An Effective Post Disaster Reconstruction Information Management System for Iraqi Projects

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Abstract. This research studies disaster management system through examined the critical success factors to develop an Effective Post Disaster Reconstruction Information Management System for Iraqi Projects. Wars cause massive disasters and great devastation for all sectors, especially to the construction sector. Post-disaster reconstruction after wars become a critical topic for many countries, especially developing ones. The Iraqi construction sector witnessed great destruction in large parts of it due to the last wars in 2014, which resulted in the destruction of many areas and a significant deterioration in infrastructure. This paper aims to construct a general model consist of the main processes of post disaster reconstruction, various terms such as risk management, Stakeholder Management and supply chain management were investigated. In addition to exploring various aspects of disaster management to better understand it, for example, the classification of disasters and the stages of disaster management. Project management principles are discovered for the commitments of this research as well as opinions of experts working in Iraqi construction sector to investigate the suitable model for post disaster reconstruction management system. The consequences of this research are used for the build of the suggested model. In conclusion, the efficiency of the planned model was verified through a survey to ensure its suitability for Iraqi construction sector.

Keywords: Post Disaster Reconstruction, Information Management System, Critical Success Factors, Reconstruction Model, ANP Technique.

1. Background

1.1. Introduction
Disasters are one of the important events that the construction projects are exposed to during the construction period. The impact of disasters is increasing on the projects constructed because they lead to massive damage to infrastructure, resulting in a huge loss of money and lives. These losses cause enormous economic damage affecting the economy of countries, especially developing ones (Kerzner, 2011). The country generally seeks to define standard measures for disaster response by defining the processes and policies that must be followed for the post-disaster recovery phase to implement the reconstruction. The severity of the disasters and their environmental, economic and social impacts vary
According to the type, size and cause of the disaster. Therefore, the reconstruction plan must be flexible enough to fit the situation variables (PMI, 2007). This paper discovers the background of disaster reconstruction, whereas it studies present critical success factors, procedures and practices, which can be exploited by decision makers for post disaster reconstruction management model. The proposed Post Disaster Reconstruction Information Management System is consisting of as much as possible proper perspectives that propose the proper refreshing procedure. This system was designed using the results of a field survey analysis conducted by exploring the relative importance of critical success factors affecting post-disaster reconstruction. Through previous studies and literary topics related to the research subject, in addition to expert opinions in the field of Iraqi construction, 282 critical success factors have been identified that must be met in the reconstruction plan. The questionnaire was prepared to determine the degree of importance of factors through the use of five-point Likert scale. The efficiency of proposed model is questioned by a cluster of decision makers and experts from construction sector, who delivered this research with their understandings for project reconstruction and with the accurate review commands of the recommended model.

1.2. Problem Statement
Iraqi construction sector suffers from massive destruction, especially in the liberated governorates due to terrorist acts, despite the size of the destruction, but there is no comprehensive plan for reconstruction, as the construction sector suffers from the lack of an integrated work mechanism. Therefore, this research represents an urgent national necessity for an Effective Post Disaster Reconstruction Information Management System for Iraqi Projects.

2. Disaster Management
Disaster term is referring to a collapse in the normal operative of a public, that has a massive contrary impact on people, work, and their surroundings, exceeds limited response ability. This condition may be the final result of a normal incident like a cyclone or earthquake; or it can be the outcome of human activities (Carroll, 2001). Disasters are events cause significant encounters for all those affected people and communities having many needs in the coming period. Pardede and Tetsuo (2007) well-defined a two-point model of the post-disaster recovery process: first, the short-period stage, where a response against the catastrophe is take on; and second, the long-period stage, that deals with happenings that recover the procedures or the project. These two stages overlap and the duration and their initiation are not determined (Pardede and Tetsuo, 2007). The plan that controls the relating of a disaster recovery practices is called a disaster reconstruction strategy or alternative plan and has numerous features such as hazard detection, safety planning, risk minimization and resource capitalization. The reconstruction model of tries to usually treat an undesirable state nonetheless disasters ordering. effects are evaluated in two phases: first, the pre-disaster and second, post disaster. The pre-catastrophe phase surrounds activities searching discovery, appraisal and research with safety planning in contradiction of hazards that can reason a disaster. while, the post-disaster stage examines the activities that take to be assumed in order to treat the disaster special effects and create the projects returning to the pre-disaster level with minimum conceivable damages. (Helsloot, 2004)

3. Disaster Reconstruction progression
Disaster controlling goals to minimize, or escape, the probable damage from risks, declare rapid and suitable assistance to sufferers of catastrophe, and develop prompt and effective retrieval. The disaster controlling cycle clarify the continuing procedure by which rules, industries, and public community plan and decrease the outcome of disasters, respond through and instantly following a disaster, and take steps to recover after disasters have occurred (Joshi, 2008). The measures planned during the disaster cycle lead to enhancing attention in the future, and providing more accurate warnings, in addition to the possibility of preventing or weakening the chance of such disasters in the future. The full disaster response cycle should provide an integrated formulation of regulations, policies, and general plans that help mitigate the effects of disasters on people, their property, and infrastructure (WHO, 2002). For an
Integrated disaster management methodology, all actors such as governments, local organizations, and humanitarian organizations must be involved to provide services. It is not possible to completely separate the stages of disaster management because they overlap with each other. The disaster management cycle takes a long time to complete and the length of each stage and the extent of its interference with the next stage depend on the strength and impact of the disaster. (Warfield, 2008)

3.1. Mitigation and Minimizing the effects of disaster
The overall goal of the first stage is to mitigate the effects of disasters or unplanned accidents, while taking all necessary measures by setting protection laws and the foundations of using buildings while not neglecting to provide the necessary health care to the population affected by the disaster (Warfield, 2008). The success of this phase depends on the integration of the rapid procedures established, so pre-disaster planning can reduce the inevitable effects of it, especially at the beginning of the disaster management cycle. (WHO, 2002)

3.2. Preparedness and respond Planning
The stage of preparation for disaster management is planned in advance and depends mainly on the existence of an integrated database to prepare in advance for any emergency situation, which mainly helps in managing the following stages in addition to raising the practical and administrative efficiency of governments. (WHO, 2002). This stage depends on taking measures and measures at the level of governments, organizations and the general public to preserve the lives of the affected population. Therefore, a rapid response by stakeholders has a good impact on the success of this stage and achieving its goal. (Joshi, 2008)

3.3. Response to minimize the hazards created by a disaster
The goal of the response stage is to deliver the aid and assistance needed to provide a safe life and support the health status of those affected, while providing semi-permanent solutions, especially as the reconstruction period takes a long time (UNDP, 2008). The actual response lies in providing the basic needs and providing more sustainable solutions. It is assumed at this stage that there is a strong and clear intervention for the governments, as they are the first concerned authority for the next stage (Warfield, 2008).

3.4. Recovery the community to normal
After controlling for a disaster, the affected inhabitants will be able to take an amount of measures intended at returning them subsists and substructure. There is no clear fact where direct assistance will turn into a full retrieval phase and formerly into long-term workable growth (UNDP, 2008). There must be a smooth evolution from recovery to sustainable development and then continuous development through preparedness and good planning for the reconstruction phase (Warfield, 2008). Restore recovery activities until regular or better conditions return. Retrieval processes, equally short and long-term, embrace restoring dynamic lifecycle structures to slightest operating criterions; transitory housing; general statistics; well-being and protection schooling; restoration; analysis programs; and economic influence studies. Statistics resources and facilities include collecting data on reconstruction and recording lessons learned. (WHO, 2002). This research will focus on the recovery phase, specifically on the reconstruction phase, to provide a clearer picture of disaster management in the Iraqi construction sector, as shown in figure (2). (Researcher)
4. Field work

Through previous studies related to disaster management and expert opinion, 282 critical success factors affecting disaster management in the Iraqi construction sector were identified. A questionnaire was developed and the respondents requested to rank these criteria for implementing of post disaster reconstruction projects according to a five-point Likert scale which is the extensively used approach in survey investigation, in Likert scale the (1 = Least Important and 5 = Most Important). The analysis of obtained data was done by using the Relative Importance Index (RII) method as in equation 1.

\[
RII = \frac{\sum (X1 \cdot S1 + X2 \cdot S2 + X3 \cdot S3 + \ldots + Xn \cdot Sn)}{(A \cdot N)}
\]

Where:
- RII = the Relative Importance Index
- S = weights of each factor
- X = frequency of each rating
- N = total number of responses
- A = highest weight (i.e. 5 in this case)

4.1. Questionnaire

The tool of this survey is using the form of closed questionnaire distributed to the engineers working in both public and private sectors of various domains to find out the evaluation of the CSF. The researcher adopted in the preparation of questionnaire paragraphs on the literature reviews, International Organization for Standardization (ISO) 22301 and 27001 for disaster reconstruction plan as well as the expert interviews to prepare the form. The targeted sample should be able to satisfy the objectives of the study; therefore, the researcher distributed (110) questionnaire forms to various destinations concerned with construction projects, 82 forms were answered only which indicates that the response rate as 75 %, which is high and good. Research sample consists of general directors, engineers working in ministries of government and infrastructure projects and experts who evaluate suitable style to accomplish infrastructure projects, also engineers in private sector and UN organizations such as UNDP, UNICEF. The questionnaire was developed by using, as much as possible; simple and understandable terms to the engineers. In short, the decision-making effort and time, and to focus on the factors of higher importance, the researcher suggested choosing the factors that got relative importance index (RII) higher than 80%.
Only 31 factors obtained relative importance content above 80%. Table 1 shows the questionnaire analysis.

**Table 1. The critical success factors.**

| No. | Factors |
|-----|---------|
| 1   | Active government participation in PDRM. |
| 2   | Stability and lack of government changes. |
| 3   | Political remediation to promote decentralization and the ability to implement the reconstruction plan. |
| 4   | Hiring experts to develop the economic side. |
| 5   | Focus on the non-oil sectors to create new development opportunities. |
| 6   | Integrated approach in all aspects of the disaster reconstruction plan. |
| 7   | Legislation framework designed appropriately for the post-disaster reconstruction plan. |
| 8   | Activating the role of effective administrative control. |
| 9   | Determine the environmental and social risks resulting from the reconstruction plan. |
| 10  | Provide appropriate alternatives by developing plans and preventive measures for the expected risks. |
| 11  | Ensure that projects are executed efficiently while observing safety procedures / standards. |
| 12  | Evaluate potential risks throughout the entire life of the project. |
| 13  | Determine the decision makers. |
| 14  | Understand the local needs to develop suitable housing design for them. |
| 15  | Define the roles and responsibilities of each party in the reconstruction process. |
| 16  | Consulting specialists and exchanging experiences in the field of catastrophe managing. |
| 17  | Create a comprehensive awareness of the importance of disaster management for the success of the reconstruction process. |
| 18  | Resorting to partnership contracts as an alternative to traditional contracting mechanisms. |
| 19  | Setting Plan to optimize the benefit of reconstruction budget. |
| 20  | The government’s ability to assess the capabilities of stakeholders and the degree to which they influence the reconstruction plan. |
| 21  | Study the national capabilities to implement post-disaster reconstruction. |
| 22  | There are strategy and policy to coordinate the operations of materials suppling can be developed into an integrated system for the supply chain management. |
| 23  | Identify and know the requirements of the post reconstruction plan precisely. |
| 24  | Risks and opportunities analysis. |
| 25  | Study the risks that supply chains may be exposed to in post-disaster reconstruction. |
| 26  | Determine the types and specifications of the quantities of construction materials. |
| 27  | Evaluating the environmental impact of construction materials reused or recycled. |
| 28  | Using the local workforce in the reconstruction process. |
| 29  | Follow-up and continuous training for participants to keep abreast of the latest technologies in disaster management. |
| 30  | Follow-up and continuous training for stakeholders to keep abreast of the latest technologies in disaster management. |
| 31  | Establish a reliable network for exchanging information. |

4.2. Analysis of the Evaluation of disaster management in the Iraqi construction sector

The researcher asked a set of questions to assess the response of the Iraqi construction sector and its readiness for reconstruction operations. The researcher found a large percentage of the bodies
responsible for reconstruction show do not have a specific guidance for implementing campaigns for reconstruction in disaster situations, while only 9% have guidance for distinguishing between regular reconstruction from emergency situations, and the survey showed that 11% of Respondents are unsure of such guidance. The survey indicated that half of the respondents indicated that the agencies working in them do not have formal partnerships with local or international bodies in the matter of post-disaster reconstruction, while 37% indicated that they have partnerships or cooperation in this field with 13% of the respondents were not sure of the existence of partnerships. The researcher notes that 47% did not take into account the environmental aspects when planning reconstruction projects after disasters, while only 25% took into account the environmental impacts when planning reconstruction projects, with a 28% not sure about the implementation of environmental considerations.

4.3. The ANP model

The ANP model aims to measure all interrelations inside the ANP model quantitatively, after building the system model, a pairwise comparison questionnaire, in place of the relative impact of affecting clusters and nodes on the affected node for all possible pairs, and by computed geometrical means for all the comparative provisions associated with each question to discover the aggregated set judgments, then, utilize the assess/compare module of the Super Decisions software. Then obtained the priorities derived from paired comparison matrices using the software Super Decisions, Automatically, the software calculated the eigenvector of priorities (the impact of each component on the other one) and the consistency ratio (CR). The relative importance of elements (or components) being compared by solving the following formulae (Nurgül, 2014):

\[ A.W = \lambda_{max}W \]

Where:
- \( A \) = the matrix of pair-wise comparison,
- \( W \) = represents the eigenvector, and \( \lambda_{max} \) the largest eigenvalue of \( A \).

If \( A \) denotes a consistency matrix, then eigenvector \( X \) can be determined using:

\[ (A - \lambda_{max})X = 0 \]  \hspace{1cm} (3-7)

Saaty (2006) suggested assuming the consistency index (CI) and consistency ratio (CR) to verify the consistency of the contrast matrix. This is defined as follows:

\[ CI = \frac{\lambda_{max}-n}{n-1} \]  \hspace{1cm} (3-8)

Where:
- \( CI \) = the consistency index
- \( n \) = the size of comparison matrix.

5. The Proposed Disaster Reconstruction Model

Based on the results of the questionnaire and the results of network analysis in addition to adopting recommendations and guidance of experts, taking into account the standard stages of disaster management, an integrated disaster management model has been proposed suitable for the Iraqi construction sector. The model is divided into four phases after considering previous studies and expert opinion to be proper and suitable to the main activities in the Proposed Post Disaster Reconstruction process:

1. Phase one: Evaluation: Understand the needs.
2. Phase two: Planning: develop a comprehensive reconstruction plan.
3. Phase three: Funding: finance the reconstruction.
4. Phase four: Implementation and monitoring; figure (1) shows components of the proposed model.

Evaluation and understanding the needs is considered an important stage of the management of post-disaster reconstruction, as the evaluation stage aims to provide a clear and accurate understanding of the concept of post-disaster reconstruction in addition to a comprehensive management of the potential risks to post-disaster reconstruction projects in Iraq through risk assessment. The assessment and needs
understanding stage also include an assessment of the needs for the reconstruction process. The first stage of the reconstruction management represents the cornerstone upon which the rest of the system depends. Therefore, accuracy and adherence to critical success criteria secures building a successful model drawn from previous experiences according to the specifics of the high-end construction sector.

Capacity analysis to know the reality of the capabilities status in the Iraqi construction sector and its readiness to plan and implement the reconstruction campaign and thus provide a ready-made database of capabilities to ensure the flow of supply chains such as materials, workers and information. Identifying the stakeholders involved in the reconstruction provides an opportunity to share ideas and solutions in addition to the experiences gained, and also includes identifying the actual needs of the stakeholders.

Figure 2. the proposed post disaster reconstruction system.

It is important at this stage to identify the environmental and social impacts of the reconstruction process, which provides an opportunity to study the potential impacts as a result of the social or environmental reconstruction process. Knowing and determining the type of financing greatly affects the stage of reconstruction. Reconstruction, especially after war disasters, requires massive funding that the government may be unable to provide, especially in developing countries. The reconstruction phase
and finding international financiers to participate in it requires an accurate determination of the request and an integrated study of the reality of the Iraqi construction sector to determine the gap between the available financing and the required to determine the type and size of funding required. The final stage of reconstruction is the actual implementation and follow-up of the flow of the plan, careful follow-up that integrates with the preparation of the reconstruction plan and ensures the achievement of its purpose in quality, time and cost. The risks associated with the reconstruction process are considered an expected factor, so controlling the risks at this stage represents a major challenge to maintain the negation of the reconstruction plan. Follow-up of funding and disbursements according to the prepared timetables, which will be integrated with the follow-up of stakeholders in the successful implementation of the reconstruction stages. Supply chains and ensuring their availability in time and quantity are considered necessary stages in the implementation of reconstruction campaigns and directly affect the quality of project delivery.

6. Conclusions and Future Thoughts
The results of this questionnaire benefit decision makers from consultants and engineers. They also provide a precise and clear understanding of the requirements of the Iraq reconstruction plan by finding weights critical success factors. Through the results of the questionnaire, the researcher found the following conclusions:

1- Although the Iraqi Ministry of Planning developed a methodology for the reconstruction of Iraq after the disasters of the war it was exposed to, but many not a few percent of respondents are unaware of the existence of a reconstruction plan or they are not sure of its existence, which indicates a clear weakness in the group work organization and stakeholder consultation in the planning stage.

2- There is a great deficiency in studying the environmental impacts resulting from disasters were 47% did not take into account the environmental aspects when planning reconstruction projects after disasters, while only 25% took into account the environmental impacts when planning reconstruction projects, with a 28% not sure about the implementation of environmental considerations.

3- A large percentage of the bodies responsible for reconstruction show do not have a specific guidance for implementing campaigns for reconstruction in disaster situations, while only 9% have guidance for distinguishing between regular reconstruction from emergency situations, and the survey showed that 11% of Respondents are unsure of such guidance.

4- The researcher proposes studying the effects of disasters on the economy by specialists in the economy and examining the possibility of relying on other industries as an alternative to oil.

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