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Research on the Reality and Path of Resource-Based Enterprises' Digital Transformation

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Abstract: With the rapid development of information and communication technology, big data, cloud computing, and other digital technologies have become the impetus for the transformation of resource-based enterprises. The digital transformation of resource-based enterprises mainly involves business process reengineering and business model innovation. At present, there are several problems, such as traditional ideas that are difficult to change, insufficient online participation, inconsistent data standardization, insecure database, and shortage of talents. Based on the case study of large coal mining enterprises in Ordos and the mechanism analysis from strategic planning, operation management, and marketing, this study puts forward three paths, which are information network management, process intelligence management, and service platform management. Finally, the study points out that data mining, marketing strategy, data standards, data security, and team construction should be improved.

Keywords: Resource-based enterprises; Digital transformation; Big data analysis; Business model innovation; Information network management

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1. Introduction

The Digital China Index Report 2019 states that China has transformed from consumer internet to industrial internet. Big data, cloud computing, artificial intelligence, and other digital technologies are gradually changing from providing services for consumers to integrating into traditional industries. Traditional resource-based enterprises have problems with low production efficiency, frequent safety accidents, and serious overcapacity. With the competitive environment changes in the industry and market, digital technologies have become the impetus for the transformation of resource-based enterprises.

The existing research of resource-based enterprises mainly focuses on national strategy, such as carbon emission and institutional environment, but emphasizes less on digital transformation. Based on the case study of South Korea and Mongolia, it is found that different energy policy goals lead to differences in carbon dioxide emissions and energy security [1]. Another study found that the cross-regional transfer of resource-based enterprises will not only degrade the ecological environment but also improve it [2]. In a study, the survey data of 23 coal chemical enterprises in China were used to calculate the total carbon emission of the coal chemical industry [3], and several suggestions were proposed to reduce carbon emission.

Although academics continue to deepen research on the digital transformation of manufacturing [4-6], there is still lacking research on digital technology and resource-based enterprises. The reality, problems, and mechanism of resource-based enterprises' digital transformation are still unclear. Resource-based enterprises are related to national energy security as well as ecological and environmental protection. However, in the process of digital transformation, there are some problems that are different from manufacturing, such as lower data standardization and utilization, lower online user participation, and the difficulty to implement e-commerce. Therefore, it is necessary to further analyze the digital transformation of resource-based enterprises. This article aims to analyze the reality and problems of resource-based enterprises' digital transformation, explore the mechanism from three dimensions, including strategic planning, operation management, and marketing, and finally put forward three digital transformation paths.

2. Reality and problems

2.1. The reality of resource-based enterprises' digital transformation

The digital transformation of resource-based enterprises mainly involves business process reengineering and business model innovation (**Figure 1**).

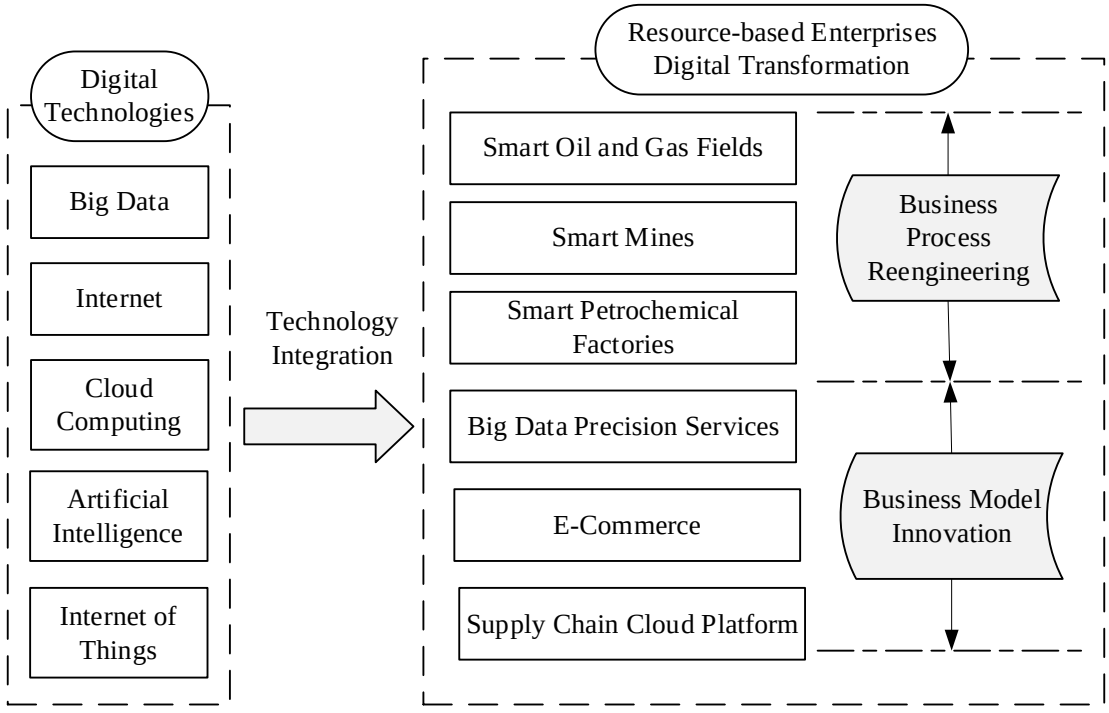

Figure 1. The reality of resource-based enterprises' digital transformation

2.1.1. Business process reengineering

Business process reengineering mainly involves smart oil and gas fields, smart mines, and smart petrochemical factories.

Smart oil and gas fields use big data, artificial intelligence, and other digital technologies for oil and gas development, which can realize unmanned, automatic alarm, and remote control as well as achieve the integration of control, operation, and decision-making. PetroChina Tarim Oilfield has realized the preliminary exploration of smart oil and gas field construction by building the underground, wellbore, and surface integrated digital platform. Sinopec Northwest Oil Field has also implemented intelligent drilling, real-time monitoring, oil well digitization, and robot patrol inspection.

Based on the perception technology, smart mines use the internet of things (IoT) to obtain real-time data and realize real-time online monitoring, automatic collaborative control, disaster fault warning, disaster auxiliary rescue, intelligent mining, as well as other modes. Smart petrochemical factories include intelligent design, production, control, and operation. They integrate technical resources, human resources, and process flow through digital technologies. Sinopec Jiujiang Petrochemical, Yanshan Petrochemical, Zhenhai Refining & Chemical, and Maoming Petro-Chemical Shihua have all achieved automatic data acquisition rates of more than 90%, established a new model of automatic, digital, and intelligent management, as well as increased labor productivity by more than 10%.

2.1.2. Business model innovation

Business model innovation mainly involves big data precision services, e-commerce, and supply chain cloud platform.

Big data analysis can effectively monitor the output, type, and inventory of production, accurately grasp the consumption of consumers, establish demand and price prediction models, as well as realize the balance of supply and demand. In 2015, China Coal Big Data Center was launched in Taiyuan, providing vehicle positioning information, statistical data on national coal production, sales, transportation, inventory, import, and export, as well as macroeconomic market analysis.

At present, e-commerce is mainly self-operated and contains third-party platforms, such as China Coal Trading Center, North Coal Electronic Trading Center, etc. E-commerce has alleviated the scattered situation in the coal industry, but issues such as unreasonable transportation and information asymmetry have not been fundamentally solved. Based on big data and cloud computing, the supply chain cloud platform integrates the supply, consumption, logistics, and financial service subjects as well as overcomes the disadvantages of blind production, information asymmetry, and excessive links in the supply chain.

2.2. Problems in the digital transformation of resource-based enterprises

Although the digital transformation of resource-based enterprises has changed from theory to reality, there are still several problems.

First, it is difficult to change traditional ideas. Resource-based enterprises managers have difficulty in looking for a breakthrough in the traditional concept of resource dependence, and employees also do not have enough understanding of digital transformation, which will affect the implementation of digital strategy. Meanwhile, upstream and downstream firms have not reached a consensus on digital transformation, and data are not interconnected.

Second, online user participation is low. Compared with e-commerce in the traditional retail industry, customers have a lower acceptance of coal e-commerce and are more willing to choose offline transactions. Resource-based enterprises have been in the seller's market position for a long time, but with the emergence of overcapacity, enterprises are in a passive position. Due to inertial thinking, resource-based enterprises often lack marketing experience and service awareness.

Third, the degree of data standardization is low. Most of the data information systems established by resource-based enterprises are business-driven, lack unified data standards, have different database formats, which cannot be connected, and face issues with data sharing. Different data information systems cannot be connected, and the data utilization rate is low, so it is difficult to play the core role of digital technology. Fourth, there are hidden dangers in data security. With the development of e-commerce and supply chain cloud business platforms, the online data of resource-based enterprises often contain business secrets, and the criminal motivation of hackers is becoming stronger. Big data information security is mainly reflected in many aspects, such as data security, equipment security, network security, and customer privacy security.

Many resource-based enterprises restrict the development of big data platforms for data and customer privacy security.

Fifth, there is a lack of interdisciplinary talents. Data acquisition, preprocessing, analysis, and visualization all need the participation of computer and resource-based professional researchers. Resource-based enterprises are often located in economically backward areas, the talent introduction mechanism is flawed, and the attraction to high-end talents is inadequate. Moreover, the knowledge structure between technicians and managers is unreasonable, and phenomena such as the inability of technicians in understanding management and managers in understanding technology are serious.

3. Mechanism analysis

3.1. Case study

From November to December 2020, our research team successively conducted field research in Ordos, Inner Mongolia Autonomous Region. By combining field investigations and in-depth interviews, the research team observed large coal mining enterprises on-site and carried out in-depth interviews with managers from strategic planning, information business, technical services, and production management departments. The research team also visited relevant departments of Ordos High-Tech Development Zone, participated in the symposium on the digitization of resource-based enterprises, as well as mastered detailed and first-hand materials as much as possible. Relevant information provided by enterprises and news reports made public by the media were also included. In addition, the contact information of the interviewed staff was obtained for further verification of the information to ensure triangulation.

The digital application of resource-based enterprises is mainly divided into five layers: the equipment layer, control layer, production execution layer, operation management layer, and decision support layer. They are all integrated through a unified data center. Generated from the equipment layer, the data flow from bottom to top. The control layer and production execution layer transfer the data to the operation management layer. After data analysis at the operation management layer and decision support layer, the results are displayed to the managers. Then, these managers will make decisions with the support of the data, pass instructions from top to bottom, and finally return to the equipment layer.

Based on the data obtained from operation management and marketing levels, big data technology is used to analyze it. After that, they are transmitted to the strategic planning level, which provides data support for strategic planning. Then, the new strategy continues to drive the operation management and marketing levels, forming a complete closed-loop system (**Figure 2**).

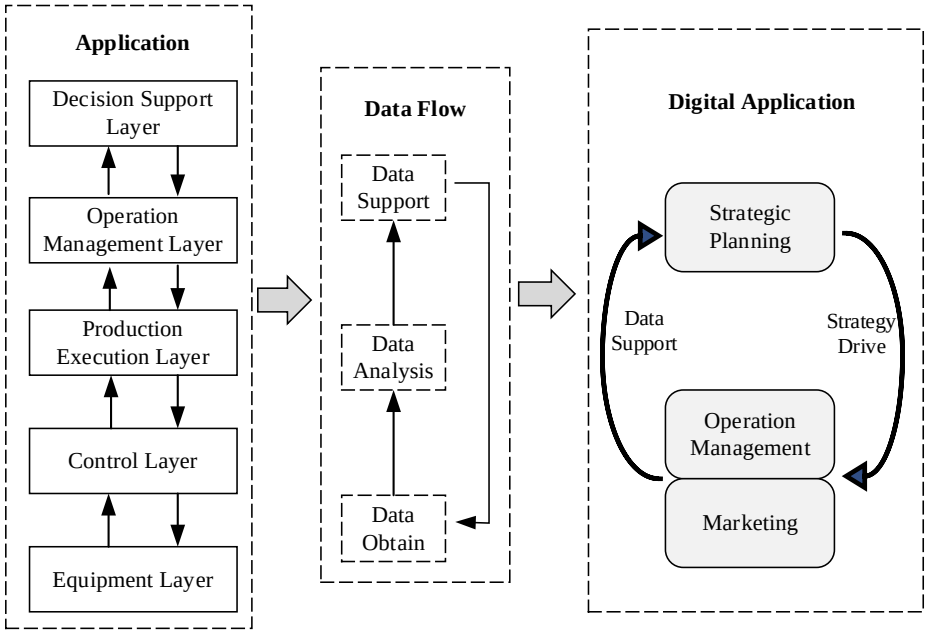

Figure 2. Digital application of resource-based enterprises

3.2. Mechanism

According to the resource-based view (RBV), the key to obtaining sustainable competitive advantage is to obtain scarce, valuable, non-imitable, and irreplaceable resources [7]. In the process of digital application, massive real-time data can be obtained. Data analysis and processing support strategic decision-making, and at the same time, circularly guide the data acquisition process. As a new scarce, valuable, non-imitable, and irreplaceable factor of production, data can give full play to its value in real-time and enhance the sustainable competitive advantage of resource-based enterprises.

Kaplan and Haenlein believe that digital transformation refers to the application of digital technology to all fields of society and a series of changes; that is, it represents the use of digital technology to solve traditional problems [8]. Digital transformation leads to destructive innovation, including the creation of new markets and value networks. Combined with the characteristics of digital transformation and application of resource-based enterprises, it can be seen that the digital transformation of resource-based enterprises is mainly through strategic planning, operation management, and marketing (**Figure 3**).

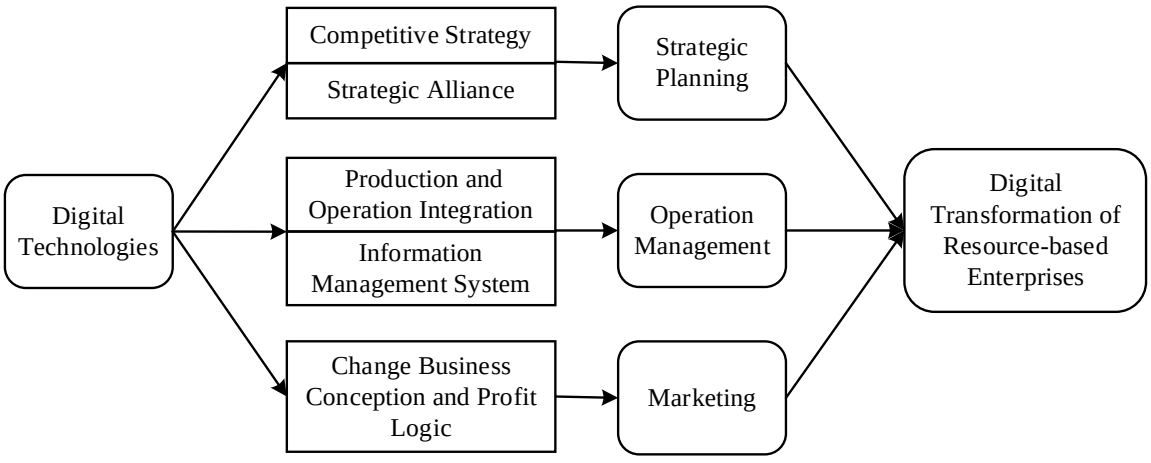

Figure 3. Mechanism of resource-based enterprises' digital transformation

3.2.1. Strategic planning

As a new key production factor and an important strategic information resource, data provide crucial support for strategic planning [9]. Resource-based enterprises are at the top of the supply chain, and there are many intermediate links with consumers, so it is difficult to obtain consumer data. Digital technology provides a large amount of data resources. On one hand, the data analysis of consumers and competitors can provide accurate data support and decision-making basis for managers to formulate strategies (such as what competitive strategies to implement, how to transform products and processes, etc.) and guide the future development of the enterprise [10]. On the other hand, the strategic alliance based on the big data value chain can promote knowledge sharing and bring win-win benefits (such as platform strategy and industrial ecosystem), provide important support for resource-based enterprises to establish long-term competitiveness, as well as realize the subversive transformation of enterprises' culture, ability, structure, and process.

3.2.2. Operation management

Digital application can integrate product design, decision-making, material management, and other links, form a flat organization structure [11], as well as realize the integration of production and operation management. In a narrow sense, resource-based enterprises mainly involve the mining and primary processing of non-renewable resources. In the mining industry, digital monitoring systems, ground monitoring distributed control system (DCS), and belt centralized monitoring systems can realize real-time monitoring as well as effectively make up for the lack of safety monitoring in traditional production. In the primary processing industry, electrical automation and intelligence have made works unmanned, reduced production costs, improved efficiency, and enhanced the core competitiveness of resource-based enterprises. In addition, the application of information management systems, such as resource management systems, customer relationship management systems, and supply chain management systems, can improve operation management efficiency and production flexibility [12].

3.2.3. Marketing

Digital technologies have changed the business conception and profit logic of traditional resource-based enterprises, relying solely on the sales of resource-based products. By establishing a big data analysis model, resource-based enterprises can collect customers' operation records, browsing traces, and other data, analyze customers' real trading intentions, as well as provide accurate marketing schemes and prediction services. Through business model innovation, the value chain of resource-based enterprises can be extended to service links with high added-value and realize the integration of scale economy in addition to scope economy. Cloud platform controls the information of the supply chain through cloud computing, allows the full communication of information of all subjects, scientifically matches the production, consumption, and logistics subjects, enables consumers to place orders on demand and producers to produce on-demand, as well as promotes large-scale production of multi-batch and personalized orders.

4. Path analysis

According to the analysis of the problems and mechanism, this paper puts forward three paths for the digital transformation of resource-based enterprises: information network management, process intelligence management, and service platform management (**Figure 4**).

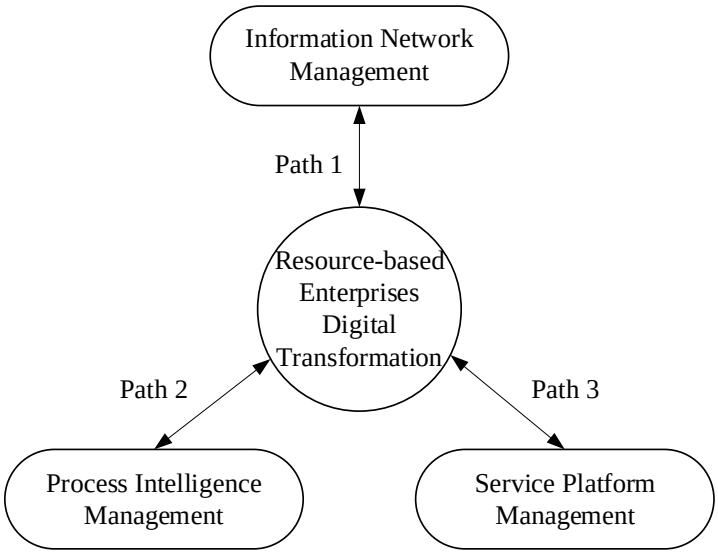

Figure 4. Paths for the digital transformation of resource-based enterprises

4.1. Information network management

The information network management path mainly reflects data sharing. According to the White Paper on the Integrated Development of China's Big Data and Real Economy, released by China Academy of Information and Communications Technology (CAICT) in 2019, many enterprises are beginning to set up professional data management teams and chief data officer positions to separately control big data analysis, which will help to realize enterprise data sharing. Information network management is a sharing economic model, which can promote the circulation and sharing of data resources within and among enterprises, significantly reduce the production, operation, and management cost, as well as realize the scale effect.

At the same time, data information sharing also helps to establish a more accurate safety warning model and improve the production safety of resource-based enterprises. Information network management also includes logistics management data sharing. Through the information sharing platform, disclosing logistics data can greatly improve logistics efficiency, effectively reduce logistics costs, and promote the efficient and coordinated development of logistics management. Based on big data and artificial intelligence, it can realize intelligent cargo distribution and vehicle search improve the utilization of logistics resources. Moreover, it can realize the intelligent planning of vehicle routes and the optimization of logistics transportation.

4.2. Process intelligence management

The process intelligence management path mainly reflects advanced technology. Based on massive real-time and historical data intelligence analysis, the production process can transform from delayed decision-making to real-time decision-making or even rehearsed decision-making, and the product life cycle can be greatly shortened. With the development of digital technology, virtual reality technology can also be applied to the process flow. For example, in terms of optimization, virtual reality technology can simulate the three-dimensional virtual space remotely, reduce the number of personnel entering the mine, and improve the safety factor.

Process intelligent management is also conducive to the green transformation of resource-based enterprises. Big data analysis is used to accurately judge and regulate energy consumption on the production line, assist resource-based enterprises to save energy, and reduce consumption. Taking the iron and steel industry as an example, based on big data analysis, iron and steel enterprises can predict the supply plan of

energy medium, formulate refined management schemes, and optimize the furnace temperature control parameters of each section according to the production plan and process model, so as to achieve energy conservation and consumption reduction.

4.3. Service platform management

The service platform management path mainly reflects service accuracy. Traditional resource-based enterprises mainly focus on resource exploitation and primary processing. They do not pay attention to individual needs and customer services, which are those with low value-added. Service platform management is essential to extend resource-based enterprises from direct resource exploitation and processing links to high value-added service links as well as from labor and resource-intensive to technology and service-intensive. Due to the different scale and market positioning of resource-based enterprises, they need to comprehensively measure their resource element endowment and actively explore a service platform suitable for their development.

Service platform management is also conducive to meeting customers' personalized needs and realizing the customer-centered market service concept. Traditional resource-based enterprises cannot realize personalized customization due to capital, technology, and other reasons. As an interactive platform between enterprises and consumers, the internet enables enterprises to obtain consumers' personalized demand information at low cost, carry out the collaborative division of labor with the help of big data, cloud computing, and other technologies, as well as realize personalized production at a low cost. In addition, service platform management also breaks the regional restrictions on consumption. According to the 47th Statistical Report on China's Internet Development released by China Internet Network Information Center (CNNIC), as of December 2020, the number of internet users in China had reached 989 million, and the internet penetration rate had reached 70.4%. With the gradual penetration of the internet, the service platform can give full play to its role, broaden sales channels, and enhance the profitability of enterprises.

5. Conclusion and implications

As the impetus for resource-based enterprises' transformation, digital technology will penetrate and integrate the whole value chain. At present, the digital transformation of resource-based enterprises is still at the primary stage. There are several problems in the transformation, such as insufficient data mining, low online participation, a low degree of data standardization, hidden dangers in data security, and a shortage of professionals. Based on the case study of large coal mining enterprises in Ordos and the analysis of the digital transformation mechanism of resource-based enterprises, this paper puts forward three paths, which include information network management, process intelligence management, and service platform management. Several implications for the government and resource-based enterprises will be proposed below.

First, it is important to achieve a breakthrough of traditional concepts and formulate a digital transformation strategy. Managers should break off from traditional management thinking, improve their digital cognition level, learn from the successful experience of the manufacturing and service industry, as well as enhance the understanding of employees on digital transformation. Upstream and downstream enterprises in the industrial chain should establish strategic alliances, share data, coordinate production and sales, as well as create a resource-based industrial ecosystem to achieve mutual benefit and win-win situations.

The second is to change the marketing strategy and cultivate multidimensional market demand. Resource-based enterprises should establish customer-centered consciousness, learn from the buyer evaluation mechanism and credit guarantee mechanism in retail e-commerce platforms, as well as provide

customers with fast and excellent online experience. Big data analysis should be used to segment customer groups, formulate different marketing plans for different groups, predict their potential needs according to the consumption records, cultivate multidimensional market needs, and ensure the implementation of new business models.

Third, unified data standards should be formulated, and an integrated system should be established. Large resource-based enterprises should cooperate with industry associations to formulate unified industrial data technical standards and specifications, especially the data technical interface between different systems within enterprises and among enterprises. They should also build a resource-based industrial database, discard the inefficient operation mode of separate and decentralized processing, as well as build a big data information integration system under the common goal of building a big data platform for resource-based enterprises.

Fourth, it is necessary to improve relevant laws and regulations as well as strengthen data security management. The government should establish laws and regulations related to digital technology, especially for privacy and intellectual property protection. Enterprises should strengthen data security management and establish a comprehensive data security center and guarantee system, which includes sensor network security, data acquisition security, data storage security, data processing security, core office network security, and cloud security, to ensure the construction of a big data platform.

The fifth is to introduce interdisciplinary talents and build a professional team. The government should formulate talent introduction policies, such as preferential policies for housing subsidies, tax reduction and exemption, children's education, etc. Enterprises should formulate incentive policies for high-end talents, such as resettlement fees and equity incentives, promotion channels, etc., and build a professional technical leadership team. Enterprises should strengthen the training for employees in terms of digital skills, so that they can adapt to new job requirements and ensure the specific implementation process of digital technology.

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Disclosure statement

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