Location Selection Assessment Research of the Dispatch and Control Center of South-to-north Water Diversion Project

Ni LI[1,a], Yong-Qiang LIU[2,b*], Yue-Ling YAO[3,c]

[1,2,3]College of water conservancy and hydropower engineering, Hohai University, Nanjing, China

[a]nina.lee525@gmail.com, [b]ljc2002@hhu.edu.cn, [c]381800735@qq.com

*Corresponding author

Keywords: Location Selection, Assessment and Optimization, South-to-north Water Diversion Project, Dispatch and Control Center, Factor Classified and Rating Method, Comprehensive Evaluation.

Abstract: The location selection of the dispatch and control center of South-to-North Water Diversion Project is one of the fundamental aspects of the construction. However, the discussions are not enough. On the basis of analyzing and summarizing the influence factors, assessment indicators based on factor classified and rating method were established, using qualitative and quantitative evaluation to ensure the scientificity and rationality of the result. The example of Nanjing dispatch and control center of the project's East-Route obtained an optimized area, lay the foundation of maximizing the operation and management period's benefit, from the perspective of theory and practice.

Introduction

With the gradual completion of the construction project, the East-Route Project of South-to-North Water Diversion turns into the operation management period from the construction period. For the project's first phase in Jiangsu, the original River Diversion Project has formed a sound management system, and the construction and operation of new assets are taken charge by Jiangsu water source co., LTD[1]. At present, the East-Route project has been applied officially. The project entity's business is also changing from construction to operation, maintenance and management functions. In order to ensure the project's safety, stable operation and scientific management from a technical perspective, to realize its comprehensive benefits, The South-to-North Water Diversion Project Construction Committee Office of the State Council approved the construction of dispatch and control centers in Jiangsu and Shandong[2]. Since the dispatch and control center affects the entire operation management period, its location should be selected carefully.

Assessment Indicators

Location selection of the dispatch and control center can be divided into two parts, namely area selection and address determination. For area selection, the indicators like match the local planning, relative location of collaborating institutions should be taken into consideration. And for address determination, it's necessary to consider the indicators like the size and cost of the site, convenience of employee's life, scalable conditions, etc[3]. After this, the appropriate construction mode can be chosen combining the actual condition.

According to the actual demand of project management organization, and the comprehensive assessment of eligible area[4], the following indicators are used to make the location selection:

(1) Cost of investment: including the land cost, construction and installation cost, purchase of office buildings, etc. The land cost is under a high uncertainty. It may be greatly influenced by location and plot ratio

(2) Coordination with the local planning: including its coordination with the spatial layout and land use in urban comprehensive plan[5].

(3) Relative location of collaborating institutions: In location selection, the research considers not only the direct cost, but also thinks about the implicit cost and reduces the opportunity cost. A close

position with collaborating institutions contributes to increase cooperation efficiency and reduce operating cost.

(4) Difficulty to acquire lands and office buildings: The actual land supply affected by indicators such as annual land supply target and vacant land. It also contains the demolition cost and cycle[6].

(5) Convenience of staff's life: including relative location of residence, public transport, living facilities, etc. Better convenience of life can solve staff's worries and improve the staff's loyalty.

(6) Expandable conditions: Office facilities construction is a permanent investment which costs a massive fund. The modification is expensive and difficult once the construction is completed. As a consequence, expandable conditions play an important role in the long term development.

By utilizing factor classified and rating method, the research can make classify scores for all the indicators of each possible area. Then determine the optimize location according to the scores.

Factor Classified and Rating Method

Factor classified and rating method combines the factor rating method and classified graded method. Based on the determination of all the indicators, it uses the scores given by external specialists and internal management personnel to quantize the indicators. Then decide their weights, and adopt the quantitative analysis method to manage the scores.

Tab. 1 Benchmark and Evaluation Scale of Location Influence Factors

Influence factors	Weight	Benchmark of evaluation		
		Scale	Description of evaluation	Score
Cost of Investment	30%	1	Lower cost of land/office building	100
		2	Medium cost of cost of land/office building	70
		3	Higher cost of land/office building	50
		4	Highest cost of land/office building	30
Coordination with the Local Planning	20%	1	Basically fit the local planning	100
		2	Good coordination with the local planning	70
		3	Worse coordination with the local planning	50
Relative Location of Collaborating Institutions	20%	1	Very close to collaborating institutions，lower cost of transport	100
		2	Close to collaborating institutions	70
		3	Far to collaborating institutions，higher cost of transport	50
Difficulty to Acquire Lands and Office Buildings	10%	1	Sufficient available land / less difficulty, short cycle of demolition	100
		2	Have available land / have some difficulty of demolition	70
		3	Insufficient available land / large difficulty, long cycle of demolition	50
Convenience of Staff's Life	10%	1	Close to staff's residences, perfect public transport and facilities	100
		2	Far to staff's residences, good public transport and facilities	70
		3	Very far to staff's residences, lack of public transport and facilities	50
Expandable Conditions	10%	1	Great expandable conditions	100
		2	Limit expandable conditions	70
		3	Almost no expandable spaces	50
Total	100%			

The main steps are:

(1) Determine influence factors of location selection plans.

(2) Organize an expert group composed of external specialists and internal management personnel. They grad the factors and give weights by the factors' relative importance. The total weight of each factor is 100%. [7]

(3) Determine evaluation scale, and rank the factors, divides several scales. That is to determine the incidence of each factor.

(4) Experts rank the alternative areas by their influence factors. Depending on the average, determine the grand and score of each area.

(5) Multiply the score and weight of each area to obtain its evaluating value.

(6) Sum up all the values to get the composite score of the area.

(7) Choose the area which gets the highest score to be the preferred location.[8]

Benchmark and evaluation scale of location influence factors are decided by experienced external specialists, engineering technicians, and administrative staffs.

Application Example ——Location Selection Plan of Nanjing Dispatch and Control Center of the Project's East-route

Alternative Proposals

As the South-to-North Water Diversion Project's administrative organization in Jiangsu province, Nanjing dispatch and control center is responsible for the water resources unified scheduling on the premise of flood prevention, and the management of water supply business.

Nanjing dispatch and control center undertakes three major functions: dispatch and operation; office work and assistant management; professional archives management[9]. Taking all the function configuration demand into account, the preliminary design construction scale of the center can be estimated, which is higher than the average scale of office buildings.

According to Nanjing urban master planning to 2020, Nanjing will form a three level urban hierarchy system, namely "Center-New town-Satellite city". The central city is constituted by "Xinjiekou-Hexi-South railway station area", which undertakes most urban functions of Nanjing. Dongshan, Xianlin and Pukou are three satellite cities located surround the central city. They play a significant role of linking the eastern and western regions[10]. As a result, for Nanjing dispatch and control center's location selection, Xinjiekou Center, Hexi New Town, South New Town and Dongshan, Pukou, Xianlin satellite city can be taken as alternative proposals.

Factor Analysis

Cost of Investment. The investment cost of alternative areas mainly includes land cost, construction and decoration cost, etc. When construction and decoration costs are similar, land price becomes the key factor. According to Nanjing annual land supply plan, the key plate construction land like Hexi center, satellite cities, south new town and Yanziji new town account for 75% of total land supply, while central city and other areas account for 25%.

(1) Xinjiekou center area is out of vacant commercial land. The land price is the highest.

(2) Hexi new town has certain land supply. There is several undeveloped land. Its land price is lower than the central city, about 10 million yuan/Mu[11]. However with the development of Hexi area, land price increases rapidly. Part of the area is given a high land price.

(3) South new town is close to Nanjing South Railway Station and Nanjing Dajiaochang Airport. There are more vacant lands surround it. The land price is lower than other satellite cities, about 8-12 million yuan/Mu.

(4) Pukou satellite city has lots of land supply which offer more options. The land price is approximately 4-5 million yuan/Mu.

(5) Xianlin satellite city's land supply is enough, but commercial land supply is less. The land price is lower than the central city, about 5 million yuan/Mu.

(6) Dongshan satellite city has the same situation with Xianlin. However, its land price is the highest among satellite cities, about 6-7 million yuan/Mu.

Tab. 2 Collect of Commercial Land Transfer Situation in 2010-2012 for the Possible Areas

Area	Land Number	Land Name	Acreage (Mu)	Plot Ratio	Unit Price (Million/Mu)	Total price (Million yuan)
Hexi New Town	NO.2011G22	North of Shuiximen Street, west of Jiangdong Road	78.19	6.5	17.47	1366
	NO.2011G01	South of Nanxi River East Street	15.29	6.0	9.29	142
South New Town	NO.2012G84	East of Nanjing South Railway Station	143.13	5.36	12.53	1793
	NO.2012G83	West of Nanjing South Railway Station	145.63	3.26	7.60	1107
Pukou Satellite City	NO.2012G55	Plot 05, north of Pukou Headquarters Avenue	85.00	6.5	4.31	366
	NO.2012G48	Plot 01, north of Pukou Headquarters Avenue	81.15	3.0	3.71	301
Xianlin Satellite City	NO.2012G14	Plot E2 in Xianlin Center	21.28	3.5	4.70	100
	NO.2012G64	Plot C8 in Xianlin Center	13.22	1.6	5.44	72
Dongshan Satellite City	NO.2011G04	South of inner loop, east of Suyuan Avenue	104.1	3.5	7.68	800
	NO.2010G02	North of Xuejiu Road in Jiangning District	146	2	6.30	920

Note 1. Because of the lack of vacant commercial land in Xinjiekou Center, there is a data deficient;
2. The source of these data is Nanjing municipal land and resources bureau, for reference only.

Coordination with the Local Planning. According to Nanjing urban master planning, from 2010, Nanjing began a new round of large-scale urban construction. In the aspect of industrial development, modern service industry is prioritized within 10km away from the central city. The central city will form three service industries concentrated area, namely old town CBD, Hexi CBD and south new town CBD. Meanwhile, in the satellite cities and new cities, with the support of industrial park in 10-20km range, the development focus on equipment manufacturing, fine chemistry, steel industry, aviation logistics and advanced technology[12].

The master plans of the service industries in central city and in satellite cities have their own focus:

(1) Xinjiekou center carries out a double control strategy of population and construction strength. The development focusses on industries like business, commerce and trade, travel, finance, etc. It comes into being global shopping center and modern city tourism service area.

(2) Hexi new town plans to be an internationalization of ecological regional financial and economic center which bases in Nanjing, echoes Shanghai and develops in East China. The development takes finance as the core, concentrates on culture and information services, and coordinates supporting industries like business, restaurant and leisure entertainment.

(3) South new town takes Nanjing south railway station as the center. It has positioned itself as the important integrated transport hub in the Yangtze River Delta even the east China, to connect

Nanjing central city with Dongshan satellite city, southern Anhui and northern Zhejiang. And eventually becomes the comprehensive transportation hub and influential city sub-center.

(4) Dongshan satellite city has been positioned as an important part of Nanjing south center, also the innovation base and modern service industry base. But so far, the development in Dongshan mainly depends on the large residential area. Its service function has grave deficiencies.

(5) Xianlin satellite city has been positioned as an important science and technology innovation center in Yangtze River Delta; new and high-technology industrial base in Nanjing; service center in East Nanjing; and high quality livable new town. Recently, its core area is the university town.

(6) Pukou satellite city has been positioned as national essential new and high technology industry and advanced manufacturing base; comprehensive service center; and independent north center with relatively perfect function. However, it is seriously restricted by the traffic conditions and relies heavily on the central city.

Relative Location of Collaborating Institutions. The Jiangsu section of the South-to-North Water Diversion Project is made up of new water diversion project and the original river diversion project. The two projects utilize separate management system and mechanism. The collaborating institutions of Nanjing dispatch and control center are Jiangsu Water Resource Department, second and third level management institutions. Considering the "unified scheduling, joint operate" demand[13], the location of Nanjing dispatch and control center should be easy to join existing facilities.

(1) The Water Resource Department is located in Xinjiekou, the condition of public transport is the best.

(2) Hexi is relatively close to the Water Resource Department. Their straight-line distance is approximately 4km while the actual distance is about 6km. Hexi has convenient transportation and perfect public transport system which is advantageous to the communication of telecom and flood control infrastructures.

(3) South new town is relatively far from the Water Resource Department. The straight-line distance is more than 9 km, while the actual distance over 12km which takes about half an hour by car. There is public transport system such as the metro.

(4) The straight-line distance between Pukou satellite city and the Water Resource Department is about 14 km, and the actual distance is over 20km which takes more than 45 minutes' drive. In addition, since it needs to go through the Nanjing Yangtze Tunnel, there exists no public transport. The transit cost is the highest.

(5) The straight-line distance between Xianlin satellite city and the Water Resource Department is about 15 km, and the actual distance is over 20 km which takes more than 45 minutes' drive. Public transport system is relatively weak.

(6) Dongshan satellite city has the similar situation with Xianlin.

Difficulty to Acquire Lands and Office Buildings. The location selection of Nanjing dispatch and control center should base on the current situation of lands and office building supply in each area. The research analysis selectively the actual supply of lands and office buildings, as well as the demolition cost and cycle. As a result, the difficulty to acquire lands and office buildings and the operating space are important factors.

(1) Xinjiekou center has almost no vacant land. The office buildings have really high prices. It's difficult to acquire lands and office buildings. The area around Water Resource Department doesn't have purchase land self-built conditions.

(2) Hexi new town has appropriate land price and there is available vacant land. But Influenced by land use index, these lands are in short supply. Besides, Hexi has lots of office buildings on sale whose prices are lower than that in Xinjiekou. It's less difficult to locate in this area.

(3) After the demolition of Dajiaochang Airport, there will be large vacant land in south new

town. However, restricted by the demolition work, its cycle doesn't fit the South-to-North Water Diversion Project's progress.

(4) According to the land supply in 2011 to 2012, most lands in Dongshan satellite are residential land or for scientific research and design. Commercial land is limited and its plot ratio is low.

(5) There are more available lands in Pukou and Xianlin satellite cities. But it's lack of mature office buildings. It's not difficult to locate in these areas.

Convenience of Staff's Life. Most staffs in Nanjing dispatch and control center live in central city. The public transport system and basic supporting infrastructure are essential for convenience of staff's life.

(1) Xiejinkou center is close to most staffs' residences. There are express buses and perfect living facilities. The convenience of staff's life can be ensured.

(2) Hexi new town is relatively far from most staffs' residences. Nevertheless, the public transport is highly developed and supporting infrastructure is gradually improved. The staffs could get a high life convenience.

(3) South new town is far from most staffs' residence. The public transport system is developed. But the supporting facilities are incomplete.

(4) Dongshan satellite city is far from most staffs' residence. The metro could get to part of the area, but public transport is not properly developed. The supporting facilities have a gap with central city. The life convenience is not ideal.

(5) Xianlin satellite city is a long way from most staffs' residence. The public transport is poorly developed. The supporting facilities are primarily used for university town. The life convenience is not ideal.

(6) Pukou satellite city is the most far from most staffs' residence. There's no metro and the public transport is seriously inadequate. The life convenience is the worst.

Expandable Conditions. From the perspective of long-term development, whether the chosen location has enough expandable conditions, whether it can provide enough land and building reserves for the future is also an important factor[14]:

(1) Xinjiekou center is out of vacant commercial land, only office buildings can be purchased. It cannot provide enough expandable space for further development. The expandable conditions are limited.

(2) Hexi new town and South new town have more potential land. Certain land can be made available. However, there exists the request for plat ratio. The expandable conditions are well.

(3) There are enough land in the satellite cities, and the requirement for plat ratio is not high. So the expandable conditions are great.

Comprehensive Evaluation Based on Factor Classified and Rating Method

Based on the above analysis, to decide the location of Nanjing dispatch and control center, there are six principal factors: Cost of investment, coordination with the local planning, relative location of collaborating institutions, difficulty to acquire land and office buildings, convenience of employee's life, and expandable conditions. After comprehensive comparison, proceed from the assessment indicators[15], factor classifies and rating method is utilized to obtain scores of each area, and to get composite score. In the end, a comprehensive evaluation of location selection can be established, shown in the following table.

After years of construction, Hexi New Town will be built as the political, financial and commercial sub-center of Nanjing. Its facilities tend to be perfect with a relative low land price[16]. Therefore, it holds the highest composite score. According to the result of the comprehensive evaluation, Hexi New Town can be chosen as the location of Nanjing dispatch and control center of South-to-North Water Diversion Project.

Tab. 3 Composite Rating Scale of Nanjing Dispatch and Control Center's Address Selection

Influence factors	Weight	Alternative areas					
		Xinjiekou Center	Hexi New Town	South New Town	Dongshan Satellite City	Xianlin Satellite City	Pukou Satellite City
Cost of Investment	30%	4 / 30	3 / 50	3 / 50	2 / 70	2 / 70	2 / 70
Coordination with the Local Planning	20%	1 / 100	1 / 100	2 / 70	3 / 50	3 / 50	3 / 50
Relative Location of Collaborating Institutions	20%	1 / 100	2 / 70	2 / 70	3 / 50	3 / 50	3 / 50
Difficulty to Acquire Lands and Office Buildings	10%	3 / 50	2 / 70	2 / 70	2 / 70	1 / 100	1 / 100
Convenience of Staff's Life	10%	1 / 100	1 / 100	2 / 70	2 / 70	2 / 70	3 / 50
Expandable Conditions	10%	3 / 50	2 / 70	2 / 70	1 / 100	1 / 100	1 / 100
Composite Score	100%	69	*73*	64	65	68	66

References

[1]ZHANG Li, WANG Huimin. Innovative System of Multi-dimensional Operation in the Eastern Route of South-to-North Water Transfer[J]. Science & Technology Progress and Policy. 2006, (11):86-88. (In Chinese).

[2]Develop and Research Center of Ministry of Water Resource. Research about Construction and Management System of South-to-North Water Diversion Project[J].China Water Resources. 2003, (1): 70-74. (In Chinese).

[3]Research on the Location Selection Method of Logistics Distribution Center Based on GIS [D]. Master's Thesis of Central South University. 2012. (In Chinese).

[4]JIANG Yongsheng. The environmental impact and countermeasures of the Eastern Route of South-to-North Water Diversion Project[M]. Hefei: Anhui science and technology press,2012. (In Chinese).

[5]WU Jun. Discussion of harmonization of land use general planning and urban planning[J]. Charming China. 2011, (21): 305. (In Chinese).

[6]LI Qian, WANG Hailong, YANG Zhengqing, et al. Macroscopic analysis and research of the intensified utilization of urban lands[J]. Land and Resources Information.2008, (7):15-21. (In Chinese).

[7]WANG Nan, LI Wenjing, YUAN Xiaojuan. Factor rating method used in the study of location selection of vehicle inspection station[J]. China Quality Supervision. 2013, (11):68-69. (In Chinese).

[8]NIE Guihong. Factor rating method and location selection of enterprise that has direct contact with customers[J]. China Business & Trade. 2012, (1): 251-252. (In Chinese).

[9]LIU heng, GENG Leihua, et al. Research of critical technical problems of South-to-North Water Diversion Project's operational risk management[M]. Beijing: Science Press.2011. (In Chinese).

[10]CHENG Maoji, WANG Bo. Nanjing overall urban planning implementation evaluation and related thought[J]. Modern Urban Research. 2011, (4): 018. (In Chinese).

[11]CHEN Yongzhan, YANG Tiejun. Technical proposal for the construction of Nanjing Hexi New Town[A]. Memoir of The seventh city road and traffic engineering academic conference[C]. Beijing, 2002. (In Chinese).

[12]ZHOU Lan. A new round of discussion of the overall urban planning method[J]. City Planning Review. 2002, 2(002):1. (In Chinese).

[13]Chen Jiagui, Corrado Clini. Sustainable water integrated management of the south-to-north water diversion project (east route) in China[M]. Beijing: Economic management press. 2010.

[14]PENG Jizeng. Business analysis based on the industrial cluster theory: the construction of a business enterprise location selection model[J]. Finance and Economics. 2006, (11):53-55. (In Chinese).

[15]LIU heng, GENG Leihua, JIANG Beilei, et al. Research on the operational engineering risks management of the Mid and Eastern Route of south-to-north water diversion project[M]. Beijing: China Environmental Science Press, 2010. (In Chinese).

[16]DENG Fangyan, The Guidance Strategy for the construction of New Towns: A Case Study of New Town Development to the Western of Qinghuai River[J]. Modern Urban Research. 2009, (12):81-85. (In Chinese).