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Social Network Analysis of Sustainable Human Resource Management from the Employee Training's Perspective

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Abstract: Employee training is not only important for the continuous growth of human resources but also guarantees sustainable human resource management in enterprises. It is very important to understand corporate behaviour related to employee training not only from the perspective of a single enterprise but also from that of multiple enterprises. The purpose of this study is to explore multiple enterprises' employee training behaviours by conducting a content analysis of corporate social responsibility (sustainability) reports and a social network analysis. This study also seeks to find a way to achieve sustainable employee training by analysing the similarities in the different types of corporate training behaviours. Our analysis shows that, in 2017, 108 types of training activities were implemented by 53 enterprises; the key employee trainings (e.g., security training and skills training) and enterprises (e.g., bank of communication) are identified. The training behaviours of some of the enterprises are similar to some extent, and eight groups of firms that are very similar are identified. The results of this study show that social network analysis performs well for studying corporate employee training behaviours. Some suggestions to minimize the investment costs of training and to improve the sustainability of human resource management from the employee training perspective are provided.

Keywords: employee training; social network analysis; sustainability reports; sustainable human resource management

1. Introduction

In recent years, due to the increase in awareness of sustainable development as well as environmental protection in enterprises, sustainable resource management has become an increasingly critical issue that is receiving increasing interest in management research and business practice. As resources are limited, enterprises must seek reasonable ways to manage resources to achieve sustainability [1,2]. There have been some studies on corporate sustainable resource management, for instance, water resource management [3–5], mineral resource management [6,7], energy resource management [8,9], and science and technology resource management [10,11]. While these studies mainly focus on the sustainability of natural resources, they neglect human resources, which is considered the most important valuable core asset and resource of an enterprise, especially in the age of artificial intelligence. A considerable number of studies (see, [12,13]) about human resource management have been conducted; however, the study of sustainable human resource management is still rarely considered (e.g., [14,15]). In fact, the importance of human resource management for

organizational sustainability has been highlighted by some scholars [16–18]. We therefore explore corporate sustainable resource management from the perspective of sustainable human resource management in this study.

Corporate sustainable human resource management is a new area of research and practice [14]. There are still significant research gaps regarding sustainable human resource management, in particular, how human resource management addresses the sustainability of human resources [19]. Only a few studies have examined this issue; for instance, the work by Ehnert [20] explores the meaning of and reasoning for sustainability in human resource management as well as applications of the concept for human resource management through an analysis of 50 European multinational enterprises. Kramar [19] examines the major features of sustainable human resource management and highlights a relationship between sustainability and human resource management. Tooranloo et al. [21] identify the factors that have an impact on the successful implementation of human resource management sustainability in organizations. Human resource management is a series of work practices involving people, among which employee training has a very important part. Some managers and scholars have realized that employee training is not only an important incentive for the continuous growth of employees but also guarantees the sustainable development of the enterprise (e.g., [22–26]). Therefore, it is very interesting and important to analyse the sustainability of human resources from the perspective of employee training.

Relatively little is known about corporate employee training in terms of contents, types and forms. The overall cognition of corporate training programmes is rarely discussed in the previous literature. In addition, due to the lack of standardized enterprise training data, the majority of scholars only focus on the content and effect of enterprise training within a single enterprise, which cannot reveal the relationship between enterprise trainings and enterprises' features (e.g., the type of industry, the scale of business, etc.). Therefore, in order to obtain the set of enterprise trainings from a broader perspective (that is, a set of enterprises), as well as to identify the relationships between enterprise trainings and enterprises, this study collect relevant data from the corporate social responsibility (sustainability) reports through content analysis and data mining methods. Furtherly, in order to characterize corporate employee training behaviours, we introduce the method of social network analysis since the advantage of social network analysis in human sociology [27], in which some enterprise behaviours and user behaviours have been analysed through social network analysis [28,29], for instance, enterprise cluster behaviour [30], collaborative behaviour [31], and social influence [32]. More importantly, due to enterprises and employee training activities are different classes of things, general network model, which can only represent the same class of nodes, cannot describe their relationships. Therefore we utilize the social network analysis method, a two-mode affiliation network, to reveal corporate training behaviours that always involve various types of training activities. We believe that social network analysis is able to provide a deeper understanding of corporate employee training behaviours from the perspective of network structures, providing a clearly and intuitively graphic expression. In sum, on a basis of corporate social responsibility (sustainability) reports, content analysis method and social network analysis method are synthetically integrated in this study to extract corporate training data, and to study corporate employee training behaviours to explore corporate sustainable human resource management.

The aim of this study is to explore sustainable human resource management from the employee training's perspective to analyse features of corporate behaviour related to employee training. The contributions of this study include: (1) we explore the training behaviours of enterprises from the perspective of network to examine the sustainable human resource management of enterprises, enriching the theoretical research on the corporate sustainability. (2) In contrast to traditional research on employee training (see, [33–35]), which mainly focus on a single enterprise or the same type of enterprises or a single type of training, in this study, we explore multiple training programmes from the multiple enterprises' perspectives, expanding the research of corporate employee training. In addition, we construct a framework with three dimensions to analyse corporate training activities, making the

cognition of corporate training programmes be more systematic and scientific. (3) Mining the training data from sustainability reports makes the analysis of training be more objective, providing a way to solve the difficulty of acquisition of enterprise training data. On the other hand, the similarities among corporate training behaviours are used to reveal the sustainability of enterprise within a group of enterprises, providing a macroscopic, comprehensive view to analyse the sustainability of an enterprise.

The rest of this paper is organized as follows: Section 2 reviews the related works on sustainable human resource management, employee training, and social network analysis. Section 3 explains our research methodology. First, sustainability reports are analysed through the content analysis method to identify corporate employee training activities. Subsequently, the modelling rules of three networks: the enterprise-employee training activity network, the employee training activities network, and the enterprise network, are given. Third, degree centrality, the core-periphery structure, and other indicators of social networks are introduced to explain corporate behaviours of employee training. Section 4 presents the general results. Fifty-three Chinese enterprises are analysed. In Section 5, we discuss the results we obtained as well as contributions and theoretical and empirical implications. Finally, the conclusions are provided in Section 6.

2. Literature Review

2.1. Sustainable Human Resource Management

Sustainable human resource management, a concept that links the concept of sustainability and human resource management, has become a new research area of human resource management in recent years. We can find some terms that are used in the literature, for instance, "*Sustainable HRM*", "*Sustainable Human Resource Management*", "*HR Sustainability*", "*Sustainable Management of HRs*", and "*Green Human Resource Management*". There is no consensus about the definition of sustainable human resource management. For instance, "*Sustainable human resource management is regarding achieving organizational sustainability through the development of human resource policies, strategies and practices that support the economic, social and environmental dimensions, at the same time* [36]", "*Sustainable HRM is the utilization of HR tools to help embed a sustainability strategy in the organization and the creation of an HRM system that contributes to the sustainable performance of the firm* [37]", "*a management of human resources that meets the current needs of a firm and society at large without compromising their ability to meet any future needs* [38]", and "*The adoption of HRM strategies and practices that enable the achievement of financial, social and ecological goals, with an impact inside and outside of the organization and over a long-term time horizon while controlling for unintended side effects and negative feedback* [39]". Generally, sustainable human resource management emphasizes the realization of long-term human resource reproduction while achieving economic, social and ecological goals [19]. In this study, we argue that sustainable human resource management can achieve the optimum allocation of human resources based on the concept and idea of sustainability and provide enterprises the integrated benefits of economic, ecological and social integration while realizing the sustainable development of enterprises, employees, customers and society.

Macke and Genari [40] provide a systematic review of sustainable human resource management and identify the most recent developments in the literature. Thus far, scholars have studied the different aspects of sustainable human resource management. For instance, some studies focus on the relationship between sustainability and human resource management [19,20]. Some scholars study the factors affecting human resource management sustainability in organizations [21]. Some studies emphasize the economic benefits, employee behaviour and the improvement in social and environmental health that sustainable human resource management can bring [20,41]. It has been concluded that human resource management is important for the sustainability of enterprises, regardless of whether the firm engages in environmental sustainability and certain other factors.

As we can see from the above discussion, the current research has affirmed the importance of sustainable human resource management in the development of enterprises [42]. Employee training,

as an important measure of sustainable human resource development, should receive more attention, which could improve the examination of how employee skills, experience and ability can be improved through employee training and promote sustainable human resource management [43]. Therefore, this study attempts to analyse corporate employee training in multiple enterprises as well as multiple types of training activities to explore sustainable human resource management.

2.2. Employee Training

Employee training, one of main ways for an enterprise to improve its core competitiveness, plays a vital role in the performance, survival and development of an enterprise [44]. Employee training helps improve the knowledge and technology required by enterprises and improves work attitudes, employees' work ability and the work results of employees [45]. Some scholars, such as Hanaysha and Tahir [46], define employee training as a systematic process that helps employees learn how to improve their knowledge, skills, or behaviours through a beneficial programme that seeks to improve their work efficiency and corporate performance.

Some works evaluate whether training is effective in various fields, for instance, medical health [47,48] and contingency management [49,50]. These studies examine and reveal the important role of and demand for employee training. Meanwhile, there are many factors that can affect the efficiency of employee training and the training experiences of employees, such as the internal environment (e.g., learning environment), external market, institutional environment, organizational strategy of enterprises, training method and duration, and wage system [51–54]. Some conclusions have been published, for example, the incidence of employee training increases with labour market tension [51].

In terms of research methods, we can see that a questionnaire survey is the main approach used to obtain the data related to employee training. Other methods, such as structural equation modelling, among others, are also used together to analyse employee training [44,52,54,55]. It is obvious that the majority of studies on employee training are based on qualitative analysis, and quantitative analysis is less used to analyse training programmes. In particular, there is a lack of analysis and research on the content and types of employee training, the relationships among different types of employee training, and corporate behaviour related to employee training. Social network analysis, developed by sociologists, provide a quantitative way to analyse and involves mathematical methods as well as graph theory, this is a popular method that is used to analyse the relationships among objects. Therefore, social network analysis is used in this study to make up for the above lacks.

2.3. Proposed Methods

Social network analysis originated in the 1930s. The theoretical basis of social network analysis is graph theory and sociology and anthropology theory. Social network analysis assumes that network members can interact and that their behaviours are largely influenced by the relationship patterns embodied in the network structure [28,32]. Many scholars have employed social network analysis to solve problems related to natural resource management, environmental management, sustainable development and corporate behaviour analysis (e.g., enterprise cluster behaviour and collaborative behaviour) [29–31,56,57]. Therefore, the application of social network analysis to study corporate behaviour related to employee training broadens the fields where this method can be applied.

The aim of this study is to quantitatively analyse sustainable human resource management from the perspective of employee training by using social network analysis. On the one hand, social network analysis can represent qualitative social relations in a quantitative form by using scientific, rich and systematic methods and techniques for the analysis of social - networks [27,29,30]. It is believed that social network analysis can compensate for and expand the shortage of research on employee training by using qualitative methods. In addition, social network analysis emphasizes the mutual influence and dependence of actors through mapping and analysing the internal relations among people, groups, organizations, communities, etc. [58,59]. It is helpful to build and describe the relationships that exist

between trainings and enterprises, among trainings and among enterprises by utilizing social network analysis. Moreover, it is worth noting that enterprises and employee training activities are different classes of things, cannot be coped with general network model. While the two-mode affiliation network in the social network analysis method can exactly provide a way to describe the relationships between enterprises and employee training activities. Meanwhile, social network analysis can measure the complexity and features of a network by using indicators from multiple perspectives. We believe that social network analysis is able to deeply understand corporate employee training behaviours. The popular indicators include degree centrality, closeness centrality, and betweenness centrality, which are always used in the centrality analysis of social networks. Other network analyses also include size and density, the core-periphery structure analysis, and structural holes. In this study, mainly degree centrality, density, and the core-periphery structure are used to analyse corporate behaviours related to employee trainings.

3. Research Methodology

Social network analysis can effectively describe the relationships that exist among enterprises; in particular, a two-mode affiliation network can be used to easily describe and explain the relationships between training programmes and enterprises. Therefore, we use content analysis and social network analysis together. To understand the current state of corporate employee training and to analyse corporate behaviour related to employee training from the perspective of multiple enterprises, the research methodology involves two steps: (1) identifying employee training programmes and (2) identifying the relationships between enterprises and employee training activities. These steps also involve building an enterprise-employee training activity network, an employee training activities network and an enterprise network.

3.1. Identification of Employee Training Activities and Keyword Selection

For corporations to keep their competitive positions in the market, they must provide financial support to the education of employees and give them more options in terms of training and personal development because, to a significant extent, the knowledge they have is key to maintaining this competitive position [60]. However, the high cost of employee training and other factors cause many enterprises, especially manufacturing companies, to be faced with several challenges that may limit the implementation of employee training. It is estimated that, for most companies, between 3% and 5% of their income would be invested on the education of employees [61]. As a result, the willingness and investment behaviour related to employee training vary among different enterprises. Some enterprises might prioritize certain training programmes. Generally, enterprises determine the appropriate content for training programmes (or training activities) to enhance the professional development of staff. For instance, training programmes for new employees, training programmes for senior managers, multicultural or cross-cultural education and training, security training, and occupational health training [62,63]. To understand the current status of training activities, we will analyse them from four aspects: training content, training managers, training staff and training format.

In order to get these training activities, content analysis is used firstly. Content analysis, a type of textual analysis, has been used to study corporate sustainability reports and has made some progress [64]. We use content analysis to identify the training activities and programmes mentioned in social responsibility (sustainability) reports. Enterprises commonly issue sustainability (or corporate social responsibility (CSR)) reports each year. A sustainability report is an organizational report that discloses a firm's sustainability performance from several aspects, for instance, economic, environmental, social and governance performance, so that the public can better understand the firm's strategy, approach, and implementation of its sustainability efforts. In this study, we use sustainability reports as a tool to better understand the status of employee training conducted by enterprises and to better understand the status of corporate sustainable human resource management.

Regarding the timeliness and the availability of the reports, we use social responsibility (sustainability) reports issued in 2017 as data sources. We used "training" as the keyword. Because we investigate Chinese enterprises that submit Chinese reports, we used the corresponding Chinese term for the keyword to identify training activities. Then, we used NVivo10 software to encode and analyse the company data by compiling a large amount of scattered data-related to employee trainings. We employ manual and automatic coding methods to obtain the data. Then, we manually verify these data. During this process, the data for some synonymous words or phrases are merged and some irrelevant words or phrases are removed. After a careful reading of the material, a list of training activities implemented by the corresponding enterprise, as noted in the social responsibility (sustainability) reports, is obtained and identified.

3.2. The Construction of Networks Related to Employee Training

3.2.1. Enterprise-Employee Training Activity Network

After identifying the training activities and corresponding enterprises, we build three networks to describe and interpret corporate behaviour related to employee training. The first network is an enterprise-employee training activity network, which is a two-mode affiliation network, and can be expressed by:

$$G_{E-A} = \left(V^E, V^A, E^{EA} \right), \tag{1}$$

where V^E is the set of enterprises that implement employee training, $V^E = \{v_i^E\}$. V^A is the set of training activities identified in the sustainability reports issued in 2017, $V^A = \{v_j^A\}$. E^{EA} is the set of relationships between the enterprises and the corresponding training activities, $E^{EA} = \{e_{ij}^{EA}\}$. $e_{ij}^{EA} = 1$ if training activity v_j^A is implemented by enterprise v_i^E, and $e_{ij}^{EA} = 0$ if training activity v_j^A is not implemented by enterprise v_i^E. The direction of the link is from the enterprise node v_i^E to the training activity node v_j^A. Let n be the size of the node set V^E, and let m be the size of node set V^A. In this study, $n = 53$ and $m = 108$.

To further analyse the relationship between corporate behaviours related to employee training and the relationships among the different types of employee training, we separate the two-mode network into two single-mode networks, that is, the employee training activities network G_{A-A} and the network of enterprises G_{E-E}. For the specific modelling rules, please see Sections 3.2.2 and 3.2.3.

3.2.2. Employee Training Activities Network

If two activities are implemented at the same time by one enterprise, then these two training activities can be regarded as being related to each other. In other words, there is a correlation between these two activities. The training activities network is therefore expressed as:

$$G_{A-A} = \left(V^A, E^{AA}, W^{AA} \right), \tag{2}$$

where $E^{AA} = \{e_{ij}^{AA}\}$ and $e_{ij}^{AA} = 1$ if two activities are implemented by the same enterprise; otherwise, $e_{ij}^{AA} = 0$, and $e_{ij}^{AA} = e_{ji}^{AA}$. $W^{AA} = \{w_{ij}^{AA}\}$ and $w_{ij}^{AA} = \begin{cases} \left| E_i^A \cap E_j^A \right|, \ i \neq j \\ 0, \ i = j \end{cases}$, E_i^A represents the set of enterprises that implement the activity v_i^A. $\left| E_i^A \cap E_j^A \right|$ represents the number of enterprises that have implemented both activities v_i^A and v_j^A. The value of w_{ij}^{AA} can be interpreted as a correlation between the two training activities.

3.2.3. Enterprise Network

If two enterprises perform the same training activity, then these two enterprises can be regarded as common target participants who have the same regarding a certain type of staff training or education.

In other words, they have the same expectations for their employees. The enterprise network is therefore denoted as:

$$G_{E-E} = \left(V^E, E^{EE}, W^{EE} \right), \tag{3}$$

where $E^{EE} = \{ e_{ij}^{EE} \}$ and $e_{ij}^{EE} = 1$ if enterprise v_i^E and enterprise v_j^E employ the same training activity;

otherwise, $e_{ij}^{EE} = 0$ and $e_{ij}^{EE} = e_{ji}^{EE}$. $W^{EE} = \{ w_{ij}^{EE} \}$, and $w_{ij}^{EE} = \begin{cases} \left| A_i^E \cap A_j^E \right|, i \neq j \\ 0, \; i = j \end{cases}$, A_i^E represents the

set of employee training activities implemented by enterprise v_i^E; $\left| A_i^E \cap A_j^E \right|$ represents the number of common training activities conducted by enterprises v_i^E and v_j^E. The value of w_{ij}^{EE} can be interpreted as the difference in the willingness of two enterprises to engage in staff development and the difference in their resource investment of enterprises in staff development. w_{ij}^{EE} can be used as an indicator of the collaborative potential for staff development.

3.3. Indicators of Corporate Employee Training Behaviour

Once we develop the rules for constructing the network and obtain the related data, the networks G_{E-A}, G_{A-A}, and G_{E-E} can be developed. Some indicators of social networks can be used to characterize corporate employee training behaviour, for instance, degree centrality, core-periphery, and density.

3.3.1. Degree Centrality

Degree centrality (e.g., in-degree and out-degree) can be used to measure the importance and position of each node. In network G_{E-A}, the in-degree of the training activity node v_j^A, denoted as $k_{v_j^A}(G_{E-A})$, simply refers to the number of enterprises that conduct this training activity and is measured by the formula $k_{v_j^A}(G_{E-A}) = \left| E_j^A \right| = \sum_i e_{ij}^{EA}$. This variable can be interpreted as the extent to which the training activity is valued by enterprises. The larger the in-degree of a training activity node is, the higher its value. In other words, from a practical point of view, we can assume that the higher the value of $k_{v_j^A}(G_{E-A})$ is, the greater the investment in this type of training activity will be. The out-degree of enterprise node v_i^E, expressed as $k_{v_i^E}(G_{E-A})$, refers to the enterprise's willingness and commitment to training activities related to employee development and can be measured by the formula: $k_{v_i^E}(G_{E-A}) = \left| A_i^E \right| = \sum_j e_{ij}^{EA}$. The larger the out-degree of an enterprise node is, the stronger the willingness and commitment of the enterprise to employee training and development is. Because G_{E-A} is a two-mode network, according to social network analysis method [65], we use the following formula to normalize the degree centrality scores:

$$Enterprise \; v_i^E \; normalized \; centrality \; (G_{E-A}) = \frac{k_{v_i^E}(G_{E-A})}{m}, \tag{4}$$

$$Training \; activity \; v_j^A \; normalized \; centrality \; (G_{E-A}) = \frac{k_{v_j^A}(G_{E-A})}{n}. \tag{5}$$

In network G_{E-E}, the degree of an enterprise, denoted as $k_{v_i^E}(G_{E-E})$, represents the difference in the investment in and willingness to conduct employee training and education among enterprises and is measured by the formula: $k_{v_i^E}(G_{E-E}) = \sum_j e_{ij}^{EE}$. Therefore, the degree of similarity in investment behaviour related to employee training depends on the weight of each link in G_{E-E}. In network G_{A-A}, the degree of training activity, denoted as $k_{v_i^A}(G_{A-A})$, represents the correlation with other training activities and is calculated by the formula: $k_{v_i^A}(G_{A-A}) = \sum_j e_{ij}^{AA}$. The strength of the correlation

depends on the weight of each link in G_{A-A}. For the sake of simplicity and to make the results easier to compare, we use the following formulas to normalize the degree centrality scores.

$$Enterprise\ v_i^E\ normalized\ centrality\ (G_{E-E}) = \frac{k_{v_i^E}(G_{E-E})}{n-1}, \tag{6}$$

$$Training\ activity\ v_j^A\ normalized\ centrality\ (G_{A-A}) = \frac{k_{v_j^A}(G_{A-A})}{m-1}. \tag{7}$$

3.3.2. Core-Periphery Measures

Core-periphery structure analysis is an important part of social network analysis. The measure used to examine the core-periphery network structure is given as the following formulas [63]:

$$\rho = \sum_{i,j} e_{ij}\delta_{ij}, \tag{8}$$

$$\delta_{ij} = \left\{ \begin{array}{c} 1,\ if\ c_i = CORE\ or\ c_j = CORE \\ 0,\ otherwise \end{array} \right\}, \tag{9}$$

where e_{ij} indicates the presence or absence of a link in the observed data. δ_{ij} represents the presence or absence of a link in the core-periphery image. c_i refers to the class (core or periphery) to which node v_i is assigned.

3.3.3. Density

The size of the network is defined as the number of nodes in the network. The density of the network is measured by the following formula:

$$d(G) = 2M/[(m+n)(m+n-1)], \tag{10}$$

where M represents the number of actual links in the network.

4. Results and Analysis

4.1. Data Collection

Considering the availability of the sustainability reports as well as the social position of the enterprises, in this study, 53 enterprises were selected from fortune 100 enterprises in China in 2017, and their 2017 sustainability reports (PDF documents) were downloaded from the firms' official websites. The list of selected enterprises is shown in Table 1. The sectoral distribution of these enterprises is shown in Figure 1. After collecting the reports, each PDF was converted to extractable text. The words or phrases related to training were extracted through content analysis method for which details are provided in Section 3.1.

As a result, 108 categories of training activities were identified. For the sake of analysis, we divided these 108 types into four big groups: the specific content of the trainings, the management personnel receiving training, the staff receiving training, and the training methods, as shown in Figure 2. As we can see from Figure 2, the employee trainings include 57 types of training (which are coded from C1 to C57), 23 types of managers (which are coded from M1 to M23), 18 categories of staff that were trained (which are coded from S1 to S18), and 10 types of training methods (which are coded from Me1 to Me10).

Table 1. The enterprises selected in this study.

| No.	Company Name	Rank in 2017	Abbreviation
1	State Grid Corporation of China	1	SGCC
2	China Petroleum & Chemical Corporation	2	CPCC
3	China National Petroleum Corporation	3	CNPC
4	Industrial and Commercial Bank of China	4	ICBC
5	China State Construction Engineering Corporation	5	CSCEC
6	China Construction Bank	6	CCB
7	Agricultural Bank of China	7	ABC
8	Ping An Insurance (Group) Company of China	8	PAG
9	SAIC Motor Corporation Limited	9	SAIC
10	Bank of China	10	BOC
11	China Mobile Communications Group Corporation Limited	11	CMCC
12	China Life Insurance (Group) Company	12	CLIC
13	China Railway Construction Corporation = Limited	14	CRCC
14	Huawei Investment & Holding Corporation Limited	17	HIHC
15	China Resources (Holdings) Corporation Limited	18	CRHC
16	China Southern Power Grid Company Limited	20	CSPGC
17	The People's Insurance Company (Group) of China Limited	23	PICC
18	China National Offshore Oil Corporation	24	CNOOC
19	China Minmetals Corporation	26	CMC
20	China FAW Group Corporation Limited	27	CFGC
21	China Telecommunications Corporation	29	CTC
22	China North Industries Group Corporation Limited	32	CNIGC
23	COFCO Corporation	33	COFCO
24	Beijing Automotive Group Corporation Limited	34	BAGC
25	Sinochem Group Corporation Limited	35	SGC
26	Bank of Communication	39	BOCO
27	Power Construction Corporation of China	42	PCCC
28	Baoshan Iron & Steel Corporation Limited	44	BISC
29	China National Chemical Corporation	46	CNCC
30	China Merchants Bank	47	CMB
31	HBIS Group Corporation Limited	49	HBIS
32	Industrial Bank Corporation Limited	50	IBC
33	China Shipbuilding Industry Corporation	51	CSIC
34	Guangzhou Automobile Group Corporation Limited	52	GAGC
35	Shanghai Pudong Development Bank	54	SPDB
36	China Minsheng Bank	55	CMSB
37	China Pacific Insurance(group)Corporation Limited	57	CPIC
38	China National Building Materials Group Corporation	58	CNBM
39	China Shenhua Energy Company Limited	61	CSEC
40	China Huaneng Group Corporation Limited	63	CHGC
41	Shaanxi Yanchang Petroleum (Group) Corporation Limited	64	SYPC
42	CRRC Corporation Limited	66	CRRC
43	China Vanke Corporation Limited	67	CVC
44	China Energy Engineering Group Corporation Limited	68	CEEGC
45	China Everbright Group	71	CEG
46	China National Machinery Industry Corporation Limited	72	SINOMACH
47	Shaanxi Coal and Chemical Industry Group Corporation Limited	74	SCCIGC
48	Zhejiang Geely Holding Group	78	GEELY
49	Wuchan Zhongda Group	79	WZG
50	State Power Investment Corporation	86	SPIC
51	China Huadian Corporation Limited	90	CHC
52	Datong Coal Mine Group Corporation Limited	95	DCMGC
53	China National Aviation Fuel Group	97	CNAFG
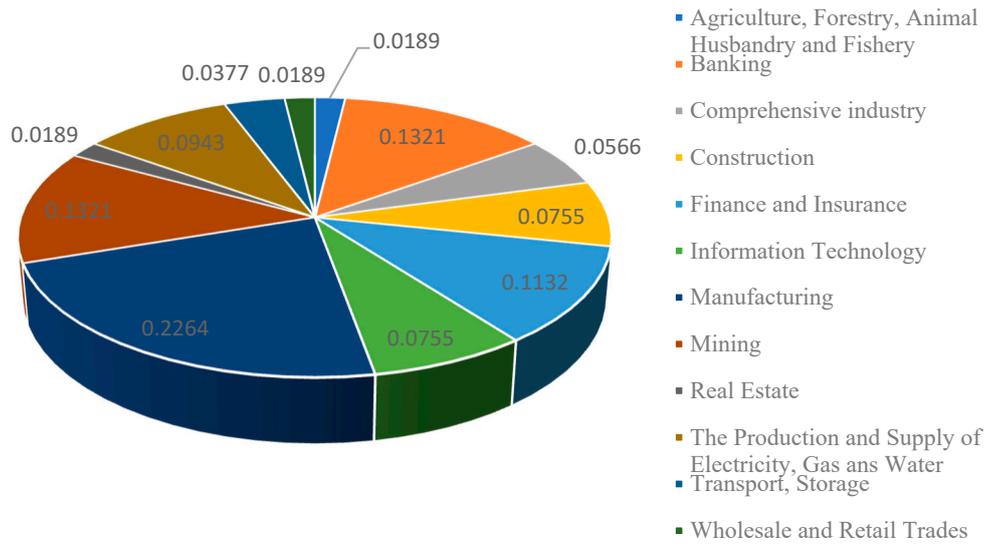
**Figure 1.** The sectoral distribution of enterprises.
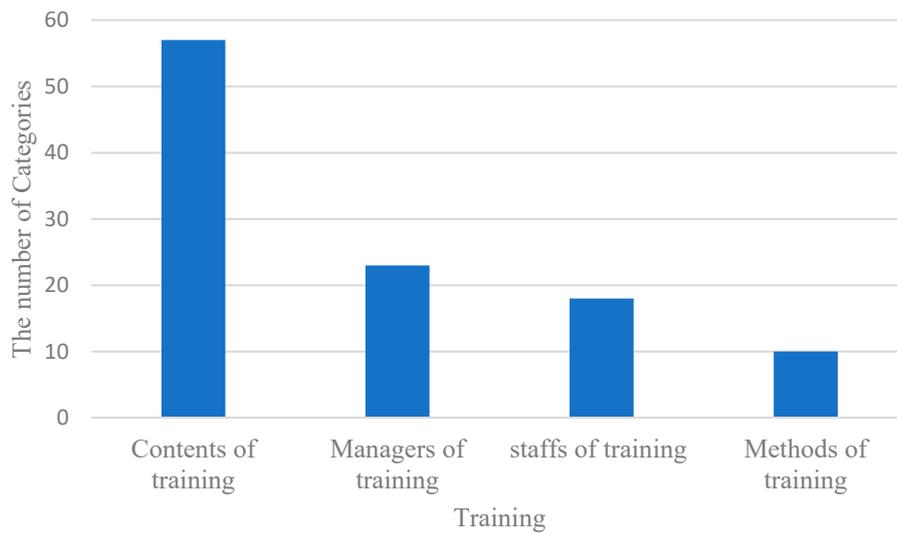
Figure 2. The distribution of categories of training activities.

4.2. Visualization of the Networks

According to the modelling rules described in Sections 3.2.1–3.2.3, three different networks were constructed. UCINET software was used to construct these networks. The enterprise-employee training activity network G_{E-A} is shown in Figure 3. The employee training activities network G_{A-A} is shown in Figure 4. The enterprise network G_{E-E} is shown in Figure 5.
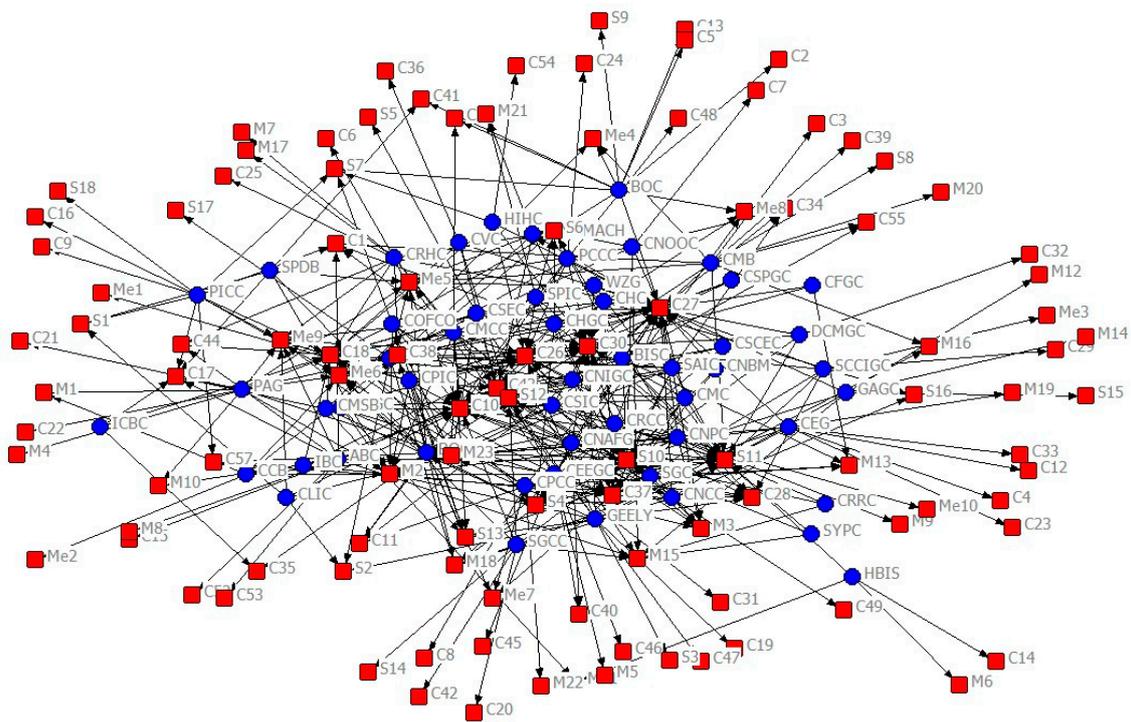
Figure 3. Enterprise-employee training activity network G_{E-A}.
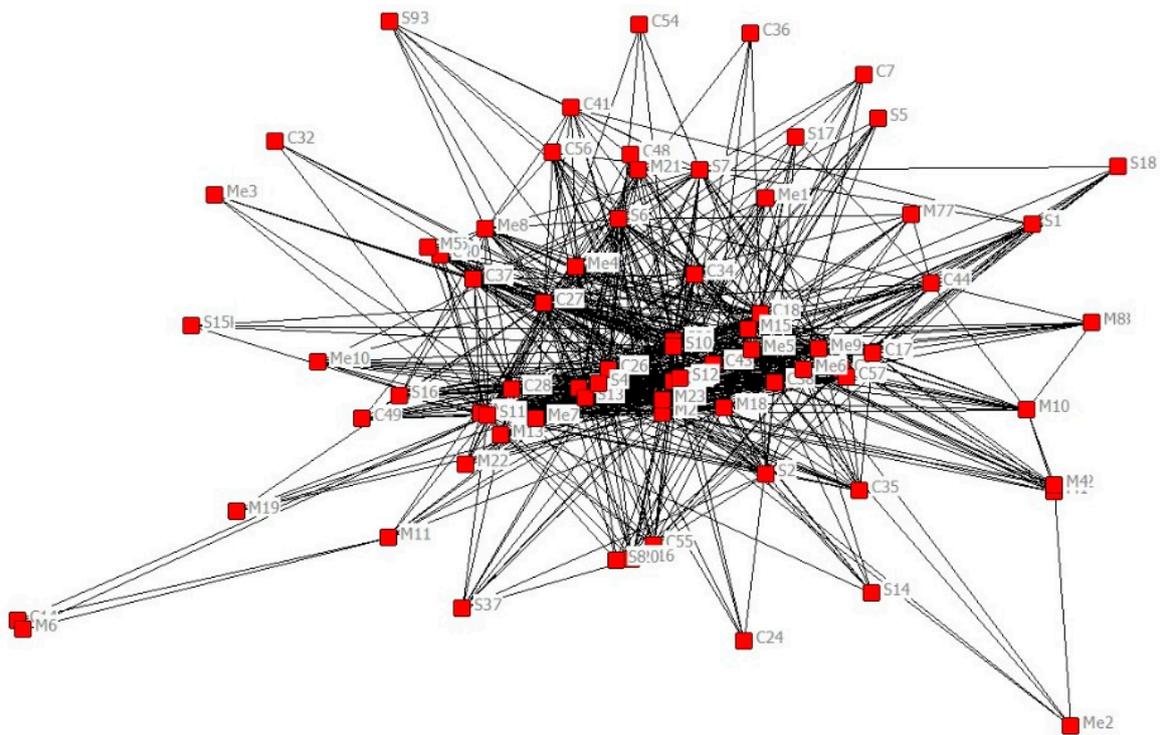
Figure 4. Employee training activities network G_{A-A}.
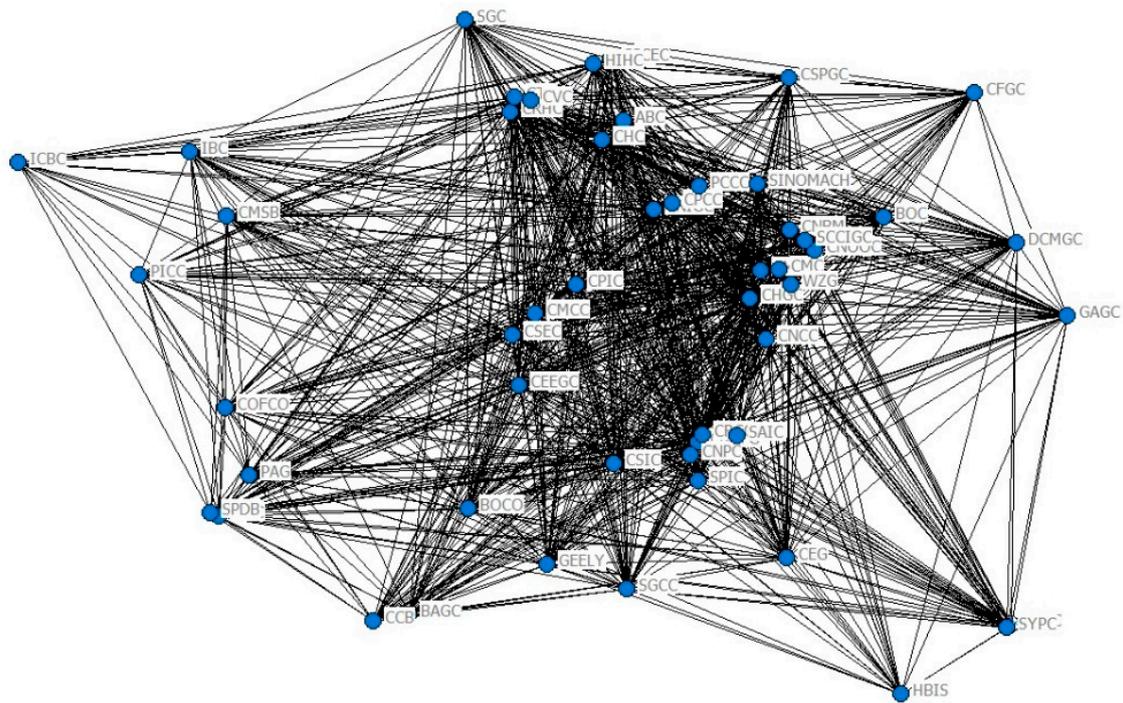
Figure 5. Enterprises network G_{E-E}.

4.3. Centrality and Structure Analysis of the Social Network

4.3.1. Centrality Analysis of the Two-Mode Network

Once we constructed network G_{E-A}, the centrality of each node was obtained. Figure 6 ranks the two-mode normalized degree of centrality for the 53 enterprises. We can see that BOCO, CEEGC, CNPC, GEELY, and ABC are the top five enterprises that conduct the most types of training activities. In other words, these five enterprises have the greatest willingness and strongest commitment to employee training activities.
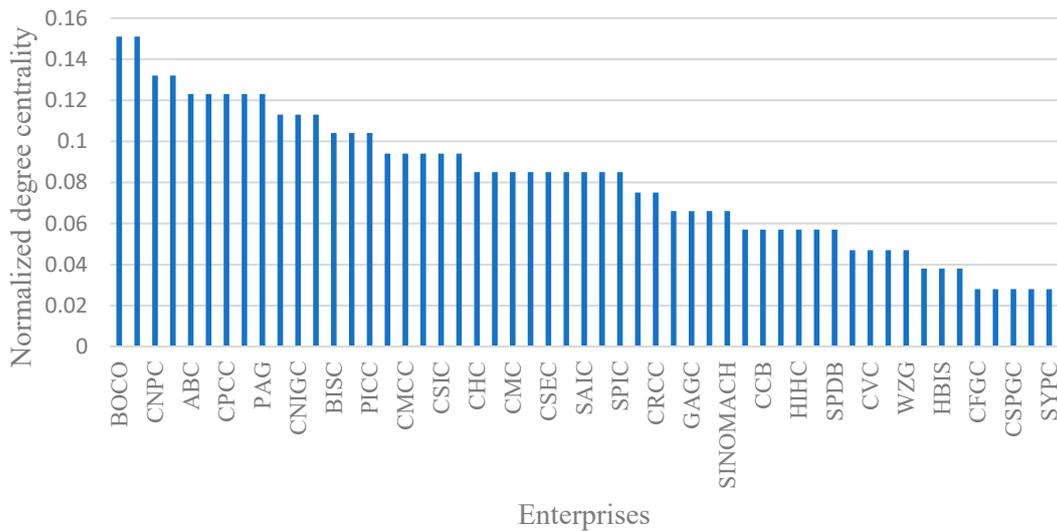

Figure 6. Two-mode normalized degree centrality of 53 enterprises.

According to the ranking of the two-mode normalized degree of centrality for 108 training activities, as shown in Figure 7, we can see that C27 (Security training), S11 (Skills training), S10 (Technical personnel training), C30 (Emergency training), C10 (The party training), C43 (Occupational health

training), M23 (Senior management training), C18 (Anti-corruption training), C26 (Compliance legal rules training), and C38 (Social responsibility training) are the top 10 training activities that are implemented by the enterprises. In other words, the enterprises pay these 10 training activities the most attention.
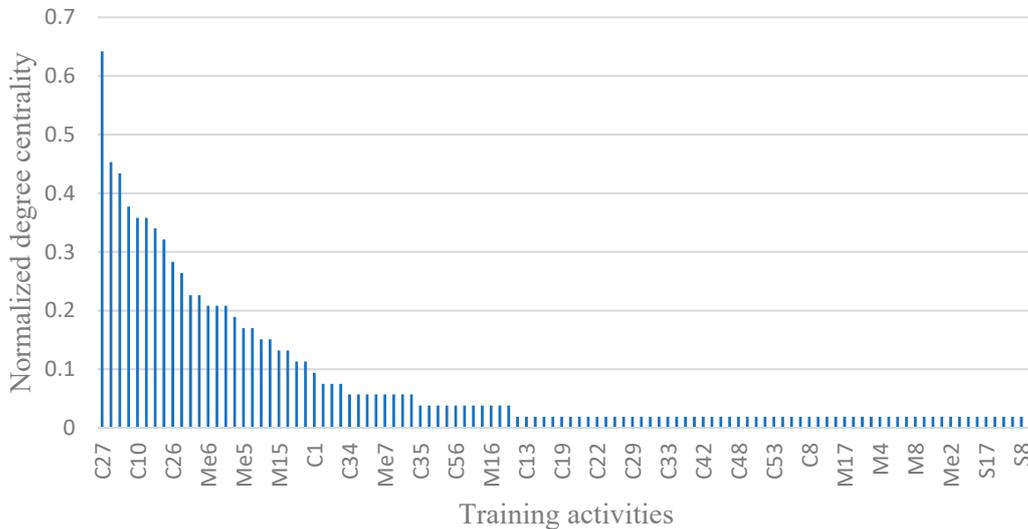

Figure 7. Two-mode normalized degree centrality of 108 employee training activity nodes.

4.3.2. Single-Mode Centrality Analysis

The degree of centrality of each node in G_{A-A} and G_{E-E} is shown in Figures 8 and 9, respectively.
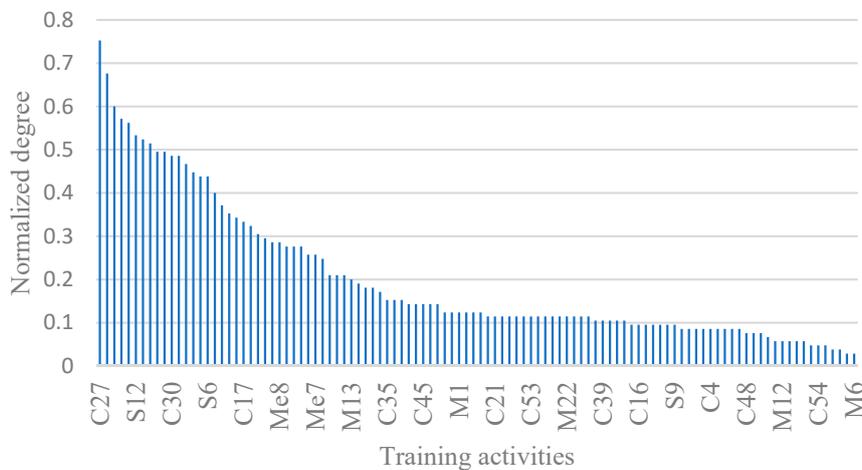

Figure 8. Single-mode normalized degree centrality of 108 training activities.

As shown in Figure 8, C27 (Security training), S11 (Skills training), and C18 (Anti-corruption training) are the top three training activities that have the maximum correlation with the other training activities. In other words, these top-ranked training activities are the most basic types of training implemented by the enterprises. Most of the enterprises prefer expanding the content offered in the training on the basis of these training activities. The expansion of an enterprise's training can be considered as an extension that is based on these basic training types. There are no isolated training activities, which means that the training activities identified in this study are all correlated. Enterprises do not just carry out only one type of training activity; they usually implement a variety of training activities.

Figure 9 shows that CEEGC's behaviour related to employee training has the greatest degree of similarity with the other enterprises. In other words, in terms of employee training, CEEGC behaves

in a manner that is similar to most of the other enterprises, followed by CMCC, CSEC and the China Shipbuilding Industry Corporation (CSIC). From the investment point of view, CEEGC, CMCC, CSEC and CSIC's investments in staff development are universal, involving the most types of training activities. There are no isolated enterprises in network G_{E-E}, which means that all 53 enterprises engage in similar training behaviours. In terms of employee training behaviour, enterprises have some common preferences. The reasons for these common preferences might stem from political policy, such as anti-corruption policy.
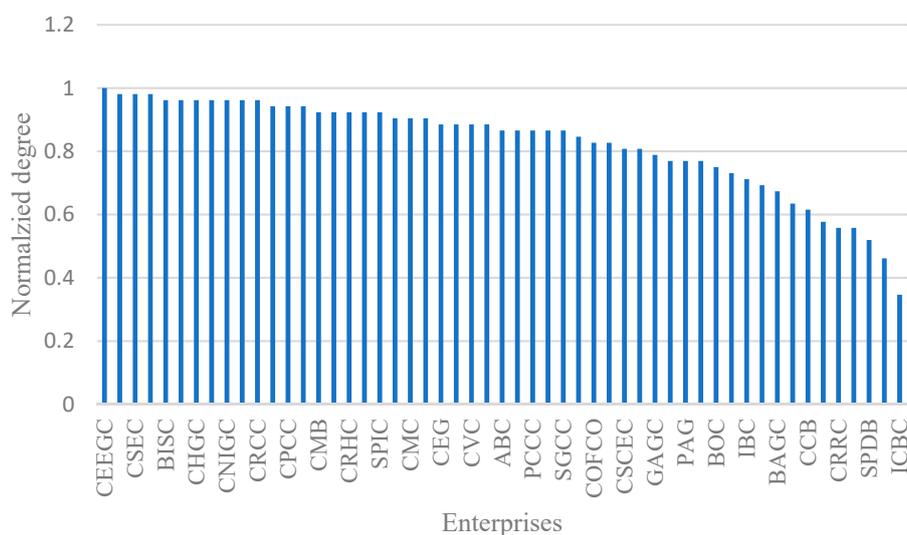

Figure 9. Single-mode normalized degree centrality of 53 enterprises.

4.3.3. The Core-Periphery Structure Analysis

According to the core-periphery analysis of the social network, the positions of the nodes in the network can be identified in terms of the classification of the core and periphery nodes. In network G_{E-A}, the core nodes include 23 enterprise nodes (CRHC, SGC, CMSB, BOC, BOCO, CNCC, CEEGC, CMC, DCMGC, COFCO, CHGC, HBIS, CMB, CNIGC, IBC, PAG, CNAFG, PICC, CPIC, SPIC, CPCC, CNPC, GEELY) and 32 training activity nodes. The other nodes in G_{E-A} are periphery nodes. The original fitness is 0.299, and the final fitness is 0.307. In network G_{A-A}, the core training activities include C10, C18, C26, C27, C30, C37, C38, C43, M23, S10, S11, and S4. In network G_{E-E}, the core enterprises include BISC, BOCO, CEEGC, CHC, CHGC, CMC, CMCC, CNAFG, CNCC, CNIGC, CNPC, CPCC, CPIC, CRCC, CRHC, CSEC, CSIC, GEELY, PCCC, SAIC, and SINOMACH.

4.3.4. Structural Features of the Networks

The density, clustering coefficient, and average geodesic distance are used to characterize and compare the structures of G_{E-A}, G_{A-A}, and G_{E-E}, as shown in Table 2.

Table 2. Structural indicators of three networks.

Network	Number of Nodes (Scale of Network)	Density	Clustering Coefficient	Average of Geodesic Distance
G_{E-A}	161	0.080	0	3.245
G_{A-A}	108	0.374	1.360	1.8
G_{E-E}	53	2.123	2.407	1.2

5. Discussion

The purpose of this study is to explore corporate behaviour related to investment in and the willingness to conduct employee training and education through social network analysis. This section

further reveals and discusses the main features of corporate employee training behaviour based on the results obtained in Section 4 and attempts to develop strategies that can be used for employee training to improve the sustainable development of corporate human resources.

According to the results we obtained in Section 4, we can see that some key training activities and key enterprises have been identified through social network analysis. Do correlations exist among the employee training activities? According to the results in Sections 4.2 and 4.3, there are no isolated training activities. Therefore, it is reasonable to say that the training activities identified in this study are all correlated. Enterprises do not just carry out only one type of training activity, they usually implement a variety of training activities that might be implemented by other enterprises.

Do enterprises engage in similar employee training behaviour? According to the analysis in Section 3.2.3, the value of w_{ij}^{EE} measures the similarities in corporate employee training. In other words, the similarity in behaviours related to corporate training is measured on the basis of the training activities that have been implemented. The higher the w_{ij}^{EE} is, the greater the similarity between enterprises i and j. As shown in Figure 5, we can see that there are no isolated nodes in network G_{E-E}, showing that all 53 enterprises engage in similar training behaviours with different degrees of similarity. Moreover, enterprises have some common preferences in terms of employee training behaviour. That is, various enterprises might implement some of the same training activities. What is the extent of this similarity? Social network analysis is able to provide an intuitive and visible representation of the similarity by using the method of multidimensional scaling. The layout of the enterprise network is therefore designed by using the method of multidimensional scaling, as shown in Figure 4. The distance between any two enterprises represents the similarity in their behaviour related to employee training. The closer the distance is, the greater the similarity in the two enterprises' behaviour. Therefore, according to the results of the network analysis, eight groups with considerable similarity have been identified, as shown in Table 3.

Table 3. The groups divided by similarity.

No.	Group
1	SPDB, CLIC
2	SYPC, CRRC
3	CTC, CRHC, CVC
4	HIHC, CSCEC
5	CNIGC, CPCC
6	CNBM, SCCIGC, CNOOC
7	CMB, CMC, WZG
8	CNPC, CNAFG, CRCC

Furthermore, the similarity in this behaviour can also be revealed by the degree of centrality of the nodes in network G_{E-E}. According to the results, the average value of the raw degree is 42.9, indicating that on average, each enterprise will behave similar to the other 43 enterprises. In other words, the probability that any two enterprises will behave similar in terms of employee training is 0.827. More specifically, the employee training implemented by CEEGC (China Energy Engineering Group Corporation Limited), CMCC (China Mobile Communications Group Corporation Limited), CSEC (China Shenhua Energy Company Limited) and CSIC that is similar to that used by all the other enterprises.

From the perspective of training categories, the reason that enterprises behave similarly can be determined by looking at the results of network G_{A-A}. One reason is that each Chinese enterprise provides some basic training activities, although its production and services are different. In 2017, security training, skills training, and anti-corruption training were the basic training activities provided by these 53 enterprises.

Some scholars [43,66–68] note that employees need to receive environmental training, which is considered a factor for improving environmental performance, to acquire environmental knowledge

and to be able to address environmental concerns. In other words, green training is crucial to any success implementation of activity related to environmental management [69]. In this study, four training activities related to environmental training were identified: C7 (Training on low-carbon management), C37 (Environmental protection training), C41 (Green credit training), and C44 (Training on energy conservation and emission reduction). However, only 1.9% of the enterprises implemented C7, 22.6% of the enterprises implemented C37, 3.8% of the enterprises implemented C41, and 5.7% of the enterprises implemented C44. Overall, environmental training is minimal. Compared with other countries, the environmental training provided in Chinese enterprises is far from sufficient in terms of both content and quantity. For instance, according to a CIPD/KPMG survey, 42% of U.K. organisations hold training to make their employees friendly to the environment [70].

It is of great social and economic significance to understand the current situation regarding corporate behaviour related to employee training investment to improve corporate sustainable development. This study provides the following theoretical and managerial implications. First, from the perspective of employee training, this study provides an important contribution in the field of sustainable human resource management. Second, we expand the application of social network analysis to corporate employee training. Three different networks are constructed to interpret the features of corporate employee training in terms of key training activities, key enterprises, the correlation among training activities, and the similarities in behaviours related to employee training. Third, the research findings complement previous qualitative studies on employee training. In addition, our research extends the study of employee training conducted by a single corporation to that of employee training conducted by multiple corporations.

Regarding the managerial implications, this study indicates that it is beneficial for managers to understand the connection and differences among employee training provided by various enterprises. By identifying the key training activities and key enterprises, we can discover the current status of training activities in Chinese enterprises and which types of training activities should be strengthened to improve the sustainability of human resources. In addition, our results lead us to provide some suggestions to managers, for instance, (1) because all 53 enterprises have similar training behaviours, firms can cooperate in the provision of corporate training to reduce corporate training costs and improve the quality and efficiency of the training at the same time. (2) Furthermore, we identified the similarities in corporate employee trainings and suggest that companies that are very similar should participate in trainings together to reduce training costs. In addition, these firms can also take this opportunity to communicate and promote the exchange and sharing of knowledge among employees both inter-industry and intra-industry. (3) Employee training related to the environment is provided much less often than it is in other countries and should be strengthened.

6. Conclusions

Human resources are the core resource of an enterprise, especially in the age of artificial intelligence. Employee training and education is of great significance for improving the overall quality of employees and promoting the sustainable and healthy development of human resources. There is a lack of quantitative research on employee training as well as on the behaviour related to the willingness to provide and investment in employee trainings. In addition, previous research has mainly focused on a single enterprise, neglecting the perspective of multiple enterprises. To close these gaps, on the one hand, content analysis and social network analysis are used in this study to reveal the current status of employee training, for instance, the types, content and distribution of trainings provided by various enterprises. On the other hand, the correlations among training activities and the similarities in enterprises' behaviour related to employee training are analysed from the network perspective.

Our results show that our method performs well when studying corporate employee training behaviours. The structure of three networks can intuitively show us the relationships among trainings,

among enterprises, and between trainings and enterprises. Indicators of social network can be used to reveal the characteristics of training behaviours, in particular the similarity of corporate training behaviours. The main findings include the following: (1) 108 types of training activities were implemented by 53 enterprises; (2) the key types of employee training (e.g., security training and skills training) and key enterprises (e.g., bank of communication) were identified; (3) the training activities identified in this study are all correlated; and (4) all 53 enterprises engage in similar training behaviours with different degrees of similarity. Eight groups of similar firms were identified.

In addition, some main conclusions are obtained based on our study, as follows: Firstly, employee training behaviours vary from enterprises, which is reflected in the diversity of training contents and forms. Training behaviours of enterprises have different preferences and characteristics. However, security training and skills training are the basic contents of corporate trainings. It shows that enterprises should also introduce characteristic trainings while ensuring implementation of basic trainings. Secondly, corporate employee trainings are affected by the society to some extent. For example, anti-corruption, energy conservation, environmental protection and other social trends and hot topics in that year have been incorporated into training contents in some enterprises. It shows that some enterprises have realized that employee training should be integrated with the trend of national social development. We suggest that more enterprises should also realize this point. Thirdly, corporate employee training behaviours are similar to some extent. We argue that increasing the similarity of trainings (that is, setting up similar training systems) could be a way to enhance corporate sustainability of human resource management in terms of reduction of training costs and increase of employee creativity. For those enterprises that have similar training behaviours, we suggest these enterprises to conduct collective or shared trainings. On the one hand, they can reduce the costs of implementing trainings while achieving the goals of training through the shared trainings. On the other hand, shared trainings can provide a communication platform for information and knowledge spreading among employees in different companies to improve their knowledge and creativity, making the employees be more sustainable. Fourthly, there is a certain degree of correlation between training activities. Enterprises are suggested to consider the relevance between training contents when they set up the content of training activities, so as to establish a systematic training system to achieve better training effects.

There are several limitations regarding the content of this study, and several future studies are proposed to address these limitations. First, because the 2017 sustainable reports of some enterprises are not available, the social responsibility (sustainable) reports of only 53 firms are analysed. Therefore, our next step is to expand the number of investigations. In addition, we use only one year of data to examine the status of employee training. Next, we will consider the change in employee training over time. Third, this study directly analyses only corporate employee training behaviour, the next step will be to further analyse the influencing factors of corporate training behaviour from the social network perspective.

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