# Stakeholders Analysis for Utility Relocation in Construction Project

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Abstract: Communication is a complicated task while executing utility relocation projects in developed city. The main reason behind this is the number of stakeholders involved. This research tries to identify and classify the stakeholders during the utility relocation projects through interviews with the experts, questionnaire and clustering approach. First, 25 stakeholders and the 6 attributes, Power, Profit, Influence, Impact, Legitimacy, and Urgency are identified from interviews with the experienced engineers. The questionnaire is then developed based on the 6 attributes. The k-prototypes approach is adopted to analyze the results of the questionnaires and classify these stakeholders. The project managers can customize their communication techniques or choose suitable timing to involve the stakeholders with similar characteristics for each group in order to promote communication efficiency, and reach the anticipated objective.

## 1 INTRODUCTION

Many researches have discussed stakeholders management, analysis or mapping in recent years (Smith et al., 2004; Bourne, 2005; Newcombe, 2010; Jeffrey et al., 2010; Jing et al., 2011; etc.). All of these researches emphasize that the stakeholders' management influences the success of a project. Construction projects are full of uncertainties and risks because of the on-site condition, especially when the construction project includes the relocation of utility lines. Most of the utilities are buried underground in Taipei, Taiwan, which entail the water system, electricity, gas, sewage and so on, and they each under a different jurisdiction with different specialization. Communication among the different stakeholders is complex and difficult. For this reason, recognizing the stakeholders in utility relocation project to improve communication among them and ensure project success is the objective of this research. This research tries to identify the stakeholders and their attributes during the utility relocation projects through interviews with the experts. The attributes become the basis for the questionnaires. The k-prototypes approach is then applied to analyze the results of the questionnaires and classify the stakeholders during utility relocation.

## 2 STAKEHOLDERS

The concept of stakeholders was first raised by Freeman in 1984. Freeman defines the stakeholder as any group or individual who can affect or is affected by the achievement of the organization's objectives (Freeman, 1984). According to "A Guide to the Project Management Body of Knowledge" (PMI, 2008), project managers spend the majority of their time communicating with team members and other project stakeholders, whether they are internal or external to the organization. PMI (2008) also states that project stakeholders are individuals and organizations that are actively involved in the project or whose interests may be affected as a result of project execution or project completion.

### 2.1 Stakeholders Recognition

Taipei is a fully developed city in Taiwan with crowded population. Most of the infrastructures, such as the electricity system, and gas utilities were built decades ago. Thus, when a property owner wants to build new infrastructure, communication becomes a major issue for utility relocation. This research will analyze the stakeholders during utility relocation of the MRT (Mass Rapid Transit) construction project, a classic example for utility relocation in Taiwan. Generally, utilities involved in


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such project include Street Light, Sewage System, Water System, Gas, Electricity, Telecommunication, Signalization, Military Information and Storm Drainage. Many jurisdictions and agencies are involved. Different types of utilities also require different expertise. This research utilizes the engineers' practical experiences to identify 25 stakeholders during the utility relocation project. Table 1 shows how Taiwanese engineers typically categorize the stakeholders:

Table 1: Stakeholders' classification using practical experiences.

| | |
|---|---|
| Group 1 - Cable Pipeline Units | |
| 1 | Taipower Power Supply Station |
| 2 | Taipower District Office |
| 3 | Chunghwa Telecom District Office |
| 4 | The Parks and Street Lights Office, Taipei City Government |
| 5 | Traffic Engineering Office, Taipei City Government |
| 6 | Network Transmission Squad of the Signal Group, Army Corps |
| 7 | Fixed Line Companies |
| 8 | Telecommunication Companies |
| 9 | Cable Companies |
| Group 2 - Fluid Pipeline Units | |
| 1 | Storm Drainage Section of the Hydraulic Engineering Office, Public Works Department, Taipei City Government |
| 2 | Sewage Systems Office, Public Works Department, Taipei City Government |
| 3 | Engineering Division, Taipei Water Department |
| 4 | Taipei City Fire Department |
| 5 | Natural Gas Companies |
| Group 3 - Client | |
| 1 | Client (Department of Rapid Transit Department, TCG) |
| Group 4 - Contractors | |
| 1 | Material Suppliers |
| 2 | Utility Contractors |
| Group 5 - Elected Representative & Law Enforcement | |
| 1 | Local Traffic Police |
| 2 | Local Police |
| 3 | Local Borough Office |
| 4 | Local Representatives and Council Members |
| Group 6 - User | |
| 1 | Local Community Management Center |
| 2 | Local Financial Sector |
| 3 | Local Businesses |
| 4 | Local Residents |

## 2.2 Stakeholders Classification

Ronald (1997) identified 3 attributes: Power, Legitimacy, and Urgency and use them to classify the stakeholders into 7 groups – Dormant, Discretionary, Demanding, Dominant, Dangerous, Dependent, and Definitive. In his research, Power means the ability of those who possess power to bring about the outcomes they desire (Salancik and Pfeifer, 1974). Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions (Suchman, 1995). Ronald argued that Urgency is based on the time sensitivity and the criticality, so they define urgency as the degree to which stakeholder claims call for immediate attention (Ronald, 1997). Newcombe (2003) included the property developer, British Rail, design practice, insurance company, general public, contractor, users, and local authority as the key stakeholders in the Swindon redevelopment project. He applied the power/predictability matrix and the power/interest matrix to classify the stakeholders and analyze the stakeholders' influence. Bourne (2005) used the Stakeholder Circle methodology to classify and prioritize stakeholders, develop strategies and monitor effectiveness. Different from the above mentioned researches which used qualitative method or analysis software to classify the stakeholders, this research tries to classify the stakeholders by using the quantitative attributes or characteristics of stakeholders.

# 3 METHODOLOGY

This research identifies the stakeholders of utility relocation projects through interviews with the experts. 25 stakeholders are first identified from the interviews, and then 7 attributes, Power, Interest, Influence, Impact, Legitimacy, Urgency, and Public/Private sector are adopted to set up the questionnaires. The 6 former attributes are numeric data type. Power, Legitimacy, and Urgency are defined in section 2.2. Interest refers to the stakeholders' level or concern regarding the project outcomes. Influence is the stakeholders' active involvement in the project. Impact means the stakeholders' ability to affect changes to the project's planning or execution (PMI, 2008). The last data is categorical data type, which represents whether the stakeholders belong to the public or private sector. Because the k-prototypes approach

can be applied toward mixed data type, it is adopted in this research to analyze the results of the questionnaires and classify the stakeholders during utility relocation.

### 3.1 Questionnaire

The questionnaire is designed to get the attribute value for each stakeholder. The questionnaire assigns a seven-point Likert scale for the 6 attributes of each of the 25 stakeholders, which will be discussed later on. The "7" in the scale means the highest, "6" means higher, "5" means high, "4" means average, "3" means low, "2" means lower, and "1" means the lowest. In order to achieve objectivity and professional result, the members need to have utility relocation related experience. In addition, the recipients of the questionnaires are from both public and private sectors, for example, Department of Rapid Transit Systems, Sewage Systems Office, Chunghwa Telecom, Water Department, gas companies, contractors and so on. There are 37 participants for this questionnaire, including engineering staff or officials who have participated in utility relocation related projects, among which 14 has over 20 years of experience, 13 with 10 to 20 years of experience, 5 with 5 to 10 years, and 5 with 1 to 5 years.

### 3.2 K-prototypes Algorithm

The clustering algorithms have numerous scientific and practical applications, such as in artificial intelligence, pattern recognition, and medical research. In general, it can be divided into various categories based upon their principles and algorithms. The traditional clustering methods include the following: 1) Partitioning methods; 2) Hierarchical methods; 3) Density-based methods; and 4) Grid-based methods. The k-prototypes algorithm is a type of Partitioning methods proposed by Huang (1998). This algorithm provides a straightforward approach to integrate the k-means and k-modes algorithms to cluster mixed-data-type objects. The objective function is defined as follows:

$$P(W,Q)=\sum_{l=1}^{k}\left(P_l^r+P_l^c\right) \quad (1)$$

in Equation (1),

$$P_l^r=\sum_{i=1}^{n}w_{i,l}\sum_{j=1}^{p}\left(x_{i,j}-q_{l,j}\right)^2 \quad (2)$$

and

$$P_l^c=\gamma\sum_{i=1}^{n}w_{i,l}\sum_{j=p+1}^{m}\delta\left(x_{i,j},q_{l,j}\right) \quad (3)$$

where $W$ is an $n\times k$ partition matrix, $Q = \{Q_1, Q_2, \ldots, Q_k\}$ is a set of objects in the same object domain, where $1 \le l \le k$. Let $X = \{X_1, X_2, \ldots, X_n\}$ be a set of $n$ objects. Object $X_i$ is represented as $[x_{i,1}, x_{i,2},\ldots, x_{i,m}]$, where $1 \le i \le n$, $1 \le j \le m$. Equation (2) is the squared Euclidean distance measure of the numeric attributes and Equation (3) is the simple matching dissimilarity measure of the categorical attributes. The weight $\gamma$ is used to maintain a balance between both data types. Interested readers are encouraged to refer to Huang's paper for details on this algorithm (Huang, 1998).

## 4 ANALYSIS RESULT AND DISCUSSION

This research used the questionnaires to assign values to stakeholders' 6 attributes with the addition of whether the stakeholders are from public or private sector, and the k-prototypes approach to analyze the stakeholders. Based on Roland's classification result (Ronald, 1997), this research uses 7 as the initial number of groups. The numbers of each group is shown in Figure 1. Only 1 stakeholder (local community management center) is classified under Group 1, so the researchers consider that most of its attribute values are close to the means of Group 6, it means the characteristics of local community management center are similar to those of Group 6, so it was combined with Group 6 into the new Group.

After the adjustment, table 2 shows the means of each attribute in each group. Group 1 now includes the Storm Drainage Section of Hydraulic Engineering Office of Public Works Department and Sewage Systems Office in Taipei City Government, Sewage Systems Office of Public Works Department in Taipei City Government, and client (Department of Rapid Transit Department, TCG). Group 2 includes the Parks and Street Lights Office and Traffic Engineering Office of Taipei City Government, Network Transmission Squad of the Army Corps Signal Group, and Taipei City Fire Department. Group 3 includes Taipower Power Supply Station, Taipower District Offices, Chunghwa Telecom District Offices, Engineering Division of Taipei Water Department, and natural gas companies. Group 4 includes the fixed line companies, telecommunication companies, cable

companies, and utility subcontractors. Group 5 includes local traffic police, local police stations, local borough offices, and local representatives and council members. Finally, Group 6 includes material suppliers, local financial sector, local businesses, local residents, and local community management center. The classification results indicates that Group 3 has the highest values in power, profit, influence, legitimacy, and urgency while Group 1 has the second highest values in power, profit, influence, legitimacy, urgency, and the highest value in impact. Project managers need to pay more attention to the stakeholders within these 2 groups.

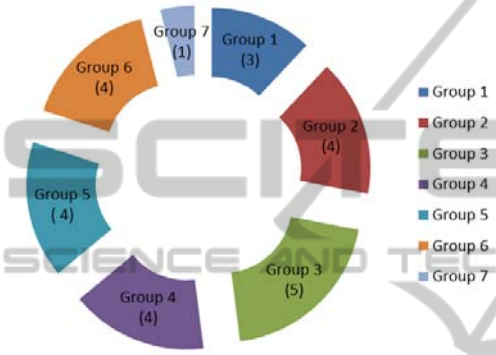


Figure 1: The numbers of each group (Before adjustment).

Table 2: The means of attribute in each group.

| Attribute \ Group | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Power | 5.4234 | 4.7432 | 5.4541 | 4.7365 | 4.0676 | 3.6270 |
| Interest | 5.0180 | 4.5203 | 5.3568 | 4.8378 | 3.9662 | 4.3946 |
| Influence | 4.9459 | 4.6149 | 5.7027 | 4.5203 | 3.9122 | 3.8865 |
| Impact | 5.4955 | 4.1081 | 5.3459 | 4.1554 | 3.6149 | 3.6865 |
| Legitimacy | 5.3604 | 4.9730 | 5.4703 | 4.4122 | 3.6014 | 3.4865 |
| Urgency | 5.0090 | 4.8108 | 6.0595 | 4.5203 | 3.1081 | 3.3297 |

## 5 CONCLUSIONS

This research utilized questionnaire and k-prototypes clustering approaches to classify the stakeholders for utility relocation projects. Comparing with the traditional classification method, which depends on the engineers' subjective opinions, this method proposed objective and quantitative classification. The authors first interviewed experienced engineers to identify a list of 25 stakeholders, who are then classified into 6 groups. Stakeholders in each group are with similar characteristics. According to this information, project managers can plan for communication accordingly. For example, the project team can seek advices from the group with the highest attribute values early in the processes. In conclusion, project managers/team can customize their communication strategy for each group.

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