Sustainability indicators monitoring system designed for Keppel Land

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Abstract: Today, enterprises are paying more and more attention to the concept of sustainable development, which includes economic sustainable development, social sustainable development and environmentally sustainable development, only when these three points are met can a truly good, socially responsible and successful business be called. This paper focuses on the environmentally sustainable development of enterprises. One of the main purposes of the establishment and development of enterprises is to make contributions to the better development of the human society under the Contemporary Social Environment of rapid development, however, in doing so, it will sometimes harm the living environment of human beings, consume and destroy the precious natural resources on which human beings depend for survival, and sometimes bring great damage to human body's health. Therefore, in the face of how to create more material wealth for human society under the condition of maintaining the sustainable development of the environment, this paper has made a series of research and exploration. In this study, firstly, the meaning of sustainable development, sustainable monitoring systems and indicators of sustainability were thoroughly reviewed. Then, taking the real estate enterprises that have a great impact on the environment as an example, Keppel Land, a well-known Singapore multinational company in the world, was selected in the study to design a series of environmental sustainability monitoring indicators, and each indicator was analyzed in detail, so as to provide a certain direction of help for the enterprise's more sustainable development in the future.

1. Introduction

1.1 The meaning of sustainable development

Sustainable development is an economic growth mode that focuses on long-term development. It refers to the economic development that, on the basis of meeting the constraints of environmental resources, not only meets the needs of the current generation of economic growth, but does not endanger the ability of future generations to meet their own needs, and guarantees the continuous increase of the net social welfare level now and in the future (Brundtland, Khalid, Agnelli, Al-Athel, & Chidzero, 1987). As the microcosmic subject of market economy and an important member of society, the sustainable development of enterprises is a solid foundation for the sustainable development of economy, environment and society (Zu, 2013). This is mainly because many of today's economic, social and environmental problems are closely related to the business mode and state of enterprises. The development of enterprises will directly cause changes in economic, social and environmental conditions. Therefore, the sustainable development of enterprises is not only the common interest of enterprises and society, but also the common task faced by enterprises and society. Sustainable development is the general term of economic sustainable development, environmental sustainable development and social sustainable development. Its main characteristics are as follows: economic sustainability is the leading factor, environmental sustainability is the basis, and social sustainability is the goal. It is the integration of economy, environment and society (Holden & Linnerud, 2006).

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1.2 Monitoring systems

The monitoring system is composed of indicators. The monitoring system mainly contains three characteristics, namely, early warning, optimization and supervision, which can enrich the existing solutions of the monitored party, realize the possible abnormal situation in the future and achieve the preventive measures (Sučić, Andjelkovic, & Tomsic, 2015). As sustainable development receives increasing attention from all sectors of society, international organizations, non-governmental organizations, governments and enterprises begin to develop systems that can monitor the impact of their organizational activities on the three dimensions of environment, society and economy (Reyers, Stafford-Smith, Erb, Scholes, & Selomane, 2017). The monitoring system is a useful tool to enable organizations to more effectively understand the gap between the results of development over a given period of time and the results set for more sustainable and inclusive goals (Davidson, 2009). Including regular monitoring and inclusive procedures. The monitoring system includes micro-level monitoring and macro-level monitoring. At the macro level, the measurement of short-term and long-term economic progress should include an analysis of liquidity measurement and inclusive wealth stock (Wageningen University & Research, n.d.). The national accounting system must be used to measure not only the turnover of goods and services, but also the stock of natural capital. At the micro level, monitoring systems should support benchmarking analysis among enterprises to stimulate learning behavior and innovation. More accurate quantification and communication are needed for product sustainability (Dizdaroglu, Yigitcanlar, & Dawes, 2012). The monitoring system is based on science and contains multiple efficient features that promote better understanding, standardization, and informed decision-making.

1.3 The development of indicators

Indicators are signals or symbols of complex events and systems. They are information sets indicating system characteristics or events. Indicators can be variables or functions of variables. They can be qualitative variables, ordered variables and quantitative variables. Indicators are used to indicate and describe the state of a phenomenon, environment, and field in order to provide information, which is beyond the meaning of the parameter value itself (Gallopín, 1996). The purpose of using indicators is to simplify information about complex phenomena (such as sustainable development) so that communication can be easy, convenient and quantitative. Indicators can provide decisive guidance for decision-making in many aspects,indicators can transform knowledge of the natural and social sciences into manageable units of information for use in decision-making processes, indicators can help measure the state of sustainable development and facilitate progress towards sustainable development goals, indicators can provide early warning to prevent economic, social and environmental losses timely (National Academy of Sciences, 2011). At the same time, indicators are also an important tool for communicating ideas and values. Although the idea of establishing sustainability indicators is attractive, it is clear that because the concept of sustainable development is so wide in scope, the suitability of the sustainability indicators established, and the availability of data inevitably arise. The problems involved in the development of indicators include the dimension of indicators, the relevant scale of measurement, the possible errors in measurement, the weight of measurement data, the reliability of measurement methods (Opschoor & Reijnders, 1991). Pavlovskaia (2014) pointed out that a good sustainable development indicator should have seven conditions, including calculating the data of the indicator can directly manage the action, the indicator is easy to understand, the indicator can be measured, the content of the indicator measurement is important and meaningful, the event state described by the indicator is short with the time interval it acquires, the data on which the indicator is based can be compared in different regions and can be compared internationally. As mentioned above, sustainable development indicators involve environmental, economic and social aspects. When it comes to the sustainability of enterprises, indicators need to cover all the three aspects and integrate them into the policy strategy and decision-making process of enterprises. Then, when the sustainable development indicators are applied in enterprises, it is mainly reflected in this way：

Economic indicators are generally related to the economic operation of a company, so that

business managers and shareholders can understand the details (Barone, 2019). Moreover, the contribution of enterprises to the sustainable development of the larger economic system should be considered, not only the company itself, for example, the value of stocks or other financial products, and annual returns (Study. come, 2019).

Environmental indicators should refer to the company's environmental impact. Enterprises should make their activities avoid harming the environment. Managers should strive to reduce the impact of the company on the ecosystem by reducing the consumption of natural resources, reducing waste and ensuring that low toxic waste is discharged in a safe and legal manner through good management (Ministry of the Environment, Government of Japan, 2001). Examples of enterprise environmental indicators are resource and energy utilization indicators, "three wastes" emission indicators, "three wastes" treatment indicators, and green production indicators (Keeble, Topiol, & Berkeley, 2003).

Social indicators are related to the labor force, community and region on which enterprises depend. An enterprise within the triple bottom line will strive to benefit employees, communities and other social entities affected by its existence(Zhao, Zhao, Davidson, & Zuo, 2012). The social indicators of enterprises mainly include social contribution indicators and personnel treatment indicators.

2. Overview of Keppel Land

Keppel Land is one of Singapore's largest multinational real estate listed companies under Keppel corporation. As a diversified real estate company, Keppel Land has won many awards in its residential development projects, established commercial real estate projects with investment value, and integrated the high-quality combination of cities and towns to provide innovative real estate solutions for customers. Keppel Land is committed to building an environment with lasting value for the community, which integrates life, work and leisure. Keppel land, which operates across Asia, is one of the region's leading residential developers, with sites in Singapore and overseas capable of building about 46,000 homes (Keppel Land, 2018). Keppel land is also an outstanding developer of quality office buildings in Singapore and is committed to expanding its commercial projects in major Asian cities.

As a leading sustainable development company, Keppel land makes the company profitable in a socially and environmentally responsible manner. In the face of the current environmental changes, the company has taken positive measures to reduce the environmental pollution caused by its activities. For this reason, Keppel Land is constantly examining the pollution sources caused by their production process, and exploring how to reduce the impact on the environment while carrying out its business. Currently, it mainly includes reducing waste, water consumption and energy consumption, so as to save energy and reduce emissions, improve operation efficiency and bring new concept of community life to people. To this end, Keppel Land has taken a series of actions for sustainable urbanization and made contributions to sustainable development in the field of Keppel land to promote the sustainable development of the real estate industry.

To support 17 United Nations sustainable development goals, Keppel has adopted six sustainable development goals that are most consistent with its business development direction and strategy and are being firmly implemented. These six sustainable development goals are determined according to the potential impact and contribution of the company to these goals. They include the sustainable development of the environment, the support for the sustainable development of society and the sustainable development of the company's economy. These policies indicate the sustainable development plan for the society, environment, stakeholders of the company and the development of the company itself.

3. Sustainability dimensions of Keppel Land

Keppel Land has been trying to play a leading role in the sustainable development of the real estate sector. As a real estate industry, if it wants to truly achieve sustainable development, it must

not only consider how to build a good building and win economic benefits, but also consider the corporate social responsibility, environmental responsibility and responsibility to the company's stakeholders, and strive to build a better future of sustainable development for the next generation.

3.1 Social-cultural dimension

3.1.1 Talent management

Talent should be the greatest asset of Keppel Land. Every employee represents the brand of Keppel Land. Therefore, the company needs to cultivate professional, competent and diversified talent pool to provide the company with a continuous stream of talents and innovative ideas. And the company also needs to actively establish close relations with employees through various activities, grasp the employees' thoughts on the company and their work, make timely adjustments in the feedback of employees, and strive to seek their due benefits for their employees.

3.1.2 Safety and health of employees

Every staff member is the foundation of the development of Keppel Land. Keppel Land should provide a safe working environment for employees, especially those working in the front line, for example, construction site. Because, Keppel is a real estate company, it will have a lot of the opportunity to work on construction sites, so the company should be all staff to instill safety and health knowledge, for staff to take active safety and health management method, and the method of using the technology to reduce security risks, ensure every staff's personal safety and health.

3.1.3 Cultivating communities

Keppel land, as a responsible corporate citizen, should continue to participate in and contribute to the communities in which it operates after completion of the project. Keppel should strive to benefit the communities and other social entities affected by its existence, fulfill its corporate social responsibilities in many ways, and support various community plans and community outreach efforts, such as environment, education and health care, and other charitable causes. To contribute to the growth and development of the community.

3.2 Economic dimension

The economic dimension in the sustainability dimension shows that companies have a responsibility to compensate strongly those shareholders who provide capital by purchasing stocks or other financial products through return on investment. Corporate strategy should seek long-term benefits for this group. In the framework of sustainability strategy, this dimension not only refers to the creation of profits for enterprises, but also includes the continuous economic benefits for society. Therefore, according to the company's actual situation, Keppel Land needs to carry out rigorous assessment and supervision of sustainable economic development in the five aspects of profitability, cost control, risk management, financial situation and human resources. When problems are found, timely adjustment should be made so that enterprises can return on benefits to all stakeholders and promote the economic development of society while maintaining the good operation of the company.

3.3 Environmental dimension

Keppel Land would use a lot of energy such as water, electricity, steel and so on to carry out construction production in the process of implementing a construction project. These activities will produce sewage discharge, consume electricity and consume energy, and the real estate industry will produce noise pollution when carrying out construction projects, land reclamation will cause damage to local ecological diversity, and chemical pollution to air and water and soil caused by a large number of chemicals used in the construction process. These are all harmful to different aspects of the environment. Therefore, Keppel must strictly control every stage of activities in the whole life cycle of every project, integrate the sustainable development principle of Keppel into the whole supply chain, so as to truly fulfill its obligations to protect the environment. At the same time, Keppel needs to constantly improve and enhance its efforts in environmental protection and support

for environmental sustainability.

4. Indicators for monitoring sustainability development in the environmental area of Keppel Land

4.1 List of recommended indicators

Based on the above discussion on the sustainable development of Keppel Land's environmental dimension and the actual situation of Keppel Land as a member of the real estate industry, certain monitoring indicators are designed.

Table 1

Indicator name	Definition	Measurement	Targets	Key challenges
Saving electric energy	Reduce the amount of electricity used to operate the property	Reduced annual electricity consumption	It is expected to save about 1.5 million kWh per year	Further improvement of power efficiency may require continuous improvement of technologies and schemes
Water consumption	Consumption of water resources used in company operations and construction activities	Increase or decrease in water use	Reduce water use by 30% by 2030, based on the 2010's level	Further improvements in water efficiency may require new technologies and research
Total suspended solids	Controlling the total suspended solids in the sewage discharged from water use projects in construction sites	Diminution of total suspended solids in sewage discharged from water use projects at construction sites	Keep the total suspended solids in the discharged water below the legal limit of 50 mg/litre	Further reduction of total suspended solids in drainage may require further improvement of building materials used in construction projects and improve the corresponding technology
Carbon emission reduction	Carbon emissions from the processes of property, investment industries, production and transport materials and business	Reduction rate of carbon emissions	Based on the 2010's emission level, reduce carbon intensity by 40% by 2030	Further reductions in carbon emissions may require new technologies and research and development
Materials usage	Intensity of use of materials throughout the life of a construction project	Reduction rate of materials usage intensity	Keeping Keppel Land's materials usage intensity under its Sustainable Design Standards	Further reduction of material use intensity may require the development of new environmentally friendly materials to replace traditional building materials and the design of scientific and efficient material use matching scheme.
Environmental noise pollution	Measuring whether the environmental noise produced by Keppel Land's construction projects meets the national environmental noise emission standards	Measuring equivalent continuous noise level at construction sites for a specified period of time	Strictly controlled under the construction noise permit level required by National Environment Agency, and the relevant national standards	The sources of noise pollution in construction sites need to be strictly controlled.
Recyclable waste recycled	Recycling and processing of recyclable waste generated from construction projects	Effective recyclable waste recycled rate comes from industrial construction projects	Compliance with relevant standards	For wastes that are not easy to recycle, further planning and upgrading technologies may be needed.

4.2 Analysis of key points

In general, in order to realize the vision of building and environment integration, Keppel should

adopt a comprehensive and positive environmental management approach. This should be done mainly through three ways, including setting clear environmental strategies for sustainable development, implementing environmental management systems in strict accordance with the internationally accepted ISO 14001 standard, and managing the supply chain properly throughout the project life cycle from the start-up and design stage to the construction and operation stage (Keeping & Shiers, 2009).

4.2.1 Saving electric energy

Electric energy consumption is very significant in the real estate industry (Danigelis, 2018). Effective periodic monitoring must be carried out to reflect the changes of electricity consumption, and the specific data of each period should be compared as a basis for improving electricity consumption. Keppel Land focuses on the design, development and management of its properties. In order to reduce the use of electricity in the property, a series of measures have been taken, including high efficiency air distribution system, revolutionary cooling tower water management system, integrated sensor technology to optimize fresh air intake, intelligent lighting solution, intelligent building control system and installation of solar panels. Through these energy-saving equipment and measures, it can effectively reduce the energy consumption of buildings and residential buildings in all aspects. Because these technologies are being implemented for the first time recently, according to Keppel's data analysis, they are expected to save about 1.5 million kWh of electricity per year. However, the maturity of the technology needs to be verified by practice, and Keppel may need to continuously improve the technology and scheme if it wants to further improve the efficiency of power use.

4.2.2 Water consumption

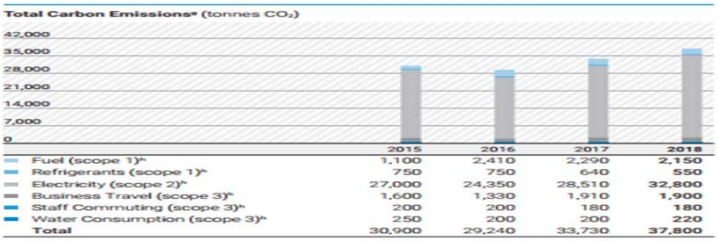
According to the survey of Keppel Land's work activities, Keppel Land uses a large amount of water resources to carry out the normal operation of its construction activities on its own construction projects, and its office also uses water. Therefore, facing the important project of water use, it is necessary to monitor so that the company can control water consumption in all aspects and protect water resources. Keppel Land has always adhered to the recommendations set by the Singapore Standard SS CP48:2005 for water services. According to the company's statistics, in 2018, the total water consumption of Keppel Land is about 620,000 m^3, and the estimated water consumption of the company's office is about 3000 m^3 per annum or 9.1 m^3 /person per annum. Keppel's water saving devices are water saving accessories certified by PUB's Water Efficiency Labelling Scheme, such as automatic turn off taps and flow regulators. Reducing water consumption can not only effectively protect water resources, but also help Keppel Land save costs.

4.2.3 Total suspended solids

In the water use project of construction site, Keppel Land will include many aspects of water use, such as construction water and domestic water. If the total suspended solids in the effluent discharged from these water use projects exceeds the standard, then when discharged into the sewage treatment plant, it will affect the microbial treatment capacity of the sewage treatment plant, and seriously can cause the collapse of the sewage treatment plant (Government of South Australia, 2016). Therefore, the total suspended solids in the effluent must be strictly controlled. By investigating the water use of public facilities at Keppel's construction sites in Singapore, the company usually recycles and reuses the water as much as possible, and the recycled water is used to clean vehicles. Through appropriate land control measures, the total suspended solids contained in the discharged water are below the legal limit of 50 mg/litre. However, regular monitoring is still needed to prevent the total suspended solids in sewage from exceeding the standard, and if Keppel wants to further reduce the total suspended solids in sewage discharged from construction sites, it may need to further improve the selection and quality of materials used in construction projects and improve the application of other technologies.

4.2.4 Carbon emission reduction

Keppel's carbon emissions come in two forms. One is direct emissions, including fuel used in generators and the consumption of refrigerants in air-conditioning systems. The second is indirect emissions, which come from the carbon emissions generated by the electricity consumed by the real estate and hotels invested by Keppel Land, as well as other indirect emissions, which come from the production and transportation of building materials, business travel and employees' commuting (Figure 1). Faced with how to reduce carbon emissions, Keppel Land has taken measures to improve the efficiency of building energy use and develop energy-saving buildings. The carbon emission intensity of Keppel Land in 2018 is about 20% lower than that in 2010. Keppel's goal is to reduce its carbon intensity by 40% from 2010 levels by 2030 under the company's Carbon Management Plan. In the process of this goal, Keppel should not only needs to develop new technology and equipment, but also needs to strictly control the carbon emission sources of every stage and every link in the supply chain of construction projects, so as to timely adjust the aspects needing improvement.



	2015	2016	2017	2018
Fuel (scope 1)^	1,100	2,410	2,290	2,150
Refrigerants (scope 1)^	750	750	640	550
Electricity (scope 2)^	27,000	24,350	28,510	32,800
Business Travel (scope 3)^	1,600	1,330	1,910	1,900
Staff Commuting (scope 3)^	200	200	180	180
Water Consumption (scope 3)^	250	200	200	220
Total	30,900	29,240	33,730	37,800

Fig. 1 Direct and Indirect Emissions (Keppel Land, 2018)

4.2.5 Materials usage

As a construction and real estate industry, Keppel consumes a lot of building materials in every construction project. Through identification and measurement, there are 10 most commonly used building materials, including cement, sand, concrete, aggregate, brick, steel, aluminum, glass, paint and ceramic and granite bricks (Patel & Vyas, 2011). To effectively save resources and protect the environment, Keppel should improve the use efficiency of these resources and reduce the use intensity of materials. It is necessary to measure the amount and way of use of each material in the whole process of each building project to know whether the intensity of use of materials in each building project has been changed or reduced, and timely adjustment can be made to the material allocation and use scheme. However, further reduction in material use intensity may require Keppel to develop new environmentally friendly materials to replace traditional building materials and to design scientific and efficient material use allocation schemes.

4.2.6 Environmental noise pollution

Environmental noise pollution indicator is a monitoring indicator for whether the generated environmental noise meets the environmental noise emission standards stipulated by relevant countries. Excessive environmental noise pollution will interfere with other people's normal life, work and learning. Environmental noise pollution is a kind of energy pollution, which like other industrial pollution, it is a public hazard to human environment (Murphy & King, 2014). In terms of the nature of the field Keppel Land is engaged in, when the company starts a construction project, it will produce certain construction noise, such as the use of electric welding machines and vibration machine in the construction process. Therefore, in order to solve this problem, Keppel Land needs to monitor whether the noise generated in each construction project meets the standards through environmental noise pollution indicator, and improve it in time where the deficiencies are found. The standard of this indicator in monitoring the noise decibel generated by the construction project of Keppel Land will strictly in accordance with the standard of national environment agency (Table 2), as well as the noise control regulations of relevant countries when Keppel Land undertakes construction projects overseas. When preparing to start a construction project, Keppel Land can predict and calculate the noise decibels produced by the construction equipment to be used

according to the indicator, and compile the construction plan which can effectively reduce the noise pollution in the construction site. In addition, this indicator will be tested from the beginning to the completion of each project of Keppel Land, so as to grasp the situation of noise pollution in time and deal with it in time according to the corresponding situation.

Table 2: Construction Noise Control

Construction Noise Control

Maximum permissible noise levels for construction work commenced on or after 1 October 2007

Mondays to Saturdays

Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	65 dBA (Leq 1 hr)	55 dBA (Leq 1 hr)
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

Sundays and public holidays

Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq* 12 hrs)	
	75 dBA (Leq 5 mins))	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	-	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

*reckoned as the equivalent continuous noise level over the specified period, i.e. 5 mins, 1 hr or 12 hrs.

Source: National Environment Agency. Noise Pollution. 2018.

4.2.7 Recyclable Waste Recycled

For a real estate company, when completing a construction project,it will also produce a lot of construction waste (Sapuay, 2016). If a large amount of waste is not timely treated in an environmentally friendly way, it will be a great harm to the local environment. Osmani points out that in the construction industry, there are three main types of industrial wastes, one is the material with potential value in construction, which is easy to reuse or recycle, including concrete, masonry, brick, ceramic tile and pipeline, asphalt and soil. The second type is not directly recyclable, but can be recycled elsewhere, including timber, glass, paper, plastic. Materials, oils and metals; the third category includes chemicals,for stance, paint, solvent, asbestos, plaster, water and aqueous solutions that are not easy to recycle or have special cleaning problems (cited in EI Haggar, 2011). Many of these industrial wastes come from precious natural resources. When the construction industry wants to achieve sustainable development in the environment, it should try its best not to waste building materials. According to the survey, as a real estate company, Keppel Land will also encounter the same industrial waste mentioned above in the construction project. Among them, ‘recyclable waste recycled’ may is a good indicator to control and improve the utilization rate of building waste. It can be used to measure the policy, evaluation, and review of Keppel Land's recycling effect on recyclable construction waste, so that Keppel Land can timely adjust its program on recyclable industrial waste (WP Group, 2019). According to Keppel Land's statistic data on the amount of waste generated by its properties, the total amount of waste generated by its completed properties in Singapore and overseas in 2018 is estimated to be about 10,000 tons. Therefore, the total amount of waste produced by the enterprise and the total amount of recyclable waste that has been recycled can be detected by the indicator of waste recycled, which can effectively guide the company to adjust the recyclable waste recycling policy and program. However, due to the nature of Keppel's field of work, there will be many kinds of waste products. For the treatment of not easy recycled

waste, more perfect solutions and measures may be needed.

5. Conclusion

This paper reviews the concept of sustainability monitoring system and indicators, and describes the situation of Keppel Land,combined the three sustainable development dimensions of social culture, economy and environment with the actual situation of Keppel Land, and determined a certain range of three dimensions applicable to Keppel Land. In the process of analysis, this paper finds that for a real estate company, the environmental issues that need attention are very complex throughout the whole life cycle of a construction project. Therefore, this paper sets up certain environmental monitoring indicators for Keppel Land to monitor this particular dimension. These monitoring indicators are designed based on the research of Keppel's operating principles, national and international environmental standards and the actual situation of the company. To some extent, these indicators can help Keppel Land to conduct regular assessment and improvement of specific factors in the specific dimension of environment, quickly find problems, and timely improve its environmental management issues. However, as these indicators have not been carried out in-depth practice, their effectiveness and feasibility need to be further verified, which also provides an opportunity to improve the indicators in the future.

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