

Industrial Zones Development in Hanoi towards 2030's SDGs

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In recent years, the Hanoi Urban Governance has built and promulgated many management policies on socio-economic and environment and increased investment for sustainable development of industrial zones. However, Hanoi is still facing and addressing the conflicts of environment associated with group interests, including the conflicts of environment caused by industrial waste and its effects on the livelihood of people living in zones where the accident of industrial pollution occurs. Therefore, the urgent need now is to take management measures, specific solutions to regulate the activities of the state management, to address the security of society and to protect the ecology of environment in response to the risks of industry that is becoming more and more aggravated. In the time of COVID-19, the task of economics development is very important, many issues of the environment have not been solved, the pressure on the environment is growing, the risk of Hanoi becomes obsolete technological dumps.

The study focuses on the process of building industrial zones in Hanoi from 2008 until now. By using the revised Pressure – Status – Responses (PSR) model, firstly developed by OECD 2003, fourteen major issues grouped and divided in 03 criteria such as: Pressure (P) is identified by disaster, industrial accident, population growth, and land-use change; State (S) is measured by land, water and air indexes, public health and society's vice. And, Response (R) is implemented risk management policies effectiveness and efficiency. According to the revised PSR model of 14 indicators integrating into the Hanoi Industrial Zones (IZ), the authors assessed a set of 14 major issues relate to the risks of 08 Hanoi Industrial zones in order to manage the development of Industrial zones towards 2030's Sustainable Development Goals (SDGs).

Keywords: Risk Management, Industrial Zones, revised PSR, Hanoi.

Industry and its activities are considered as devastation of landuse, degradation of natural resources. Because industry is to consumer so much of energy and fossil fuels and to emit toxic wastes that pollute the land (solid waste), water pollution (liquid waste), air pollution (such as fine PM2.5, SO₂, NO₂, CO, CO₂...) and It is the main cause of global climate change such as increasing temperature, sea water rise... In addition, industrial development is also often related to the geographical distribution of the population (including relocation and resettlement). The impact of distribution on people can be significant as they face security of region, public health, conflict of environment, and other aspect of society Nguyen (2015). The paper focuses a number of the risks of Industrial zones (IZs) that should be considered in developing Hanoi industrial zones towards 2030's SDGs.

1. OVERVIEW OF MANAGING IN INDUSTRIAL ZONES

In Vietnam, the state management of industrial zones has been decentralized, with central and local governments taking the main responsibility for attracting FDI and managing industrial zones. The Ministry of Planning and Investment (MPI), a role of the central authority, is responsible for calling/encouraging foreign investor in IZs and/or central economic zones (EZs). However, the research report also assessed the FDI attraction as low (Ohno 2015). In 2014, there are in total 12 central economic zones and more 05 five economic zones (blue dots) will be constructed in the next future.



Figure 1: Vietnam distribution map of central economic zones
 (Source: Land Administration Agency, 2014)

There are 5 industrial zones invested, built and managed by foreign partners (Japan: 3, Singapore: 1, Thailand: 1); some old Economic zones (EZs) are owned by Taiwan and Malaysia; a number of high-technology IZs and EZs are directly managed by central government; the rest is invested and managed by local governments or domestic investors (Ohno 2015). The National goal of Vietnam is to become an industrial country by 2020 and Vietnam government has tried to encourage high-tech industries and attract the FDI for industrial zones development, but the policy has not been effective. The supporting industries, as one of the most important stages, have not broken through the invisible barrier of policy framework, State-owned enterprises reform and SMEs strategy development (Ichikawa 2005).

In 2008, the 12th National Assembly issued Resolution No. 15/2008/QH12 on adjusting the administrative boundaries of Hanoi Capital (QH 2008). The new Hanoi capital, including the former Hanoi City with the former Ha Tay province, Me Linh district of Vinh Phuc province and 4 communes of Luong Son district of Hoa Binh province with a total natural area of 3,344.6 km², population of 6,350,000 people (Nguyen 2020). And, 2030's Hanoi Industrial Zones Planning approved by increasing a number of 33 industrial zones with total area about 80 km² but by the end of 2017, 08 industrial zones have officially entered operating with a total area of 12.35 km², basically filling 95% of the area and 7 industrial zones are in the process of building technical infrastructure to prepare for attracting investment. The system of technical infrastructure in the zones is invested in complete construction, total investment capital is about 150 million USD and over 1500 billion VND, meeting the requirements of demand for investors. By the end of 2017, industrial zones in Hanoi attracted 629 investment projects, of which 325 FDI projects are from 20 foreign countries with registered capital reached US\$5.4 billion; 304 projects registered for domestic investment, registered capital reached VND 13,386 billion. The list of investing industries includes: Mechanical industry, electronic components, information technology, plastics and supporting industries. The FDI's projects in Hanoi are from: Japan (29%), South Korea (7%), Taiwan (5%), China (4%), Thailand... Japanese enterprises account for nearly 30% of registered capital with many large corporations such as MeiKo (manufacturing electronic boards) with registered capital \$300 million, Cannon (electronics production) registered capital of more than \$250 million and Yougfat registered capital of 100 million USD (Tran 2018).

The development of industrial zones has been directed by the Hanoi government, which is one of the breakthroughs in socio-economic development, creating regional/regional linkages. Hanoi industrial zones with high occupancy rate (as average 87% seen in Table 1) have created economic transformation, contributed to the budget and achieved some important initial results in industrialization and modernization (Tran 2018). However, the risks and hazards of industrial zones continued to increase, with many incidents causing serious environmental disasters, e.g: fire incident at the factory of Rang Dong thermos light bulb company, Thanh Xuan district (8/2019), and affecting the COVID-19 virus to the people's lives

and production chains. Therefore, Hanoi government has just controlled and monitored the industrial zones as an attempt of achieving its objectives.

Table 1. The scope of Hanoi Industrial zones and its occupancy

Industrial Name	Investment Capital	Area (km ²)	Occupancy rate (%)
Bac Thang Long	\$90.3 million	2.74	100
Nam Thang Long	VND92 billion	0.3	100
Noi Bai	\$35 million	1.15	90
Hanoi – Dai Tu	\$12 million	0.4	70
Sai Dong B	VND120.36 billion	0.49	100
Thach That – Quoc Oai	VND410 billion	1.5	95
Phu Nghia	VND660 billion	1.7	65
Quang Minh 1	VND592 billion	4.07	80
Average		12,35	87

(Source: Hanoi Management board of Industrial Zones and Export Processing Zones, 2017)

The responsibility of Hanoi government through the management board of IZs and EPZs is to improve the quality of workers’ lives and ensure the financial resources for implementing policies of IZs development. The 2017 management-results report shown that Hanoi IZs clearly identify target investors and use relevant promotion techniques (see in Table 2). The investment projects attracted to Hanoi IZs are the fields such as: electronics industry, mechanical engineering gas, pharmaceuticals, textiles, and infrastructure investment for IZs; Many FDI projects are export processing enterprises, as supporting industries for Samsung, contributing to export products, and do more jobs in the North of Vietnam. (the total number of employees working in Hanoi IZs are 145,937 people, of which Vietnamese workers are 144,739 people, 1,198 foreign workers).

Table 2. The list of top-ten countries investing on Hanoi Industrial Zones

Country/Territory	Investment Capital	Investment Project	Proportion (%)
Japan	\$3212 million	159	54.7
China, Hongkong - Macau	\$576 million	19	9.8
Vietnam	\$552.9 million	295	9.4

Korea (South)	\$392.3 million	49	6.7
Singapore	\$291 million	16	5.0
Netherland	\$242 million	2	4.1
Thailand	\$158.3 million	18	2.7
Taipei	\$148.4 million	14	2.5
British Virgin Islands	\$86 million	7	1.5
Malaysia	\$45.5 million	11	0.8
Sum	\$5,704.4 million	590	100

(Source: Hanoi Management board of Industrial Zones and Export Processing Zones, 2017)

The environmental risk management of Hanoi IZs conducted a number of contracts that should be assessed the impact of environmental changes on land, water and air pollution. Monitoring and modelling of the risks of Hanoi IZs shown that the rapid increase of industrial solid waste, including a large part of hazardous industrial wastes, is becoming one of the urgent environmental problems. In addition, the state management tools of environmental protection in Hanoi IZs has not kept pace with actual requirements for managers. The spread of COVID-19 pandemic in Hanoi IZs, as one of the causes affecting the public health, is a challenge of ‘Right and Good’ risk management towards 2030’s SDGs. The terms ‘Right’ and ‘Good’ management lead to effectiveness and efficiency, respectively (Malik 2014).

2. PRINCIPLES OF PREVENTING IN INDUSTRIAL RISKS

According to the OECD, the purpose “Risk Management” is the creation and protection of value. It improves performance, encourages innovation and supports the achievement of objectives.

In the context of developing Hanoi IZs, risk management policies and industrial processes are developed and implemented in order to overcome limitations and to mitigate risks of natural resources, society and artificial things.

According to the analysis of data related to Hanoi IZs, the author applied the principle of industrial risk prevention. It requires a change in awareness and attitudes of stakeholders, sets up ISO 31000:2018 and provides guidelines for green technologies and management into the organization. The approach of industrial risk prevention in Hanoi IZs is to focus as follows:

- Continuously applying the strategy of industrial risk prevention (the most important principle);

- Preserving materials and energy, removing hazardous raw materials and reducing mass as well as the toxicity of all hazardous wastes and vapors at the source (the principle of eliminating and minimizing the environmental damage at the source);
- Reducing negative impact throughout the production of life cycle (the principle from cradle to grave);
- Encouraging innovation of industrial-support services (the main principle of steering sustainable growth and human development).
- And, Managing industrial risks according to the OECD risk management as the Figure 2.

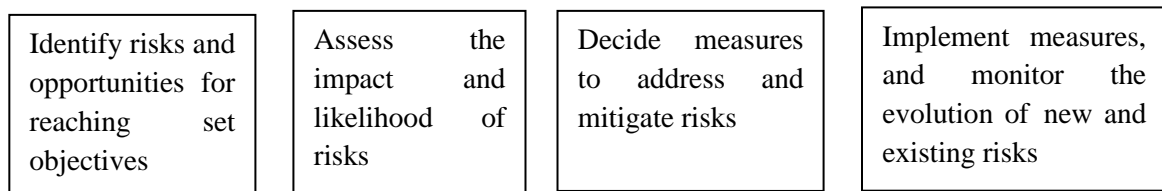


Figure 2. Four key steps for risk management

(Source: OECD, 2021)

The PSR framework, developed by the OECD in 2003, is the Pressure-State-Response model which provides a first classification of indicators into indicators of environmental pressures, both direct and indirect, indicators of environmental conditions and indicators of societal responses. It distinguishes a number of environmental issues which reflect major environmental preoccupations and challenges in OECD countries. Thus, for each issue, indicators of environmental pressure, conditions and societal responses were defined (OECD 2003).

The revised major issues relate to the approach of industrial risk prevention dealing with aspects of change management, addition (if application) the other issues relate to the environmental principles as rules and regulations, Polluter-Pays, Benefit-Pays, and sustainable development, focusing on the Vietnam Laws on Environmental Protection, 2021(QH 2014).

The revised PSR model, a cause-effect relationship, is developed to focus on industrial risk policies and implementing. The fourteen major issues grouped and divided in 03 criteria such as: Pressure (P) is identified by disaster, industrial accident, population growth, and land-use change; State (S) is measured by land, water and air indexes, public health and society's vice. And, Response (R) is implemented risk management policies effectiveness and efficiency (Nguyen 2019).

According to the revised PSR model of 14 indicators integrating into the Hanoi IZs, the author can conduct the risks for assessing 08 industrial zones in Hanoi as well as managing industrial risks with focus on security/safety of environment and community.

3. RISK PILOT ASSESSING OF HANOI INDUSTRIAL ZONES

The scope

- The scope of risk pilot assessing is to focused on 08 Hanoi IZs (Table 1) consolidated by the Prime Minister's Decision No. 1107/QĐ-TTg dated August 21th, 2006 on approving the Industrial Zones Development Plan of Hanoi up to 2020 and vision to 2030 (Figure 3).
- Based on the new PSR model, the result of the study is to assess the risk of Hanoi IZs and to propose a number of solutions related to Hanoi IZs risk management towards the 2030 SDGs.

The content

- Classification of Hanoi IZs development according to the criteria as investment capital, area, and total employees.
- Classification of Hanoi IZs management according to the risks of environment and society.
- Scoring of Indicators according to the new PSR model

Methods

- Data collections, and information analysis.
- Field surveys.
- Expert interview.

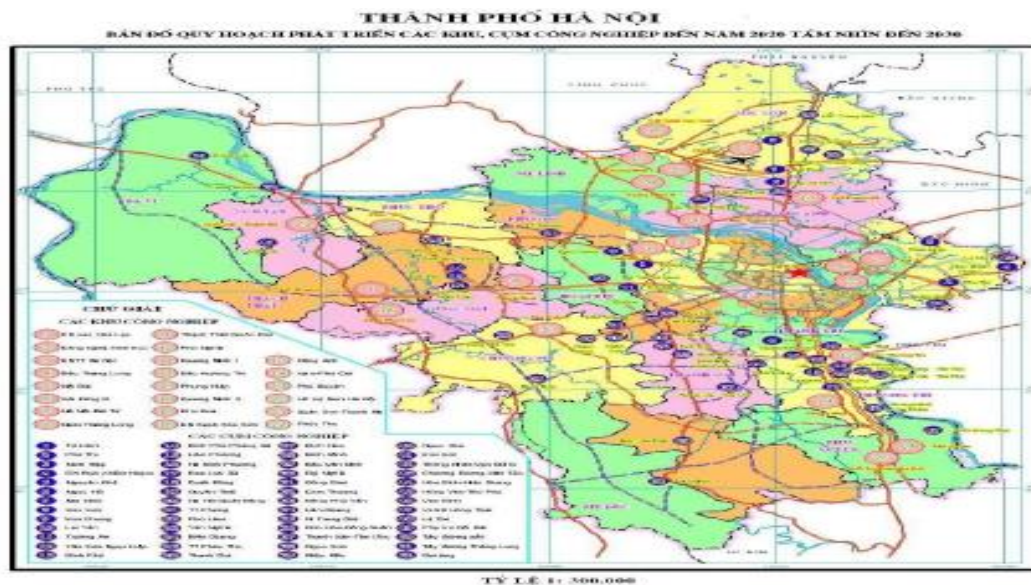


Figure 3. Hanoi Industrial Zones Development Plan

(Source: Hanoi Master Plan of Socie-Economic Development, 2016)

Industrial Zones Development in Hanoi Towards 2030's Sustainable Development Goals (11932)
Nguyen Viet-Hung, Pham Minh-Hung, Nguyen Van-Hau and Nguyen Tien-Hiep (Vietnam)

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The result of risk pilot have identified a set of 14 major issues of industrial risks deviding in 03 groups such as Pressure: e.g. disaster, industrial accident, population growth and land-use change; States: e.g. land, water, air pollution, public health and society's vice; and Responses : e.g. water processing center, high-advanced technology, CDM, ISO:31000 and Eco-Industry (seen as Table 3).

Table 3. The PSR model for assessing industrial risks

Group (1)	Notation (2)	Issue (3)	Explanation (4)	Scoring (5)
Pressure	P1	Disaster	Natural disasters can be faced such as storms, tornadoes, floods, earthquakes etc.	1. less occur and not serious (0-3); 2. Serious, but not unexpected and infrequent (4-6); 3. Often, suddenly, seriously (7-10).
	P2	Industrial Accident	The risks of human made impact IZs environment such as fire, explosion, nuclear materials leakage or the spread of the COVID-19 virus.	1. Property damage (0-3); 2. Loss of environment, ecosystem (4-6); 3. human die and harm to animal and trees (7-10).
	P3	Population growth	The growth rate of the mechanical population (reflecting the distribution of employees in IZs)	1. Low rate <2% (0-3). 2. Moderate rate from 2 to 3% (4-6). 3. High rate > 3% (7-10).
	P4	Land-use change	Warehouse, dormitory, medical care centre, utilities and canteen, etc.	1. Specialized Planning (0-3); 2. Detailed Planning (4-6). 3. General Planning (7-10).
State	S1	Solid waste (mg/l)	According to VN solid waste (QCVN: Solid waste)	1. Low polluted (0-3). 2. Average polluted (4-6). 3. High polluted (7-10)
	S2	Liquid waster (mg/l)	According to VN water discharge (TCCP B)	1. Low polluted (0-3). 2. Average polluted (4-6). 3. High polluted (7-10)
	S3	Emission	According to VN air quality (QCVN: Air)	1. Low polluted (0-3). 2. Average polluted (4-6). 3. High polluted (7-10)
	S4	Public health (occupational diseases)	According to the report of medical cares relate to the due to exposure to poison in the form of solid, liquid and gas	1. lightly injure(0-3); 2. heavily injure (4-6); 3. die (7-10).

	S5	Society' vice	According to the report of legal initiatives such as environmental conflict, jobless, abuse, etc.	1. High HDI ¹ (0-3). 2. Average HDI (4-6). 3. Low HDI (7-10)
Resposes	R1	Water processing center	To eliminate and reduce wastewater in both quantity and toxicity	1. The water treatment/process improves (7-10) 2. Wastewater reuses (4-6) 3. Wastewater recycles (0-3)
	R2	High-advanced technology	To improve the efficiency of technology, and protect the ecological environment	1. Non applied (7-10) 2. Average applied (3-6) 3. Good applied (0-3)
	R3	Clean Development Mechanism	To reduce emission of IZs through the CER credit	1. Non applied (7-10) 2. Average applied (3-6) 3. Good applied (0-3)
	R4	ISO: 31000	To provide the model of risk management for organization to achieving its objectives.	1. Non integrated or rarely (7-10) 2. Average integrated (4-6) 3. High integrated and high efficiency (0-3).
	R5	Eco-industry	To manage the risks of IZs effectiveness and efficiency. Management system: Good practice and Righ thinking	1. Non integrated or rarely (7-10) 2. Average integrated (4-6) 3. High integrated and high efficiency (0-3)

(Source: Author, 2021)

Table 4. the level of environmental risk in idustiral zones

Total score (weighted index)	The level of environmental risk
0 – 200	Non risk
200 – 400	Low risk
400 – 600	Risk
600 – 800	Potential risk
800 – 1000	High risk

(Source: Author, 2021)

¹ Human Development Index (HDI) is a construct designed to measure human development of countries around the world. HDI is a composite statistic of life expectancy, education and income per capita indicators, which are used to rank countries into four tiers of human development. In other words, the HDI is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. More information may be found here: <http://hdr.undp.org/en/content/human-development-index-hdi>

The 14 major issues of the PSR model were monitored/assessed the impact and likelihood of risks in 08 IZs with the value of detailed total score (seen in Table 5) for each industrial zone (from a to h). The total score of each IZs were compared to the level of environmental risk in Table 4.

Table 5(a). The result of assessing risks in Bac Thang Long IZ

Group (1)	Notation (2)	Issue (3)	Scoring³ (4)	Weighted Index⁴ (5)	Total Score⁵ (6)=(4)x(5)
Pressure	P1	Disaster	6	5	40
	P2	Industrial accident	8	6	48
	P3	Population growth	6	6	36
	P4	Land-use change	8	5	40
State	S1	Solid waste	9	9	81
	S2	Liquid waste	9	9	81
	S3	Emission	8	8	56
	S4	Public health	9	6	54
	S5	Society's vice	9	9	81
Responses	R1	Water processing center	6	7	42
	R2	High-advanced technology	8	7	56
	R3	CDM	7	6	42
	R4	ISO: 31000	5	8	40
	R5	Eco-industry	2	9	18
Total Score				100	705

(Source: Author, 2021)

Table 5(b). The result of assessing risks in Nam Thang Long IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	5	30
	P2	Industrial accident	8	6	48
	P3	Population growth	6	7	42
	P4	Land-use change	8	8	64
State	S1	Solid waste	9	6	54
	S2	Liquid waste	9	6	54
	S3	Emission	8	8	64
	S4	Public health	9	6	54
	S5	Society's vice	9	9	81
Responses	R1	Water processing center	6	6	36

	R2	High-advanced technology	8	8	64
	R3	CDM	7	6	42
	R4	ISO: 31000	5	8	40
	R5	Eco-industry	2	9	18
Total Score				100	691

(Source: Author, 2021)

Table 5(c). The result of assessing risks in Noi Bai IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	5	30
	P2	Industrial accident	8	6	48
	P3	Population growth	6	7	42
	P4	Land-use change	8	7	56
State	S1	Solid waste	9	6	54
	S2	Liquid waste	9	8	72
	S3	Emission	8	8	64
	S4	Public health	9	6	54
	S5	Society's vice	9	8	72
Responses	R1	Water processing center	6	6	36
	R2	High-advanced technology	8	8	64
	R3	CDM	7	6	56
	R4	ISO: 31000	5	8	40
	R5	Eco-industry	2	9	18
Total Score				100	697

(Source: Author, 2021)

Table 5(d). The result of assessing risks in Hanoi-Dai Tu IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	3	24
	P2	Industrial accident	8	5	40
	P3	Population growth	6	7	42
	P4	Land-use change	8	4	32
State	S1	Solid waste	9	6	54
	S2	Liquid waste	9	7	63
	S3	Emission	8	7	56
	S4	Public health	9	5	45
	S5	Society's vice	9	7	63

Responses	R1	Water processing center	6	6	36
	R2	High-advanced technology	8	8	64
	R3	CDM	7	6	42
	R4	ISO: 31000	5	8	40
	R5	Eco-industry	2	8	16
Total Score				100	640

(Source: Author, 2021)

Table 5(e). The result of assessing risks in Sai Dong B IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	6	36
	P2	Industrial accident	8	10	80
	P3	Population growth	6	8	56
	P4	Land-use change	8	6	45
State	S1	Solid waste	9	8	72
	S2	Liquid waste	9	9	81
	S3	Emission	8	5	40
	S4	Public health	9	8	72
	S5	Society's vice	9	9	81
Responses	R1	Water processing center	6	8	48
	R2	High-advanced technology	8	8	64
	R3	CDM	7	6	42
	R4	ISO: 31000	5	9	45
	R5	Eco-industry	2	9	18
Total Score				100	775

(Source: Author, 2021)

Table 5(f). The result of assessing risks in Thach That – Quoc Oai IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	5	30
	P2	Industrial accident	8	6	48
	P3	Population growth	6	5	30
	P4	Land-use change	8	5	40
State	S1	Solid waste	9	6	54
	S2	Liquid waste	9	7	63
	S3	Emission	8	6	48

	S4	Public health	9	6	54
	S5	Society's vice	9	8	72
Responses	R1	Water processing center	6	8	48
	R2	High-advanced technology	8	8	64
	R3	CDM	7	6	56
	R4	ISO: 31000	5	8	40
	R5	Eco-industry	2	5	10
Total Score				100	643

(Source: Author, 2021)

Table 5(g). The result of assessing risks in Phu Nghia IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	4	24
	P2	Industrial accident	8	3	24
	P3	Population growth	6	4	24
	P4	Land-use change	8	8	64
State	S1	Solid waste	9	4	36
	S2	Liquid waste	9	3	27
	S3	Emission	8	5	40
	S4	Public health	9	6	54
	S5	Society's vice	9	4	36
Responses	R1	Water processing center	6	9	54
	R2	High-advanced technology	8	6	48
	R3	CDM	7	4	28
	R4	ISO: 31000	5	3	15
	R5	Eco-industry	2	4	8
Total Score				100	482

(Source: Author, 2021)

Table 5(h). The result of assessing risks in Quang Minh No1 IZ

Group (1)	Notation (2)	Issue (3)	Scoring (4)	Weighted Index (5)	Total Score (6)=(4)x(5)
Pressure	P1	Disaster	6	4	24
	P2	Industrial accident	8	6	48
	P3	Population growth	6	7	42
	P4	Land-use change	8	8	64
State	S1	Solid waste	9	5	45
	S2	Liquid waste	9	6	54

	S3	Emission	8	7	56
	S4	Public health	9	8	72
	S5	Society's vice	9	8	72
Responses	R1	Water processing center	6	6	36
	R2	High-advanced technology	8	4	32
	R3	CDM	7	3	21
	R4	ISO: 31000	5	4	20
	R5	Eco-industry	2	6	12
Total Score				100	598

(Source: Author, 2021)

4. Result and recommendations

Based on the new PSR model, the results of risk pilot assessing are to decide measures to address and mitigate risks of each industrial zone. The major issues of assessing risk in Hanoi IZs were scored a high value than the others, e.g: Pressure criteria: P2 -Industrial Accident, P4-Landuse change; State criteria: S2-Liquid waste, S4-Public health, S5-Society's vice; and Response criteria: R1-Water processing center, and R3- High advanced technology. Firstly, Hanoi Government should manage the industrial accident-not delayed or avoided (P2), and it is necessary to integrate land-use change to the IZ detail planning (P4) in order to build the monitoring system of liquid waste (S2) and the medical centre for employee treatment (S4), and ensure the policies relate to the society's aid/support for unemployees (S5) as well as connect individual wastewater system to water processing center (R1) and encourage the green technology and management for organization/enterprises. Secondly, the pilot results were scored the highest value of 775 in Sai Dong B IZ (potential risk), and the lowest value of 482 in Phu Nghia IZ (risk). According to the fourth step of OECD risk management, Hanoi government should implement integrated measures, and continuously monitor the existing risks at the high level of emergency.

Last, not a least, the new PSR model identified a set of 14 major issues could be used for Hanoi risk management of Industrial zones development towards 2030's SDGs.

The following are four general recommendations, related to which a number of key steps of OECD risk management are also suggested, along with the agencies who might take primary and secondary responsibility of Hanoi IZs:

1. Industries can play an important role in developing of Socio-Economic, especially if Hanoi government learn to identify IZs risks and challenges for calling high-advanced technology, CDM, promoting ISO 31000: 2018 and approaches of Eco-Industry.
2. Industrial Risk strategies must ensure the public health and reduce the risk impacts on society and environment.
3. Hanoi IZs policies should be considered the PSR model as a tool of IZs development towards SDGs 2030.
4. Industrial policy package should therefore strive to create a cooperation platform learning and sharing good practices of risk management on Internet.

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³ The scoring of individual indicator was estimated by using the evaluating scale in column 5 in Table 3.

⁴ The weighted index was valued as the scale of 10.

⁵ The value of total score, by each individual score multiplied values in column 4 with column 5, cumulated the value of all indicators. Its value indicated that the individual PSR could be higher score than others in the group.

Biographical notes

Working as a Trainer, Vice Head of the Center for Technology and Library- NAPA, I studied a Msc degree on Environmental Sciences and mid 2005 I started my PhD study at University of Greifswald, Germany. Now I do teaching and consulting on environmental risk management with several institutes, develop the GIS application for BA's program of urban management, and continue my applied research on e-governance application on urban planning with focus on sustainable development for natural resources in Vietnam.

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