

Construction of Enterprise Performance Management System Based on Internet of Things under Sustainable Development

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Keywords: Enterprise Performance, Sustainable Development, Internet of Things, Efficiency Management System

Abstract: Driven by the Internet of Things technology, enterprises need to build a complete set of enterprise performance management system to better promote economic construction and social development. This paper made a detailed analysis of the construction and optimization of enterprise performance management system based on the Internet of Things under sustainable development. This paper put forward the evaluation method of sustainable development. Based on this research, the experimental results of the construction of enterprise performance management system based on the Internet of Things were analyzed. The experimental results showed that there were great differences in the understanding of performance management system among employees at different levels and positions. At the same time, all branches have encountered similar problems. Based on the analysis of the differences in performance management, it was believed that enterprises lacked a unified and standardized performance management system, which made them have different understanding of performance management. Therefore, the implementation of performance management should be strengthened. 12% of middle managers believed that the company's performance should be decided by the superior. 21% of technical managers believed that it should be decided directly by the superior, and only 8% of technical operators said that it should be decided directly by the superior. It showed that the responsibility objectives were too high, too many and unrealistic. The strength of evaluation was small, and the positive and negative incentive effects were weak. The manager just has a purpose but has no way or ability. He has no time to review his goals, and does not evaluate until the assessment is completed. In a word, in the context of sustainable development, the enterprise performance management system based on the Internet of Things is a scientific evaluation model and incentive mechanism to comprehensively evaluate employees, managers and consumers, which is of great significance to promote enterprises to fulfill their social responsibilities and promote sustainable social development.

1. Introduction

This paper takes sustainable development as the starting point and Internet of Things technology as the support to deeply study the enterprise performance management system based on the application of Internet of Things. On this basis, a reasonable and efficient performance management system based on the application of the Internet of Things under the sustainable development of enterprises is constructed to achieve the goal of maximizing the value among enterprise stakeholders. Le Han combed the relationship between corporate diversification strategy and corporate performance in the literature from the concept, motivation, type and other aspects of diversification strategy [1]. Zhou Chi mainly discussed the dynamic employment of enterprise performance under uncertainty. The company first interviewed a limited number of candidates, and then made recruitment decisions based on this [2]. Cherkos Tomas aimed to improve the performance and contribution of micro and small enterprises by analyzing the impact of important internal and external factors [3]. One of the main objectives of sustainable development is to eradicate poverty and gender inequality, but access to finance is considered a way to eradicate poverty and gender inequality. Nwosu Emmanuel O. focused on the impact of obtaining formal credit on the company's operating performance [4]. However, these scholars did not explore the construction of enterprise performance management system. The research found that the technology based on sustainable development was very helpful to the construction of enterprise performance management system. In this regard, relevant documents on sustainable development were consulted.

Some scholars also have some research on sustainable development. Sustainable social responsibility should be undertaken by multiple stakeholders rather than voluntarily. Based on the principle of sustainable development, Khan Sher Zaman took 307 small and medium-sized enterprises in China as the research object, and discussed the role of sustainable development strategy on enterprises' sustainable competitiveness and business performance [5]. According to the 20-year data set from Science database, Bartolacci Francesca aimed to present a complete knowledge framework, that is, research on sustainable development and financial performance of SMEs [6]. However, these scholars did not study the construction of enterprise performance management system based on the Internet of Things under sustainable development, but only unilaterally discussed its significance.

2. Enterprise Performance Management Methods under Sustainable Development

2.1 Construction Principles of Performance Management System under the Sustainable Development of Enterprises

To build and implement an enterprise performance management system based on the Internet of Things, it is necessary to first define the core concept of sustainable development. Based on this, the following principles can be followed in specific operations. Figure 1 shows the enterprise performance management system under sustainable development.

People oriented is required. The construction of the performance management system based on the Internet of Things under the sustainable development of enterprises needs to fully consider the multi stakeholders such as employees, customers and society, so as to improve the indicators of various dimensions in the performance appraisal system [7-8].

The principle of innovation needs to be adhered to. In the specific operation process, it is necessary to clarify which aspects are innovative, which are bottlenecks that need to be broken through, and how to achieve innovation better. In order to solve these problems, they should be detailed into the work processes of each department. Only in this way can the innovation work be better implemented.

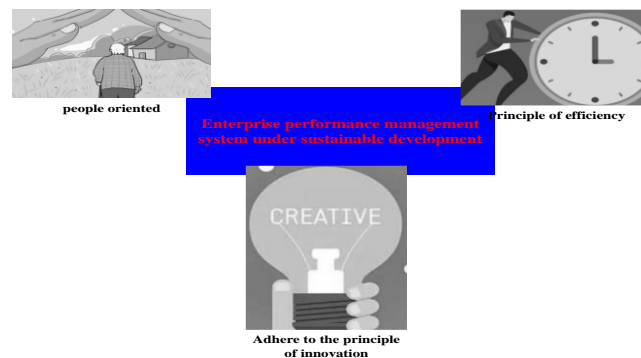


Figure 1: Enterprise performance management system under sustainable development

The principle of efficiency needs to be emphasized. In order to effectively implement the performance management system based on the Internet of Things under the sustainable development of enterprises, the efficiency of performance management must be improved, which maximizes its benefits in the shortest time.

In order to achieve the above objectives, the enterprise should be comprehensively evaluated through reasonable use of all the evaluation indicators and scoring standards in the evaluation system, so as to determine the status of each work and the specific score, which is used as a reference to judge whether it has achieved the expected goals.

2.2 Role of IOT Technology Application in Enterprise Performance Management System

With the acceleration of economic globalization, more and more enterprises begin to re-examine their own development strategies in order to gain more competitiveness in the market competition. Among them, performance management, as an important part of the business management process, has been valued by many enterprises [9-10]. Performance management refers to a management system for evaluating, assessing, rewarding and punishing employees according to a certain process in daily work [11-12]. The performance management system based on the Internet of Things under sustainable development mainly includes five aspects. The first is effective inspection of product quality. The second is real-time monitoring and treatment of environmental pollution or energy waste in the production process. The third is to effectively control the logistics link. The fourth is to timely feedback information to employees and make improvements according to the actual situation. The fifth is to timely optimize the production and operation process or scheme according to the feedback information to better meet user needs, so as to reduce production costs and improve work efficiency. As an indispensable part of enterprise operation management, performance appraisal plays an irreplaceable role. However, with the increasing economic level and the rapid development of Internet technology, enterprises are facing unprecedented challenges and opportunities [13].

At the same time, the performance management system based on Internet of Things technology has other advantages. First, IoT technology plays an important role in improving work efficiency. Second, IoT technology can realize real-time monitoring and collection of employees' daily work content, which provides enterprises with a more efficient and comprehensive information management platform. Third, Internet and mobile phone and other network resources can be fully utilized to provide employees with a more convenient, rich and comprehensive information exchange and communication platform. Figure 2 shows the application of Internet of Things technology in the performance management system. To sum up, in order to effectively promote economic construction and social development to achieve remarkable results, it is imperative to build and optimize the enterprise performance management system based on the Internet of Things under sustainable development.

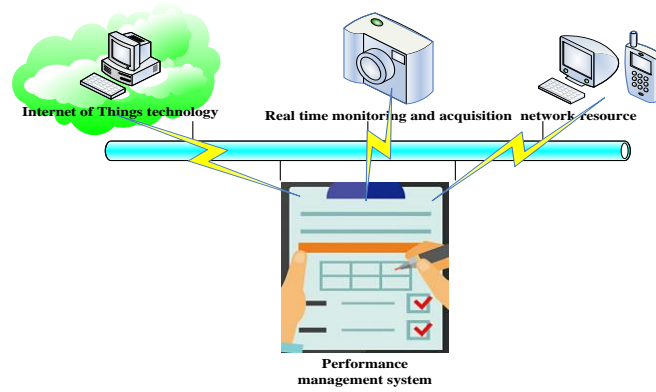


Figure 2: Application of Internet of Things technology in performance management system

2.3 Evaluation Method of Sustainable Development

There are mainly two indicators of sustainable development, namely qualitative and quantitative indicators. Qualitative indicators are difficult to quantify, such as political, economic environment, enterprise management level, and enterprise culture.

(1) Quantification of qualitative indicators

In the process of sustainable development, some indicators are qualitative and quantitative. At present, there are many methods, usually fuzzy comprehensive evaluation method is used for dimensionless.

Fuzzy comprehensive evaluation can be applied to indicators that are difficult to express in precise language. It is supposed that factor set $I = (i_1, i_2, \dots, i_m)$ is used to describe a thing, and an evaluation can be obtained from the perspective of each factor, which is represented by $B = (b_1, b_2, \dots, b_m)$. The number and name of their elements can be determined subjectively according to actual problems. Each i_o is comprehensively evaluated to construct a judgment matrix.

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1z} \\ t_{21} & t_{22} & \cdots & t_{2z} \\ \vdots & \vdots & \ddots & \vdots \\ t_{m1} & t_{m2} & \cdots & t_{mz} \end{bmatrix} \quad (1)$$

The weight set of each index to be determined: $S = (s_1, s_2, \dots, s_m)$. Because the evaluation of Z is uncertain, the comprehensive evaluation should be a fuzzy subset of B: $N_1 = S \cdot T = (n_{11}, n_{12}, \dots, n_{1z})$. N is normalized to $N_2 = (n_{21}, n_{22}, \dots, n_{2z})$. Among them:

$$n_{2k} = \frac{n_{1k}}{\sum_{k=1}^z n_{1k}} \quad (2)$$

This result is a vector, which reflects the membership degree of the evaluation object on B.

(2) Consistency of indicators

For very small indicators, let:

$$\dot{c}_{okl} = Z_{ok} - c_{okl} \quad (3)$$

For the intermediate indicator, let:

$$\dot{c}_{ok} = \begin{cases} \frac{2(c_{ok} - z_{ok})}{z_{ok} - z_{ok}}, & \text{if } z_{ok} \leq c_{ok} \leq \frac{z_{ok} + z_{ok}}{2} \\ \frac{2(z_{ok} - c_{ok})}{z_{ok} - z_{ok}}, & \text{if } \frac{z_{ok} + z_{ok}}{2} \leq c_{ok} \leq z_{ok} \end{cases} \quad (4)$$

Among them, o and k represent the order of the index. c_{ok} is the measured value. Z_{ok} and z_{ok}

are respectively the maximum and minimum values of the allowable upper and lower limits of indicators. c_{ok} is the result of c_{ok} consistency.

(3) Immeasurable rigidity of index

Dimensionless refers to the standardization and normalization of data. The algorithm adopts mathematical transformation to eliminate the influence of original indexes. “Standardization method”, “extreme value treatment method”, “efficiency factor method” and other methods are generally adopted.

Standardization Method

It is took:

$$c_{ok}^* = \frac{c_{ok} - \bar{c}_k}{d_k} \quad (5)$$

Obviously, the average and mean square deviation of c_{ok}^* are 0 and 1 respectively, and c_{ok}^* is called the standard observation. In the above formula, \bar{c}_k and d_k are the average value and mean square deviation of the observation value of the k-th index respectively.

Extremum Treatment

If let $Z_k = \max_o \{c_{ok}\}$, $z_k = \min_o \{c_{ok}\}$, there are:

$$c_{ok}^* = \frac{c_{ok} - z_k}{Z_k - z_k} \quad (6)$$

c_{ok}^* is dimensionless, and $c_{ok}^* \in [0,1]$.

Efficiency Coefficient Method

The efficiency coefficient method is used to dimensionless indicators.

$$c_{ok}^* = v + \frac{c_{ok} - z_{ok}}{Z_{ok} - z_{ok}} \times f \quad (7)$$

Among them, c_{ok}^* is the dimensionless result of c_{ok} .

3. Experimental Results of the Construction of Enterprise Performance Management System Based on the Internet of Things

The enterprise performance management system based on the Internet of Things technology is a new development concept, which can improve employees’ work enthusiasm and innovation awareness, and also improve employees’ sense of responsibility and honor to a certain extent. At the same time, the building of a scientific, reasonable, operable and practical enterprise performance management system based on the Internet of Things technology can not only assess employees, but also supervise and feedback the enterprise’s business decisions to improve the enterprise’s operational efficiency. Therefore, it is of great value to conduct enterprise performance management based on Internet of Things technology.

3.1 Development and Current Situation of M Enterprise Performance Management

When M enterprise began to implement performance management, the enterprise management department was mainly responsible for the evaluation and supervision. When formulating performance management methods, it only set annual assessment indicators for managers of all departments and middle and senior managers, that is, the business objective responsibility system. The company’s performance is mainly related to the company’s performance and the company’s middle management, without corresponding performance management for other employees. In the process of implementation, the middle and senior management of the company have paid more attention to the business objectives of the enterprise than included employees, which has led to the

poor performance evaluation effect.

The company’s performance management has not formed a systematic management system, and has no clear performance objectives and management objectives, so that the effect of performance evaluation has not been achieved. At the same time, the company’s performance management has not established an effective monitoring mechanism, which makes employees lack confidence in the effect of performance evaluation and do not know how to improve it. However, in practice, the formulation of performance indicators is not scientific enough, resulting in a mere formality of assessment work.

This paper investigates the current situation and problems of performance management in M enterprise through questionnaire survey and analysis of human resources related systems. A total of 200 questionnaires are collected from this survey.

3.2 Current Situation and Problems of Employees’ Understanding of Performance Management System

This paper takes M company as an example to study the understanding of M company’s performance management system by personnel at all levels. The employees of the headquarters and subordinate branches of the company are surveyed and the following conclusions are drawn, as shown in Figure 3. Figure 3 (a) shows M company’s internal employees’ perception of the performance management system. Figure 3 (b) shows the employees’ perceptions of the performance management system of M’s subsidiaries. Among them, A means very well understood. B means basic understanding. C means partial understanding. D means that they don’t understand. E means completely unknown.

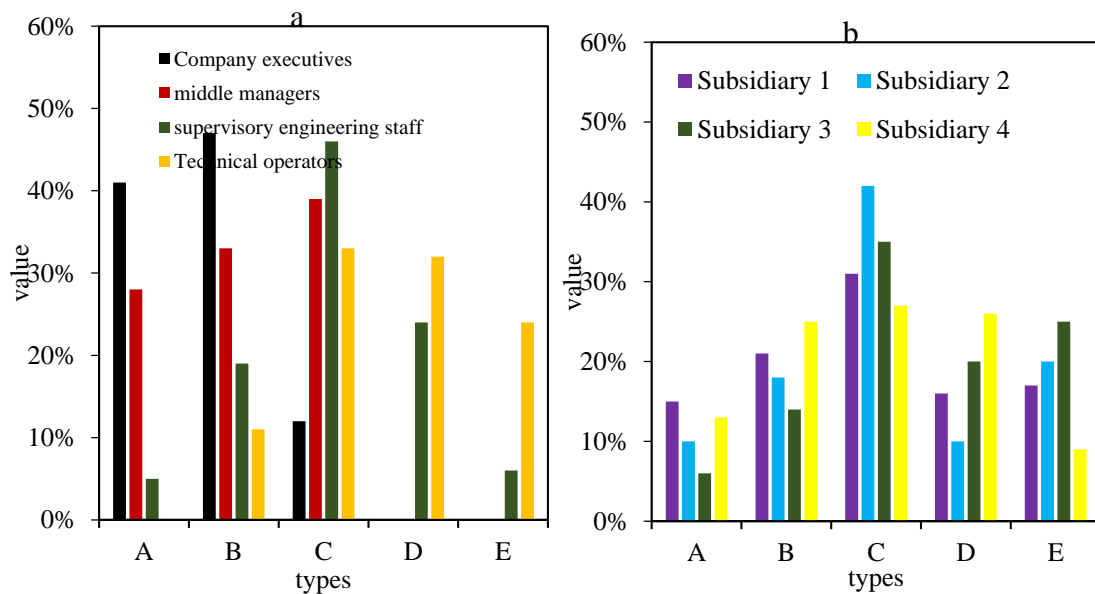


Figure 3: Cognition of employees of M company and its subsidiaries on performance management system

In the survey of M company’s internal employees’ perception of the performance management system, the company’s senior executives and middle managers are familiar with the performance management system. There are also some technical managers and operators who are not familiar with the performance management system. In the survey on the cognition of the performance management system of M company’s subsidiaries, the number of people who partially understand the system is the largest.

The difference in understanding the system is mainly related to the way employees get the system. Therefore, this paper investigates the cognition of employees in M company and its subsidiaries. The results show that there is a certain gap between the headquarters and subsidiaries of M company in terms of promotion, publicity and application. The middle and senior management and technical managers of M company are used to understanding the performance appraisal system through communication, exchange, performance appraisal, self-study and other related systems. Employees in technical operation positions are more inclined to learn through employee induction training and employee manual. As shown in Figure 4, the internal employees of M company and the employees of its subsidiaries have access to the performance management system. Among them, Figure 4 (a) is the internal staff of M company, and Figure 4 (b) is the staff of each subsidiary. Among them, a refers to self-study system. b stands for performance training. c means communication. d stands for Employee Handbook. e means induction training.

Through the investigation and analysis of the above problems, it can be found that there is a large deviation in the understanding of the performance management system of employees at all levels and positions, and the same problem exists in all branches. In view of such a big gap in performance management, the main reason is that the company does not have a unified and standardized performance management system, which leads to inconsistent understanding of the performance management system. Therefore, the implementation of performance management should be strengthened. At the same time, there are many kinds of performance management systems within the company. Middle and senior managers and technical management personnel are mainly familiar with performance training, self-study and communication with leading colleagues. However, most of the employees in technical operation posts learn about it through induction training and other channels, and they know little about it. Therefore, when carrying out performance publicity and implementation, the publicity and implementation of grass-roots employees should be strengthened, and multiple channels are adopted to increase publicity.

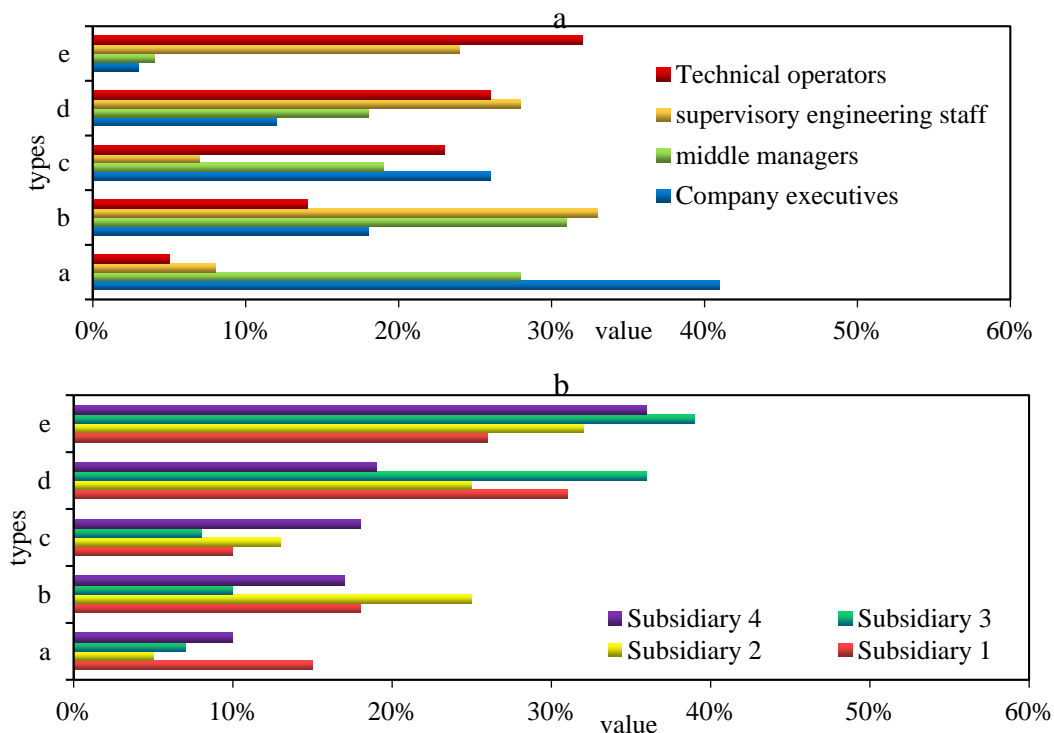


Figure 4: Access to performance management system by employees of M company and its subsidiaries

3.3 Problems and Current Situation in the Formulation of Enterprise Performance Evaluation

As for the decomposition of the work plan, the company’s middle managers generally follow the economic responsibility system formulated by the company. Other employees are required by department leaders and their own work responsibilities. Figure 5 shows M company’s employees’ understanding of the performance setter. Among middle managers, 12% believe that performance should be directly determined by their superiors. 30% think it should be made by the human resources department. 42% think it should be made by the assessment committee. 10% think it should be made by the company’s senior executives. 6% think it should be made by external consultants. Among the technical managers, 21% believe that it should be made directly by their superiors. 38% believe that it should be made by the human resources department. 15% believe that it should be made by the evaluation committee. 19% believe that it should be made by the company’s senior executives, and 7% believe that it should be made by external consultants. Among the technical operators, 8% think it should be made directly by the superior. 57% think it should be made by the human resources department. 23% think it should be made by the evaluation committee. 8% think it should be made by the company’s senior executives, and 4% think it should be made by external consultants.

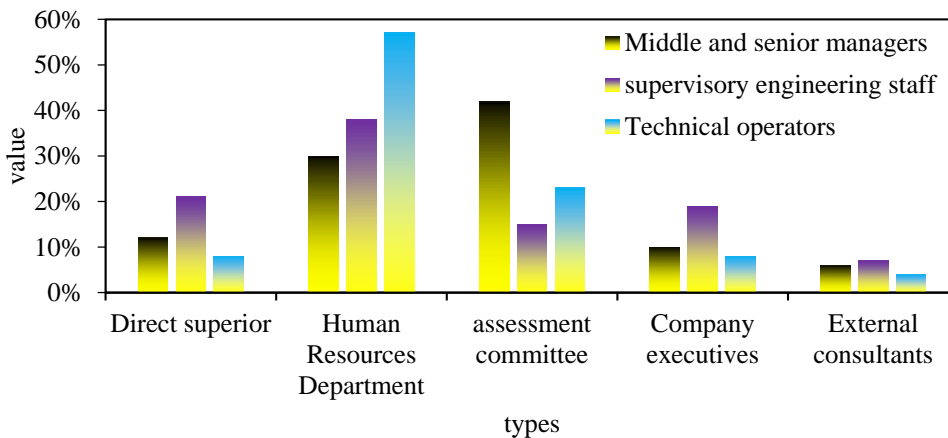


Figure 5: M company’s employees’ understanding of performance setters

The performance system is only to achieve the results of the assessment, not to manage the performance. The existing performance system basically covers all grades, and there is no dead space. However, there is no work concept that makes employees at all levels catch up and work hard. The main reason is that the goal of responsibility is too high, too many, too casual, serious, unrealistic and impossible to achieve. The power of evaluation is not strong, and both positive and negative incentive effects are weak. Managers have only goals but no means, or lack of ability. There is no timely review of the objectives, no time to guide, and only to wait for the end of the assessment period, and the assessment is completed.

3.4 Cognition of the Company’s Employees on the Assessment Makers and Subjects

Employees at middle and senior management, technical management posts and technical operation posts have different understanding of the determination and implementation of the company’s performance evaluation system. As shown in Figure 6, 48% of senior executives and 32% of middle managers believe that performance appraisal should be formulated according to the responsibility system. 31% of technical managers believe that it should be formulated according to

the post responsibilities, and 35% of technical operators believe that it should be formulated according to the leadership requirements.

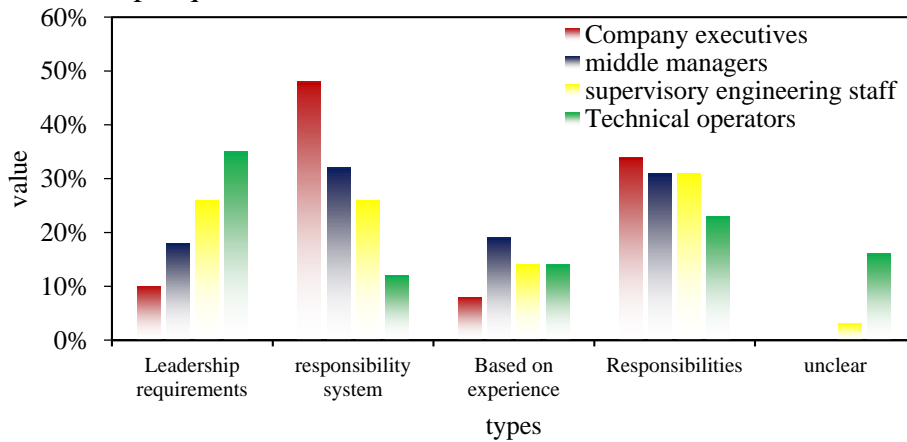


Figure 6: Perceptions of employees at all levels of M company on performance setters

In the performance evaluation, the role of the human resources department is mainly as the formulation and supervision of performance management policies, rather than as the implementer. The appraisal object of the company must be determined according to the company structure and the characteristics of the examiner. Figure 7 shows the setting of performance appraisal subject. In the recognition of the subsidiaries on the setting of performance appraisal subject, most people think that it is set by the Human Resources Department.

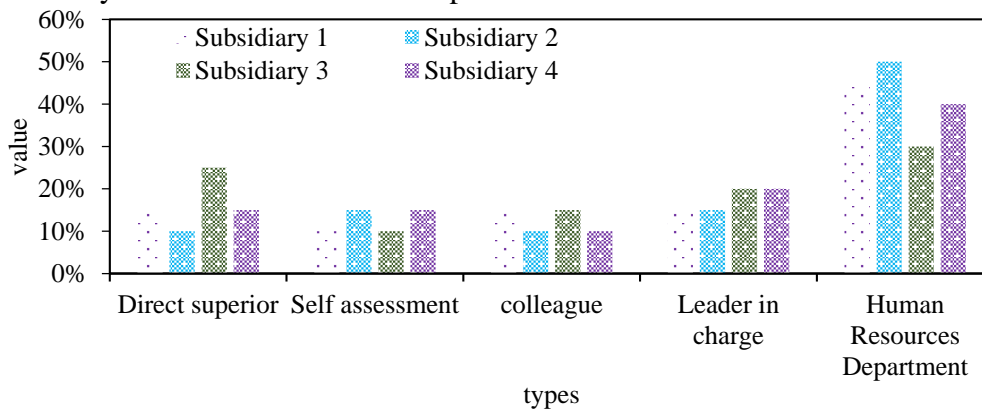


Figure 7: Setting of performance appraisal entity

The human resources department is the formulation and implementation unit of the company's performance management system, so most employees think this is the work of the human resources department.

3.5 Performance Feedback and Results

The survey has been found that most employees have raised questions about their performance appraisal, and more than 60% say their performance level is inconsistent with the appraisal results, as shown in Table 1.

After the preliminary inquiry and investigation, most departments do not give feedback on the work results, nor do they conduct necessary work interviews, which leads to the staff's disapproval and ignorance of the work needs to be improved. In the current situation, performance evaluation is an effective management tool. Enterprises should use this method to make employees realize that

they and the company are both prosperous and lose, so as to realize their real value and role.

Table 1: Results of performance appraisal and self-evaluation

	Number of people	Proportion
Totally conform	20	10%
Basically consistent	60	30%
Not very consistent	70	35%
Large gap	50	25%

3.6 Specific Steps of Enterprise Performance Management

The enterprise performance management based on the Internet of Things under sustainable development includes four aspects: strategic planning, system construction, process optimization and evaluation. First, as the core content of organizational management, strategic planning is the first step to build and implement the enterprise performance management system. In the process of formulating strategic objectives, enterprises need to plan according to the actual situation. Secondly, the system construction is the basis for the construction of the performance management system. In this process, relevant systems must be sorted out and improved. Thirdly, process optimization is the link that performance managers need to constantly improve in their performance management work. Finally, as an effective means to assess the work effectiveness of managers, assessment and evaluation can help the management to effectively evaluate the work quality of employees.

In the whole management process, it is necessary to fully consider the characteristics of the enterprise itself, the external environment of the enterprise, the internal mechanism of the enterprise and the individual factors of employees, which have an important impact on the performance evaluation results. To sum up, enterprises must start from the strategic planning stage if they want to effectively carry out enterprise performance management based on the Internet of Things under sustainable development. Specifically, in order to make the whole performance management process more standardized and standardized, it is necessary to scientifically and rationally optimize the design of strategic planning and budget indicators, personnel recruitment, employee training, production operation, etc. In this process, it is also necessary to comprehensively consider the internal and external environment of the enterprise and the development stage. Finally, it is necessary to formulate a specific and effective evaluation index system based on the personal situation and job responsibilities of employees.

4. Conclusion

Sustainable development is a cause that requires the joint efforts of all people. It is a comprehensive evaluation of enterprise economic activities and social development. Based on the analysis and research of IoT technology, this paper proposed to build an enterprise performance management system based on IoT under sustainable development. This has enabled the concept of sustainable development to be better implemented, and has provided a more comprehensive and efficient management system for the production and operation of enterprises. Under sustainable development, the enterprise performance management system based on the Internet of Things mainly combined the Internet of Things with big data on the basis of Internet technology. Through the establishment of a comprehensive and comprehensive consideration of various elements and indicator systems, and their application in various industries, the system has been effectively operated. Enterprise performance management is a comprehensive and extensive work. First of all, all basic work needs to be done well and implemented to specific posts. Secondly, the evaluation of staff quality and comprehensive quality and ability should be done well. Finally, the data should be

effectively analyzed and processed to provide guidance for the next step of work. Under the sustainable development, the enterprise performance management system based on the Internet of Things is a set of scientific assessment mode and incentive mechanism established by comprehensively evaluating employees, managers, consumers and other subjects, which is conducive to promoting enterprises to better fulfill their social responsibilities and promote sustainable social development.

Acknowledgement

This article is a phased achievement of the 2024 Jiangsu University Philosophy and Social Science Research General Project "Performance Evaluation and Countermeasures of Enterprise Sustainable Development from the Perspective of Dual Carbon" (No. 2024SJYB1433)

References

- [1] Le Han. "Literature review on diversification strategy, enterprise core competence and enterprise performance." *American Journal of Industrial and Business Management* 9.1 (2019): 91-108.
- [2] Zhou Chi, Wansheng Tang, and Ruiqing Zhao. "An uncertain search model for recruitment problem with enterprise performance." *Journal of Intelligent Manufacturing* 28.3 (2017): 695-704.
- [3] Cherkos Tomas, Muluken Zegeye, Shimelis Tilahun, Muralidhar Avvari. "Examining significant factors in micro and small enterprises performance: case study in Amhara region, Ethiopia." *Journal of Industrial Engineering International* 14.2 (2018): 227-239.
- [4] Nwosu Emmanuel O., and Anthony Orji. "Addressing poverty and gender inequality through access to formal credit and enhanced enterprise performance in Nigeria: An empirical investigation." *African Development Review* 29.S1 (2017): 56-72.
- [5] Khan Sher Zaman, Qing Yang, Najib Ullah Khan, Sonia Kherbachi, Martina Huemann. "Sustainable social responsibility toward multiple stakeholders as a trump card for small and medium-sized enterprise performance (evidence from China)." *Corporate Social Responsibility and Environmental Management* 27.1 (2020): 95-108.
- [6] Bartolacci Francesca, Andrea Caputo, and Michela Soverchia. "Sustainability and financial performance of small and medium sized enterprises: A bibliometric and systematic literature review." *Business Strategy and the Environment* 29.3 (2020): 1297-1309.
- [7] Lucky Esuh Ossai-Igwe. "An empirical examination of the influence of corporate social responsibility dimensions on the small and medium enterprise performance in Northern Malaysia." *International Journal of Business Innovation and Research* 16.2 (2018): 243-265.
- [8] Bach Thang, Thanh Le, and Yen Bui. "Informal short-term borrowings and small and medium enterprises' performance in a credit crunch: evidence from vietnam." *The Journal of Development Studies* 57.8 (2021): 1321-1335.
- [9] Abagissa Jemal. "The assessment of micro and small enterprises performance and challenges in Addis Ababa, Ethiopia." *International Journal of Applied Economics, Finance and Accounting* 9.1 (2021): 8-18.
- [10] Florio Cristina, and Giulia Leoni. "Enterprise risk management and firm performance: The Italian case." *The British Accounting Review* 49.1 (2017): 56-74.
- [11] Desmaryani Susi. "The Role of Regional Government in Growing Small and Medium Enterprises' Performance towards Creative Industry in Jambi Province." *Jurnal Bina Praja: Journal of Home Affairs Governance* 9.1 (2017): 159-169.
- [12] Sutduean Jutamat, Singasa Ayoruethai, Sriyakul Thanaporn, Jermstittiparsert Kittisak. "Supply chain integration, enterprise resource planning, and organizational performance: The enterprise resource planning implementation approach." *Journal of Computational and Theoretical Nanoscience* 16.7 (2019): 2975-2981.
- [13] Daradkeh M K. "An Empirical Examination of the Relationship between Data Storytelling Competency and Business Performance: The Mediating Role of Decision-Making Quality." *Journal of Organizational and End User Computing*, 2021, 33(5), 42-73