than the construction project in normal environment. Further, considering that every construction project is unique, the risks in involving a community in a disaster reconstruction are very specific and they would be very different compared to normal environment and contractor-based methods. The variations on scale of disaster impact, existence of local culture and wisdom, government capacity and funding availability have made it even more unique. In dealing with risks, the construction industry has acknowledged that risk management is an important factor in achieving project objectives (Kangari, 1995), minimizing losses and enhancing profitability (Akintoye and MacLeod, 1997). However, the implementation of risk management has not yet become a common practice in post-disaster housing reconstruction project (da Silva, 2010). As a result, there is a need to implement risk management process in CPHRP in order to enhance the probability of CPHRP to meet its objectives.

The risk management process is classified in different way by scholars. Thompson and Perry (1992) divide it into risk analysis and risk management, while Boothroyd and Emmett (1996) classify it as risk assessment and risk management. In more detail, Baker *et al*. (1999) states that risk management consists of five stages, risk identification, risk analysis, risk evaluation, risk response and risk monitoring , while Winch (2009) classifies it as risk identification and classification, risk analysis, risk respond, and risk monitoring. However, it is generally the process of identification, evaluation or assessment, respond or treatment and risk communication. Figure 1 shows the concept of risk management process.

Accordingly, this paper focuses on risk assessment stage. According to BS IEC 62198:2001 the purpose of risk assessment is to analyse and evaluate identified risks to determine whether treatment is required. Risk assessment or analysis can be carried out using qualitative or quantitative techniques. Egbu (2009) lists some techniques that can be used on risk management, qualitative techniques such as brainstorming, checklists, Delphi technique, probability-impact (P-I) score tables, interviews and risk register, and quantitative techniques such as decision trees, earned monetary value (EMV), sensitivity analysis, and Monte Carlo simulation. This study conducted interview and literature review as a method for risk identification, while probability-impact analysis is deployed for risk assessment method.

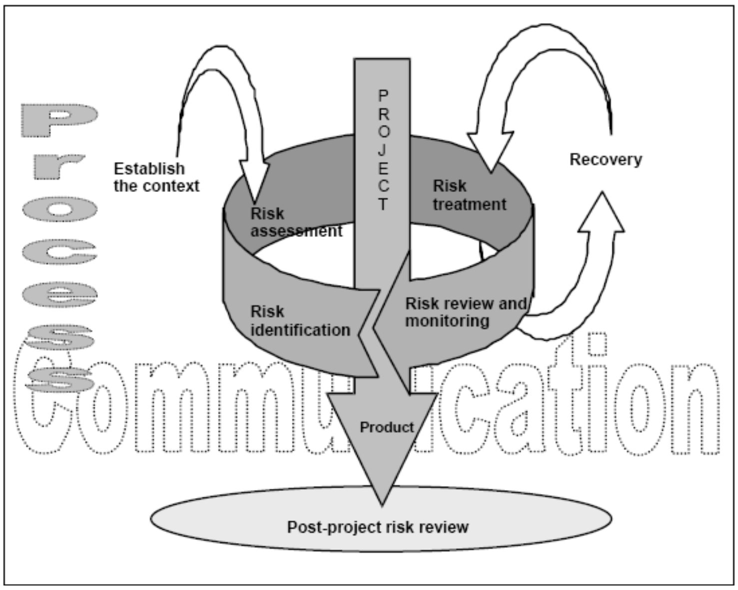

Figure 1. Project risk management concept (BS IEC 62198:2001)

Methodology

A questionnaire survey was conducted aiming to assess the identified risks on CPHRP. Risk identification was carried out through extensive literature review and interviews conducted in Indonesia. Following this step, a structure questionnaire was developed and piloted in November 2011. The results from pilot study required minor revisions to the format of the questionnaire and additions on the risks list. The finalized questionnaire was categorized in 8 activities which consists of 61 risks, and drafted in two languages, English and Bahasa Indonesia. In the questionnaire, respondent was invited to rate the level of probability and impact of particular event on a five-point Likert scale, varying from 'Very Low', 'Low', 'Moderate', 'High', 'Very High'. Guidance on judging the risk impact on project time was provided in the questionnaire and can be seen in Table 2. The risks factor (probability-impact factor) is calculated by multiplying probability factor and impact factor. The identified risk is classified as 'High' if the value of the probability-impact factor is located in the shaded cells of Probability-Impact matrix (Table 3).

Table 2. Risk impact on time (after PMI, 2008)

Project objectives	Relative or numerical scales				
	Very low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very high 0.80
Time	Insignificant time increase	<5% time increase	5-10% time increase	10-20% time increase	>20% time increase

Table 3. Probability-Impact matrix (after PMI, 2008)

Probability		Threat				
		Very low: 0.05	Low: 0.10	Moderate: 0.20	High: 0.40	Very high: 0.80
Very High	: 0.90	0.05	0.09	0.18	0.36	0.72
High	: 0.70	0.04	0.07	0.14	0.28	0.56
Moderate	: 0.50	0.03	0.05	0.10	0.20	0.40
Low	: 0.30	0.02	0.03	0.06	0.12	0.24
Very Low	: 0.10	0.01	0.01	0.02	0.04	0.08

The questionnaire was administered in December 2011 and completed in February 2012. The survey applied the snowball sampling where some respondents persuaded to inform researcher's other potential respondents to be invited. The questionnaire was emailed to 92 potential respondents and 73 completed questionnaires were received by the researchers, representing a 79% feedback rate. The response rate was considered very satisfactory. Among these 73 questionnaires, 65 questionnaires were categorized as valid. The validity criterion was based on two factors, respondent having had experience in CPHRP and one of the project locations being in Indonesia.

Respondents come from different demographic background. The highest comes from international NGO (35%), followed by consultant (28%), academia (14%), government (12%) and local NGO (11%). Respondents were working in various positions during the CPHRP, ranging from facilitators (29%), consultant/supervisor (29%), advisor (28%), project staff (23%) and project manager (20%). Analysing the respondents' experience in terms of duration and location, it shows that most of respondents have been working for more than six years (80%), on the other hand their working experience in reconstruction were less than six years (75%). This implies that most post-disaster reconstructions projects are a recent phenomenon in Indonesia. The majority of respondents have worked on the reconstruction of Aceh followed by Yogyakarta and Padang. Forty four respondents have been working only in one location, while seventeen respondents and four respondents have been working in two and three different locations respectively. The overlapping of respondent location in reconstruction project is shown in Figure 2. In addition, 91% of respondents have been working in Indonesia while 9% of them have also worked outside Indonesia, such as in Sri Lanka, Pakistan and Haiti.

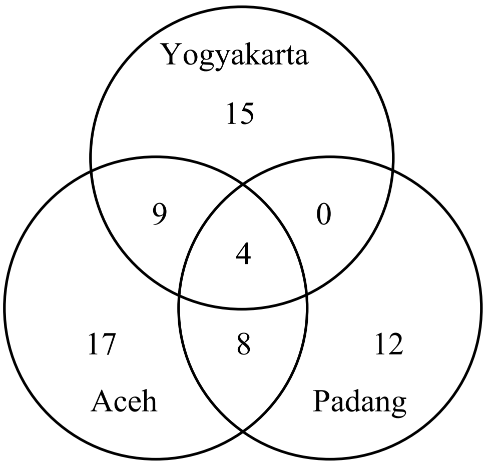

Figure 2. Number of respondents based on project location in Indonesia

Results and Discussions

Data was analysed using Statistical Package for Social Sciences (SPSS) 16.0, including the descriptive statistics, a one sample t-test was also conducted at a 95% significance level with a test value of zero in order to evaluate the significant level of risks statistically. The results of descriptive statistics and one sample t test are shown in Table 4. By analysing the mean value of probability-impact factor of each event and referring it to Table 3, high risk event can be identified. It can be seen from Table 4 that twenty events (in shaded row) out of sixty one events can be categorized as 'high risk' events. Although there is much variation in standard deviation, the result of t-test suggests that the finding is statistically significant as the significant value is very high at 0.00 (less than 0.05).

Table 4. High risk events (shaded row) as perceived by respondents

No	Events	Mean	Stdev.	Test Value = 0			
				t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
						Lower	Upper
A	**Initiation stages**						
1	Lack of central government capacity	0.187	0.175	8.630	0.000	0.144	0.230
2	Lack of local government capacity	0.222	0.171	10.506	0.000	0.180	0.265
3	Unclear reconstruction policy	0.209	0.182	9.277	0.000	0.164	0.254
4	Lack of implementers/NGOs reconstruction knowledge (in general)	0.179	0.170	8.472	0.000	0.137	0.221
5	Lack of implementers/NGOs community based knowledge (on how it should be done)	0.185	0.176	8.496	0.000	0.142	0.229
6	Failure to manage stakeholders	0.196	0.150	10.518	0.000	0.158	0.233
7	Problems of communication and coordination	0.243	0.172	11.372	0.000	0.201	0.286
8	Unclear roles and responsibilities of stakeholders	0.164	0.140	9.454	0.000	0.129	0.198
9	Inappropriate reconstruction organisations	0.171	0.170	8.106	0.000	0.129	0.214
10	Lack of government support	0.171	0.184	7.463	0.000	0.125	0.216
11	Insufficient funding	0.233	0.218	8.617	0.000	0.179	0.288
12	Tight schedule	0.193	0.183	8.543	0.000	0.148	0.239
B	**Facilitators recruitment and training**						
1	Shortage of facilitators	0.187	0.172	8.743	0.000	0.144	0.229
2	Lack of facilitators' knowledge and experience	0.202	0.176	9.272	0.000	0.159	0.246
3	Lack of trainers' knowledge and experience	0.141	0.152	7.510	0.000	0.104	0.179
4	Insufficient training materials and unclear outcomes	0.119	0.149	6.408	0.000	0.082	0.156
5	Tight schedule	0.182	0.171	8.598	0.000	0.140	0.224
C	**Housing damage assessment**						
1	Lack of housing database	0.260	0.201	10.452	0.000	0.211	0.310
2	Too many parties involved	0.232	0.204	9.155	0.000	0.181	0.282
3	Non-uniform assessment method	0.206	0.178	9.358	0.000	0.162	0.250
4	Coordination problems	0.233	0.168	11.172	0.000	0.192	0.275
5	Insufficient numbers of surveyors/facilitators	0.185	0.171	8.711	0.000	0.143	0.227
6	Inexperienced surveyors/facilitators	0.198	0.183	8.750	0.000	0.153	0.243
7	Transportation/access problems	0.305	0.235	10.467	0.000	0.247	0.363
8	Collusion in defining damage category	0.205	0.196	8.438	0.000	0.156	0.253
D	**Beneficiaries identification and land tenure**						
1	Lack of beneficiaries databases	0.282	0.205	11.045	0.000	0.231	0.332
2	Insufficient numbers of surveyors/facilitators	0.181	0.155	9.452	0.000	0.143	0.220
3	Inexperienced surveyors/facilitators	0.197	0.155	10.199	0.000	0.158	0.235
4	Transportation/access problems	0.259	0.219	9.505	0.000	0.204	0.313
5	Collusion in deciding beneficiaries'	0.211	0.193	8.785	0.000	0.163	0.259
6	Problems with land tenure/rights	0.280	0.233	9.679	0.000	0.222	0.338
7	Validation problems	0.272	0.216	10.164	0.000	0.218	0.325

No	Events	Mean	Stdev.	Test Value = 0			
				t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
						Lower	Upper
E	**Programme socialisation**						
1	Shortage of facilitators	0.171	0.159	8.691	0.000	0.132	0.210
2	Inexperienced facilitators	0.183	0.154	9.554	0.000	0.144	0.221
3	Lack of local government support	0.152	0.152	8.074	0.000	0.114	0.190
4	Competition between donors/implementers/NGOs	0.157	0.152	8.303	0.000	0.119	0.195
5	Community resistance	0.178	0.169	8.506	0.000	0.136	0.220
6	Failures in community meetings	0.179	0.164	8.826	0.000	0.139	0.220
7	Tight schedule	0.191	0.186	8.280	0.000	0.145	0.237
F	**Forming community organisation**						
1	Inexperienced facilitators	0.176	0.150	9.464	0.000	0.139	0.213
2	Failure to establish community organisations	0.153	0.154	8.010	0.000	0.115	0.191
3	Community resistance	0.159	0.139	9.278	0.000	0.125	0.194
4	Community leader too dominant	0.171	0.159	8.630	0.000	0.131	0.210
5	Community is manipulated by other parties	0.168	0.146	9.264	0.000	0.132	0.204
6	Disagreement on community contract/consensus	0.163	0.147	8.967	0.000	0.127	0.199
7	Tight schedule	0.153	0.138	8.926	0.000	0.119	0.188
G	**Community/labour training**						
1	Facilitators shortages	0.165	0.153	8.672	0.000	0.127	0.203
2	Inexperienced facilitator	0.175	0.151	9.307	0.000	0.137	0.212
3	Labour shortages	0.237	0.178	10.729	0.000	0.193	0.281
4	Limited knowledge by labour of how to construct earthquake resistant houses	0.236	0.178	10.721	0.000	0.192	0.280
5	Insufficient training materials and unclear outcomes	0.131	0.124	8.570	0.000	0.101	0.162
H	**Housing design and material**						
1	Inexperienced facilitators	0.137	0.134	8.208	0.000	0.104	0.170
2	Lack of facilitators' technical knowledge	0.134	0.124	8.710	0.000	0.103	0.164
3	Unclear building code	0.135	0.138	7.897	0.000	0.101	0.169
4	Too many variations put forward by the community	0.179	0.146	9.837	0.000	0.142	0.215
5	Too many cultural considerations	0.157	0.159	7.966	0.000	0.118	0.196
6	Unconfirmed source/type of materials	0.150	0.152	7.959	0.000	0.113	0.188
7	Material price increases	0.251	0.191	10.580	0.000	0.204	0.298
8	Tight schedule	0.160	0.155	8.302	0.000	0.121	0.198
9	Limited budget	0.178	0.157	9.180	0.000	0.140	0.217
10	Too much paperwork prior to initial payment at start of construction work	0.244	0.205	9.576	0.000	0.193	0.294

From 8 groups of activities in CPHRP, respondents perceived that only two group do not contain high risk events, programme socialisation and forming community organisation. Many high risk events present in initiation stage, damage assessment and beneficiaries' identification. Three high risk events in initiation stage are originated from government. They are lack of local government capacity, unclear reconstruction policy, and failure in managing coordination and communication. Simplified the bureaucratic process and controlling material prices is another challenge for government in speeding up the reconstruction process. This fact suggests that increasing government capacity to tackle future disaster is highly needed.

In damage assessment and beneficiaries' identification stages, the pace of CPHRP is hampered by lack of database. Database on how many houses are affected, how severe is the destruction, and who is eligible to receive the assistance are the common problems took place during CPHRP. Although community-based approach can minimise collusion, the lack of database can create a chance for survivors to do a conspiracy in deciding the damage category and eligible beneficiaries. It turns the validation process to become a long process. Thus, developing an up-to-date database system is immensely important. It has to be created long before the disaster struck. Further, clearly trouble-free access to the affected areas play an important role to guarantee that the housing reconstruction can be delivered as scheduled.

In the aftermath of earthquake, many organisations quickly provide assistance to assess the safety of houses if it should be occupied by the survivors. The problem emerges because organisations sometime bring their own assessment method. Then, when official assessment is carried out by government, and there is a difference in damage category, it creates confusion and dissatisfaction among beneficiaries, especially when the damage category is lowered down. For instance, when damage category is changed from heavily damage to moderate, beneficiaries will make a big complaint because it relates to the amount of fund they will receive in the future. The process of giving an explanation and understanding to the beneficiaries can consume a lot of time. As a result, providing uniform assessment method from the very beginning is essential to achieve time objectives of CPHRP.

Moreover, in facilitator recruitment and training, respondents perceived that lack of facilitator knowledge and experience can restrain the reconstruction process. Same condition take place in community/labour training where respondents also suggest that lack of knowledge of labour on how to construct earthquake resistant house and together with their shortages are high risk events that affect the time completion of CPHRP.

Conclusions

Several activities in pre-construction stage of CPHRP can be categorised as high risk and are mostly originated from government. Lack of government capacity can lead to unclear reconstruction policy, problems of communication and coordination, and long bureaucratic process. Moreover, lack of housing and beneficiaries' database, and their validation have been perceived by respondents as other obstacles in speeding up the reconstruction process. It exacerbated by lack of facilitators' knowledge and experience, and labour shortages. Insufficient funding and increasing of material prices have also been acknowledged to be the problems that can slow down the reconstruction programme. As a result, by giving much attention on above high risk events and creating possible solution prior to disaster, it is hoped that the success of CPHRP can be enhanced.

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