Study on the Mechanism of Industrial Integration in Industrial Parks Based on System Dynamics

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ABSTRACT

City fusion is an organic integration of industrial development and urban functions. Based on cities, it provides a carrier and development space for industrial development, supports industries with power, and promotes the improvement of urban functions. As the integration of industrial parks in the industrial park involves many elements, the current urban integration does not meet the expectations of stakeholders. Therefore, it is of great significance to systematically study the various elements of the industrial integration in the industrial park, analyze the mechanism of its interaction between elements, master its inherent operation process, and promote the industrial-urban integration in the industrial park. From the perspective of system theory, based on system dynamics, starting with the relationship between industrial development and urban function development, this paper studies and studies the intrinsic mechanism of industrial integration in industrial parks based on system dynamics, in order to provide a theoretical basis for the future development of industrial-urban integration basis.¹

INTRODUCTION

As a gathering place for industries with high density, the Industrial Park shoulders the important mission of driving regional economic development, promoting adjustment and upgrading of industries, and promoting new urbanization. The development of industrial parks has become the focus of industries, and promoting new urbanization. The development of industrial parks has become the focus of attention of all levels of government and has also become the core driving

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force of many regional development. Under the new situation, the development of modern industrial parks is no longer a mere industrial processing and manufacturing of science and technology products, but should also include the construction of related infrastructures and various living supporting services. The industrial parks urgently need to move from a single functional area to an integrated functional area upgrade.

Industrial parks mainly involve industries, cities and people in the process of industrial integration. However, in industries and cities, there are many other elements such as enterprises, serving employees, permanent residents and so on. How industrial parks are integrated into one another is essentially how the various factors interact with each other. In other words, whether the industrial parks can eventually realize the integration of the industrial regions depends on the interaction between the components. Therefore, it is necessary to consider the integration mechanism of industrial parks in the industrial park as a whole and to systematically study the mechanism of its components.

INDUSTRIAL DEVELOPMENT AND URBAN FUNCTION DEVELOPMENT INTRODUCTION

Industry is The Carrier of Urban Functions

In urban economics, aggregation and diffusion are the essence of urban function. Industrial activities determine the city has the ability to meet the needs of different groups of people. Cities must attract various regions of the capital, technology, talents and other production conditions through industries to transform them into nutrients for their own operation, produce material products or provide services to play the role of cities Of the various functions, and through the means of information to the surrounding areas spread to attract more resources, so continuous cycle, and constantly optimize the urban development. Therefore, it is necessary to have an excellent system of industrial activities as a material carrier in order to effectively utilize the functions of the city.

Industrial Structure Limits The City's Function

Industrial structure refers to the composition of the various sectors of the national economy and within the various industrial sectors. The entire urban economy consists of a large number of industries. The composition ratio of different industries, i.e., the industrial structure, reflects the development of the urban economy and the cities with too many low-end industries account for the backwardness of the urban economy. The function of the city is to some extent a carrier of the urban economy, and a city with a developed economy must have a relatively developed urban function. Therefore, the industrial structure is through the urban economy and thus the function of the city.
Industrial Upgrading Changes City Functions

The city has a very high level of comprehensive functions. History shows that the upgrading and optimization of the industrial structure can make the city function a big leap forward to a more advanced platform. By superimposing new functions on the original functional levels and forming a city structure more in line with the needs of urban development New city function system. In the initial stage of city formation, urban development was still immature and industrial development was relatively simple. With the continuous improvement of urban facilities, the division of labor and gradual upgrading of industrial structure, the relationship among industries became more complicated and deepened to form an organic whole. As a result, urban functions are followed by a holistic and pluralistic character.

ANALYSIS OF INDUSTRIAL PARK INTEGRATION SYSTEM IN INDUSTRIAL PARKS

The main body of industrial integration in the industrial city has two industrial parks and urban functions. Analyzing the integration of industrial park and urban functions from the perspective of system dynamics means that the relationship between the two should be discussed systematically. Industrial parks and cities are not isolated, can be seen as two large systems. Before constructing the causal feedback graph, we use the system block diagram to draw the main subsystems and their interrelations of the industry-urban fusion system in the industrial park, as shown in Figure 1:

![Figure 1. Industrial park industrial integration system block diagram.](image)

The environmental subsystem, the population subsystem and the economic subsystem in the above block diagram are actually the sub-systems under the urban subsystem. The explanation and description of each subsystem are as follows:

1. Industrial subsystem. Industrial sub-system is an integral part of industrial park integration system in the industrial park. The service quality, commuting time and accessibility of the infrastructure in the industrial park plays a decisive role on whether the industrial park can achieve a balance between job and residence. The
industrial park total The output value, the number of leading enterprises in the park, etc. also directly reflect the level of industrial integration.

(2) Population subsystem. The population subsystem includes both local urban residents and workers in the park, as well as the "talent" necessary for the development of the industrial park. In essence, the potential bridge between industrial and urban integration is "human", and one of the manifestations of the convergence of industrial cities is also "human". Specifically, the increase in the number of relevant personnel will promote the upgrading of the industrial structure, enhance the capability of technological innovation, increase the GDP of industrial parks and attract more outstanding enterprises to settle in industrial parks, forming a virtuous circle. This result may directly lead to the increase of government revenue, promote the development of regional economy and even the effect of talent pooling, thereby increasing the attractiveness of the city to qualified personnel and enhancing the government's position.

(3) Economic subsystem. Economic subsystem involves the government revenue, investment in the park, industrial park output, regional economy. Investment in the park can indirectly reflect the government's support for this industrial park. In the development of the park, especially in the initial stage of development, the investment in infrastructure directly affects the willingness and investment efficiency of the enterprises involved in the park.

(4) Environmental subsystem. Each system is in a dynamically changing environment, and all of the environmental factors need to be considered in the evolution of the system. Industrial Park in the city fusion system environment subsystem has two meanings: First, the ecological environment, and second, the social environment. For the former, the average concentration of PM2.5 and resource consumption can be used to reflect the social environment, including the level of transport facilities, infrastructure service level, education level and employment opportunities.

CAUSAL INTEGRATION MODEL OF INDUSTRIAL PARKS IN DOWNTOWN AREA

Subsystem Causal Feedback Model

A. INDUSTRIAL SUBSYSTEM CAUSAL FEEDBACK DIAGRAM

The total investment of the industrial park on the one hand reflects the local government's emphasis on this park, on the other hand can reflect the comparative advantage of industrial transfer to absorb. The degree of infrastructure investment directly affects the company's willingness to enter the park. The positioning of the industrial park determines the direction of the industrial restructuring and follow-up of the park. The output value of the tertiary industry reflects whether the industrial
layout of the industrial park forms a leading enterprise. Therefore, Facilities, the number of leading enterprises, the tertiary industry output value, the total output value of the park as the core, draw the industrial subsystem causal feedback diagram as follows:

Industrial subsystem causal feedback structure, the inflow into the park - the total investment in the park as a starting point, the system includes nine feedback loops. The starting points of the nine circuits are the total investment in the park, followed by infrastructure, the final point of action for the financial revenue, the overall performance of industrial parks and the virtuous circle between the economy. In Loop 2, based on current human needs for life and quality of life, the length of commute time in a park not only reflects the traffic conditions in the park, but also directly affects the attractiveness of its personnel. In general, the increase in the number of qualified personnel will be technical Upgrade into new impetus and vitality, technological innovation directly affect the ecological and tertiary industries, while reducing the concentration of PM2.5, increase the total output value of industrial parks and promote local economic development, and industrial park talent, enterprises attracted to attract The key role is the initial total investment in the park, infrastructure investment and improvement. Thus, the park's total investment, infrastructure plays a decisive role in the operation of industrial subsystems. Once the total investment in the park is reduced, the level of infrastructure services is declining, the potential for brain drain and non-renewal of enterprises will rise.

![Figure 2. Industrial subsystem causal feedback diagram.](image)

**B. POPULATION SUBSYSTEM CAUSAL FEEDBACK DIAGRAM**

There are two meanings of the population in the industry-urban fusion system: one is the resident population of the industrial park; the other is the floating
population. The floating population indirectly reflects the economic development of the city and the industrial park. Therefore, taking the total population as the starting point of the subsystem, we select the corresponding elements of population, industry and environment and draw the following diagram of the causal feedback of the population subsystem:

As can be seen from Figure 3, the population subsystem under the industrial-urban integration system in the industrial park mainly includes four circuits. Among them, Circuit 1 and Circuit 2 are similar, mainly reflecting the relationship between the total population, production and output of the park. The increase of the total population will inevitably lead to the increase of production demand, indirectly injecting additional production impetus into the industrial park, leading to the improvement of the production level in the industrial park and further attracting more outstanding talents to the park to form a positive link between population and industry Feedback. Circuit 3 and Circuit 4 structure mainly reflects the population, technology and the relationship between output value of the park. The reason why the level and perfection of infrastructure investment in the park is linked to the wishes of enterprises in the park is that infrastructure is another key point attracting talent. For the park workers, the convenient traffic conditions, good living environment, is the premise of stable residence in this long time. Therefore, the higher the level of infrastructure services, the lower the rate of brain drain.

![Figure 3. Population subsystem feedback diagram.](image)

C. ECONOMIC SUBSYSTEM CAUSAL FEEDBACK DIAGRAM

Economic sub-systems in the industry-urban fusion system in the industrial park can start with the location of the park's GDP and regional economy, select the elements related to other subystems, analyze the polarity of the positive and negative roles between the elements, and construct the following causal feedback diagram.
GDP can directly reflect the economic development in a certain area and reflect the local government's revenue. The size of a year's financial investment in an industrial park is often based on the amount of fiscal revenue in the previous year and the current government's emphasis on the industrial park. The size of the investment quota also plays a decisive role in the financing of the park. Generally speaking, the larger the investment amount, the more smooth the progress, on the contrary, the initial investment amount of the park is smaller, the desire of enterprises to settle down, resulting in lower levels of financing. The park's total investment and infrastructure, there is a positive feedback of the number of personnel, and the increase in the number of talents will indirectly lead to the increase of the park's output level, stimulating the entire region's economic development level.

![Figure 4. Economic subsystem feedback diagram.](image)

**D. ENVIRONMENT SUBSYSTEM CAUSAL FEEDBACK DIAGRAM**

![Figure 5. Environmental subsystem causal feedback diagram.](image)
Any system is in a dynamic environment, with the environment and information exchange and energy exchange. The discharge of waste in the industrial park directly affects the concentration of PM2.5, and the amount of waste discharged changes with the advanced level of production technology used in the park. Taking the PM2.5 concentration index that best reflects the environmental quality as an entry point, the causal feedback diagram of the environmental subsystem can be drawn as follows:

Starting with innovative inputs, the subsystem consists of two loops. Park enterprises to adopt advanced production technology and improve resource efficiency, reduce emissions and PM2.5 concentration, reduce pollution losses, thus boosting the level of regional economic development, the perfect realization of ecological and economic benefits "Win-win." If we consider the relationship between fiscal revenue and the total investment in the park, the potential link between the government's attitude and the financial level and the development of the park will be further clearly reflected.

**System Overall Causal Feedback Model**

![Figure 6. Industrial park production system integration feedback system.](image)

Industrial infrastructure, population subsystems, economic subsystems and environmental subsystems together with the infrastructure in the industrial park and the total urban population as a link, the overall causal feedback model of industrial integration in the industrial park can be obtained as follows.

Based on a comprehensive analysis of the four subsystems, the key to the good and bad of the operation of the industrial-urban integration system in the industrial
park depends on the total investment in the previous period and the degree of infrastructure construction. Overall, both of them directly or indirectly promote other system components such as the number of enterprises settled, financial capital, technological innovation and output value of the park. If the integration of the city industrial park production inputs - the park total investment is large, the corresponding proportion of investment in infrastructure, high level of service, it can attract more high-end by well-known enterprises to enter the park, increase the proportion of investment in innovation, technological innovation, enhance resources Re-use the level to reduce waste emissions and reduce the concentration of PM2.5, while achieving ecological and economic benefits. At the same time, infrastructure such as transportation directly reflected in the commuting time between the park and the city, while the current employment psychological point of view, the ease of transportation a large selection factors for the careers of those companies, smaller elements if this index, To a large extent, this will lead to the election of job seekers in the park. The number of talent introduction leads to an increase of total incremental production needs, according to the principle of supply and demand, production and living will becomes larger than supply and demand, and then act on the infrastructure, the system forms a positive feedback, and ultimately healthy population, economy, ecology, etc. cycle.

CONCLUSIONS

Under the active encouragement and guidance of the national policies, the modern industrial park is actively adjusting itself to the transformation and upgrading of the diversified functional areas. With the efforts of all parties, the integration of the industrial parks and cities is finally achieved. Starting with the analysis of the relationship between industrial development and urban functions, this paper regards the integration of industrial and urban areas in industrial parks as a whole. Based on the system dynamics, a causal feedback model of industrial-urban integration system in industrial parks is established. The internal mechanism of this system is explored. To provide a theoretical basis for the integration of industrial parks in the industrial park.

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