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From Functional Space to Experience Space:
Applying space syntax analysis to a museum in China

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Abstract: Space syntax starts from the ontology of space to quantify the space and uses mathematical logic to reveal and describe the logic of the space structure. However, the application of space syntax analysis to museums in China has rarely been explored. In light of this, this study employs space syntax to analyse the Gulangyu Organ Museum (Xiamen, China) and uses the topological depth, visual graph analysis, and agent simulation to describe the structure of the museum space. Accordingly, several suggestions are proposed, including rearranging the layout of the museum's functions and transforming the museum from functional space to experience space. This study can serve as a valuable reference for the application of space syntax in the design and optimization of space design and functional layout. We believe that the findings of this study can also be applied to other cultural institutions (e.g., galleries) with similar characteristics.

1. INTRODUCTION

The museum delivers history, culture, and customs to society and communities, and therefore, it becomes an indispensable place for study and travel. As a space with a host of essential social functions (e.g., collection, preservation, public education, research, and culture), the museum is an important destination for city residents and tourists alike and plays a critical role in the configuration of a city and public space (Di Pietro et al., 2014).

A museum is not a museum without the exhibition. Museums and exhibits (i.e., items on display in museums) can "talk" with visitors, so in many cases, the exhibition becomes the soul of visitor experience (McLean, 1999). Thus, investigating museum space, which largely accommodates exhibits and visitors' dialogue, is of great significance. Regarding space organization, the meeting frequency of visitors with exhibits is the main evaluation factor, so designing a functionally reasonable space layout that satisfies cultural needs of visitors, ensures comfortable and pleasant visitor experience, makes visitors meet exhibits smoothly, and reduces unnecessary repetition of tour path, is of paramount importance.

In China, a wide variety of museums focus on exhibition merely by adjusting space and design and thus largely ignore human experience. Yet,

with the rapid development of society, people gradually realize that visitors are the sole users of museum space, so the experience of visitors has gradually become the core of the design. The transformation and restructuring of museum space from functional space to experience space is indispensable, both timely and enormously (Yuan & Wang, 2016).

Space syntax encompasses a set of theories and analytical, quantitative, and descriptive tools for the analysis of spatial formations at different scales: city, neighbourhood, and architecture (Dalton, Hölscher, & Turner, 2005; Hillier, 2007; Hillier & Hanson, 1989). Its main interest is the relations between human beings and their inhabited space. Space syntax focuses on lines (e.g., streets and passages) and provides a good guide to evaluate a space layout. In addition, it can examine how people move by analysing the urban network (or interior passages) and design applications. Space syntax analysis includes axis analysis (for the street network and walking system), isovist analysis (for public space), and convex space analysis (for building interior space). At present, architects and architecture researchers are gaining a new understanding of space syntax: it is a new language to elaborate a space, analyse the intricacies of internal relations, and use the topology of space to depict the relationship between elements (Bafna, 2003).

Space syntax analysis has been empirically used at different spatial scales (city, neighbourhood, or architecture) in existing literature (Ye, Li, & Liu, 2018; Bendjedidi, Bada, & Meziani, 2019). At the urban or neighbourhood scale, Wu, Yang, and Xiao (2014) conducted space syntax analysis in a number of large-scale urban spaces. Zhou et al. (2018) employed space syntax to analyse the street network evolution in ancient Beijing. Ye et al. (2019) identified street greenery in the daily lives of city residents and examined its relationship with housing prices. Sheng, Yang, and Liu (2014) assessed consumer demands of the Wangfujing Area in Beijing (China) with the employment of space syntax.

There are also many architecture-scale space syntax studies. Jeong and Ban (2014) compared spatial configurations in old apartments in South Korea. Letesson (2014) used space syntax on the analysis, induction, and integration of Bronze Age Crete. Chau et al. (2018) assessed the design of three recently constructed dementia support facilities using space syntax analysis and provided evidence on whether or not the design caters to preferences, needs, and requirements of residents with dementia. Chambers, Bafna, and Machry (2018) adopted space syntax analysis and statistical analysis to shed light on the relationship between apartment layout and depressive symptomology among some residents living in low-end housing.

Compared with Western contexts, particularly the United States and Europe, space syntax studies, especially cutting-edge ones, are very scarce in China. To the best of our knowledge, there are few Chinese space syntax studies published in top-ranking academic journals. One of the exceptions is the work of Li et al. (2016). The authors applied space syntax analysis to Gulangyu (Xiamen, China) and reflected the associations between street network integration and the areal fabric. By and large, Chinese scholars merely applied space syntax analysis to spatial structure, spatial design, spatial efficiency, and space usage forecast (Tao & Ding, 2015). Even today, the quantity, quality, depth, and breadth of the relevant academic literature remain lean.

In light of the above issues, we chose the Gulangyu Organ Museum ("Organ Museum" for shorthand hereafter), a highly-reputed museum in Gulangyu (detailed in Section 2), as the study case. As the original function of the Organ Museum is residence, the designation of the National Key

Cultural Relics Protection Unit has become a double-edged sword for the development of the museum. The museum building itself is of historical value, but the limitation of the space pattern brings numerous challenges for today's museum. The streamline of the living space does not adapt well to the exhibition space. This study hopes to supplement the quantitative analysis of space syntax, to provide a valuable reference for this museum's future optimization and space utilization, and to help it transform from functional space to experience space.

This study proceeds as follows: first, we employ space syntax analysis to evaluate the current internal space configuration of the Organ Museum; second, based on the optimization of either visit route or functional layout, we put forward two transform schemes (which are evaluated by space syntax analysis) and discuss the relationship between space syntax and space function; and finally, we propose optimization suggestions accordingly. This study can serve as a valuable reference for applications of space syntax in a museum's spatial design and functional layout. Hopefully, it can enhance the museum space layout, improve the visitor experience, and enrich empirical studies of space syntax at the architecture level, particularly in urban China. The findings and suggestions of this study can also be applied to other cultural institutions (e.g., galleries) with similar characteristics.

The remainder of the paper is structured as follows. The next section (Section 2) introduces the study case, evaluation indices in the framework of space syntax, and the research framework of this study. Section 3 presents the results of space syntax analysis. Section 4 puts forward suggestions on function re-layout. Section 5 concludes the paper and presents directions for future research.

2. STUDY CASE AND METHODOLOGY

2.1 Study case

With a picturesque and unique colonial landscape and cultural attractions, Gulangyu (also known as Gulang Island and Kulangsu) is a small island off the coast of Xiamen, China. Xiamen (formerly called Amoy and presently known as the "Garden on the Sea") is situated in south-eastern Fujian province (Yang, Zhou, & Shyr, 2019), and it is one of the earliest four special economic zones opened to foreign investment and trade in China. The city is now composed of six districts: Siming, Huli, Xiang'an, Tong'an, Jimei, and Haicang.

With a total area of nearly 2 km^2, Gulangyu is a popular domestic tourist destination and also home to around 20 thousand people (Li et al., 2017). In 2002, it was granted the title of "the island of music" by the Chinese Musicians' Association because a large number of famous classical musicians of China come from this island. On July 8th, 2017, the island, with its enchanting and romantic atmosphere, was officially included in the UNESCO list of World Cultural Heritage. This island is traffic-free, thanks to strict vehicular regulations of the government (Yang et al., 2019).

The Organ Museum (*Figure 1*) is located in the Eight Diagrams Building (or bagua lou in Chinese), a representative of the early architecture in Xiamen. The red-domed tower was designed by the former president of the original Gulangyu Hope Wilhelmina Hospital, Dr. John Abraham Otte, and was built in 1907. This building is 3,710 square meters in size and 25.7

meters in height. Its dome is 10 meters in height, with 8 ridgelines. The museum opened in early 2005 and has more than 100 organs, including three kinds of reed organs, pianicas, accordions, and three large pipe organs.

The Organ Museum is the only such museum in China and also the largest of its kind throughout the world. Its largest and most famous organ is six meters high. Due to the abovementioned distinguishing features, the museum is expected to well serve two purposes: reconnecting locals with their sense of belonging, and reinvigorating a pride of place (Jiang, Claramunt, & Klarqvist, 2000). In 2006, the Organ Museum was designated as a "National Key Cultural Relics Protection Unit" by the National Cultural Heritage Administration.

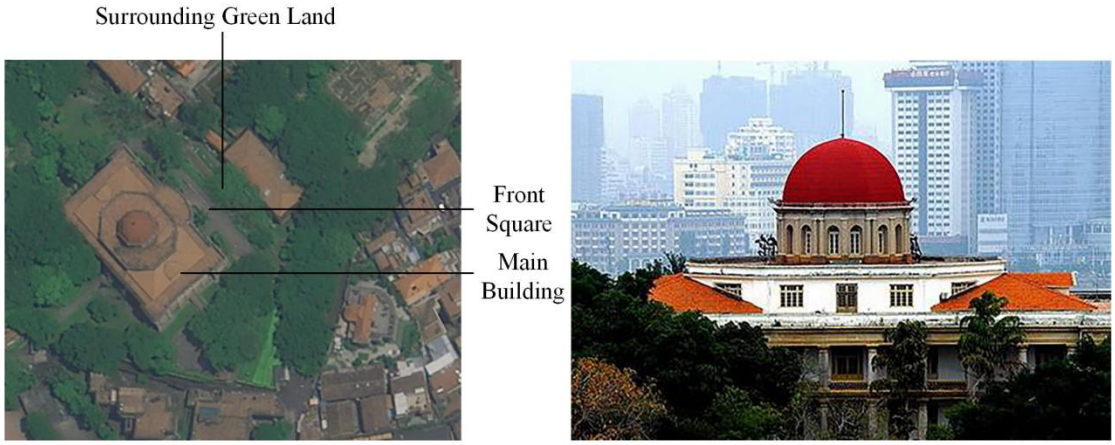

Figure 1. The Organ Museum

2.2 Methodology

The dominating activity behaviours of visitors in the museum include walking, watching (exhibits), and rest. In the space syntax framework, integration is used to describe space accessibility. The use of integration and space topologies can optimize the museum space from the perspective of visitor streamlines. Moreover, space syntax also provides visual graph analysis for visitors' watching behaviour. With the aid of visual graph analysis, it is possible to complete a hotspot analysis of visitors' sights and scheme of exhibition space, and seek to meet the characteristic "guidance and display" in the museum space. Finally, an agent simulation is used to evaluate before-and-after space layout.

2.2.1 Integration analysis

The core concept of space syntax, spatial configuration, represents relations between different components of a spatial system. Association degree is determined by the relations between an element and other elements. Integration reflects aggregation and discretization of a space unit and other units. The higher the integration degree, the higher the reachability and convenience, the higher is the connectivity with the system. Integration includes global integration and local integration. Global integration represents the association between a node and all other nodes, while local integration describes the association of a node and other nodes within a certain geographic range. Mathematically, the integration degree can be expressed as follows:

$$C_i = (\frac{1}{N}\sum_{k=1}^{N} d_{ik})^{-1}$$

where C_i is the integration degree of point i, d_{ik} represents the shortest path from point i to point k, and N is the number of points.

2.2.2 Visual graph analysis

Visual graph analysis is an intuitive method of spatial analysis because it presents the perspective of able-sighted occupants (Turner, 2003). It can reflect the visible area in the analysis space from a certain point. The expression of the numerical value in this graph can be decremented from warm to cool. In theory, it should be conducted in a three-dimensional space, but for simplicity, space is usually reduced to a two-dimensional continuous plan in visual graph analysis.

2.2.3 Agent simulation

Agent simulation develops from visual graph analysis based on the fact that the change of human beings' behaviour is subject to perception and understanding of the spatial structure. In the agent simulation analysis, the agent determines the next step after three steps, and the trajectory superposition of hundreds of agents is generally considered as the simulation of human flow in this building, which can be used for (re)organization and evaluation of a tour line (or trajectory) (Penn & Turner, 2002).

2.3 Research framework

Firstly, field trips were made to the Organ Museum so as to understand how to effectively divide the space into convex spaces and draw the graph reflecting spatial divisions and functional patterns, and several visitors were randomly chosen to do movement tracing. The behaviours of these visitors are used as a reference for two suggested transformation schemes. Secondly, the space configuration of the Organ Museum and calculated evaluation indices were analysed by using the multi-platform spatial network analysis software DepthmapX 0.50 (developed by Tasos Varoudis). Thirdly, based on the results of visitor movement traces and space syntax analysis, two optimization schemes were proposed and the configuration under the two schemes compared with the original using topology analysis (space total depth and integration), visual graph analysis (visual integration), and agent analysis (visit route and flow distribution). This approach can serve as a valuable reference to future research of museum space and function. The research framework is shown in *Figure 2*.

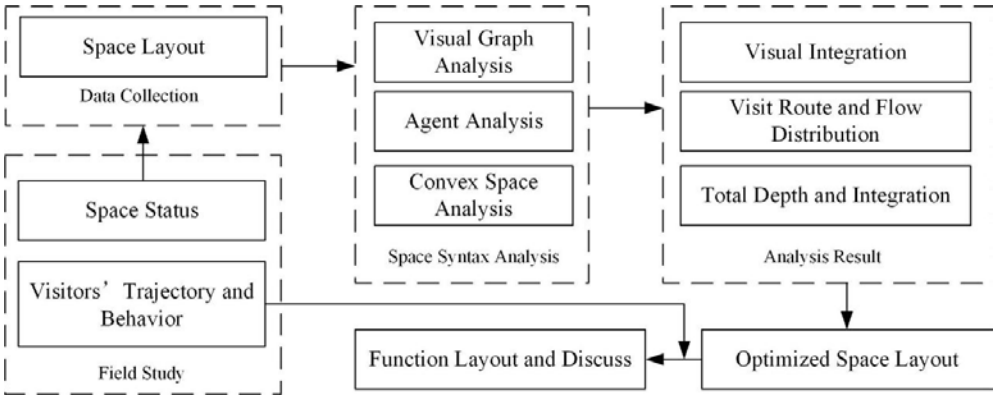

Figure 2. Research framework

3. RESULTS

3.1 Space division

The museum is originally divided into various components, including ticket office, exhibition room, lounge, studio, storage room, administrative office, undeveloped space, and basement. The museum can be classified into the following six categories based on their major function (*Figure 3*):

1. Front square (outdoor exhibition space, parking lot, park green land, etc.);
2. Entrance hall (hall, desk, deposit box, etc.);
3. Exhibition space (general exhibition room, permanent exhibits exhibition room, lounge, etc.);
4. Ancillary facilities (audio-visual room, warehouse, etc.);
5. Administrative office (guard room, reception room, conference room, office, etc.);
6. Service space (stairs, storage room, toilet, electromechanical room, etc.).

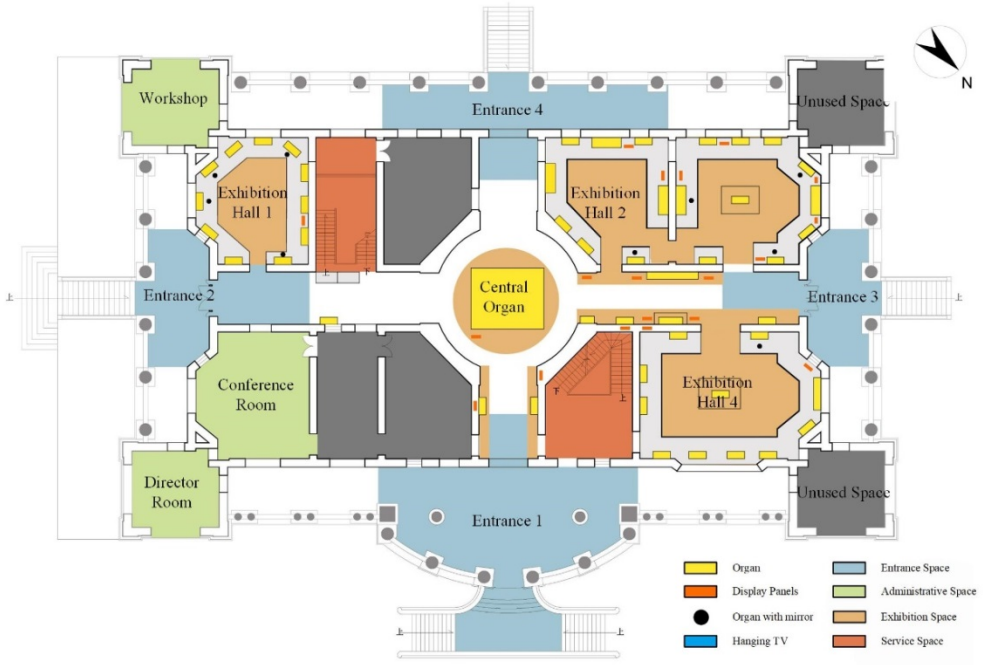

Figure 3. Ground floor plan of the organ museum

The museum has three floors, and the exhibition hall is on the ground floor (*Figure 3*). The ground floor is elevated, so visitors enter the museum through stairs. Entrance 1 is the main entrance. After walking through Entrance 1, visitors can see many organs and panels on both sides of the corridor (Space 8 in *Figure 4 (a)*). Administrative staff can use staircases in Spaces 19 and 21 to access offices on the second and third floors. The central area locates the largest and also the most famous organ. The counter is in the left corridor (Space 12), next to the staircase in Space 21, which is not open to visitors. Conference rooms and unused spaces (Spaces 11, 15, and 18) are on the opposite side of the counter. The right channel (Space 5) connects four open exhibition halls (Spaces 6, 17, 19, and 20). Both the second and third floors are currently not open to visitors.

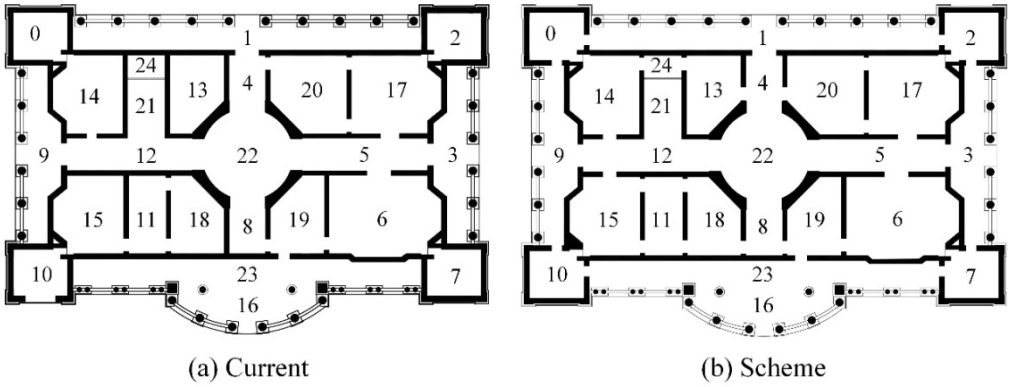

Figure 4. Plans of organ museum spaces

3.2 Convex Space Evaluation

Figure 5 depicts the topology of the current and scheme's exhibition hall convex spaces. We find that Space 5, which connects to five spaces including the central part of the exhibition hall (Space 22), has the highest degree of connectivity. Both Space 12 and 22, which connect to four other spaces, bear the second highest connectivity degree. The spaces with the lowest connectivity degree are on the edge, and most are foyers.

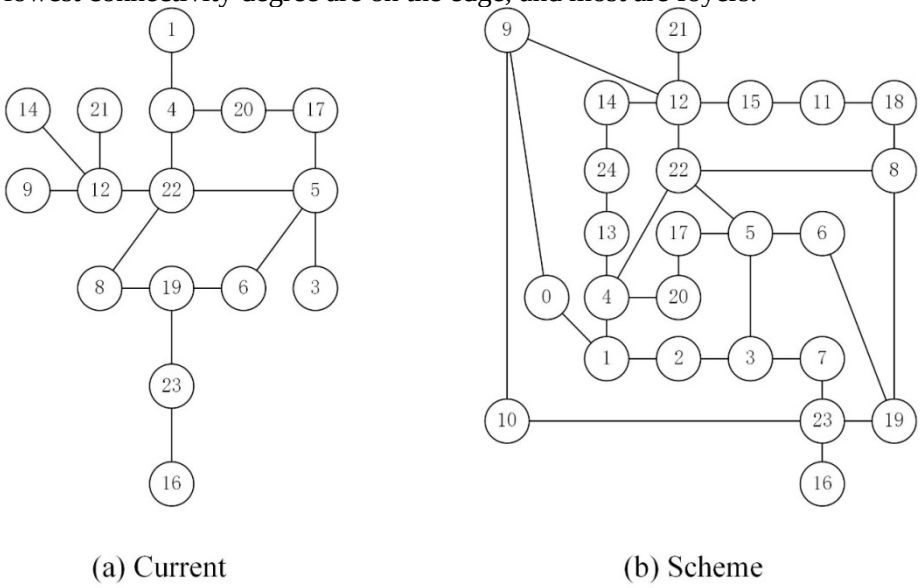

Figure 5. Exhibition hall convex spaces topology

Table 1 presents the total depth and integration index of each space of the exhibition hall. Space 16 has the highest total depth, whereas Space 22 has the lowest total depth. The connectivity degree of cross-corridor (Space 4, 5, 8, 12) is relatively high, and its total depth is low. This indicates that this area is highly accessible. The degrees of connectivity and integration of many exhibition spaces is low. The space directly below the dome (Space 22) is the first destination of visitors, so its total depth is fairly low. The space in the corners of the exhibition hall is the most inaccessible for visitors, so the total depth is high. Integration degrees of the central and cross-corridor are the highest, while the external space is the lowest and its total depth is the highest.

Next, visual graph analysis can be used to analyse the museum's exhibition space after changing the opening and closing state and to determine the layout of exhibits.

Table 1. Space syntax parameters of the exhibition hall spaces

Space Number	Total Depth	Intergation
0	Not open	Not open
1	55	0.659
2	Not open	Not open
3	49	0.775
4	41	1.101
5	35	1.318
6	49	0.775
7	Not open	Not open
8	37	1.198
9	51	0.732
10	Not open	Not open
11	Not open	Not open
12	37	1.198
13	Not open	Not open
14	51	0.732
15	Not open	Not open
16	73	0.454
17	48	0.799
18	Not open	Not open
19	47	0.824
20	48	0.799
21	51	0.732
22	29	1.883
23	59	0.454

3.3 Visual graph analysis and agent simulation

Each site's visibility will be evaluated through the interrelation of the visual graph in this plan. The location of the organs is assumed to be as it is now.

According to the result (*Figure 6 (a)*), the cross corridor and exhibition space on the west side have a high degree of visual integration, and the middle space of the plan is the most attractive to visitors in the current situation. The exhibition hall on the southeast side, which is not attractive to visitors, has low integration. Therefore, the present exhibition space organization has some defects, which cannot guarantee full contact between exhibits and visitors, so it is not easy to form a good interactive and visual encounter mode of exhibits.

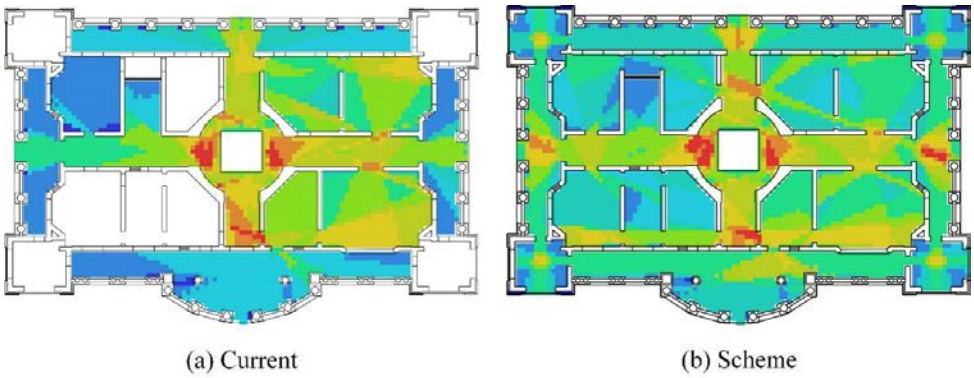

Figure 6. Result of visual graph analysis

Agent simulation is applied to judge whether the museum space reflects a better guiding and hinting mode, which is a reference for the streamline organization of visitors. We put 1000 agents into this space and had them walk around repeatedly to simulate visitors' visiting tracks in this museum (*Figure 7 (a)*). It shows that the flow of people is mainly concentrated on the northeast of the entrance colonnade and the cross corridor. Through simulation, we found that the present exhibition space does not reflect clear tour route organization and spatial guidance.

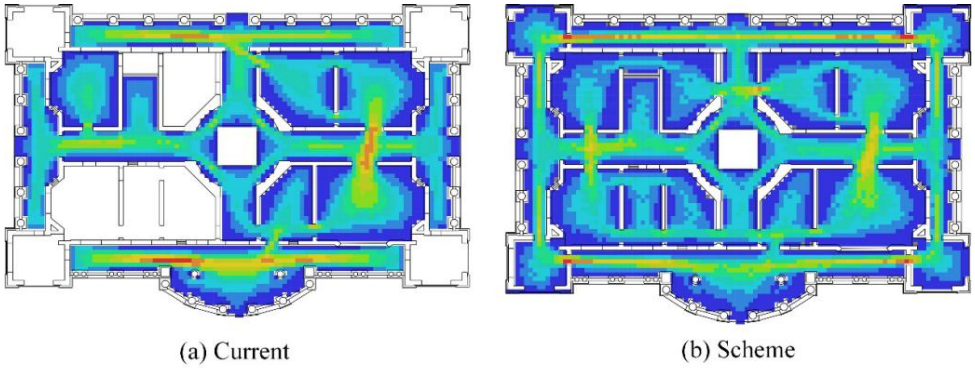

Figure 7. Result of agent simulation

To sum up, the current spatial and functional layouts of this museum seem not so good in their spatial integration, visual integration, and visiting trajectory. In other words, they can be improved.

3.4 Visitors' dwell times and behaviour analysis

Two typical visitors' trajectories were selected to describe dwell times of visitors. *Figure 8 (a)* reflects the trajectory of a female visitor accompanied by a child. She explained the information about the central organ and another organ in the corridor (Space 8) to her child, so long dwell times at these places can be observed. They spent more than 1 minute before the central organ and took many photos here. *Figure 8 (b)* describes the trajectory of a middle-aged male visitor. The visitor seemed to enjoy reading information boards. His long-time stay is mainly due to the careful reading of display panels. Long stays at the central organ and display boards are obvious. In addition, there is an interesting phenomenon: as many organs have a dressing mirror, the female visitor dwell time before the mirror is modestly

longer than that of male counterparts. Moreover, auto-play organs and hanging TVs in corridors also make many visitors stay around longer.

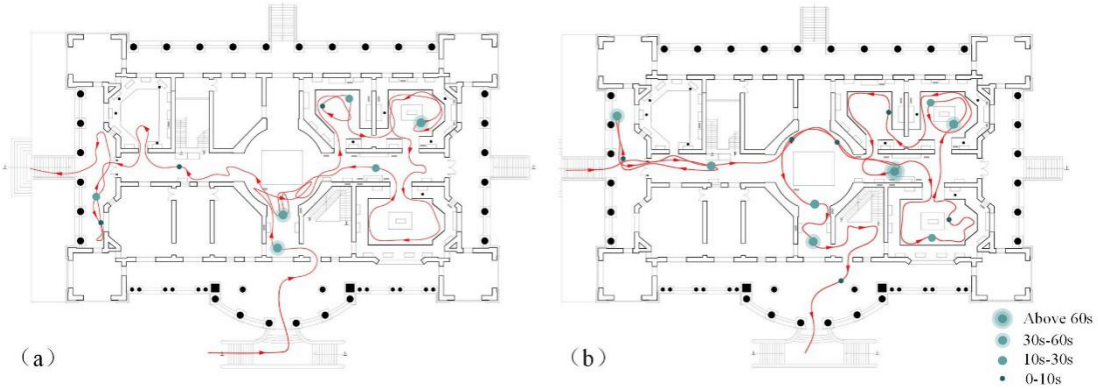

Figure 8. Two typical visitors' dwell times

In summary, visitors generally have more intense interest in interactive, innovative, and multimedia exhibits. In the future, the exhibition hall, the viewing room, and the organ concert hall could be added. In addition, new, highly interactive exhibits are also attractive to visitors.

4. SUGGESTED OPTIMIZATION SCHEMES

4.1 Space layout solution

Presently, some rooms on the ground floor are blocked for conference and office uses. Given this, the partition in the exhibition space on the ground floor is removed (*Figure 4 (b)*), several small rooms are combined into a large room, and all the doors are kept open for human movement. This solution unblocks Spaces 20 and 17, Spaces 15, 11, and 18, and thus enlarges the size of the museum's collections and modifies its organizational structure. Moreover, it can be seen from the reconstructed spatial topology (*Figure 5(b)*) that the accessibility between various spaces presents a clear level and that the topology verifies the advantages of the spatial sequence.

Figure 6 (b) presents the visual graph analysis of this scheme. The central space keeps high visual graph integration. Moreover, due to the unblocking of internal space and the surrounding rooms, four entrance spaces show relatively high integration degrees, so that once visitors enter the museum through any entrance, they can get a better visual experience.

Figure 7 (b) presents the result of agent simulation. This scheme's space layout presents a clearly visible stream of visits, and the overall smoothness of the tour line is greatly improved.

Presently, the Organ Museum's exhibition space is functionally simple, and the exhibition currently only serves the viewing function. The exhibition lacks interaction with visitors, thereby hindering the dialogue between visitors and exhibits. *Table 2* presents the space syntax analysis results of this scheme. By comparing *Table 1* and *Table 2*, we find that this scheme elevates the museum's intelligence and greatly improves visual graph integration. This optimization scheme will be the basis of the functional layout. More information is succinctly described in the following section.

Table 2. Space syntax analysis result

Space Number	Total Depth	Intergation
0	202	0.787
1	210	0.750
2	223	0.696
3	194	0.829
4	181	0.906
5	167	1.008
6	161	1.059
7	184	0.887
8	148	1.189
9	173	0.962
10	175	0.947
11	167	1.101
12	154	1.145
13	218	0.716
14	202	0.857
15	167	1.101
16	194	1.135
17	198	0.808
18	167	1.101
19	137	1.326
20	198	0.808
21	156	1.105
22	152	1.145
23	153	1.135

4.2 Function Layout Solution

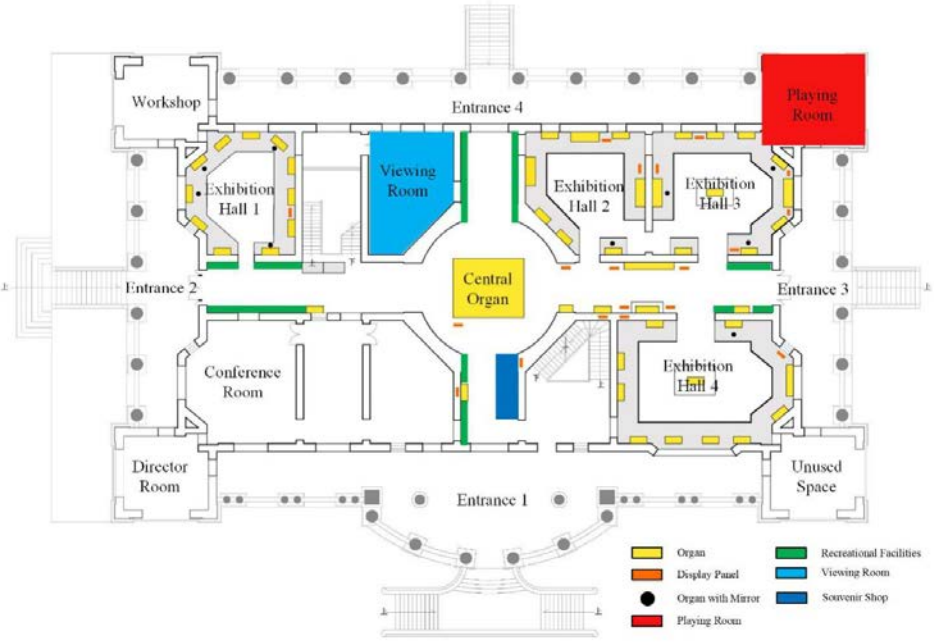

Figure 9. Suggested function layout

The entrance/exit of a building has a strong retention effect on visitors. In most of the cases, its surrounding area can serve as a waiting space. One reason is that when many visitors come together, their interest and timing are vastly different, so most of them would choose to stay at the exit of the exhibition hall or the entrance of the next exhibition hall. In addition, as

population ageing is happening virtually everywhere, the notable increase in elderly tourists in the near future would be unavoidable (Szeto et al., 2017). The waiting place which caters to the demands of tourists may be more favourable to elderly tourists as they are easily fatigued due to poor physical health and declining functional abilities. When people arrive at these places, fatigue increases. As such, it is important to set recreational facilities for them. The proposed layout of recreational facilities is shown in *Figure 9*.

As *Table 2* shows, Space 2 has the highest total depth and the lowest integration, so it can be the focus of transformation. We suggest placing functions which can greatly attract visitors to improve the visitor experience. Meanwhile, we suggest placing an organ playing room here to attract visitors and increase the interactive experience. Moreover, the total depth and integration of Space 13 are 218 and 0.749, respectively. This space has a relatively high degree of total depth and low integration. This room is large and near the corridor, therefore, we chose to use it as a cinema room. This cinema room can attract people using organ-related videos, thereby increasing visitor interactive experience. The proposed layout of the viewing room is shown in *Figure 9*.

Souvenir sales affect the behaviour of visitors. The main entrance area would be less attractive to visitors if it is just used as a transport space. The layout of a souvenir sale space (*Figure 9*) makes the traditional transport space interesting, thereby stimulating the interaction. Due to the high connectivity between this room and other spaces, we suspect that a souvenir shop would effectively increase visitors' dwell time.

5. CONCLUSIONS

It is widely recognized that the museum contributes to cultural bearing and fusion of space and memory. In this study, we employ space syntax to quantitatively analyse the Organ Museum's spatial structure and succinctly discuss the relationship between the behaviours of visitors and space. Based on the results of space syntax analysis, we propose two optimization schemes to transform and restructure the museum. Due to the observation that, currently, the exhibition merely serves for viewing use and lacks interaction with visitors, we put forward a series of measures to resolve these problems. These measures include: (1) providing recreational facilities for waiting use; (2) providing a performance room to improve the interaction between visitors and the museum; (3) providing a cinema room to attract visitors; and (4) providing a souvenir shop to increase visitors' dwell time. This study offers some constructive suggestions on the optimization of the spatial distribution of a museum and enriches architecture-scale space syntax studies. Our findings and suggestions can also be applied to other cultural institutions (e.g., galleries) with similar characteristics.

The space topology that is established according to the principle of space syntax describes spatial relationships within the architecture. Space syntax translates the spatial relation to the mathematical relation and thus makes space quantitative analysis possible. Because the architecture scale is small, visual graph analysis and agent simulation can perform well, and their results can directly guide the generation of different schemes or be used for reference in the design process.

There are some limitations in this study. First, we only use manual tracking and behavioural depiction, which may bring about inaccuracy. However, in our case, some objective data collection methods, such as GPS,

may not be suitable, as signals may be considerably compromised in indoor space (Li et al., 2019). Secondly, this study has certain subjective factors for the determination of exhibition spaces' open and closed state. Meanwhile, it does not discuss the combination of various opening and closing states and its possible effects on visual integration and virtual agent flow. Thus, subsequent research can further consider the combination of syntactic theory and multiple factors in architectural culture.

ACKNOWLEDGEMENTS

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REFERENCES

Bafna, S. (2003). "Space Syntax: A Brief Introduction to Its Logic and Analytical Techniques". Environment behavior, 35(1), 17-29.

Bendjedidi, S., Bada, Y., & Meziani, R. (2019). "Urban Plaza Design Process Using Space Syntax Analysis". International Review for Spatial Planning Sustainable Development, 7(2), 125-142.

Chambers, E. C., Bafna, S., & Machry, H. (2018). "The Association between Apartment Layout and Depressive Symptomology among Hispanic/Latino Residents in Low-Income Housing: The Ahome Study". Journal of Urban Health, 95(1), 51-60.

Chau, H.-w., Newton, C., Woo, C. M. M., Ma, N., Wang, J., & Aye, L. (2018). "Design Lessons from Three Australian Dementia Support Facilities". Buildings, 8(5), 67.

Dalton, R. C., Hölscher, C., & Turner, A. (2005). "Space Syntax and Spatial Cognition". World Architecture, 11(2005), 107-111.

Di Pietro, L., Guglielmetti Mugion, R., Renzi, M. F., & Toni, M. (2014). "An Audience-Centric Approach for Museums Sustainability". Sustainability, 6(9), 5745-5762.

Hillier, B. (2007). Space Is the Machine: A Configurational Theory of Architecture. Space Syntax.

Hillier, B., & Hanson, J. (1989). The Social Logic of Space. Cambridge university press.

Jeong, S. K., & Ban, Y. U. (2014). "The Spatial Configurations in South Korean Apartments Built between 1972 and 2000". Habitat International, 42, 90-102.

Jiang, B., Claramunt, C., & Klarqvist, B. (2000). "Integration of Space Syntax into Gis for Modelling Urban Spaces". International Journal of Applied Earth Observation Geoinformation, 2(3-4), 161-171.

Letesson, Q. (2014). "From Building to Architecture: The Rise of Configurational Thinking in Bronze Age Crete". Spatial analysis social spaces: interdisciplinary approaches to the interpretation of prehistoric historic built environments, 49-90.

Li, Y., Xiao, L., Ye, Y., Xu, W., & Law, A. (2016). "Understanding Tourist Space at a Historic Site through Space Syntax Analysis: The Case of Gulangyu, China". Tourism Management, 52, 30-43.

Li, Y., Yang, L., Shen, H., & Wu, Z. (2019). "Modeling Intra-Destination Travel Behavior of Tourists through Spatio-Temporal Analysis". Journal of destination marketing management, 11, 260-269.

Li, Y., Ye, Y., Xiao, L., Xu, W., Law, A., & Wang, D. (2017). "Classifying Community Space at a Historic Site through Cognitive Mapping and Gps Tracking: The Case of Gulangyu, China". Urban Design International, 22(2), 127-149.

McLean, K. (1999). "Museum Exhibitions and the Dynamics of Dialogue". Daedalus, 128(3), 83-107.

Penn, A., & Turner, A. (2002). "Space Syntax Based Agent Simulation". Springer-Verlag.

Sheng, Q., Yang, T., & Liu, N. (2014). "Spatial Conditions for Targeted and Optional

Consumption: A Space Syntax Study on Wangfujing Area and Three Shopping Malls". Architectural Journal, 6, 98-103.

Szeto, W., Yang, L., Wong, R., Li, Y., & Wong, S. (2017). "Spatio-Temporal Travel Characteristics of the Elderly in an Ageing Society". Travel Behaviour Society, 9, 10-20.

Tao, W., & Ding, C. B. (2015). "Application of Space Syntax to Content and Methods of Home Space". Scientia Geographica Sinica, 35, 1364-1371.

Turner, A. (2003). "Analysing the Visual Dynamics of Spatial Morphology". Environment Planning B: Planning Design, 30(5), 657-676.

Wu, M., Yang, Y., & Xiao, L. (2014). "The Usage of Space Syntax in General Urban Design". Proceedings of Urban Planning Forum, pp. 94-104.

Yang, L., Wang, X., Sun, G., & Li, Y. (2019). "Modeling the Perception of Walking Environmental Quality in a Traffic-Free Tourist Destination". Journal of Travel Tourism Marketing, 1-16.

Yang, L., Zhou, J., & Shyr, O. F. (2019). "Does Bus Accessibility Affect Property Prices?". Cities, 84, 56-65.

Ye, Y., Li, D., & Liu, X. (2018). "How Block Density and Typology Affect Urban Vitality: An Exploratory Analysis in Shenzhen, China". Urban Geography, 39(4), 631-652.

Ye, Y., Xie, H., Fang, J., Jiang, H., & Wang, D. (2019). "Daily Accessed Street Greenery and Housing Price: Measuring Economic Performance of Human-Scale Streetscapes Via New Urban Data". Sustainability, 11(6), 1741.

Yuan, R., & Wang, D. (2016). "From ‘Functional Space’ to ‘Experience Space’: The Analysis and Thinking About Contemporary Museum Space". Huazhong Architecture, 34, 15-19.

Zhou, L., Tian, L., Zhang, Z., & Li, W. (2018). "The Street Networks Evolution in Beijing Old City since the Establishment of the Republic of China: A Syntactical View". Acta Geographica Sinica, 73, 1433-1448.