Design and application of public digital models in multi-source heterogeneous environments in the energy industry

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Abstract. This paper proposes a multi-level model automatic generation technology scheme in the multi-source heterogeneous environment of the energy industry, and realizes the function of automatic generation of the system digital model from business model, logical model to physical model. Construct service reuse capabilities, combine the digital model resource center and interactive interactive platform technology with high reusability characteristics, and provide service reuse components for other newly built application systems.

Keywords: Digital models; Energy industry; Automated generation; Business reuse.

1 Introduction

In recent years, relevant government departments and related industries at home and abroad have carried out the construction of big data centers and have gained a lot of construction experience. Data is the core asset of the big data center, but data is not a production factor by nature, and the original business data can only be deeply processed through collection, collation, integration, analysis and utilization to achieve the "elementalization" process, of which the integration and sharing of data is an important factor affecting the process of data "elementalization", which is precisely a problem that has long plagued the digital construction of enterprises. In addition, the traditional way of integrating and organizing the internal interfaces and data mapping of the system leads to many and complex development interfaces, high development costs, insufficient manageability and scalability, and is not supported for existing applications and technical stack heterogeneous environments, requiring a large number of customized technical solutions. All of the above will have a negative impact on the software research and development, information construction and digital transformation of enterprises. Therefore, it is necessary to establish a public data model for the energy industry that adapts to the current situation of energy data center construction. To this end, we apply a public digital model to the multi-source heterogeneous environment of the energy industry. This paper builds business reuse capabilities, and provides business reuse components based on the high technology reusability of the

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digital model resource center and interactive interactive platform. In this way, the standard access of multiple data sources can be realized on the bottom, and the standardized construction of the data mart layer table can be realized on the top.

2 Design scheme of public digital model for energy industry in multi-source heterogeneous environment

The public data model of the energy industry is based on the external data sources of enterprises, including Internet of Things data, government data and other external data, etc., with Internet data sources as auxiliary data sources, including patents, papers, journals and other professional data on various third-party platforms. Through the technical support of the knowledge graph, a pool of common entity objects is constructed. The public data model is based on this object pool, collected extensively, and incorporated on demand, supporting the construction of a data mart for enterprises in the energy industry.

3 Design content and steps

3.1 Determines the data subject field in the common data model

As the "energy brain" of the energy industry and the "public service platform" for governments, enterprises, society and individuals, the energy big data center needs to access all kinds of data including energy basic information, business entity ledgers, energy flow information and social operation data. The theme domains designed with this as the logic are as follows.

3.1.1 Establish an energy-based information model.

According to the parameters, the energy data model, the energy equipment data model, the energy flow data model and the social operation data model are constructed. Code for energy categories. This information is defined in accordance with the national standard GBT 29870-2013_Energy Classification and Code.

Table 1. Energy distribution standard code

Construction and establishment of energy classification standard codes	
Energy type	**Coding**
Alternating current	ACE
Gas	GAS
Vapour	STE
Hot and cold water	WAT
Gas	FGS

Fuel	OTL
Biomass	BIO

(1) Construct an energy basic information model

a. Determine the energy category and code the energy category (Table 1); Wherein, for the method of determining the energy category can be energy classification by energy substances, energy substances may be one of alternating current, direct current, gas, fuel oil, steam, hot water, cold water and other substances;

b. Code each class of energy classifications as the first metadata of the common data model and store it;

c. The energy data model contains energy inlet labeling and energy outlet type of energy medium.

(2) Establish a business entity ledger model

We classify and code and refine the key attributes of business entities at each level that generate or consume energy, and establish a ledger information model for business entities separately; The energy entity is not limited to energy production, conversion, and consumption equipment such as boilers and air conditioners, but also includes logical entities such as administrative regions and industries.

(3) Establish energy flow data model

a. Energy relationship model: refers to the connection relationship between energy inlets and outlets of different energy business entities;

b. Energy Measurement Model: Measurement model of energy inlets and outlets of different energy business entities.

Establish a connection between energy inlet and energy outlet of different energy equipment for the same type of energy substances; Connectivity can construct an information model for energy flow networks. Energy inlets and outlets are marked with different markings. Energy matter flows through the energy equipment of production, transmission, distribution and consumption, forming an energy flow network, which depicts the connection structure of the integrated energy world and is the third core element of the public data model.

(4) Establish a social operation data model

The social operation data model mainly refers to the real-time operation data of various industries and management departments of society, such as traffic flow data, futures and securities price data.

3.1.2 Build a pool of entity objects for the Energy Big Data Center.

The elements of an object pool include an object and its associated properties, which can be unlimited. The main sources of elements in an object pool are as follows:

a. The various entity businesses of the original information system of the energy industry enterprises carry out data governance and abstraction, extract relevant elements, and establish a physical object pool of the public information model, such as retrieving the boiler room energy consumption table from the business system In the entity object pool, extracting the table data, adding "boiler room consumption" objects, and adding "natural gas", "water meters", "electricity" and other objects. In the

entity object pool, extract the table data, and add attributes such as "cumulative traffic", "residual traffic", "total power", "peak", "valley", "level" and so on.

b. From the Internet or other digital resources, obtain the relevant instance files of the relevant entity business, use the image recognition technology to extract the information of the picture, extract keywords and automatically generate the summary, and finally store it in the entity object pool of the public information model. From the Internet or other business systems, retrieve data according to the boiler room consumption keywords, obtain the relevant entity business in the returned data collection, use the picture recognition technology to extract the information of the picture, keyword extraction and automatic summary generation, and finally store it in the local system. For example, a large number of "boiler room consumption" (figure 2) is obtained from the Internet, and according to the picture recognition technology, the relevant boiler room consumption information information is extracted, and the field header information in the table is extracted.

Table 2. Boiler room consumption chart

Energy consumption table of boiler room									
Time: Year Month Date						Recorder:			
	Natural gas (cubic meter)		Water meter						Remark
	Cumulative	Residual		Meritorious total	No power	Peak	Valley	Flat	
Agency 1									
Agency 2									
XX Bu-									
XX Bu-									

3.2 Build a logical model

The public data model logical model of the energy industry consists of three parts: the structural model, the basic model and the domain model. The basic requirements of the common data model are simplicity and completeness. Simplicity means that model standards need to be simple enough not to significantly affect the proper functioning of business systems. Completeness means that the model standard needs to meet the description of all concepts involved in the business system and other business systems with which it has a shared business relationship, so that all information of the business system has clear standards.

(1) The structural model is the basis for the definition of the common data model, using the XML Schema schema language for each.

An abstract description of entities common to a business domain or entities within a domain and their relationships. The model consists of three parts: the structural model, the base model, and the domain model. The structural model is the defining basis of the information sharing model, and basic properties (such as id, ref, metadata, relationship Metadata, etc.) and primitive data types (such as abstract data types Object Type, relational data types Association Type, metadata Types, etc.) can be de-

fined by referencing the syntax and primitive data types of the XML Schema. All other models must be defined on the basis of the structural model, ensuring that the receiver can interpret it correctly according to the structural model.

(2) The underlying model is a collection of common data types that are the basic definitions of common concepts in an information-sharing environment, such as almost all business systems contain descriptions of people, which abstract all parts of people into people types.

(3) The domain model is a model composed of a collection of types that extends the common types of the domain on the basic model according to the needs of the business domain.

3.3 Build a physical model

Using the low-code platform, using the logical model parser in the platform, the obtained logical model is parsed, pseudo-code scripts are generated, automatically executed scripts, and converted into data structure modeling in the form designer, the modeling of the form in the form designer includes data structure modeling, business rule modeling and interface layout modeling, wherein the data structure modeling is used to store the table structure in the physical database, for example, according to the logical model of the entity "boiler room consumption", the establishment of the "boiler room consumption table", at the same time, According to the logical model "boiler room consumption" to build a table, and the main key is established, according to the "boiler room" associated with the entity "natural gas consumption", "water meter consumption", "electricity consumption" are also built separately, the main key of the boiler room is used as the external key of these tables, and the association is carried out. In addition, according to the corresponding properties of these entities, the fields of each table are established. Using the Build Logical Model step, the tool platform can automatically convert the logical model into a physical model, generating the table structure of the database. Visualization tools are also available that allow users to modify the physical model. Business rule modeling is used to store the business component information and business logic information of the form, and interface layout modeling is used to store the form layout styles corresponding to each type of terminal.

4 Conclusion

This paper mainly designs a technical scheme for automatic generation of multi-level models in the multi-source heterogeneous environment of the energy industry. This paper designs the overall design structure and scheme of the public digital model of the energy industry, and realizes the function of automatic generation of the system digital model from business model, logical model to physical model. Based on the public digital model, the digital model resource center and the interactive interactive platform are combined with the high technology reusability during the digital transformation of enterprises. It can support the information technology department to

build high-capacity components for business reuse for enterprises. It accelerates the process of enterprise digital development and solves the chimney development problem caused by the use of non-public models. The next research will focus on expanding the application scope of the digital model to include more object-oriented features, such as complex objects and methods.

References

1. Duan Y Q, Zheng Z W, Wang Y X, et al. (2022) Attributes Structural Relationship Analysis of Data as a Factor of Production Based on DEMATEL. Information Studies: Theory & Application, 45:124-131.
2. Duan Y Q. (2022) Coping with Fragmentation of Grassroots Governance with Digital Transformation. Governance, 38:15-18.
3. Shen F W, Zhu J W. (2021) Data Empowerment: Operation Mechanism and Innovation Path of Digital Government Governance in the Era of Intelligence. Cass Journal of Political Science, pp. 104-115+158.
4. Zheng Y P, Liang C X, Lian Y L, et al. (2021) Status Quo and Problems of Digital Transformation of Local Government Departments——An Empirical Study Based on Government Hotline at City Level. E-Government, 2:38-51.
5. Lv T. (2019) Trend and Path of Digitalized transformation of the Traditional Industries. Renming Luntan. Xueshu Qianyan, 18:13-19.
6. Xu F. (2020) Explanation of the mechanism of digital transformation of local governments——Analysis based on the "Zhejiang experience" of government reform. E-Government, 10:2-19.
7. Li W A, Chen C H, Zhang X M. (2020) Governance Mechanism Construction and Crisis Management in the Face of Major Public Health Emergencies——A Written Talk by Experts on "Response to the New Coronary Pneumonia Epidemic". Business and Management Journal, 42:5+8-20.
8. Meng T G. Elements. (2021) Mechanisms and Paths of Government's Digital Transformation——Also on the Two-way Drive of "Technology Empowerment" and "Technology Empowerment". Governance Studies, 37:5-14+2.
9. Wen Y T, Yu J, Hong Z S. (2021) Innovation Path for Public Service in the Context of Digital Transformation——Based on Polycentric-Collaborative Governance Perspectives. Science of Science and Management of S.&.T. (Monthly), 42:101-122.