

# The Construction of City Drainage Facilities Utility Model Based on the Method of Factor Analysis

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## Abstract

Researching on urban drainage facilities from the perspective of utility, selection of utility evaluation method for the analysis of factor analysis method and AMOS software, according to the utility theory of value, it summarized the factors of influence drainage facilities utility, finally got 6 main factors and 16 secondary factors of affecting the city drainage facilities' utility, and to establish a set of scientific, systematic and operability of the utility value evaluation model of urban drainage facilities, to assess the objective value of utility of the urban drainage facilities.

**Keywords:** urban drainage, facilities construction, the utility model

Urban drainage facilities' good or not is an important sign to measure a city modernization level, not only related to People's Daily life, but also related to the overall image of the city. In theory, through the investigation and study on the present situation of city drainage facilities construction and its utility, is conducive to the utility model is applied to the city drainage facilities, and to verify the utility model of scientific and practical; In practice, it's helpful for in finding and solving the problems and shortcomings of the city drainage facilities construction, to the public, is to avoid the loss of the personal and property caused by poor drainage, and improve the quality of life, to the city, it's good for the construction of the drainage system to adapt international metropolis and the highly developed economy.

## 1. The Influencing Factors of Urban Drainage Utility

Proceed from the Angle of public drainage requirements, researching the influence factors of drainage utility, to explore the characteristics, advantages and disadvantages of urban drainage system, it becomes the key to the evaluation for the utility value of the urban drainage facilities from the point of view of economy.

From previous research and the practical analysis of the drainage facilities, the influence factors of urban drainage utility can be divided into the following several aspects.

Table 1. Experts and scholars on urban drainage impact factors on schedule

Factors affecting Experts	Experts
The degree of Drainage facilities unobstructed	Zhi Huang
Funding Profile	Yangshan Wu, Yunfei Huang
pre-planning	Chen Zhang, Yan Chen
post-maintenance	Cuihong Xu
the drainage system	Ligang Su, Shuping Li
The drainage condition	Qiang Xue, Yaru Guan
The utilization rate of emergency situations	Jun Wang

By scholars and experts opinions before finishing and induction, and combined with their own ideas, the author thinks that the influencing factors of urban drainage effectiveness mainly have the following a few, the following process were expounded.

### 1.1 The Public Satisfaction Index

The public satisfaction index for drainage, is the important indicators of the evaluation of urban drainage facilities, this is determined by the utility theory basic content, in economics refers to the utility for consumers by consumption or enjoy leisure and so on to make their own needs, desires, get the satisfaction of the measurement. So for the construction of the urban drainage facilities, must according to the will of the public to provide drainage services, and let the citizen's satisfaction as a final standard to assess their utility. Therefore, for the measure of utility evaluation of urban drainage facilities, ultimately depends on the people are satisfied or not.

### 1.2 The Degree of Drainage Facilities Unobstructed

The degree of Drainage facilities unobstructed play to the role of the pilot Of urban drainage utility, the pros and cons of urban drainage facilities first depends on the degree of urban drainage unobstructed, a smooth drainage system in the fastest time free of urban rain water or sewage, the life and property of the public to obtain a good protection, but a drainage unobstructed, will cause the rain flow backward fester to polluting the environment.

### 1.3 The Advanced of the Drainage System

The urban drainage system refers to drainage system of different ways of life of urban sewage, industrial waste water and precipitation formed adopted. It can be divided into two types, namely combined and triage system. Pros and cons of urban drainage systems is directly related to how much to invest, the protect environment, as well as to play its own utility, but the decision of a regional drainage system is good or bad, incomplete drainage system is in its merits, but rather whether the system adapted to local circumstances, so choose a suitable urban drainage systems is essential.

### 1.4 Effectiveness of Response to Unexpected Situations

Under normal circumstances we are talking about the validity refers to the completion of planned activities and to the extent planned results. The effectiveness of urban drainage facilities to deal with unexpected situations refers to the use of urban drainage emergency measures to face the unexpected result of situations.

### 1.5 The Drainage Condition

Urban drainage facilities, including pre-planning and post- maintenance condition, both of them are related to the play of the urban drainage facilities utility. Pre-planning of urban drainage facilities should be based on the actual situation in the city where as a reference, while the city's drainage facilities basically completed, the building has the basic shape of the city-pattern, and then make a major surgery to the drainage, not only extremely difficult and expensive cost, will also be a long time-consuming, so urban drainage facilities maintenance measures must be done, so as to be truly optimal allocation of resources .

### 1.6 The Extent of Demand for New Public Drainage Facilities

The extent of demand for new public drainage facilities plays an important indicator to the utility of urban drainage facilities. The consumers' demand as the prerequisite and basis of the utility to be effective, if a consumer is no demand for a commodity, then the product for the consumer will not have effect. Similarly construction of urban drainage facilities , if the existing drainage facilities have been able to meet the needs of the public drainage , then the investing is not efficient , on the contrary , if the existing drainage facilities completely unable to meet the public drainage requirements , the construction of urban drainage facilities is necessary and have an effective use.

## 2. Construction of Urban Drainage Facilities Utility Model

### 2.1 Constructed Conceptual Utility Model of the Urban Drainage Facilities

By analyzing the influencing factors in the previous section on the urban drainage utility to play, Based on the existing theoretical results and empirical research data, this paper constructs a utility impact of urban drainage facilities voxel model. Formulated as  $f(x) = \sum A_i U(B_i) = A_1 U(B_1) + A_2 U(B_2) + \dots + A_n U(B_n)$ . Here,  $f(x)$  indicates that a drainage facility total utility,  $B_1, B_2, B_3, \dots, B_n$  stand for the influencing factors of the urban drainage utility.  $A_1, A_2, \dots, A_n$ , the index of evaluation utility,  $f(x) = \sum A_i U(B_i)$  the total weighted utility and utility of each part.

2.2 The Analysis of Secondary Factors

Utility model proposed in the article, the first use of the influencing factors analysis, the overall utility of urban drainage facilities is regarded as the dependent variable, it's influencing factors as independent variables. By using the Analytical Hierarchy Process, get a further subdivided to the influencing factors, so as to achieve the purpose of quantifiable data.

Table 2. Correspondence between the primary and secondary variables

Main variables	Sub variable
The public satisfaction index	1.Public living environment and environmental quality
	2.Problems of drainage
The degree of Drainage facilities unobstructed	3.Drainage conditions
	4.Public thought
The advanced of the drainage system	5. System Type
	6. The service life of the drainage facilities
	7. Management operation mechanism
The drainage condition	8. pre-planning
	9. quality of basic amenities
	10. post-maintenance
The extent of demand for new public drainage facilities	11. improvement way
	12. financial support
	13. For investment in the new facilities
Effectiveness of response to unexpected situations	14. Drainage conditions on the unexpected situations
	15. Preparations for emergency
	16. The legislation plan

The main variables and secondary variables above represented by the letter, we can get the utility of urban drainage facilities route graph as follows:

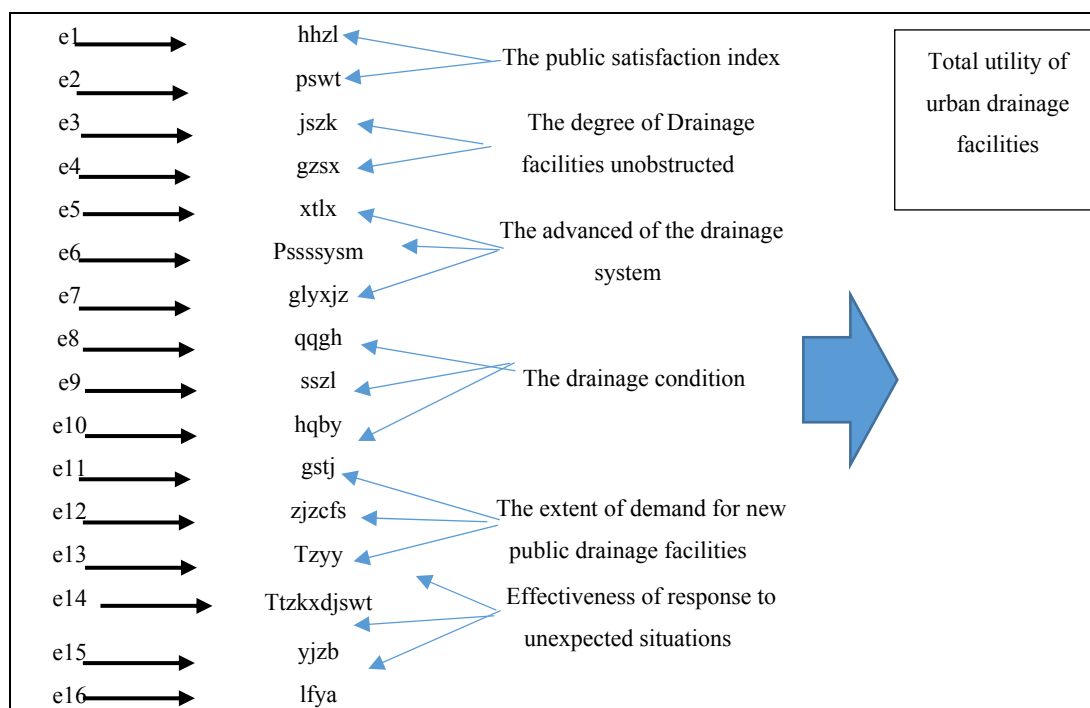


Figure 1. the utility of urban drainage facilities route graph

### 2.3 Evaluation and Testing of the Model

The article first using SPSS statistical software entry for Shanghai questionnaire data and descriptive analysis, normality tests and other treatment, after using structural equation modeling statistical software AMOS select Maximum likelihood of sample data for analysis, the specific approach we using software do descriptive analysis and parameter estimation for the various factors.

### 2.4 Descriptive Analysis and Fitting Test Model Sample

By sorting data, the descriptive statistics for each sample project in Shanghai observed variables used herein are shown in Table 3. It can be seen that the mean, variance and other indices of the sample data in line with the actual situation.

Table 3. Descriptive analysis and normality test

Variable	min	max	skew	c.r.	kurtosis	c.r.
hhzl	0.000	31.000	.016	0.176	-1.315	-3.653
pswt	2660.000	3700.000	.325	2.783	-0.143	-0.535
jszk	4566.009	12455.000	.279	2.651	-0.098	-0.465
gzsx	2.001	7.980	.004	0.037	-1.151	-5.459
xtlx	62.000	110.000	.695	2.633	-1.021	-4.653
pssm	0.000	1.000	.134	3.455	-1.546	-5.452
glyxj	0.000	1.000	.556	1.866	-1.954	-9.271
qqgh	0.000	1.000	.652	0.365	-1.289	-5.458
sszl	0.000	1.000	.580	5.500	-0.070	-0.334
hqby	30.000	30.100	.655	4.747	-0.070	-0.648
gstj	56.000	56.000	.135	3.200	-1.335	-5.230
zjzzfs	2.000	18.000	.134	1.462	-0.864	-3.886
tzyy	0.000	7.900	.635	3.864	1.651	7.834
ttzkx	0.000	1.000	.562	4.71	-1.321	-3.907
yjzb	0.000	1.000	.342	1.862	-0.655	-6.864
lfya	0.000	1.000	.265	1.320	-1.656	-5.522
Multivariate					562.725	465.862

### 2.5 The Parameters of the Model Analysis

As shown in Table 4, with maximum likelihood method to estimate the parameters of each regression coefficient results, in addition to a reference index value not estimated, the remaining regression weights have reached a significant level, 4 regression weights were significant in the model, which can also indicate good intrinsic quality of the model.

Table 4. standardized regression coefficients

Variable	<---	Variable	Estimate
hhzl	<---	The public satisfaction index	0.163
pswt	<---	The public satisfaction index	1.123
jszk	<---	The degree of Drainage facilities unobstructed	0.765
gzsx	<---	The degree of Drainage facilities unobstructed	0.782
xtlx	<---	The advanced of the drainage system	0.530
pssm	<---	The advanced of the drainage system	0.681
glyxj	<---	The advanced of the drainage system	0.371
qqgh	<---	The drainage condition	0.856
sszl	<---	The drainage condition	0.937
hqby	<---	The drainage condition	0.926
gstj	<---	The extent of demand for new public drainage facilities	0.341
zjzcf	<---	The extent of demand for new public drainage facilities	0.271
tzyy	<---	The extent of demand for new public drainage facilities	0.404
ttzkx	<---	Effectiveness of response to unexpected situations	0.712
yjzb	<---	Effectiveness of response to unexpected situations	0.603
lfya	<---	Effectiveness of response to unexpected situations	0.245

### 2.6 The Empirical Result Analysis

As can be seen from the table above, the public living environment and environmental quality of urban drainage facilities have a minimal impact on the utility, registering 0.163, followed by legislative and financial support plans which are 0.245 and 0.271, it can also be seen that from the table the biggest factor affecting the drainage facilities is the urban problems of drainage. From the perspective of the main variables as a whole, the main factor of the drainage condition should be the most important factor for urban drainage. Compared with other five main factors, it has the highest score, which precisely conforms to the case in reality: the condition of drainage facilities plays a decisive role in urban drainage utility.

As can be seen from Table 4, factors of pre-planning and post- maintenance represent 0.856 and 0.926 respectively, which is relatively high compared with the other factors. Thus, as for the pre-planning of urban drainage facilities, we need to achieve the "look ahead ", raise the planning standards, give adequate space for urban development in the future, be fully prepared to deal with unexpected situations of emergency for urban drainage, and do a good post-maintenance work for urban drainage facilities.

Results of this study indicate that the effect urban drainage facilities exert is not determined by a single factor, but as a result of a combination of factors. The total effect of the urban drainage facilities is a comprehensive and collective result of those factors. Among the various factors influencing the effectiveness of urban drainage facilities, the ones with the greatest influence on its total utility are its own situation and public satisfaction with the drainage facilities, which is decided by the definition of utility in economics and the value and use value of commodities.

### 3. Conclusion

With the continuous development of urban economy and the growing prosperity, urban residents' demands for good drainage facilities are increasingly urgent in recent years, although the theoretical research on urban drainage facilities on the rise, but from the perspective of utility theory to analyze urban drainage facilities are almost none. Therefore, the article attempts to utility theory of value from the perspective of research and drainage facilities, through the establishment of a scientific, systematic, and have the utility value of urban drainage facilities operability evaluation model to assess the effectiveness of the objective value of urban drainage facilities. However, due to the author's views and perspectives may still omissions, I hope that the experts to give me some guidance.

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