Environmental analysis and evaluation of the YongDingMen area of Beijing

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Abstract

Urban renewal is an important part of the sustainable development for human habitats. This paper implements the analytical methods of Semantic differentials (also known as the SD method) to analyze and evaluate Beijing's YongDingMen outer zone environment, in an effort to establish case files for architectural quality based on a foundation of on-site evaluations that differentiate both the grades of existing on-site architecture and existing and possible modes of right-of-way, thereby providing a scientific basis for a renewal proposal of the target zone. Through data gathered from local residents' emotional responses toward current living conditions, building density and public space configuration, an objective evaluation of the environment will be generated through quantitative descriptions of the subject environment and the processing of aforementioned data using statistical methods that isolate value based upon varying subject types. This leads to the completion of an analysis for Beijing's YongDingMen outer zone environment, thereby providing suggestions for the renewal of regional urban settlements, thus contributing to the sustainable development of human habitats in the studied area.
Keywords: semantic differentials method (SD method), Beijing YongDingMen area, environmental analysis and evaluation.

1   Introduction

Since the 21st century, China is undergoing rapid urbanization: Function-oriented industrialization has been causing increasing inadaptability and conflicts between architecture and environment; human being's "constructive destruction" to the settlements has been threatening their own survival; and the extensive traditional modernist architectural design has been seriously restricting the

healthy and orderly development of urban construction. Facing these complex problems of the built environment, architectural discipline is in a stage of structural change and has already broken through its traditional boundaries, turning to emphasize the adaptability between architecture and environment. Rational guidelines should be established for architectural design and urban planning.

Through the applying of the SD method to the built environment analysis and evaluation of YongDingMen area in Beijing, the difference between actual desires in the renewal of the target area and the subjective ideas among designers is observed. This research method effectively avoids the unnecessary costs caused by subjective bias, and acts as positive guidelines and tips for urban renewal. Therefore, the use of scientific methods to quantify the analysis and evaluation of the built environment is a basic study in the effort of achieving sustainable development of human settlements and constructing an environment-friendly society.

2 Research method and object

2.1 Research method

This paper implements the analytical methods of semantic differentials (otherwise known as the SD method) to analyze and to evaluate Beijing's YongDingMen area environment. SD method was first proposed by Osgood in 1957 as a means of psychological measurement. The application of the SD method in the evaluation of built environment is through the study of the participants' psychological feelings toward a variety of environmental characteristics of the target area. These psychological feelings are then quantified based on designed assessment scales and values, thereby ultimately coming up with quantitative description and evaluation of the target environment. Spatial measurements based on SD method can quantify the understanding of "architecture semantics" and distinguish those statistical results that are difficult to obtain through traditional interviews and surveys. Under normal conditions, people identify architectural descriptions like "beautiful", "lively", "simple" and "modern" from different scales, so the answers like "beautiful" or "not beautiful" are considered as subjective conclusions (Zhuang [1]). These errors usually prevent investigators from making correct judgments on the influence of these factors. The SD method can significantly reduce the impact caused by these errors and quantify people's description for the same event or phenomenon based on a large number of data.

2.2 Research object and qualitative analysis of the target environment

This paper focuses on the YongDingMen area which is under urban renewal. Since 2001, Beijing Municipal Government proposed preferential policies and strategic decisions to accelerate the South City development, implementing infrastructure construction, dilapidated house renovation and public space

improvement. In this context, the urban renewal strategy for YongDingMen area is proposed (Beijing Municipal Planning Commission [2]).

Figure 1:   The location.

YongDingMen area, known as "the South Gate of Beijing", possesses several important commercial, transportation and landscape facilities within the region. The area is located in the southern end of the central axis of Beijing, covering an area of 60 hectares, in which stand a large number of commodity markets and the largest commodity trading centre in Northern China. The site is close to a moat from the north, is adjacent to the central axis from the east, and is surrounded by residential communities from the south and west. In the northeastern corner of the site is the famous YongDing Gate, dating back to the Ming Dynasty; in the southeastern corner is BaiRong clothing mall; and in the west is the Beijing South Railway Station, which was completed in 2008. The characteristics of YongDingMen area includes:

1. "Wall root" culture remains. The YongDingMen area plays an important role in history in both political and military aspects. Since the Yuan Dynasty, the southern area of YongDing Gate acted as the only entrance to the capital from the south. In addition, this area is of cultural significance. In the feudal era, due to limited population capacity of the city and the closing time of YongDing Gate, businessmen and examinees travelling to Beijing congested in the Southern City and gradually causing the area to flourish. Commercial streets, guilds and other building types appeared and formed a unique "wall root" culture. The construction of the YongDingMen Relic Park in 2004 implies an increasing trend of recognizing both the nostalgic feelings toward wall root culture and the importance of rescuing it.

2. Conflicts between large clothing markets and the spatial form for small workshops are serious. There are thousands of small workshops in YongDingMen area, which have transformed to a large wholesale district in recent years. The conflicts between large clothing markets and the spatial

form for small workshops result in the disordered construction, traffic congestion and mix of commercial and residential functions in this region.

3. The operation of the Beijing South Railway Station brings in new opportunities to YongDingMen area, together with new challenges at the same time. In 2008, the Beijing South Railway Station began operation, working as an integrated transportation facility with ordinary railways, urban rails, bus rentals and other municipal transportation facilities. A large number of high-speed trains depart from here and visitors from all over the country converge here, making YongDingMen area the veritable "South Gate" of Beijing (Wen [3]). However, during the research, the Beijing South Railway Station is observed as a negative factor; it separates the north and the south regions and forms a negative urban interface. There is also serious shortage of supporting public space and service facilities; large numbers of arrivals have nowhere to stay. Besides, the station is surrounded with residential communities that are negatively influenced by visitors; and the logistic centres that rely on transportation so much have poor accessibility to the station.

4. YongDingMen area plays a key role in Beijing green lands and water system. In the new development planning of Beijing, strategies of both exploring new green lands and water systems and developing more waterfront space of existing rivers are proposed (Gao [4]). At present, there is no enough water area in the Southern Beijing, so YongDingMen area, which is not only close to the Temple of Heaven, Taoranting Park from the north, but also connects with the moat and the Lotus River from the south, is a key point in the green lands and waters system in Beijing.
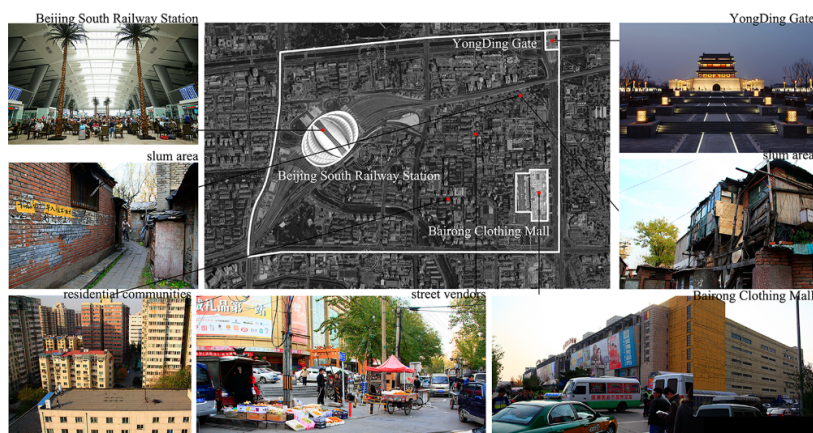

Figure 2:   YongDingMen area.

Various factors above, including historical symbols, landmarks, railway station, green lands and waters, are integrated to constitute a unique character of YongDingMen area. The impact of these factors to the environmental quality must be given thorough consideration in urban renewal strategies, and the use of

SD method will quantify this analysis and evaluation based on a large number of data, helping investigators make correct judgment.

3   Environmental analysis and evaluation based on SD method

3.1 Development of the questionnaire

3.1.1 Evaluation issues (factors)

When developing the questionnaire, we consider people's feelings (psychological quantity) toward the target area and use of space (physical) as benchmarks. This questionnaire developed 18 evaluation issues (factors), taking opinions from surrounding residents, commodity traders, and visitors on topics about perception of space, feelings to spatial design, conditions of ancillary facilities and so on.
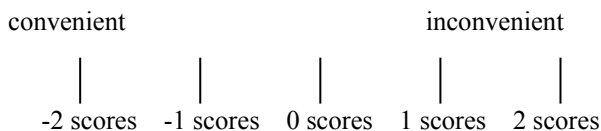
   The questionnaire includes 3 parts: research purpose and confidential declaration; basic information of the participants; and scale tables. The scale tables are further divided into 5 categories:

1.   Evaluation of traffic condition: convenient for walking – inconvenient for walking; convenient for driving – inconvenient for driving; smooth traffic – congested traffic; separation of people and vehicles – mix of people and vehicles.
2.   Evaluation of public space: sufficient – insufficient; positive – negative; enough greenspace – short of green space.
3.   Evaluation of visual quality: clean – dirty; transparent – unclear; bright – gloomy; low density – high density.
4.   Evaluation of facilities: complete living facilities – short of living facilities; complete commercial facilities – short of commercial facilities; complete recreational facilities – short of recreational facilities.
5.   Evaluation of management: well-managed – poorly managed; safe – unsafe; lively – quiet; inclusive – exclusive.

3.1.2 Likert Scales

The survey participants were required to choose "strongly agree", "agree", "not necessarily", "disagree" or "strongly disagree" for 18 issues respectively. Each choice was recorded as -2–2 points. The sum of respondents' scores to a certain issue would show people's attitude to the factor or its condition (Zhuang [5]).

   For example: the degree of convenience for walking:

<div style="text-align:center">

convenient   inconvenient

| | | | | |

-2 scores   -1 scores   0 scores   1 scores   2 scores

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   According to the total scores of this issue, we would make out the degree of convenience for walking in this area. We would then come up with a proposal of road design for higher efficiency based on big data and on-site analysis.
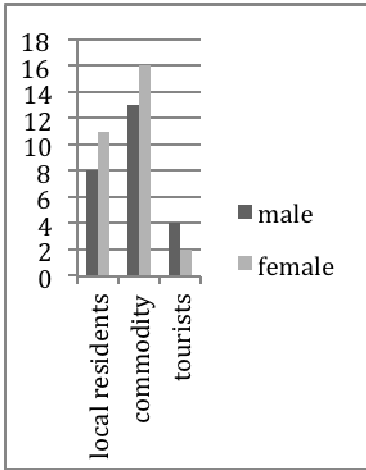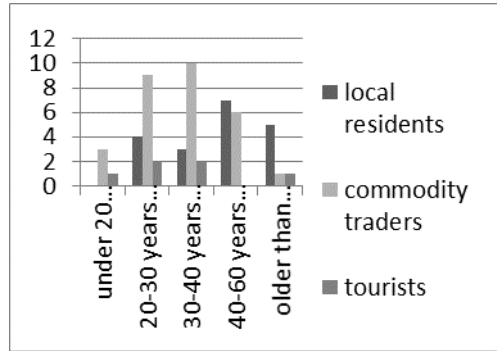
Figure 3: Gender composition of the participants.

Figure 4: Age composition of the surveyed participants.

3.2 Composition of the survey participants

There are mainly three types of people in YongDingMen area: local residents, commodity traders and tourists from all over the country; therefore, we chose participants among these three groups. After collecting the participants' personal information shown on the recycled questionnaires, we categorized them according to their gender, age group, and purpose of being in the area. Then we found: with the government's planning of constructing a commodity trade centre in the area, there are more commodity traders here, so the weight of traders' opinions should be increased; because tourism participants were selected randomly, and their opinions as "outsiders" have less effect on the target areas, so the weight of tourists should be decreased. Considering probability distribution into consideration, 60 questionnaires were handed out and 54 were collected and valid. In order to ensure the representativeness and accuracy of the results, the selection of people who were surveyed was random. The composition of the participants are as follows: local residents 35.2%, commodity traders 53.7%, visitors 11.1%; male 46.3%, female 53.7%; aged 20 and under 7.4%, aged 20–30 27.8%, aged 30–40 27.8%, aged 40–60 24.0%, aged over 60 13.0%.

3.3 Processing of data and environmental evaluation

3.3.1 Mean analysis (Huo [6])
There are 11 issues with average value greater than 0:
- convenient for driving – inconvenient for driving;
- smooth traffic – congested traffic;
- separation of people and vehicles – mix of people and vehicles;

- sufficient public space – insufficient public space;
- clean – dirty;
- transparent – unclear;
- low density – high density;
- complete living facilities – short of living facilities;
- complete recreational facilities – short of recreational facilities;
- well managed – poorly managed;
- safe – unsafe.

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This survey is used for the planning of YongDingMen urban renewal. Your personal information is used only for statistical purposes and the security is ensured.	Age：_____ Gender：_____ You are：_____（a local resident/commodity trader/tourist） Educational background：_____ Please complete the following tablet based on your opinions to YongDingMen area.

DESCRIPTION	VERY	GENERAL	MEDIUM	GENERAL	VERY	DESCRIPTION
the evaluation of traffic condition						
convenient for walking		•				inconvenient for walking
convenient for driving				•		inconvenient for driving
smooth traffic					•	congested traffic
separation of people and vehicles				•		mix of people and vehicles
the evaluation of public space						
sufficient				•		insufficient
positive		•				negative
enough greening				•		short for greening
the evaluation of visual quality						
clean				•		dirty
transparent					•	unclear
bright			•			gloomy
low density					•	high density
the evaluation of facilities						
complete living facilities				•		short for living facilities
complete commercial facilities			•			short for commercial facilities
complete recreational facilities				•		short for recreational facilities
the evaluation of management						
well-managed				•		poorly managed
safe				•		unsafe
lively		•				quiet
inclusive		•				exclusive

Figure 5:   Mean analysis.

3.3.2 Mean analysis without the maximum deviation

To improve accuracy of the results, we removed the maximum deviation and recalculated the average value of each issue. Therefore, the average values of these 18 issues were slightly changed. Among them, two issues ("short of recreational facilities – complete for recreational facilities" and "unsafe – safe") have average values decreased from greater than 0 to almost 0. However, the average values of the remaining 16 issues are still much greater than 0, indicating that the traffic problems, sight-blocking issues, and shortage of recreational facilities are actual serious existing problems, which also includes (ranking by decreasing severity): high density of construction, traffic congestion, mix of people and vehicles, blocking of sight, inconvenience for driving, shortage of living facilities, poor hygiene condition, poor management, and shortage of public space.

3.3.3 Analysis of grouped data

3.3.3.1 Grouped by identity As the data shows, different population groups have different sensitivity to different environmental issues, resulting in different values. Those issues, which are dramatically different in values, are as follows:

- convenient for driving – inconvenient for driving;
- smooth traffic – congested traffic;
- enough greenspace – short of greenspace;
- low density – high density;
- complete living facilities – short of living facilities;
- complete commercial facilities – short of commercial facilities;
- complete recreational facilities – short of recreational facilities.

Analysis of reasons:

Local residents are more familiar with the target area, and have a better understanding of the road system for walking and driving; so they would choose a more efficient way to reach the destination. Local residents also have higher demands for living quality, reflecting in less satisfaction in construction density, living facilities, visual experience, greenspace and management.

Commodity traders pay more attention to the convenience of logistics, therefore they are more sensitive to transportation issues and are less concerned for living quality. Meanwhile, commodity traders are very concerned about the degree of activity in this area, which is a key factor for their trading volume.

Tourists, as "outsiders", rarely possess deep feelings toward the area, and are more easily influenced by visual experiences.

3.3.3.2 Grouped by ages As the data shows, the values given by the population under 30 years old are lower than the ones given by the older population, particularly in:

- convenient for driving – inconvenient for driving;
- smooth traffic – congested traffic (the value given by the population under 30 is 0.79 lower than the one of older population);

- transparent – unclear (1.08 lower);
- bright – gloomy (0.97 lower);
- well-managed – poorly managed (0.40 lower).

Analysis of reasons:

Most of people under the age of 30 would like to walk or to take public transit to their destinations, and few of them own private cars. Therefore, young people are less sensitive to the traffic conditions in this area.

People with age over 30 usually have been living or working in this area for a longer time, and are more familiar with the target area. So they are more sensitive and have more demands to the spatial details and quality. Therefore, the values related to the brightness of space are higher.
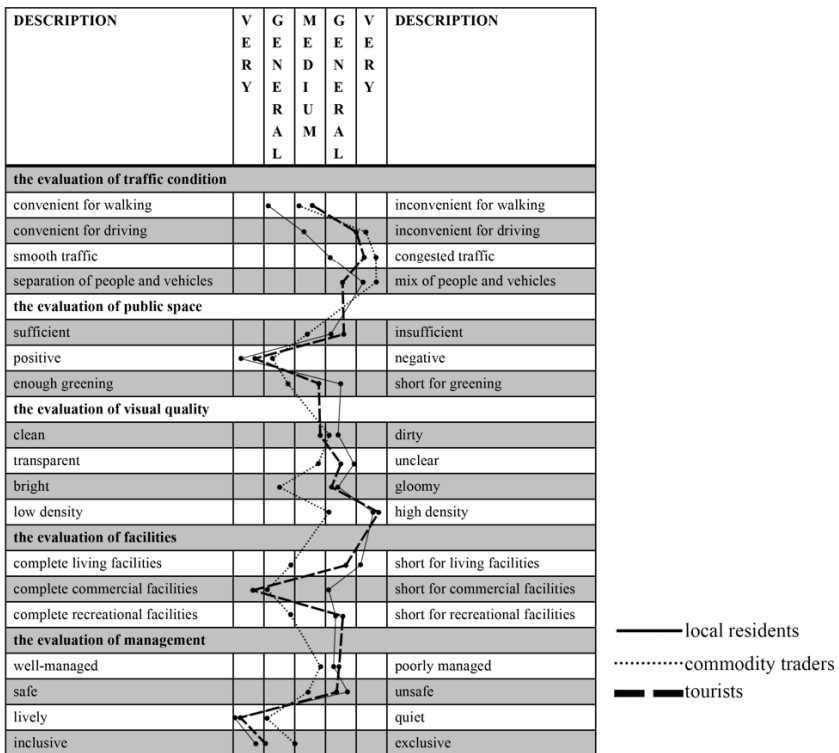

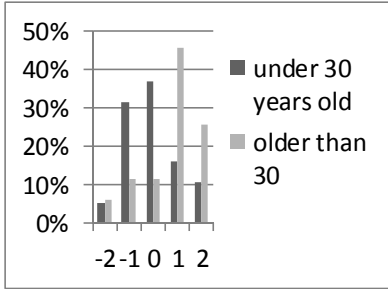Figure 6:   Mean analysis of different identity groups.

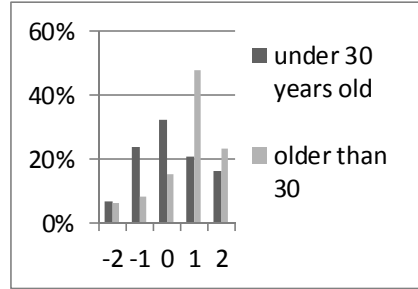Figure 7: The values of "convenient – inconvenient for driving" by different ages.

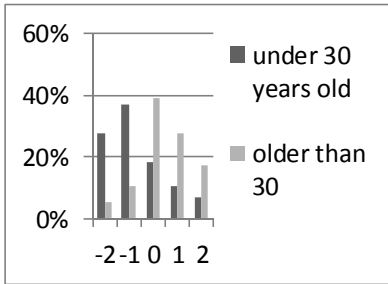Figure 8: The values of "smooth − congested traffic" by different ages.

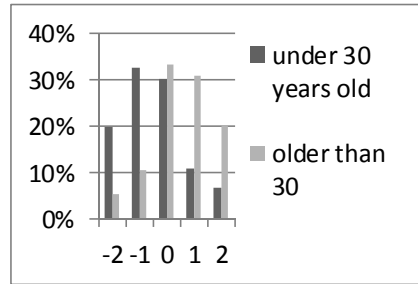Figure 9: The values of "transparent – unclear visual quality" by different ages.

Figure 10: The values of "bright − gloomy visual quality" by different ages.
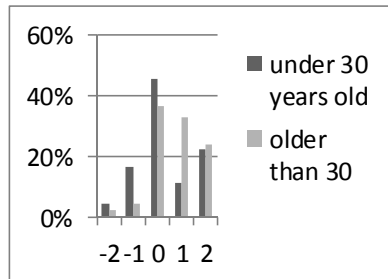

Figure 11:   The values of "well – poorly managed" by different ages.

3.3.3.3 Grouped by gender As the data shows, the values given by males and females are similar. Only in the issues "sufficient – insufficient public space" "high – low construction identity" "enough greenspace – lack of greenspace" "bright – gloomy", there are slight differences. One of the reasons for these slight differences would be females' preference to greenspace and brightness.

4   Solutions

1. In future constructions, the east-west road, which connects the Beijing South Railway Station and Bairong Clothing Mall, should be cleared as the main artery for vehicles. In YongDingMen area, traffic is complicated and accessibility to public transportation is poor. "Inconvenience for driving", "congested traffic" and "mix of people and vehicles" are major problems and the most unsatisfying issues for all groups of people. Commodity trading requires a lot of logistics and transportation, but the narrow, twisting, and inconvenient roads in this area have been seriously affecting the efficiency of logistics. Meanwhile, the narrow roads force people and vehicles to mix together, exacerbating congestion and the convenience for walking. In addition, the Beijing South Railway Station is disconnected with its surroundings (especially on the south side). The large number of people brought by railway have nowhere to stay upon their arrival and have been causing constant disturbance to local residents. There is no easy access for commodities to be transported from logistic centres to the South Railway Station. Therefore, it's urgent to build connections between the South Railway Station in the north and the commodity trading centres in the south.

2. Improve the service facilities for local residents. At present, there are not enough service facilities in YongDingMen area. Most of the commodity trading centres are wholesale markets with long service radius. Therefore, these centres do not provide the kind of support required for local residents' daily living. As the results of the field research shows ("short of living facilities" and "short of recreational facilities"), there is shortage of supporting service facilities such as shopping malls and supermarkets. Most of the local residents rely on street vendors for their daily supplies. This situation exacerbates the complication and congestion in the area. In addition, this area lacks recreational facilities for the elders and children. The elders and children have more leisure time, so their desired facilities and outdoor playgrounds should be fully taken into consideration in urban renewal planning.

3. Decrease the construction density and increase the greenspace coverage. The residential communities next to commercial markets usually have problems of harsh and dull environment, high construction density, inconvenient traffic and poor sanitary conditions. As the diagram of building quality grading shows, a large slum area exists between Yongding Gate and Bairong Clothing Mall. These slums, which not only are no longer suitable for living, but also cut off the connection between the trading markets, the Beijing South Railway Station and YongDingMen Station, need to be demolished. Therefore, in the urban renewal proposal, we would suggest to remove those informal settlements and decrease the building density while meeting the functional requirements.

   In addition, the area must contain part of the residential functions; therefore, it is particularly important to come up with an environmentally-friendly design. As for the "lack of greenspace" problem, more green space and

outdoor benches should be added to create better landscape in future planning. In combination with the open spaces (YongDingMen Square, public stadiums, and residential parks, etc.), a green system will be completed.

4. The identity of YongDingMen area as a commodity trading centre should be realized in urban renewal. The functional orientation of YongDingMen area is not clear. As the diagram of land usage shows, there are clothing markets (centred on Bairong clothing mall) and diverse stationery wholesales and distribution markets (such as Shenggou gift center and Yongwaicheng gift center); to worsen the situation, these commercial buildings have spread into the residential communities. The mixed functions of the area have negatively affected the accessibility of commercial areas, making it difficult to establish supporting logistics fields, research institutions and exhibition centres. This is an important reason of why this area has not yet been able to achieve industrial upgrading.

5. Preserve the "Active Factors". The public spaces and commercial buildings (such as playgrounds and Bairong Clothing Mall) are characteristics attractions in maintaining activities in YongDingMen area. These "active factors" have been bringing large crowds of people to this area. These buildings and structures are mostly in good construction quality, and should be properly preserved and renovated. Taking Bairong Clothing Mall as an example, although it has been attracting a large number of commodity traders, the building volume is too huge to harmonize with the environment. Therefore, its volume should be reduced to a step-back architecture with outdoor terrace on the 2nd and 3rd floor. At the same time, it is important to design a public square near Bairong Clothing Mall. It will act as logistics transit and parking space at daytime, and event spaces for product launches and performances at night time, thereby improving the spatial quality of the area. Another example is the YongDingMen Square, which is now separated from its surroundings by the roadway. We suggest to build an overhead "Gate Museum" to connect both sides and attract more tourists. After renovation, these "active factors" will be able to better promote regional development.

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