

An Effective Approach to Infrastructure Reconstruction Of Devastated Countries

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Summary: *Various infrastructure segments of numerous countries have been repeatedly subjected to natural or human-induced disasters. International aid institutions and financial institutions are trying to assist in the reconstruction of devastated countries. The development institutions normally face the problem of selecting and implementing relevant priority infrastructure projects that are needed in various sectors. Additionally, there are several local key players in the decision making process. In many cases, the decisions of these main decision makers often have contradictory objectives that lead to conflict and thereby hamper the reconstruction process. In response to this kind of problem, an effective approach has been developed within the field of Multiple Criteria Decision Analysis (MCDA), referred to as the Analytical Hierarchy Process (AHP), to assist decision makers in prioritizing projects to meet specified goals and objectives. Using the AHP approach, the problem of selecting infrastructure projects is dealt with systematically when applying this flexible MCDA technique. This approach takes into account possible uncertainties, social discrepancies and the potential lack of technical or historical data necessary to select effectively and prioritize projects. Decision makers from international financing aid institutions, donor agencies, local governmental planning and community representatives can utilize this proposed approach.*

1. Introduction

There are many countries worldwide suffer from the consequences of disasters and conflicts, often for long periods. The degradation of resources and utility services are a direct result of those conflicts. A concerted response from the international community to assist in rehabilitation to minimize human tragedies is growing and is urgently needed. Important reconstruction projects may include repairing or building main roads and bridges, residential buildings, schools, universities, hospitals, public buildings, provisions for water and wastewater facilities, telecommunication facilities and other networked services (Ayyub, 1994; Ross, 2001; Ezell et al. 2000a, 2000b). Such projects play an important role in the recovery and development of a devastated country's infrastructure.

The timely completion and proper utilization of local resources, whatever the project size, can be hampered by a lack of local technical and managerial experience and relevant project documentation. This requires importing technical assistance, materials and machinery, which increases implementation time and reduces the financial benefit and job opportunities for the local community. Moreover, incomplete designs, inconsistency in the contractual documents, inadequate allocation of technical and financial resources, lack of public co-operation and co-ordination among involved key players constitute main issues that have to be considered (Bots et al 2000). To expedite financial disbursement, a comprehensive assessment of local conditions and capabilities must also be identified and integrated within the availability of funds, implementation capacity and sustainability of the proposed project. Financial and implementation conflicts due to the absence of a local regulatory body must be resolved in a timely manner to gain the maximum benefits of reconstruction.

Tackling the problem of reconstruction in a systematic and transparent manner enables decision makers to effectively consider local issues and constraints and implement the most vital projects first. This in turn encourages local communities to commit to reconstruction, and helps them develop an appreciation for the financial support of the international aid institutions and donor community. In such circumstances, continuing collaboration and cooperation of the key players constituted by the international aid institution representatives, local governments and community leaders, are essential for the success of aid fund distribution, project selection and implementation process. To expedite reconstruction in a timely and transparent manner, a systematic, yet answerable procedure must be developed and coordinated to enable the different key players to work together in synchronism towards resolving emerging conflicting issues.

The Analytical Hierarchy Process (AHP) can convert the complex multi sector, multi objective decision-making process into a tangible numerical format that reflects the project priorities to be considered by the identified key players (Saaty, 1980, 1996). The AHP methodology is based on three principles: (1) decomposition of the problem into levels of hierarchy, (2) comparative judgments to assess pairwise comparisons of the elements within a given level in the hierarchy, and (3) fusion of levels for reaching a ranking of the alternatives. For constructing the AHP levels, the conflicting interests of the key players can be categorized and minimized to obtain different criteria that need to be considered in the selection process. Other criteria can be included in the decision processes that reflect the consequences of failure to enable subjective judgment to be incorporated into the whole reconstruction process. The list of projects sought for sponsorship could also be considered as the alternatives after careful technical, environmental and social appraisals. Unfortunately, the involved key players normally carry deep disagreement among themselves, which makes the application of AHP a difficult task. Therefore, the key players must come to a consensus on the hierarchy levels and act as one identity capable of decision making for one specific goal (the goal here is the effective reconstruction). Thus, the AHP levels can be formulated. In this way, the key players representing the donor community and beneficiaries are provided with an effective, transparent tool to be used in the project selection process. Integrating criteria set by the key players and other criteria that include uncertainties in defining the involved decision parameters and their

interrelationships results in an effective decision analysis tool (Ayyub, 1994; Lathrop, 2001; Warner, 2001).

2. Key players in reconstruction

Typical project materialization components as tabulated Table 1 are: the beneficiaries, capital providers, financial administrators / auditors and implementers. Table 1 also shows the direct and indirect key players and their roles in a typical project.

A key player with a ‘principal’ role is identified as the key beneficiary and an identity that initiates the project needs and has strong control on the country’s economic development. A player with a ‘primary’ role is an identity that has strong ties with the principal player and is considered a strong potential financing body but did not initiate the project. However, it is a strong supporter for the project needs. Finally, a key player with a ‘supplementary’ role represents an identity that has an influence on the success of the project implementation through partial or complete financial support, legislation, physical implementation and unforeseen influences.

Disagreement surface among the main players for a lengthy project list requirement is declared. The donor community usually identifies the list as a project *wish list*. The list is normally provided either by influential individuals, local community representatives or by the residing political leaders (*principal player*). The *wish list* may include several conflicting and unrealistic projects, as the key player’s declaration is not often clearly stated. The list is forwarded to the pledged financing institutions (primary player). In many cases, the financing institutes are negotiating with the residing governing identity and banking institutions and project management (supplementary players) for proper distribution of funds under specific legal and financial regulatory plans.

Table 1 Key players and associated roles for infrastructure rehabilitation

	Key players	Role
Beneficiaries		
<i>Direct</i>	Community	Principal
<i>Indirect</i>	Donor Aid Policy Makers – Businesses – Work Force	Supplementary
Capital Providers		
<i>Local</i>	Ministry of Finance – Local Government – Community	Principal and/or Supplementary
<i>International</i>	Donor International Aid Institution	Principle or Primary
Financial Administrators / Auditors		
<i>Local</i>	Ministry of Finance – Local Government – Community	Primary
<i>International</i>	Donor International Aid Department	Primary
Implementers		
<i>Local</i>	Local Government – Consultant – Project Management – Contractor	Primary and/or Supplementary
<i>International</i>	Donor Representative – Consultant – Project Management	Primary and/or Supplementary

A typical project cycle (project appraisal and social assessment, design, operation and maintenance) is tabulated in Table 2 in which the key players and the key role they play in the decision process are identified for each phase. As indicated in Table 2, several

key players with different levels of expertise, aspiration, and undeclared intentions are expected to be involved in the decision procedures throughout the life of the project implementation cycle. A wide discrepancy in opinion could easily lead to conflict, which will hamper the reconstruction process and increase donor frustration, and in severe cases cause the cancellation of the project's support and the collapse of the reconstruction process.

Tables 1 and 2 indicate the nature of the complexity of the decision-making required. The difficulty can even be increased if a large number of key players need to consider all of the sector priorities, social development, financing possibilities, implementation options, project risks, operation and maintenance procedures, and other decisions influencing factors simultaneously (Ziara et al, 2001). Such a cluster of key players and emerging technical constraints lead to a multi criteria decision analysis requirement.

Table 2 Project phases and the number of key players (decision makers) in aggregating the project wish list to executable projects

Project Cycle	Players	#
Preparation Phase		3
• Wish list preparation	Community leaders – Ministry of Planning – Local Government	
- Project appraisal & assessment	Community leaders- Ministry of Planning - Ministry of Finance – Local Government- Consultant - Donor Representative – Ministry of Public Works	7
• Preliminary acceptance to modified wish list	Steering Committee - Community leaders - Ministry of Planning - Ministry of Finance – Local Government- Donor Representative – Ministry of Public Works	7
Financing Phase	Ministry of Finance – Donor Representative- Local Government	3
• Financing agreement		
Project Design and Implementation		
• Implementation		
Project specs	Local Government - Ministry of Public Works - Consultant- Donor Representative	4
Project design	Local Government- Consultant	2
Physical work	Community Leaders - Ministry of Public Works - Local Government - Consultant - Contractors	5
Cost of executed work	Local Government- Consultant - Contractors	3
Operation & Maintenance		
• O & M	Community- Local Government- Consultant	3

3. Unifying decision

The first step of effective decision-making is for the different key players to merge into one identity through a process called group decision-making. Establishing a *steering committee* in which all key players evolve into one identity and with one goal proposed as a way to unify the decision process. Decisions taken by the committee are then systematic and productive in nature. It is not an easy task to form a *steering committee* particularly when the country under investigation has emerged from a lengthy internal conflict. However, once the consequences of failure to attract financial aid due to a lack of professional and accountable procedures are stipulated down to the local key players, a unique settlement among them is more likely to be formulated. The *steering committee* cannot represent one party or community. For each key player identity, one officially nominated decision maker backed by its own technical team is chosen to represent the party in the *steering committee*. The key players (principal, primary and supplementary) presented in Table 1, with consensus among them, form the committee. In the listed case, there are the following six key player representations in the *steering committee*;

- Local Community
- Ministry of Planning
- Local Government
- Ministry of Public Works
- Project Management
- Donor agencies

The *steering committee* is now considered by the key players to be one identity that will be accountable and in charge of scrutinizing the information and properties relative to the proposed projects, which will then be documented in the form of a project appraisal document for future auditing. For transparent and accountable procedures, the creation of a *steering committee* is an important step in refining the project's *wish list* and allocating funds to each sector required for development. The *steering committee* members, with the backing of their technical and social experts, must reach consensus and examine the long *wish list*. Omitting duplications, unrealistic projects, and those that have already received financial commitments from other donors further shortens the list. This also requires the coordination and collaboration of the multiple donor agents working in the area with the *steering committee*. Assuming successful, but possible lengthy procedures, the *wish list* is now refined into a bundle of tangible, executable multi sector, multi discipline and multi financed pledged projects (alternatives). The discussed procedure for the proposed decision-making process is shown in a pictorial format in Figure 1.

It should be noted that once the project list has been prioritized and before any project is considered for implementation, the essential project information must be collected using standardized project appraisal forms, and a reasonable financial and implementation risk analysis should be completed. The essential information may include, but is not limited to:

- Basic statistical data that may represent the initial cost of the project in standard currency,
- Summary of the project contractual and technical specifications,
- The number of direct and indirect beneficiaries,

- Environmental impact assessment studies,
- Operation and maintenance requirements,
- Local employment opportunities,
- The availability of construction materials,
- Expected completion date, and
- The overall management structure that will be in place once the project moves out of the construction phase and begins permanent operation.

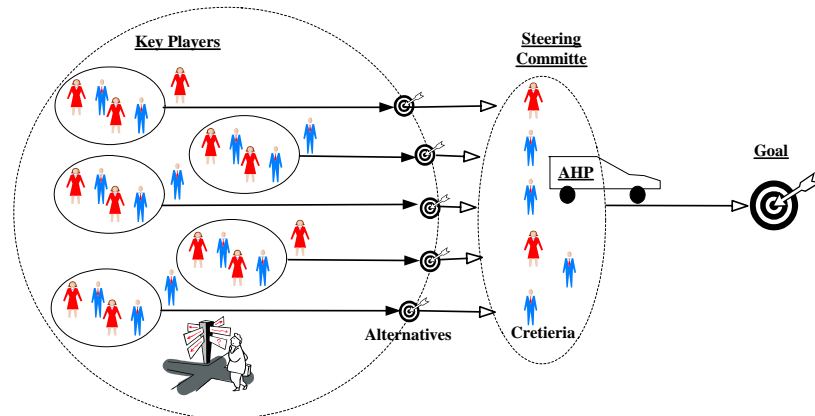


Figure 1. Effective infrastructure projects selection procedure

After the steering committee finalizes the list, the next step is to prioritize the projects using the proposed AHP tool. AHP can be introduced to the steering committee through a “technical facilitator (TF) to ensure proper implementation of the expert elicitations, consistency in opinion and having proper weighting procedures for the alternatives and criteria (Ziara et al, 2002)”. The basic feature of project the phases and expert elicitation that involves multi participants has been used to prioritize infrastructure projects in countries with very limited resources.

4. Applying AHP to infrastructure restoration

The AHP technique can be used for “setting priorities for complex, un-anticipated, multi-criteria infrastructure projects (Mustafa and Al - Bahar, 1991)”. When using AHP to model uncertain multi-objective problems, one needs a hierarchical structure to represent the problem, as well as pair-wise comparisons to establish relationships within the structure. A typical hierarchy involves representing an overall project (goal) and objectives at the top level of the decision making process. The elements affecting the decision (criteria) are at the intermediate level. The decision options (alternatives) are at a lower level. These comparisons lead to dominance matrices that direct the decision maker to the highest ranked elements in view of the information analyzed.

When rapid project selection and implementation are needed, the decision requirements through the application of AHP are presented as shown in Figure 2. The prioritization of the hierarchy elements are based on a study case of Palestine presented by Ziara et al, 2002. The structure of AHP is as follows:

1. The first level is the overall goal, which is the effective reconstruction of infrastructure through the implementation of important construction projects to support the country’s industrial and social development.

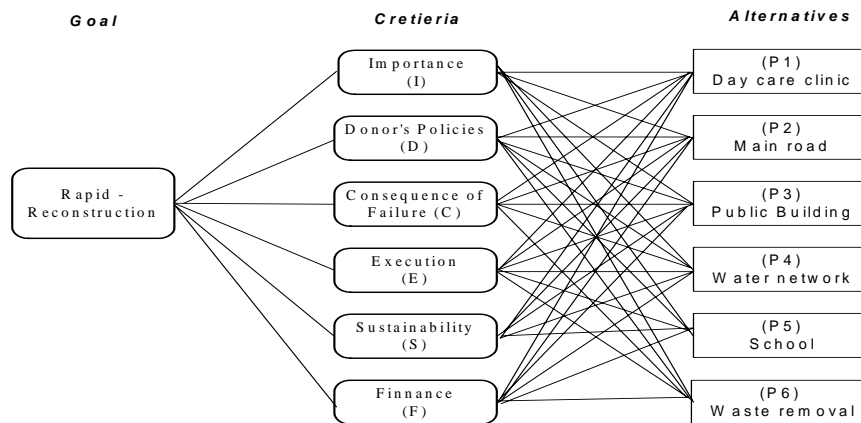


Figure 2 Three levels of hierarchy

2. The second level is comprised of the criteria, which is formulated based on the key players' aspirations, technical requirements, development plans and logistics. Typical examples of criteria might include:

- The importance of the sector for emergent reconstruction (I),
- Investor and donor policies and interest in sustaining support for reconstruction (D),
- Consequences of failure in meeting stakeholder and community aspirations and urgent requirements (C),
- Executability, technical boundaries and the merits of the project relative to local material and expertise (E),
- Sustainability; indicating how the project operator will maintain the smooth operation of the project (S), and
- Financing options and availability of funds (F)

In this level of the hierarchy, 'the criteria level', each criterion is compared to the adjacent criterion at the same level using a subjective and consistent weighting.

For procuring a fair weighting of the decision variables, opinions are elicited by the technical facilitator and decisions that reflect knowledge, feelings or emotions from steering committee key players are used. These judgments are presented as meaningful numbers on a scale from 1 to 9. For two criteria, *A* and *B*, the scale can be applied as follows:

- *A* and *B* equally important (called scale level 1),
- *A* weakly more important than *B* (3),
- *A* strongly more important than *B* (5),
- *A* very strongly more important than *B* (7), and
- *A* absolutely more important than *B* (9).

The above hierarchy and weighting were implemented for many of the World Bank financed projects in the West Bank and Gaza (Palestinian Territories). Despite the political uncertainty of the region, the rehabilitation support was within the context of the multi-donor and World Bank Emergency Rehabilitation Projects (ERP) and

Country Assistance Strategy (CAS). One of the ERP's initiatives was to improve rapidly the availability and quality of infrastructure services to expedite health, education and economic development in cities and villages of the West Bank and Gaza (WBG) between 1994 to 2000 (Ziara et al, 2002). The area has longstanding political problems and lacks public sector planning and regulatory institutions. Following many strategic development studies by the local and international aid agencies, physical infrastructure for health, education and municipal services was deemed essential to expedite economic development and decrease poverty.

The presented data given below are for projects pledged for financing by the World Bank and the multi-donor community actively participating in the region (World Bank, 1999, 2000). The information relating to the properties of the individual projects was gathered from relevant appraisal and needs assessment reports compiled by the project administrators, the Palestinian Economic Council for Development And Reconstruction (PECDAR, 1999).

Figure 3 includes the pairing of the above-specified criteria under consideration (6 criteria) using the AHP weighting and normalization process of elicited data by the technical facilitator and the steering committee members. The last column in the table represents the relative priority of the criteria called the priority vector (**P.V.**). In this case, the project sustainability criterion (**S**) has the highest priority followed by the consequences of failure (**C**) while the executionability (**E**) criterion has the lowest priority. The resulting consistency ratio, *CR*, is 0.06, which is less than 0.1, thereby indicating a satisfactory assessment of the paired comparisons.

3. The third level is comprised of alternatives to the social and political matrix in multi-sector projects that are urgently needed. The alternatives can be arranged in groups. Each group of projects is assigned to a geographical location, sector institutional requirement, or rural community gathering depending on the restructuring strategy. In the case of a country struggling with physical devastation, input elicitation from public forums and meetings, and employment generation experts should be adopted by the steering committee.
4. Finally, the composite global ranks of the projects are estimated. The cardinal ranking of the projects becomes as tabulated in Table 3: P1, P2, P5, P3, P4 and P6. For effective implementation of urgent projects and the rapid start of the reconstruction process, projects of low ranking, for example those below 0.16 (P4 and P6) may be postponed until the second phase. Thus, low ranking projects are not implemented even if funding is available, since the risk of improper implementation of such projects would be high and might result in loss of support and enthusiasm by the public and the donor community.

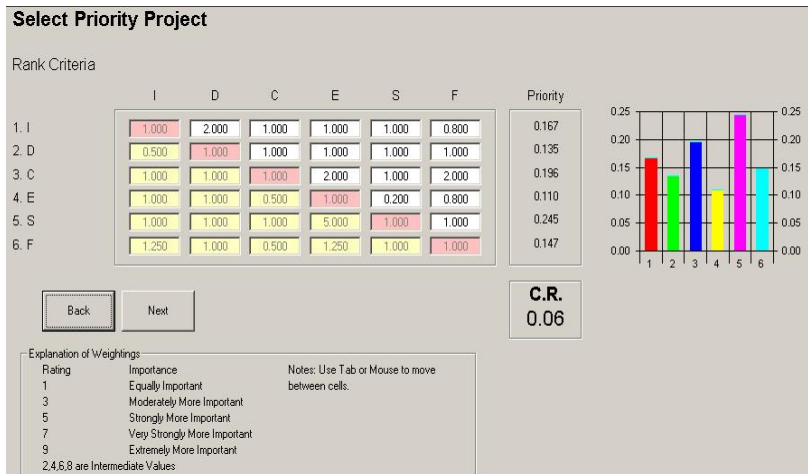
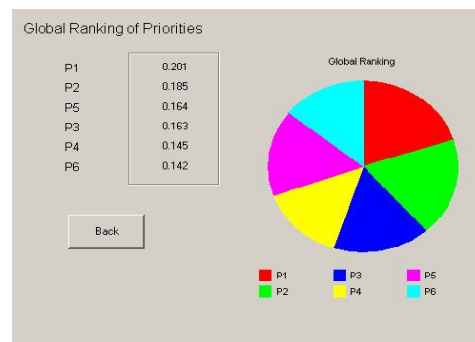


Figure 3 Criteria comparison matrix
 $\lambda_{max} = 6.383$ and the inconsistency index $C.R. = 0.0617 < 0.1$

Table 3 Global ranking of the projects

Criteria	(I)	(D)	(C)	(E)	(S)	(F)
Priorities	.167	.135	.196	.110	.245	.147
Project	Project local priority					
P1	.142	.137	.176	.184	.296	.224
P2	.124	.165	.317	.124	.094	.292
P3	.157	.116	.122	.181	.218	.162
P4	.165	.224	.119	.194	.127	.077
P5	.230	.174	.120	.196	.149	.14
P6	.181	.185	.146	.120	.116	.104



5. Conclusions

An effective MCDA approach, the Analytical Hierarchy Process (AHP), has been developed for ranking and selection of important reconstruction projects in devastated countries such as the Palestinian territories. The influential players, having the roles of 'principal', 'primary' and 'supplementary', normally involved in reconstruction, were identified. The key players were regrouped into one identity represented as a *steering committee* capable of unifying the decision process. The community leaders, local government and donor country representatives peered by experts are elicited as part of the elicitation process that responds effectively to the unique conditions of the territories with minimal conflicting procedures and under the Country Assistance Strategy of the main financing body.

The results of the case study for the Palestinian Territories indicated that the implementation of the methodology could enforce a decision on relevant reconstruction projects in a quantitative way. Based on the MCDA study with the consideration of the key players and allowing each player to participate effectively to achieve the one goal, relevant decision were made. The evolution of the key players into one decision making identity contributes to continued donor support through the completion of the

projects [World Bank, 2000]. It is unfortunate that in the past two years the political situation has reversed its course, which hampered the physical reconstruction vitally needed. However, the MCDA process outlined here should not necessarily be disregarded as it is based on the interaction among the community, local leaders, the development agents and therefore is applicable to similar countries that need rapid rehabilitation.

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