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# ESTABLISHING SHIPPING SERVICE COMPLEX STANDARD FRAMEWORK: EXPERIENCE FROM SHANGHAI

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## ABSTRACT

This paper introduced the experience of Shanghai in building the waterfront urban complex with industrial characteristics. In order to ensure the logic and scientific rationality, this paper developed the standard system on the concept of system engineering, based on which a three-dimensional space was proposed for the Shanghai Shipping Service Complex (SSC). Fundamental elements such as technology, management, economy and environment are analyzed and further classified, thus ensuring the systematicness and scientificity of the standard. The framework of standard system was then established through further elaborating the initial structure with four aspects as shipping service, building technology, environment friendly and sustainable management.

**Contribution/Originality:** This paper is a pioneer research in the standard establishment for urban complex. The primary contribution is proposing a framework and design logic in forming the standard system of the complex, providing reference for similar waterfront reconstruction projects.

## 1. INTRODUCTION

As a city aiming to build the "Excellent Global City", Shanghai is at a critical period of transformation (Shanghai Municipal Government, 2018). The Urban development is shifting from the infrastructure-based investment to the connotative development of functional construction and service agglomeration. In the past, the Huangpu River was busy for transport services, with terminals, warehouses and factories spread all over the riverside areas. However, with the expansion of the city scale, the old port area has been unable to adapt to the needs of urban development. Since 2012, the Shanghai Municipal Government has issued the "12th and 13th Five-Year Plan for the Development of the Huangpu River" so as to promote the reconstruction of old port area.

On the other side, Shanghai has been preparing to be the international shipping center for a long time. In order to further strengthen its function for the shipping center, the North Bund, as a traditional shipping service agglomeration area, firmly grasps such an opportunity of function transformation, relying on its location advantages and industry foundation.

Under such circumstances, the Huishan terminal at the North Bund, belonging to the Shanghai Port Group, was chosen to be the first step for old port transformation. It is planned to create a distinctive waterfront urban complex for shipping industry, so called Shanghai Shipping Service Complex. However, the development of waterfront complex lacks a unified standard system due to the particularity and complexity of the construction in urban spatial layout. Although there are many cases of waterfront complex in various regions, the consistency of them can be hardly figured out, leading to the challenge at the beginning stage. In some areas, there are contradictions between sporadic development and overall planning, while some regions differ in the designing. On the other hand, with the emergence of industrial agglomeration areas in cities, urban complexes have more distinct characteristics than traditional functions such as commerce, shopping, catering and residence. Therefore, this paper introduced the experience of Shanghai in building the waterfront urban complex with industrial characteristics. A standard system was then summarized with the concept of system engineering, thus providing reference for followers with similar situation.

## 2. LITERATURE REVIEW

The study of the urban complex began in the 1950s, most of which focused on basic theoretical research. (Procos, 1976). However, there is no systematic theory for urban complexes. For example, related research is from urban planning and land mixed use, forming the premise of complex development (Coupland, 1997) some scholars also carried out comprehensive researches from the perspectives of society, culture, transportation, community development and policy based on practical experience (Eizenberg, 2003; Tirrell, 2003; Cairns, 2005; Kiderra, 2007).

There are more international conferences, forums and academic researches on the reconstruction of old port area from the perspectives of economy, geography and spatial planning. McCarthy (2003); Wood (1965) first proposed the concept and classification of waterfront renewal, and the transformation of the old port area as an independent research category. The initial reason for the reconstruction of the old port area was the mismatch between the large-scale vessel and the port facilities. Based on the practical experience of Canada, Forward (1970) analyzed the influence of natural conditions such as land area and water depth on the function of the reconstruction. Breen and Rigby (1996) further summarized 130 waterfront redevelopment projects and classified them into "Commercial Waterfront", "Significant Waterfront Transformation", "Residential Development", "Cultural and Educational", "Transportation and Industrial Waterfront", "Leisure and Entertainment", and "Historical Heritage".

From the perspective of port-city relation, Norcliffe (1981) proposed three transformation modes of localization, labor agglomeration and introduction of chemical industry, boosting the urban economy through the development of new industries. In the case of Asian port city reconstruction, Robinson (1985) and Giblett and Samant (2012) sorting out the transformation of the old port area and the development of urban industry. Hoyle (1989) further divided the port-city relationship into five historical stages and proposed an Anyport model. Charlier (1992) first introduced the concept of space life cycle of port city, and demonstrated that some cities would not adopt urban-oriented waterfront development mode in order to develop ports. Based on the old port reconstruction projects in London, Rotterdam, Barcelona, New York, etc., Gordon (2001) systematically concluded the relationship between the port city and the old port area in terms of function design, driving factors and evolution process and urban cultural characteristics.

In the context of industry and technology development, scholars dived deep into the driving forces and port-industry relation. Goodwin (1999) took the development of transportation technology as the entry point. The port extended to the river estuary due to technology breakthrough, driving the migration of the manufacturing industry, thus resulting in the decline of the original port area and the abandoned industrial and port land. Since the post-industrial era, the industrial structure has changed, and the manufacturing industry gave way to the service industry, Faggi *et al.* (2013) expounds the development of waterfront and port industries, which is a function shifting from production to consumption. Williams (2004) believed that modern cities are encountered with fierce competition. Under the circle of recession and prosperity, urban planning and post-modern consumption patterns have become the driving force of reconstruction and an effective tool to improve urban competitiveness. McCarthy (1995) studied the waterfront development in Scotland, England, and concluded that the waterfront renewal projects were often less than ideal without political guidance. Taking the renovation of the Philadelphia waterfront as an example, different governance concepts may have significant impact on the waterfront transformation in the post-industrial era, especially when there is inconsistency among governors. McGovern (2008); Bunce (2009) proposed two stages of waterfront renewal: from the mid-1960s to the early 1990s, the main purpose of the reconstruction was economic growth, ensuring urban employment and gross domestic product; from the mid-1990s, the concept of sustainable development stood on the stage, becoming a major indicator and driving force for urban renewal project, especially in developed countries as Europe and America, where the planning for sustainable development has been implemented in the form of policy documents.Literature researches on the complex construction and waterfront transformation seldom talks about the function design (Wu *et al.*, 2017). From theoretical analysis to practical study, scholars focused on the elements affecting the evolution of transformation, and none of them provided a systematic study in the mode of transformation or construction. For example, the standard system remains to be explored, leaving the research gap for this article.

## 3. STANDARD SYSTEM

The SSC aims to serve the construction of Shanghai international shipping center, industry agglomeration and urban development (Wu *et al.*, 2017). Therefore, in addition to the internal environment of the complex, the standard system should also consider external factors as a whole. There are many fundamental elements such as technology, management, economy, and environment, with certain links between each other. In order to ensure the logic and scientific rationality, this paper developed the standard system on the concept of system engineering, based on which a three-dimensional space was proposed for the SSC.

### *3.1. System Structure Analysis*

1) External System

Theoretically, the SSC is an open system, which means it not only exchanges basic elements such as information, material and energy internally, but also has dynamic interaction with the outside world. Therefore, the larger urban system should be taken into consideration to analyze the system structure of the shipping service complex as a whole.

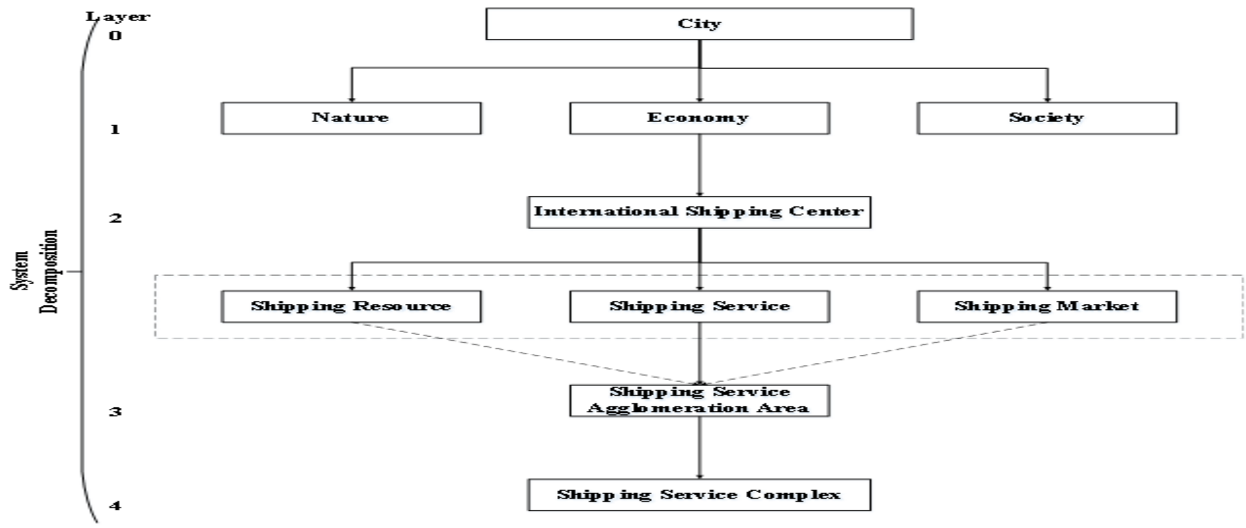


**Fig-1.** Upper System of the Shipping Service Complex

**Source::** Author's Research

Fig-1 shows the system structure of the upper layer where the SSC is part of the shipping service agglomeration area and contains three major factors as shipping resource, shipping service and shipping market. They all belong to the international shipping center system, which is at the lower layer of the economic system among the three subsystems of the city.

2) Internal system

After analyzing the external system, it is necessary to further develop the shipping service complex itself, exploring its composition and factors. From the perspective of the system theory, the shipping service complex system was decomposed into three aspects: theory, technology and practice, reflect its spatial organization, development level and evolution process. （See Fig-2）

The study on its theoretical subject is the fundamental work of complex construction. Based on the theoretical model, the concept, function and characteristics of the SSC can be clarified, which is conducive to the scientific understanding, revealing its internal mechanism. The theoretical subject mainly consists of the complex theory and agglomeration theory. Taking these two theories as the mainstay, combined with case studies, urban development theory, industrial evolution theory, etc., the concept, scope, functional standards and service characteristics of the SSC can be clarified and explained.

As per the technical subject, it's a work to transform the corresponding concepts and research objects determined by the theoretical subject into corresponding technologies, techniques or methods. The main technical contents contain building technology, underground space technology, port basin technology, ship lock technology, green technology, etc.

The practical subject is the practical application of the theoretical subject and the technical subject, reflecting the practical effect of the theory and technology of the shipping service complex. The main body of practice includes a series of basic procedures, from project design, construction to operation and management.

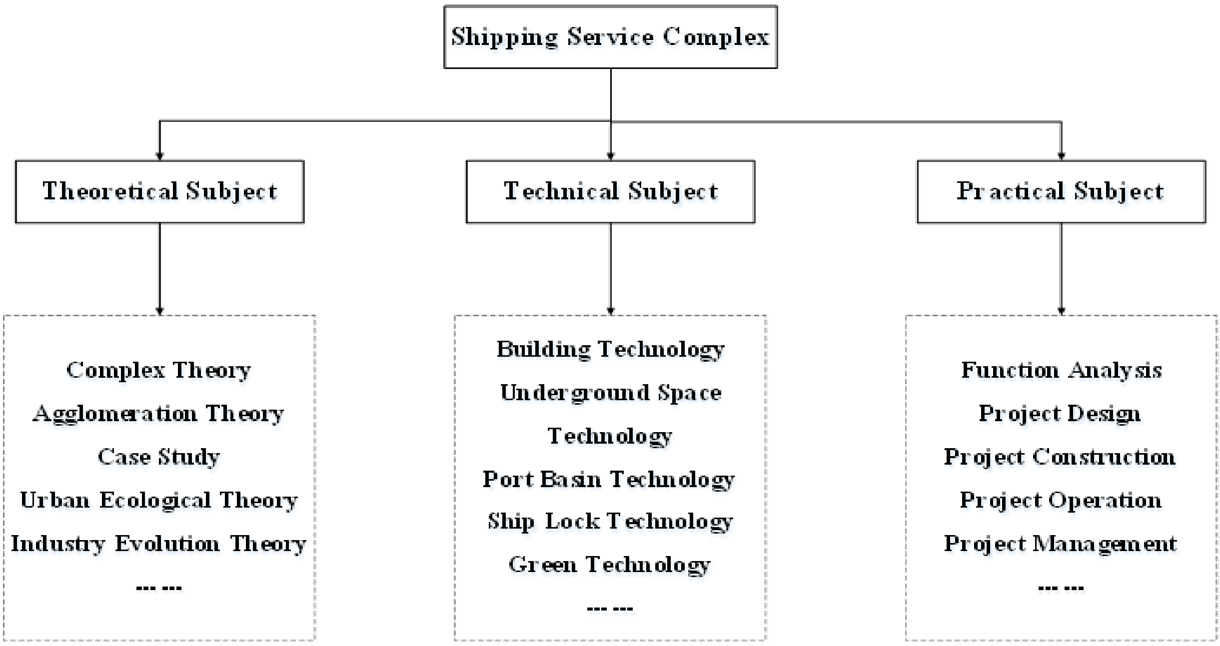


**Fig-2.** System Diagram of The SSC According to Objects

**Source:** Author's Research

### *3.2. Factor Analysis*

Factor analysis is to summarize the characteristics of the research objects and to draw the research scope of the standard system. Since the construction of the SSC is a complex system, whose factors have certain types and levels, so they are classified based on their tiers, subjects and characteristics. A three-dimensional attribute space was established according to the classification.

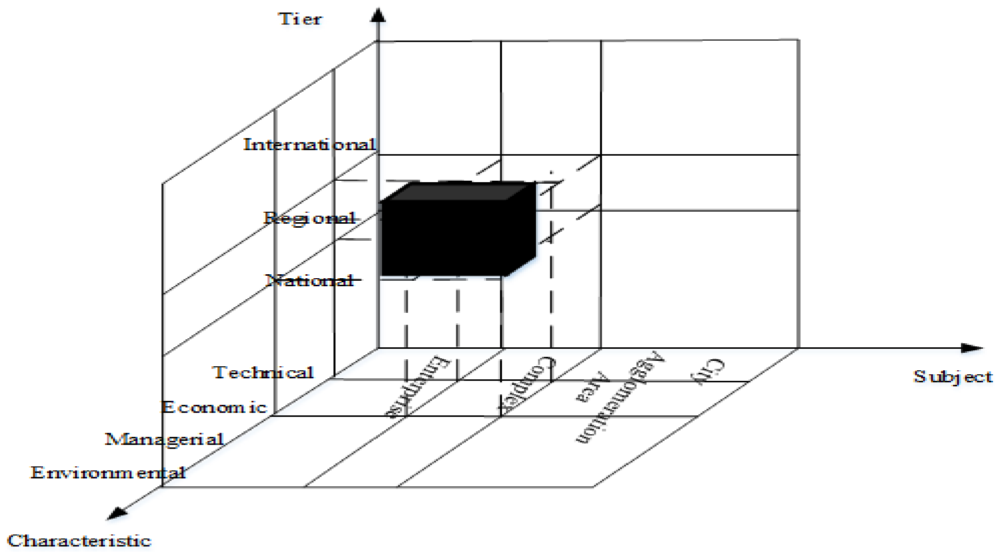


Fig-3. Three-Dimensional Attribute Space

**Source:** Author's Research

The tier classification is to divide the structural factors of the standard system into different tiers according to the scope of influence, and the relationship among each field can also be regarded as a hierarchical relationship. In this paper, the tier is incarnated in the ability of the factor. As an aspect of the quantification of the standard system, the standard should have a certain unit of measurement to characterize its vertical level. Therefore, we divided the standard into three tiers as international, regional and national level, indicating the scope of influence of the shipping service complex.

Subject classification depended on those subjects that bear the function and reflect the influence of the reconstruction project in practice. For example, enterprises are the users and immediate benefiviaries, while the complex building reflects the idea and function of the reconstruction. On a larger scale, the agglomeration area and the city will also be influenced since the emergence of such a new complex.

The classification of the characteristics is based on the nature of the standard itself. The upper layer can be divided into four categories as technology, economy, management and environment. Technology focus on the technical characteristics of the construction of the SSC, including technical and engineering plans. Economic section is to measure the economic viability and profitability of the subjects. Management reflects the status of the shipping complex from the perspective of operation management, including standards for effective management, operation and maintenance. What's more, the environment section cares for the protection of ecosystems and urban environments via the standard system.

In detail, the technical elements, as mentioned before, (see Fig-2) are subdivided into underground traffic safety, traffic capacity, parking space design, and utilization of water energy, exterior wall material, "three-defense" technology, microclimate control technology and water delivery system. The economic value of the SSC is mainly reflected in the internal and external economy, where the external economy also includes external economies of scale, information exchange and technology diffusion, which can be further subdivided and measured by the number, efficiency, innovation and specialization of the enterprise. The management elements include two major parts as functional layout and operation & maintenance. The functional layout is the general functions and shipping theme function, namely resident, business, office, entertainment, shopping, leisure, and shipping features, such as the construction of the marina. The environmental elements contain environmental protection and energy conservation, such as green energy, green materials and microclimate control.

### *3.3. Formation of Standard System*

The subject and characteristic dimension basically cover all the elements of the standard system. However, the factors are reproducible to a certain extent due to the cross complementarity of them. Therefore, it is necessary to construct a scientific and reasonable standard system by integrating similar elements. As shown in Fig-4, a two-dimensional plane is built, and the intersections (black dots in Fig-4) are marked. For example, the "complex theory" in theoretical subject can be combined with the "building technology" in technical subject, which both belong to the "Complex Building Technology". Similarly, the "economic theory" and the "profit" can be summarized as part of the "Shipping Service". What's more, the "urban ecological theory" shares the same function with "green" and "energy-saving" in environmental factors as "Environmental Friendliness". After summarizing and integrating, the initial structure of the standard system is formed with four aspects as shipping service, building technology, environment friendly and sustainable management.

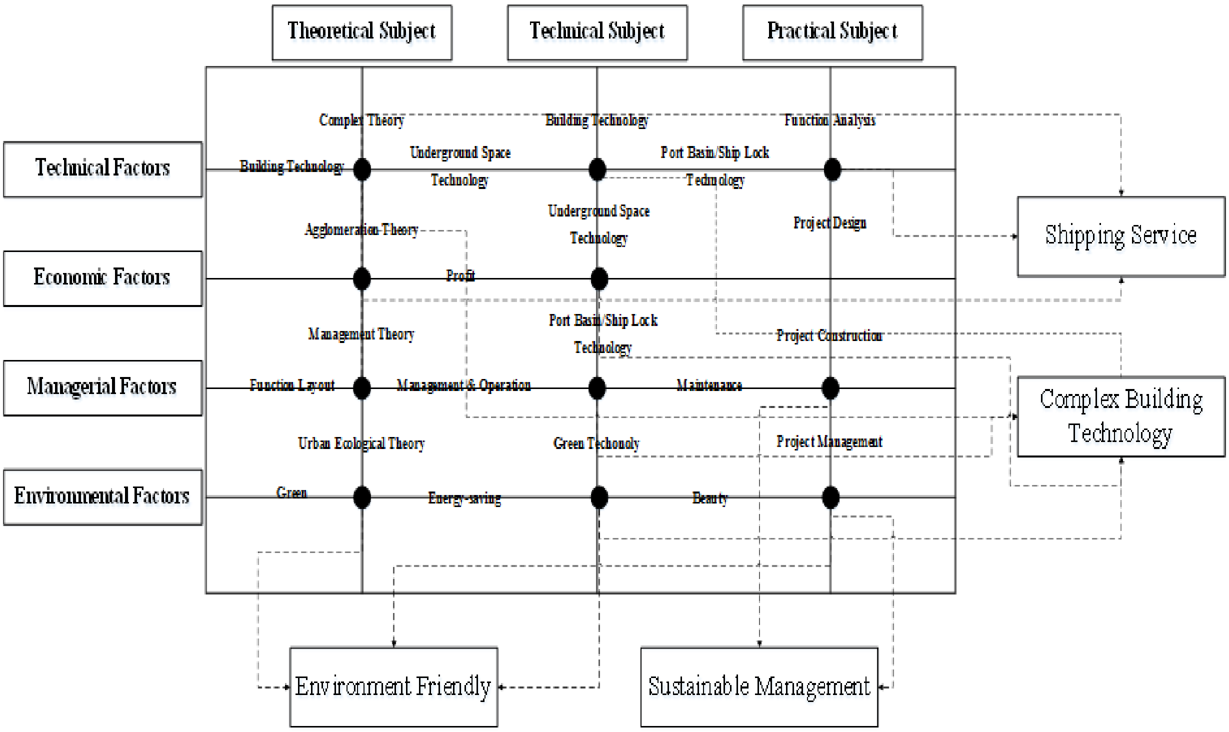


**Fig-4.** Structural Principle of SSC Standard System

**Source:** Author's Research

So far, three-dimensional standard system has finished the construction of its two dimensions under the subject and characteristic. The next step is to extrude it with the tier dimension, thus forming the whole standard system. (See details in 3.2 and Fig-3)

The shipping service function is a prominent emphasis for the shipping characteristics of the SSC. According to the tier classification, the shipping service can be subdivided and classified into international, regional and national level. The international level has a complete shipping service system. The main contents of the shipping service are emerging shipping services derived from the combination with other industries like shipping finance, facilitated with traditional shipping services as loading/unloading, transport and the like. At this stage, the headquarters of multinational shipping companies are attracted, whose business scope cover the whole world and form a global information network. Meanwhile, enterprises, suppliers, manufacturers, research institutes and affiliated institutions with related services are assembled in the complex, and all parties on the industrial chain are tightly connected. By contrast, shipping service system under the regional level is relatively mature. Traditional shipping services are well-functioned with the high-end shipping services taking shape. At the same time, the regional headquarters, branches or offices of multinational shipping companies are settled in the SSC, whose business scope covers countries in the region, such as the Asia-Pacific headquarters, forming a regional information network.

**Table-1.** Description of the SSC Standard System

| Function | Level | Description |
|---|---|---|
| Shipping Service | International | A complete shipping service system;<br>Emerging shipping services like shipping finance facilitated with traditional shipping services;<br>The headquarters of multinational shipping companies are attracted and form a global information network; Enterprises, suppliers, manufacturers, research institutes and affiliated institutions with related services are assembled;<br>All parties on the industrial chain are tightly connected. |
| | Regional | Traditional shipping services are well-functioned with the high-end shipping services taking shape;<br>The regional headquarters, branches or offices of multinational shipping companies are settled, forming a regional information network.<br>Enterprises, suppliers, manufacturers, research institutes and affiliates of related services are reasonably and effectively concentrated. |
| | National | Complete traditional shipping service functions with the high-end shipping service is in its infancy;<br>The headquarters of domestic large-scale shipping enterprises are settled, connecting to the domestic information network;<br>The enterprises, suppliers, manufacturers, research institutes and affiliates of related services are in place. |
| Building Technology | International | Applying international leading construction techniques;<br>The construction level of the project reaches international standard;<br>Technological innovation reaches international advanced level. |
| | Regional | Applying international standard construction techniques;<br>The construction level of the project reaches international standard;<br>Technological innovation reaches international standard. |
| | National | Applying national leading construction techniques;<br>The construction level of the project reaches national standard;<br>Technological innovation reaches national advanced level. |
| Environmental Friendliness | International | Emboding several major factors such as green, environmental protection and energy-saving;<br>The environmental protection reaches the international leading level;<br>The utilization rate of green energy-saving material is internationally leading;<br>The energy technology researches the international advanced level;<br>The architectural design fits well with the skyline of the city, meeting the international metropolitan aesthetic standards. |
| | Regional | The environmental protection reaches international standards;<br>The utilization rate of green energy-saving materials reaches international standards;<br>The energy technology reaches international standards;<br>The appearance and outline of the complex comply with the international metropolitan aesthetic standards. |
| | National | The environmental protection reaches national leading level;<br>The utilization of rate green energy-saving materials is national leading;<br>The energy technology reaches the national standard;<br>The appearance of the complex building is combined with the urban skyline, in line with the large urban aesthetic standards. |
| Sustainable Management | International | The management information system reaches the international advanced level;<br>The management supervision model is international leading;<br>The engineering construction and urban operation management are effectively combined at international advanced level. |
| | Regional | The management information system reaches the international standard level;<br>The management supervision model is international leading;<br>The engineering construction and urban operation management are effectively combined at international standard level. |
| | National | The management information system reaches the national advanced level;<br>The management supervision model is national leading;<br>The engineering construction and urban operation management are effectively combined at national advanced level. |

**Source:** Author's Research

The enterprises, suppliers, manufacturers, research institutes and affiliates of related services are reasonably and effectively concentrated. The shipping service system of the national shipping service complex is relatively complete, with traditional shipping service functions. The high-end shipping service is in its infancy, with a small proportion. And the headquarters of domestic large-scale shipping enterprises are settled, whose business scope covers the whole country and connects to the domestic information network. The enterprises, suppliers, manufacturers, research institutes and affiliates of related services are in place.

Complex building technology is the technical classification of the shipping service complex. With reference to the technical level, the level of construction technology, engineering construction and technological innovation will be classified into international leading, international advanced, international standards, domestic leading, domestic advanced. For example, at the international level, the international leading construction techniques are applied. Its construction level reaches international standards with international advanced technological innovation

Environmental friendliness is the standard for urban ecology and landscape. The international level complex embodies several major factors such as green, environmental protection and energy-saving. Under this stage, the environmental protection achieves the international leading level, and the utilization rate of green energy-saving material is internationally leading, with the energy technology researches the international advanced level. In addition, the architectural design fits well with the skyline of the city, meeting the international metropolitan aesthetic standards. As per the regional level complex, its environmental protection, utilization rate of green energy-saving materials and energy technology meet international standards, and the appearance and outline of the complex comply with the international metropolitan aesthetic standards. Similarly, the national level is national leading in all aspects, see details in Tab-1.

Sustainable management is the standard for the management, operation and maintenance of a complex. This paper establishes the standard from the aspects of management information system, management supervision mode, engineering construction and urban operation management. Take the international level for example, the management information system reaches the international advanced level with International leading management supervision model. The engineering construction and urban operation management are effectively combined at international advanced level.

## 4. CONCLUSION

The system engineering is proved to be an effective tool in establishing the framework of the standard system for SSC. Fundamental elements such as technology, management, economy and environment are analyzed and further developed during each stage of designing, thus ensuring the systematicness and scientificity of the framework.

The whole process was divided into three stage, including the system structure analysis, factor discussion and the formation of the standard system. The system structure was analyzed from theoretical, technical and practical subjects externally and internally, where the outline was completely depicted. Then, the factor was discussed and further classified under the three-dimensional attribute space. The aforementioned classification methods complied with each other, and have a good normative effect on the establishment of the entire standard system, which not only reflects the level of the standard, but also includes the subject characteristics. As shown in Fig-3, the main content of the standard is determined by the two-dimensional space composed of subjects and characteristics. Starting from the origin of the coordinate axis, the theoretical, technical and practical sections are built on the subject dimension. And four attributes as technology, economy, management and environment depended on the characteristic dimension. Finally, the level of the standard is determined by introducing a vertical tier dimension on the plane formed by the two dimensions. Such a three-dimensional space not only embodies the content in detail, but also contains their measurement, thus obtaining a relatively scientific and integral standard system.

Finally, the framework of standard system was established through further elaborating its initial structure with four aspects as shipping service, building technology, environment friendly and sustainable management. Further research can focus on the refining and detailing the technical level into specific indexes in evaluating the classification of the SSC. In addition, the idea proposed in this standard framework can not only be applied in the construction of the SSC, but also adapt to other riverside redevelopment projects like the WuSongKou International Cruise Terminal and Shanghai Port International Cruise Terminal.

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## REFERENCES

Breen, A. and D. Rigby, 1996. The new waterfront: A worldwide urban success story. London: Thames and Hudson. pp: 5-9.

Bunce, S., 2009. Developing sustainability: Sustainability policy and gentrification on Toronto's waterfront. Local Environment, 14(7): 651-667. Available at: https://doi.org/10.1080/13549830903097740.

Cairns, G., 2005. Megaprojects: The changing politics of urban public investment. International Journal of Public Sector Management, 17(3): 152-153.

Charlier, J., 1992. The regeneration of old port areas for new port uses. European Port Cities in Transition: 137-154.

Coupland, A., 1997. Reclaiming the city: Mixed use development. London: Taylor & Francis. pp: 156-178.

Eizenberg, J., 2003. Here comes the neighborhood: Why urban mixed-use development works. Residential Architect, 7(2): 26-28.

Faggi, A., J. Breuste, N. Madanes, C. Gropper and P. Perelman, 2013. Water as an appreciated feature in the landscape: A comparison of residents' and visitors' preferences in Buenos Aires. Journal of Cleaner Production, 60: 182-187. Available at: https://doi.org/10.1016/j.jclepro.2011.09.009.

Forward, C.N., 1970. Waterfront land use in the six Australian State capitals 1. Annals of the Association of American Geographers, 60(3): 517-532. Available at: https://doi.org/10.1111/j.1467-8306.1970.tb00738.x.

Giblett, G. and S. Samant, 2012. A review of urban waterfront regeneration in global Asian port cities and the sustainability of their development. Journal of Urban Regeneration & Renewal, 5(3): 266-279.

Goodwin, R.F., 1999. Redeveloping deteriorated urban waterfronts: The effectiveness of US coastal management programs. Coastal Management, 27(2-3): 239-269. Available at: https://doi.org/10.1080/089207599263857.

Gordon, D., 2001. City and port: Urban planning as a cultural venture in London, Barcelona, New York and Rotterdam: Changing relations between public urban space and large-scale infrastructure. Town Planning Review, 1(1): 72.

Hoyle, B.S., 1989. The port—city interface: Trends, problems and examples. Geoforum, 20(4): 429-435. Available at: https://doi.org/10.1016/0016-7185(89)90026-2.

Kiderra, I., 2007. High, density mixed-use developments will not solve transportation problems. Public Management, 86: 3-32.

McCarthy, J., 1995. The Dundee waterfront: A missed opportunity for planned regeneration. Land Use Policy, 12(4): 307-319.

McCarthy, J., 2003. Spatial planning, tourism and regeneration in historic port cities. disP-The Planning Review, 39(154): 19-25. Available at: https://doi.org/10.1080/02513625.2003.10556852.

McGovern, S.J., 2008. Evolving visions of waterfront development in postindustrial Philadelphia: The formative role of elite ideologies. Journal of Planning History, 7(4): 295-326. Available at: https://doi.org/10.1177/1538513208315756.

Norcliffe, G., 1981. Industrial change in old port areas, the case of the Port of Toronto. Cahiers Geography of Quebec, 25(65): 237-253. Available at: https://doi.org/10.7202/021515ar.

Procos, D., 1976. Mixed land use: From revival to innovation. Dowden: Hutchinson & Ross.

Robinson, R., 1985. Industrial strategies and port development in developing countries: The Asian case. Magazine for Economical and Social Geography, 76(2): 133-143. Available at: https://doi.org/10.1111/j.1467-9663.1985.tb01614.x.

Shanghai Municipal Government, 2018. Striving for the excellent global city. (Government Report). Available from http://www.shanghai.gov.cn/newshanghai/xxgkfj/2035001.pdf [Accessed 20/11/2018].

Tirrell, D.J., 2003. Preliminary mixed-use development survey. Residential Architect, 4(1): 33-37.

Williams, M., 2004. Sustainable place making in waterfront revitalisation: Balancing the interests. Australian Planner, 41(2): 30-31. Available at: https://doi.org/10.1080/07293682.2004.9982342.

Wood, D.F., 1965. Renewing urban waterfronts. Land Economics, 41(2): 141-149. Available at: https://doi.org/10.2307/3144268.

Wu, P., W. Xuefeng and G. Jiawei, 2017. Construction innovation of building complex in maritime service agglomeration area—case study of Shanghai. American Journal of Civil Engineering, 5(3): 132-140. Available at: https://doi.org/10.11648/j.ajce.20170503.12.