Research on Business Selection and Development of Power Grid Enterprises in the Context of Industrial Upgrading

Yazong Mai[1,a], Jingce Xu[2,b], Xiyun Cheng[3,c*]

{maiyazong@163.com[a], jinceshee@163.com[b], xiyun_cheng@ruc.edu.cn[c*]}

State Grid Energy Research Institute Co., Ltd., Beijing, China[1]
State Grid Energy Research Institute Co., Ltd., Beijing, China[2]
Business School, Renmin University of China, Beijing, China[3*]

Abstract. At present, the country is vigorously promoting industrial upgrading. The final landing point of industrial upgrading for enterprises undergoing this transformation is the development of a well-crafted business strategy. Industrial upgrading is a complex and multifaceted endeavor, and it involves a series of strategic decisions that impact the future of an enterprise. The process of industrial upgrading for these enterprises revolves around identifying the specific business activities they should engage in to effectively achieve this transformation. In our research, we delve into the intricacies of the business selection approach for industrial upgrading and the formulation of business development strategies, with a particular focus on power grid enterprises. We study the business selection approach for industrial upgrading and business development strategy of power grid enterprises. State-owned enterprises (SOEs) play a pivotal role in national economy, and their transformation and growth are of utmost importance to the government's overarching goals of promoting industrial upgrading and fostering the high-quality development of these enterprises. By providing a specialized toolkit for optimizing the industrial upgrading path and strategy for power grid enterprises and other SOEs, we aim to support the nation's broader objectives in terms of industrial advancement. We then propose a set of industrial development and business selection approaches applicable to SOEs, which provides tools for optimizing the industrial upgrading path and strategy of power grid enterprises and SOEs, and facilitates the country's promotion of industrial upgrading and the high-quality development of SOEs. Our research delves into the intricate process of industrial upgrading, specifically focusing on business selection and development strategies for power grid enterprises. Moreover, we extend our findings to state-owned enterprises, offering tailored approaches to support their growth and development. Ultimately, our work aligns with the national agenda to promote industrial upgrading and enhance the quality of state-owned enterprises, contributing to overall economic prosperity of country.

Keywords: Industrial Upgrading; Power Grid Enterprise; Business Selection; Development Strategy.

1 Introduction

Industrial upgrading is a strategic and systematic project, that can neither be achieved at one stroke nor remain unchanged. At present, power grid enterprises are continuously promoting industrial upgrading. On the one hand, it is necessary to conduct a timely analysis of the reasons

ICEMME 2023, November 17-19, Beijing, People's Republic of China

DOI 10.4108/eai.17-11-2023.2342694

for the problems in the implementation process and make appropriate adjustments and corrections [1]. On the other hand, based on the theoretical and practical in-depth analysis and research, it is necessary to take a long-term view to develop decision-making tools applicable to the analysis of SOEs' industrial strategies, supporting the further optimization of the practical paths of industrial upgrading and promoting strategies.

To this end, this study aims to support power grid enterprises to deploy industrial upgrading strategies in a scientific way, which could practically guide accelerating the optimization of business layout and improving business development strategies. Meanwhile, for SOEs with main business characteristics, it provides methodological support for optimizing industrial upgrading paths and strategies by scientifically constructing business selection analysis models.

2 Modelling

We adopt a two-stage determination method to construct business portfolio model (shown as **Fig. 1.** Design ideas for business portfolio modeling). The first stage is business categorization. Based on national policies and relevance to the main business, identify necessary businesses to safeguard the development of the power grid (compulsory business) and businesses that are not restricted by policies and are related to the main business (optional business). The second stage is business value evaluation. For optional business, evaluate its comprehensive value to design for enterprise's business development path.

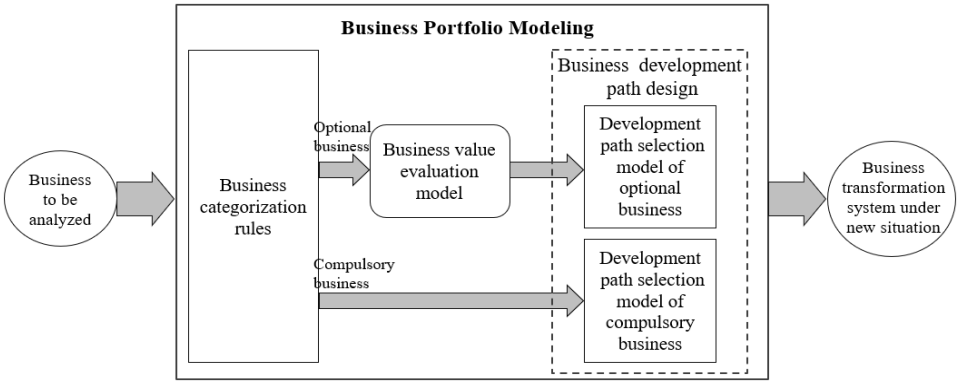

Fig. 1. Design ideas for business portfolio modeling

2.1 Business categorization rules

SOEs bear the responsibility of maintaining the stable operation of main business. Before undertaking the business portfolio, SOEs should first establish specific rules to categorize the business to distinguish between compulsory business, withdraw business, and optional business [2].

2.1.1. Policy rules

Policy rules are used to determine whether a business is restricted by state policy [3][4]. A business is categorized as withdrawing if policy explicitly states that SOEs need to withdraw. Conversely, it is categorized as compulsory if explicitly encouraged.

2.1.2. Main business relevance rule

The main business relevance rule is used to determine whether the business is related to the main business. For power grid enterprises, business selection should be centered on the principle of relevance to the power grid main business, otherwise, it will deviate from the main business and social responsibility.

2.1.3. Main business safeguarding rule

The main business safeguarding rule is used to determine whether the business is necessary to guarantee the stable operation of enterprise's main business. For SOEs, businesses that safeguards main business stable operation is indispensable.

2.1.4. Market-based substitution rules

The market-based substitution rule is used to determine whether an important supporting business for the enterprise's main business can find a substitute in marketplace, and if so, it should be categorized as withdrawing. Instead, the enterprise is required to develop the business on its own. We propose business categorization rules that meet state's requirements for SOEs as shown in Figure 2.

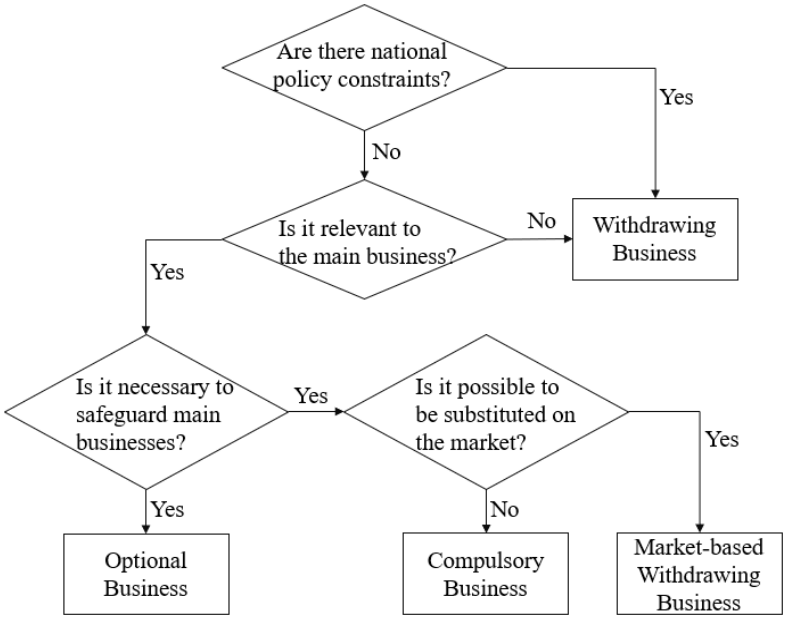

Fig. 2. Business selection decision logic

2.2 Business value evaluation method

When selecting businesses, SOEs need to consider not only the balance between business inputs and returns, but also the contribution to parent company's overall strategy, and the degree to which the business complies with policy. Therefore, we propose to evaluate the comprehensive business value from four dimensions of strategic value, market potential, policy support, and parenting advantages. The SMAP business value evaluation model is constructed as Figure 3.

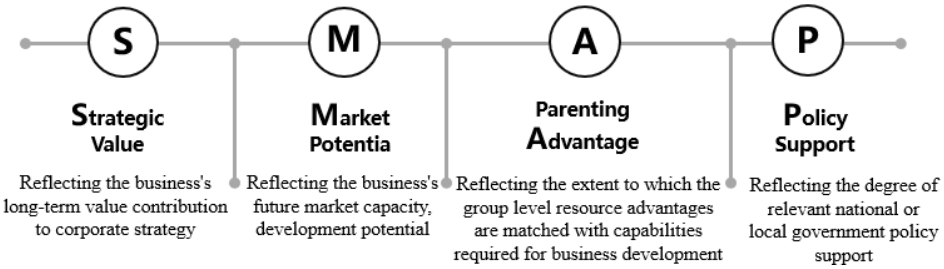

Fig. 3. SMAP model

The constructed business value evaluation indicator system is shown in Table 1.

Table 1. Business Value Evaluation Indicator System and Description

Dimension	Indicator	
Strategic Values (S)	Technology supporting value	
	Benefits creating value	
	Service guarantee value	
	Strategic reserving value	
	Ecology building value	
Market Potentials (M)	Average industry profitability	
	Competitor level in the marketplace	
	Market volume level	
	Operation advancement	
Parenting Advantages (A)	Matching of the talent	Importance of the talent
		Talent support capability
	Match of technology competence	Importance of technology
		Technology support capability
	Matching of channel resources	Importance of channel resources
		Channel support capability
	Matching of data resources	Importance of data resources
		Data support capability
	Matching of Investment capacity	Importance of capital invest
		Investment support capability
Policy Support (P)	Fitness of the new development concept	
	Degree of support from industrial policy	

2.3 Model weight calculation method

The overall business value based on the SMAP model is determined by the combined effects generated by four dimensions, as in Eq. (1).

$$V = w^T(S, M, A, P)^T\alpha. \quad (1)$$

Where w^T indicates the weighting of the four dimensions of influence, $(S, M, A, P)^T$ indicates the vector representing the four dimensions. For business value evaluation indicators, the influencing factors of each dimension need to be refined and the quantitative indicators are synthesized using a weighted summation method with the weights shown as α in the equation. The weights were calculated using hierarchical analysis.

In the business judging scale, the expert scoring method is used to score the indicators under four dimensions of strategic value, market potential, parenting advantages, and policy support. To determine the comprehensive value of business, it is necessary to estimate the weight of each dimension and the weight of different indicators under each dimension, calculate the weight system in the model, and finally obtain the comprehensive value score of the business [5][6].

The business score under expert scoring method may be affected by certain subjective factors, and using the AHP method separately may cause experts' subjective bias. However, using the model fitting method alone also faces the problem of imperfect decision-making data. Therefore, we propose a staged weighting method that integrates AHP and model fitting: First, use the AHP method to estimate the weights of experts' subjective scoring results and form the preliminary weighting results. Second, using the enterprise's existing business successful practical experience as the decision-making results, use the model fitting method to construct training data, train the business value evaluation model, and obtain the model fitting weights. Finally, using the method of weight modification, the weights calculated by the AHP method are modified using the model fitting weights to get the final evaluation weights. The staged weighting method that integrates AHP and model fitting and at the same time combines expert evaluation as well as enterprises' practical experience, could more accurately derive the weighting system and the ultimate results of business value evaluation.

3 Empirical Research

We first sort out the business development list of grid enterprises in the context of industrial upgrading and then use the business portfolio model constructed in previous sections to perform rule judgments on the businesses in the list and identify the compulsory business, the withdrawing business, and the optional business. Then, we use the staged weighting method that integrates AHP and model fitting to calculate the indicators and their weights in the model and ultimately derive the comprehensive score of business value.

3.1 Preparation for Business Value Evaluation

3.1.1. Business list sorting based on the power industrial chain

According to the basic structure of the power industrial chain source-side, load-side, storage-side, and utility-side, as well as the five categories of emerging technologies that radiate the

entire industrial chain [7] [8], the fundamental list of business selections for grid enterprises is sorted out as Table 2.

Table 2. Grid enterprise business development list

Industrial Chain	Type	Business Area
Source-side	Clean energy power generation	Centralized wind power generation
		Centralized photovoltaic power generation
		Distributed wind power generation
		Distributed photovoltaic power generation
		Comprehensive utilization of biomass energy
Grid-side	Production services	Material service
		General aviation
		Transportation and maintenance services
		Logistics services
		Mass media
	Equipment R&D	General primary equipment
		General secondary equipment
		High-end equipment and core components
		Homologation technology expansion
	Information communication technology (ICT)	Power chips
		Network communication
		Information security
		Beidou and geographic information services
	Grid energy savings	Grid-side energy conservation
Load-side	Energy-saving and environmental protection	Comprehensive energy efficiency services
		Electricity substitution
	Electric powered vehicle	Smart vehicle networking
		V2g services
		Power battery laddering utilization
	Smart energy	Energy e-commerce
		Distributed clean energy services
		Multi-energy supply services
		Smart home
		Integrated energy services platform
Storage-side	Energy storage services	Grid-side energy storage
		Customer-side energy storage
		Pumped storage
Entire domain	Emerging technology	Big data & cloud service
		Database services
		5g commercial services
		Blockchain
		Artificial intelligence (AI)
		Virtual power plant

3.1.2. Business Classification

According to first-stage business classification rules and experts' opinions, we define material services, logistics services, media, general aviation, transportation and maintenance services,

etc. as compulsory businesses for grid enterprises; the rest is classified as optional business that requires value evaluation in next stage.

For the optional business, we consider internal and external knowledge of the enterprise, industrial units, and management departments to select experts from enterprises' management departments, industrial units, scientific research units, and external institutions. A total of 57 valid questionnaires have been collected.

3.2 Calculation of Indicator Weights

First, weights of expert scoring are calculated using AHP method. Then, according to enterprise's business practice, three businesses with better status are selected to construct the training data set, including high-end equipment and core components, power chips, and big data cloud services. Each business's value is set to a higher score, i.e. 9 in this study. Given the ratio of 7:3, weights of experts' scoring are combined with actual corrected weights to obtain final weights.

3.3 Comprehensive Business Value Assessment

The business composite value score is calculated and shown in Table 3:

Table 3. Comprehensive score of business value

Business	Strategic Value Score	Market Potential Score	Parenting Advantage Score	Policy Support Score	Overall Score
High-end equipment and core components	8.2324	7.7483	7.9089	7.3259	7.8609
Power chips	8.1067	7.8483	7.6655	7.2920	7.7844
AI	8.0313	7.9282	7.0452	7.9597	7.7539
Database services	7.4744	7.4388	7.6482	7.1909	7.4555
Integrated energy services platform	7.2294	7.3898	7.6131	7.4901	7.4117
Grid-side energy storage	7.6275	7.3641	7.6384	6.7021	7.3924
Distributed clean energy services	7.4380	7.5044	7.0528	7.3855	7.3540
Information security	7.8028	6.8358	7.3477	7.3604	7.3529
Comprehensive energy efficiency services	7.4607	7.3139	6.9135	7.3939	7.2777
Smart vehicle networking	7.4178	6.9262	7.3980	7.4029	7.2777
Blockchain	7.4289	7.3105	6.9788	7.3491	7.2746
Grid-side energy conservation	7.5301	6.9874	7.2907	7.2072	7.2680
General secondary equipment	7.4874	7.0397	7.3382	7.0072	7.2443
Electricity substitution	7.4742	6.9159	7.3000	7.2258	7.2370
Big data & cloud service	7.3196	7.2785	7.0089	7.2902	7.2286
Network communication	7.3972	7.0888	6.8448	7.4491	7.1907
Energy e-commerce	6.7280	7.4850	7.4029	7.2346	7.1856
Virtual power plant	7.2263	6.9476	7.2872	6.8764	7.1027
Pumped storage	7.5643	6.7094	7.2129	6.7012	7.0938
Homologation technology expansion	7.0822	7.3871	7.2474	5.9880	7.0072
Beidou and geographic information services	7.2413	6.7939	6.6606	7.2016	6.9740
Distributed photovoltaic power generation	6.6108	7.2474	6.8481	7.2030	6.9462
Multi-energy supply services	6.9432	6.7460	7.1794	6.7814	6.9175

Power battery laddering utilization	6.9623	7.2133	6.9038	6.3678	6.9090
V2g services	6.8685	6.5388	7.0144	7.0841	6.8533
Customer-side energy storage	7.2093	6.7833	6.4889	6.4788	6.7899
Distributed wind power generation	5.8563	6.4726	6.7051	6.6020	6.3606
Centralized wind power generation	6.2407	6.1982	6.5082	6.3090	6.3057
Centralized photovoltaic power generation	6.2326	6.1628	6.5222	6.3078	6.2968
Comprehensive utilization of biomass	5.5692	5.9223	6.4618	5.8998	5.9383

Further, the value of a certain business can be analyzed based on the combination of scores, and therefore design a business development path. Businesses of high-end equipment and core components, power chips, artificial intelligence, etc. hold high business value and thus should be considered as the key businesses to be developed by grid enterprises [9]; while the business value of biomass comprehensive utilization, customer-side energy storage, etc. is relatively low, and thus can be temporarily suspended or divested.

4 Conclusions

We construct a business selection model for power grid enterprises. For businesses in the incubation period such as power chips and IGBT, it is suggested to focus on application and expand internal and external markets to strengthen upstream and downstream cooperation in the industrial chain. For businesses in a fast growth period, such as integrated energy services and database services, it is suggested to focus on promoting mixed-ownership reform, forge core competitiveness, and seek opportunities for asset reorganization and listing. For big data, energy storage, and other businesses in a rapid development period, it is suggested to grasp the window period of industrial development and use various means of industrial investment to enhance overall solution capabilities. For equipment manufacturing, smart vehicle networking services, and other businesses in the mature development period, it is suggested to scheme for transformation to promote business model innovation [10][11].

References

[1] Xiao J.: Problems and countermeasures of internal control in power grid industry groups. China Chief Financial Officer, pp.100-101 (2021)

[2] Industry chain analysis of china smart grid industry in 2020. China Electrical Equipment Industry, pp. 29-34. (2020)

[3] Manninen, K., Huiskonen, J. Factors influencing the implementation of an integrated corporate sustainability and business strategy. Journal of Cleaner Production, Vol.343, pp.131036 (2022)

[4] Faizin, M., Anoraga, S. The development of legal politics in micro business policy of jombang regency government. Audito Comparative Law Journal (ACLJ), Vol.3(1), pp.18-24 (2022)

[5] Shou Y, Cao X, Meng D.: Masked contrastive graph representation learning for age estimation. arXiv preprint arXiv:2306.17798 (2023)

[6] Shou Y, Cao X, Meng D, Dong, B., Zheng, Q.: A low-rank matching attention based cross-modal feature fusion method for conversational emotion recognition. arXiv preprint arXiv:2306.17799 (2023)

[7] Fan C., Chen Y.: Modularized division, synergy and technology innovation: a research based on strategic emerging industries. Reform & Opening, Vol.18, pp.11-13 (2019)

[8] Shou, Y., Meng, T., Ai, W., et al.: Conversational emotion recognition studies based on graph convolutional neural networks and a dependent syntactic analysis. Neurocomputing, pp.629-639 (2022)
[9] Deng M., Qu B., Xing G.: Business model exploration of customer energy service under the background of energy Internet. Power Demand Side Management, Vol. 21(03), pp.59-62+68 (2019)
[10] Loock M. Unlocking the value of digitalization for European energy transition: A typology of innovative business models. Energy research & social science, Vol.69, pp.101740 (2020)
[11] Parida, V., Sjödin, D., Reim, W.: Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. Sustainability, pp.391 (2019)