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THE REAL SITUATION OF INDUSTRIAL CLUSTER INFRASTRUCTURE AND RECOMMENDATIONS FOR INDUSTRIAL CLUSTERS INFRASTRUCTURE IN HANOI, VIETNAM

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ABSTRACT

The quality of industrial infrastructure works not only reflects investment efficiency but it also affects production and business efficiency in the process of using these kind of works. In 2018, Slaper et al. conducted research and how us that there is positive linkage between GDP growth (gross domestic) and traded growth of clusters.
Therefore, this study has analyzed the factors affecting the quality of the works, from which to propose measures to improve the quality of works mainly at the stages of survey, design, and construction bidding; Accelerate the construction of the infrastructure of industrial parks; Human resources for industrial development and industrial infrastructure construction is a decisive factor in the development of industrial zones and industrial infrastructure construction. The study has pointed out the characteristics of industrialized human resources and solutions to promote and improve the quality of human resource training for industrial revolution development and industrial infrastructure construction.

Keywords: *Industrial cluster, Recommendations, Infrastructure construction, Environment, Hanoi, Vietnam.*

INTRODUCTION

Currently, there is a different understanding among Vietnamese and foreign scholars and organizations about industrial clusters.
The concept of "Geographical clusters" or "Industrial districts" appeared at the end of the 19th century by Alfred Marshall, stemming from his study of the concentration of industrial production in the North of England. According to Marshall, Industrial clusters have three basic advantages from centralization: The pervasiveness of information; The specialization and division of labor between establishments, and the development of a diversified skilled labor market. Later, the concept evolved into two different schools of industry approaches. French researchers such as Courlet et Pecqueur, Colletis ... called local production systems. The British

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and American researchers called the Industrial Cluster "Industrial Cluster" or "Industrial districts" with the approach of G. Becattini; Michael Porter...

The table below will show overview of industrial cluster development in Vietnam to 2010 we see that Average occupancy rate compared to the finished construction area in east and northwest region is 47%.

Table 1. Current status of industrial cluster development in Vietnam to 2010

No	Local	Industrial cluster as planned		Industrial cluster building infrastructure and operating				Average occupancy rate compared to the finished construction area
		Quantity	Area as planned	Quantity	Area as planned	Completed area	Land area for rent	
		Cluster	(ha)	Cluster	(ha)	(ha)	(ha)	%
1	Whole country	1785	81.872	873	38.680	22093	9646	44
2	East, Northwest region	201	7820	104	4321	2141	1005	47
3	Red River Delta	719	29059	396	11723	7807	3222	41
4	Central Coast	349	8033	151	3880	2372	1024	43
5	Tây Nguyên - Highland	60	3574	30	1814	517	205	40
6	South East	245	12089	76	4173	1071	342	32
7	South West	211	21298	116	12769	8185	3848	47
8	Hà Nội	225	3681	105	2678	1932	643	33

Source: Department of Local Industry - Ministry of Industry and Trade

In that context, this study will address the issues for Building industrial clusters infrastructure in Hanoi, Vietnam.

Research Question

Question 1: What is the real situation of industrial cluster infrastructure in Hanoi?

Question 2: What are other recommendations for industrial clusters infrastructure in Hanoi, Vietnam?

Literature Review

Industrial Cluster Infrastructure

The Vietnamese dictionary defines "Infrastructure as the whole system of works such as roads, electricity supply roads, water supply, drainage, waste... concerning the constructions and houses being built in that area. In our understanding, "infrastructure" is specialized works for production and social life, and "infrastructure" is also a construction, but built in a certain area. As we say, the scope mentioned in "infrastructure" is narrower.

Thus, it can be understood that the infrastructure/infrastructure is a specific part of the material and technical infrastructure in the national economy whose basic function and task is to ensure

the necessary general conditions for the development of the economy. The extended production and reproduction process is normal and continuous. Infrastructure/ infrastructure is also defined as the totality of physical, technical, and architectural facilities that play a fundamental role for socio-economic activities to take place normally.

Mr. Hank Tomlinson (President of the American Chamber of Commerce) said:

"There are two types of infrastructure; hard infrastructure such as roads, energy, electricity, and soft infrastructure, education and labor quality issues. With soft infrastructure, the Government needs to focus on promoting and improving the quality of labor to meet the needs of high-tech investors (Hammoodi *et al.*, 2019). High-tech investors cannot invest in places with low-quality labor. In addition, soft infrastructure is also the economic management regulations of the Government, this is also an important factor that always needs to be improved to make it simple for production and business activities to be conducted safely and effectively".

Then we summarize previous studies in **Table 1** below:

Table 2. Related previous studies

Authors	Year	Content, results
Porter; Hallencreutz & Lundequist	2000; 2003	clusters' by regional economists, suggests that regions should identify and develop the existing regional competitive advantage
Narula	2004	SMEs often suffer from limited resources and low capabilities to generate development in internal activitieshttps://journals.sagepub.com/doi/full/10.1177/21582440211031604. Therefore, interfirm networks are crucial to SMEs' innovation processes
Gebreeyesus & Mohnen	2013	The main driving factors supporting the continued success of an innovative industry cluster remain unexplored
Batterink *et al.*; Levén *et al.*	2010; 2014	Hub firms with largest number of contacts (in industrial cluster) play a valuable role in facilitating social exchange within a cluster network.
Huy	2015	Still need to enhance risk management and governance in corporations
Slaper *et al.*	2018	Cluster theory despite of hinder cluster econometric model , but good for industry dynamic (regional).
Ye *et al.*	2021	focuses on 2 patterns that include STI-science, tech and innovation and DUI - doing, using and interact (for knowledge learning)
Soloveva *et al.*	2021	For socio economic potential of regional development, we need Investment and innovation activity

(source: author synthesis)

Beside, studeis pointed Putting Porter into practice? Practices of regional cluster building with evidence (Lundequist & Power, 2002; Trinh, 2016; Le, 2020; Jankowiak, 2021).

MATERIALS AND METHODS

Authors mainly use experiences, observations, practical situations with cases studies of industrial clusters in Hanoi, Vietnam combined with qualitative analysis, synthesis, and explanatory methods.

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This study also uses historical and dialectical materialism methods, with data and statistics in Hanoi, Vietnam.

Main Findings

Overview of the Development of Industrial Clusters in Hanoi

The below **Table 3** show us completion ration still low in some areas (Son Dong, Binh Minh, Dong Giai)

Table 3. List of industrial clusters under construction until 2010

Industrial Cluster	Location	Size (ha)	Completed (ha)	Completion ratio	Note
1.Bích Hoà	Bích Hoà, Thanh Hoai Commune	10,3	5,1	50%	The remaining area has not been cleared because there are no investors.
2.Town Phúc Thọ	Town Phúc Thọ, Phúc Thọ	40	24	60%	Continuing to implement phase II (16ha)
3.Ngọc Hồi	Commune Ngọc Hồi, Thanh Trì	75	56	75%	Phase II (14ha) is clearing.
4.Bình Phú - Phùng Xá	Bình Phú - Phùng Xá - Thạch Thất Commune	103	40	39%	Continued clearing ground and construction of technical infrastructure.
5.Bình Phú	Bình Phú, Huyện Thạch thất Commune	21	15	71%	The rest of the area faces difficulties in land clearance
6.Quất Động	Quất Động, Thường Tín Commune	68	25	37%	Phase II is clearing and building infrastructure
7.Cam Thượng**	Cam Thượng, Huyện Ba Vì Commune	15	6	40%	The remaining area has been registered by investors but has not yet been cleared.
8.Sơn Đông**	Sơn Đông, Sơn Tây Ward	72	12	17%	
9.Bình Minh	Bình Minh, Huyện Thanh Oai Commune	41	3,1	8%	continuing to compensate, clearance
10. Đồng Giai	Vật Lại, Huyện Ba Vì Commune	20	2,1	11%	The remaining area is clearing and building technical infrastructure.
11. Đại Nghĩa**	Đại Nghĩa, Huyện Mỹ Đức Commune	30	7	23%	
12. Nguyên Khê	Nguyên Khê, Huyện Đông Anh Commune	96	18,5	19%	Phase II is building infrastructure

13. Đồng Mai	Đồng Mai, Hà Đông Commune	225	200	89%
Total		816.3	413.8	51%

*: The industrial cluster is deployed according to the specific mechanism of Ha Tay before (the investor builds the infrastructure by himself according to the approved detailed plan).
Source: Hanoi Department of Planning and Investment
- 5 CCNs **(Table 4)** and 7 FCNs are carrying out site clearance and preparing to build technical infrastructure.

Table 4. List of industrial clusters that are clearing land or building technical infrastructure

No	Cluster name	Location	Size (ha)
1	Kim Chung	Commune Kim Chung, Hoài Đức	49
2	Lại Yên	Commune Lại Yên, Hoài Đức	35
3	Hà Hồi - Quất Động	Comune Hà Hồi - Quất Động, Thường Tín	160
4	Ninh Hiệp	Commune Ninh Hiệp, Gia Lâm	64
5	Phú Xuyên	Commune Phú Xuyên	240

Source: Hanoi Department of Planning and Investment

- The remaining number of industrial clusters currently the city has no policy to deploy or prepare for investment (most of them just stop at the approval of detailed planning, projects, investor selection). or is adjusting the planning or suspending implementation pending the results of the planning review. Moreover, in below **Table 5**, we see that there are 11 industrial clusters waiting for changes.

Table 5. List of industrial clusters waiting for planning changes

No	Cluster name	Location	Size (ha)
1	Đại Xuyên	Đại Xuyên, Phú Xuyên	68
2	Đông Phú Yên	Trường Yên, Chương Mỹ	80
3	Đông La	Đông La, Huyện Hoài Đức	35
4	Nam Tiến Xuân	Nam Phương Tiến, Chương Mỹ	190
5	La Phù expansion	La Phù, Hòai Đức	40
6	Quất Động expansion	Quất Động, Thường Tín	43
7	Habeco	Quất Động, Thường Tín	76,8
8	Phú Xuyên	Huyện Phú Xuyên	240
9	CCNLN Đa Sỹ	Kiến Hưng, Hà Đông	13,2
10	CCNLN La Dương	Dương Nội, Hà Đông	8,2
11	CCNLN Đại Tự	Kim Chung, Hòai Đức	7,9

Source: Hanoi Department of Construction

The Main Occupations Operating at the Industrial Clusters in the City at Present are Mainly

- Producing building materials and interior decoration: ceramic tiles, ceramics, ...
- Producing and processing food: beer, wine, beverage, instant noodles, vermicelli, confectionery, animal feed, ...

- Mechanical production and processing: assembling cars, manufacturing mechanical products, rolling and pulling steel, manufacturing and processing mechanical products for agriculture, mechanical engineering, assembling traffic equipment, ...
- Producing consumer goods, chemicals, and agricultural materials: export garments, export shoes, construction glass, preliminary processing of rubber, recycled plastic, fertilizer production, ...
- Processing forest products: Producing household wood products for export, plywood, bamboo, and rattan handicrafts.
- Producing electrical appliances, assembling electronics and electrical equipment.

The authors' comments on the recent development of industrial clusters in Hanoi are as follows: First, Industrial clusters in Hanoi has increased rapidly in both quantity and scale, contributing to meeting a part of the demand for production space of enterprises, especially small and medium enterprises; serving the purpose of relocating polluting production facilities or interspersed in residential areas; partially solving the problem of environmental pollution in residential areas. In many localities, the development of industrial zones has played an active role in the consumption of agricultural, forestry, and fishery products, goods (developed by the processing industry), creating jobs and increasing incomes for local workers. improve farmers' lives and modernize rural areas.

Second, the industrial clusters located in the inner city tend to change the purpose from industrial production to commercial services (for example Hoang Mai, Cau Giay, Yen Nghia...). Although slow, most of the industrial clusters have started to build and complete according to the plan. However, the implementation situation of the forestry clusters is very slow, even as Phu Xuyen District has not yet implemented any forestry programs. The result shows that: the more urban centers are planned in a locality, the higher the proportion of industrial parks that have not yet been implemented.

Recommendations for Industrial Clusters

Focus on building infrastructure associated with environmental protection requirements of industrial clusters

The environment is a living condition for the survival and development of production and business. Environmental pollution is a condition in which the environment is polluted by chemical and biological substances that affect human health, living organisms and cause damage and difficulties to production and business. Environment and environmental pollution are major concerns in the development of industrial clusters, it is one of the goals of the establishment and development of industrial clusters. Industrial clusters still have not made any progress in solving environmental pollution. Through some preliminary surveys in some craft villages, industrial clusters showed that "The quality of wastewater from craft villages in recent years has shown that the pollution level has not decreased but tended to increase. In craft villages processing agricultural products and food, surface water in many places has COD, BOD5, NH4, Coliform concentrations exceeding tens to hundreds of times the Vietnamese standards; Surface water in weaving and dyeing villages is also heavily polluted; COD is 2-3 times higher than Vietnamese standards, BOD5 is 1.5 - 2.5 times higher, Coliform content is also quite high. In

bamboo and rattan craft villages, in many places, the COD content in surface water has exceeded Vietnam's standards, because bamboo and rattan must be soaked in water and the processing and treatment process generates wastewater containing a lot of lignin and organic matter. The main reason for the surface water here is that COD, BOD5, NH4, Coliform content exceeds QCVN many times, the water has a rotten smell and is cloudy. According to air quality monitoring data in several craft villages by the Center for Urban Environmental Engineering and Industrial Park recently, most of the craft villages have dust content exceeding the allowable standards. The concentration of SO2 gas in bamboo and rattan craft villages in Giang and processing agricultural products and food is higher than permitted standards". Therefore, it is necessary to have the right perspective and full awareness of environmental issues. According to the author, the point of view on the environment for industrial development and industrial infrastructure construction should be emphasized by:

Through a survey in a microbial fertilizer manufacturing company in Duong Lieu Industrial Park (Box 1), the author also found that there is a pretty good model of waste treatment of this industrial park, this is also a new model for industrial clusters to study and consider. its feasibility when applied to its industrial clusters.

Box 1. Experience in wastewater treatment at Duong Lieu IZ

Due to the characteristics of the industry of processing rice paper and vermicelli from dong flour and cassava, the pollution level is quite heavy. The local government has invested in building a common waste treatment facility for CCN and assigned Blue Sun Company (a fertilizer manufacturing company) to manage, exploit and operate. The Green Sun Company has invested an additional 2 billion VND to install a system of equipment that uses waste from the production activities of the craft village to produce micro-fertilizers. Green Sun Company collects wastes from production facilities in the Cluster to use as raw materials for the production of bio-fertilizers. This technology is transferred from Japan, it collects and settles organic matter from the entire wastewater in the village, through processing to create bagging products of biological BOKASHI - MTX and NPK - MTX fertilizer.

Source: Survey at Duong Lieu Industrial Park

+ Encourage production and business establishments to apply clean technology and environmentally friendly technology.

The city should have policies to encourage and give priority support to production and business establishments that apply clean and environmentally friendly technologies such as gas instead of coal, firewood in ceramic production, and charcoal production. Bees make use of the residues of buckwheat. High technology is a progressive and inevitable trend to solve environmental pollution in craft villages and industrial zones. Besides, it also promotes research and production of industrial clusters' environmental treatment technologies and equipment with reasonable prices to equip and apply in industrial clusters to actively contribute to the environmental protection of industrial clusters.

Set up an environmental monitoring system.

Industrial clusters need to build and invest in upgrading the operational capacity of the environmental monitoring system (Monitoring) in the cluster. Through this environmental monitoring system, it is possible to timely, accurately assess, and strictly control the status of environmental quality as well as the level of environmental pollution in the air, water, odor, noise, in the environment. area and its impact on the adjacent area. From there, there are timely

and effective technical measures to ensure environmental quality in general.

+ Establishing an environmental service center.

Management boards of industrial clusters can organize and provide environmental services to achieve environmental goals, generate new income and improve attractiveness to investors. The services of industrial clusters provided to manufacturing facilities can include many areas such as:

- Wastewater collection and treatment services, solid waste treatment.
- Environmental monitoring service.
- Environmental education and training services.
- Service of providing information about the environment.

Management boards of industrial clusters can organize and support environmental services. These amounts can be compensated when collecting fees for wastewater treatment, solid waste recovery and treatment, inspection and assessment of the quality of input materials and output products according to environmental objectives, and environmental training. schools, technical consulting services. These services can be assigned to the environmental service center to perform as the management boards that are required to coordinate and monitor these activities.

Improving the Quality of Infrastructure Construction Works for Industrial Clusters

Products of the industrial infrastructure include tangible products (internal roads, electricity supply network, water supply, telecommunications services, wastewater treatment works...) and intangible products (training), public administrative services, security, culture...). These products are formed and developed through construction investment projects. Investment projects are implemented through a continuous process from investment policy to design, bidding, construction, handover and then putting into use **(Figure 1)**.

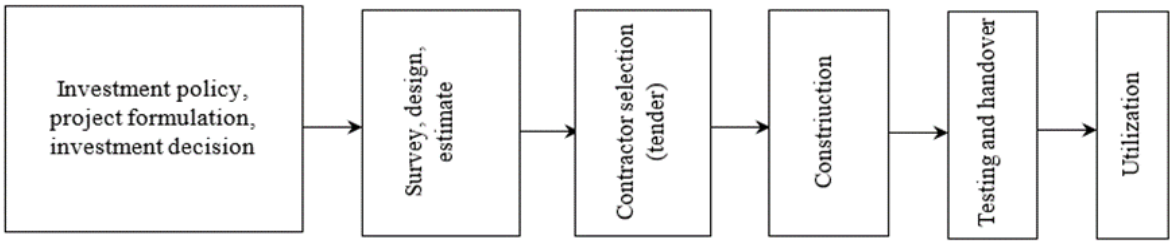

Figure 1. Construction process
Source: Made by author

The quality of construction works (internal roads, electricity networks, telecommunications facilities, wastewater treatment works...) is assessed by the degree of satisfaction of construction and use requirements.

The work and steps of quality management can be modeled in the diagram.

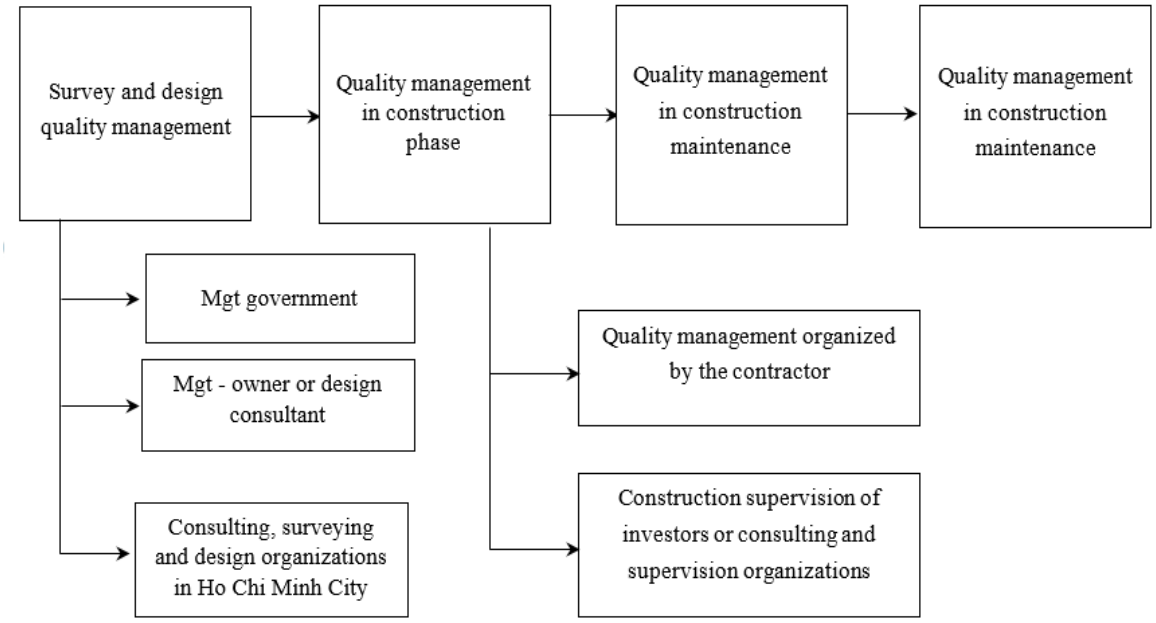

Figure 2. Construction-quality management
Source: author

To ensure and improve the quality of construction works of industrial infrastructure, it is necessary to implement several measures as follows:

First, Implementation of published construction standards and technical regulations that promulgate and develop some technical standards for industrial clusters technical infrastructure works

Construction standards are an effective tool to ensure and improve the quality of construction works of industrial clusters' infrastructure. The number of building standards is numerous and specific. Those are the standards for the processes: survey, design, construction, preservation, and maintenance of the works. In terms of objects, which are: material standards, construction product standards, environmental standards, process standards.

The works of industrial clusters infrastructure are relatively new construction products, so many new standards need to be developed.

Box 2. Some indicators in Vietnam's construction regulations on planning

- Water for concentrated industrial zones and clusters: determined by the type of industry, ensuring a minimum of 20m3/ha/day and night for at least 60% of the area
- Industrial wastewater, when discharged into surface water sources or urban sewers, must have a quality that meets environmental requirements as prescribed (TCVN 5942-1995). Industrial wastewater must be classified (contaminated water, non-polluted water, toxic water ...) before being collected and has its treatment solution. Sludge from the wastewater treatment system must be collected and transported by specialized vehicles to solid waste treatment facilities for treatment.
- When building new CCNs without knowing the size of construction land, you can refer to the following regulations on the power supply for industrial production:
- Other building materials industry, mechanical engineering: 250 KW/ha

- Food and textile processing industry: 200KW/ha
- Shoes, leather, and garment industry: 160 KW/ha
- A cluster of small industries and handicrafts: 140 KW/ha
- Handicraft production facilities: 120 KW/ha

Source: Vietnam Construction Code 01: 2008/BXD

(2). Strengthen the quality management of survey, design, and construction of industrial infrastructure.

Survey and design are important stages of the whole construction investment process. Over the years, these activities have had positive changes; contribute to improving the quality of the works and gradually improving the investment efficiency of the projects. However, in reality, there are still many construction works that are not suitable with reality when they are constructed, causing waste in investment. , which directly affects the exploitation and use process. The cause of the above situation, first of all, is due to the awareness of responsibility in managing the quality of construction survey and design works of the subjects involved in construction activities, including investors, private Project management consultants, construction consulting contractors, as well as some State management agencies in charge of construction, are still incomplete. The survey work has not been carried out following the survey process, the survey data is not suitable, there is not enough data to serve the design work. The design work has not yet implemented the regulations on checking capacity conditions for construction activities, formulating and approving tasks for design work; the design is not consistent with the approved construction planning; the application of standards and regulations is not uniform, there are still many limitations and shortcomings, or the regulations of the national technical regulations and the Vietnam Construction Regulations have not been applied or fully applied. The handling of violations on survey and design quality is not strict and timely, affecting the quality of construction works.

To overcome the above situation, to improve the quality of industrial infrastructure construction works, the survey and design of industrial infrastructure construction works should take the following measures:

- For state management agencies, it is necessary to: develop a plan to open training courses on standards and regulations related to survey, design and construction; Organizations to develop and guide the management process, inspection contents, and handling of violations for organizations and individuals whose acts of operation exceed the conditions for practice capacity, operate in contravention of the practicing certificate. , operating without a practicing certificate; Periodic inspection of owners of industrial infrastructure design survey and design works.
- Investors (or authorized project management units) investing in the construction of industrial infrastructure works have the responsibility to Properly and fully perform the rights and obligations of the owner of the surveying and designing consultancy contractor with the qualification. legal person, having the appropriate professional capacity and experience as prescribed. When appraising, approving, or accepting survey and design products, the capacity conditions of organizations and individuals performing survey and design work must be considered.

(3). Improve construction capacity and strengthen construction management including Construction progress management, construction volume management, work safety management on construction sites, management of construction environment.

(4). Develop and implement criteria and quality criteria for the construction of works of industrial infrastructure. The criteria and targets could be:

+ Investment rate for 1 hectare of land of industrial luster (CCN);
+ Design samples for each type of industrial luster;
+ Functional subdivision in 1 industrial luster.

The planning of functional subdivisions is carried out according to the specific conditions of each zone and cluster according to the motto of saving land fund, improving infrastructure investment efficiency, per current design and construction standards. . The following guidelines can be applied:

* Land for construction factory, factory: 55 - 65%
* Land for construction, technical works: 1.0 - 1.5%
* Land for construction, management, and administration center 1.0 - 1.5%
* Construction land transportation works 8 - 12%
* Land for supporting services and trees 12 - 20%

+ Each industrial luster must build at least 1 wastewater treatment station and 1 power supply transformer station.
+ The solid waste is concentrated in the technical treatment area and transported to the prescribed place for treatment according to the general planning of the City. Industrial waste and scrap yards must be fenced and not adversely affect the sanitary conditions of the surrounding production and business establishments and do not contaminate the environment. Dumpings of hazardous wastes (inflammable, explosive, epidemic…) must have measures to handle toxic substances and ensure isolation distances.
+ It is necessary to arrange a road for the fire truck outside to run along at least one side of the house, to ensure that the fire truck reaches the place where the fire fighting water is collected (fire hydrants, fire fighting water storage tanks, etc.)

Industrial cluster infrastructure is a combination of physical, technical, and social facilities that play a fundamental role in the development and operation of industrial clusters. Industrial clusters infrastructure is divided into 2 categories: technical infrastructure (hardware) and social infrastructure (software).

Soloveva *et al.* (2021) and Zohra and Mustapha (2019) pointed out regions and industries can increase (competitiveness) by cluster policy and for innovative potential as well.

To build industrial infrastructure, it is necessary to understand: indicators reflecting industrial infrastructure; construction process, and factors affecting the construction of industrial infrastructure

CONCLUSION

The State's policies on building infrastructure for industrial zones include: i) The policy of

acquiring land fund for the construction of industrial infrastructure; ii) policy on planning for industrial development and infrastructure construction planning; iii) Policy on investment and construction of industrial infrastructure; iv) Policy on management of construction investment projects; v) Policy on construction quality management.

Experience in industrial development and industrial infrastructure construction in some countries and provinces in the country has helped Hanoi City draw lessons that can be learned in the development of industrial infrastructure in Hanoi.

After describing and analyzing the following issues: i) Natural conditions and socio-economic characteristics affecting the construction of industrial infrastructure in Hanoi city; ii) Development situation of industrial zones; iii) Situation of policy formulation and implementation; iv) Industrial development planning and detailed planning of industrial infrastructure; v) Situation of construction of constituent elements of industrial infrastructure; vi) Case study on infrastructure construction of some industrial complexes in Hanoi city. The author has assessed the construction of industrial infrastructure in Hanoi city. The results and advantages of building industrial infrastructure are: Focusing on investment and planning; Through many years of construction and development, the city has built a relatively synchronous technical infrastructure system to meet the requirements of industrial development; Combine the development of industrial clusters and industrial infrastructures with the new rural construction program; Promoting the role of the State in the construction of industrial infrastructure.

Also risk management task in clusters need to be considered (Huy & Hien, 2010; Dat *et al.*, 2020; Hang *et al.*, 2020; Huong *et al.*, 2021; Thi Ngu *et al.*, 2021).

And also we need more researches in journals conducted (Yen & Huong, 2010; Hai *et al.*, 2021; Hoa *et al.*, 2021; Hoang & Huy, 2021; Huy & Thuy, 2021; Thi Hang *et al.*, 2021; Tinh *et al.*, 2021).

Research Limitation

Authors need to analyze comparisons for other countries and other markets.

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