Competitive Analysis of Power Sales Service under The New Power System Reform Based on SEM Model

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Abstract. Under the reform of the power sales side, the competition in the power market is becoming increasingly fierce. Facing the new market environment and changing situation, the power sales enterprises must improve their own competitiveness to realize the long-term development of the enterprise. This paper first analyses the influencing factors of competitiveness, and then analyses the influence degree of each influencing factor on competitiveness by designing a questionnaire and establishing a structural equation model. The results show that providing more comprehensive and better value-added services will help improve the core competitiveness of power sales services.

1. Introduction
Since 2015, with the promulgation of the "Several Opinions on Further Deepening the Reform of the Power System" ("No. 9 Document") and the six major reform supporting documents, a new round of power reform has officially kicked off. Several provinces have successively launched pilot projects for electricity reform. Among them, the power sales side reform is one of the key points of this round of power reform, and the nationwide power sales business will be open to social capital, which will greatly affect the terminal sales model of the power market [1-2]. In the future, the overall pattern of the entire power market will be divided into five categories according to market entities, which can be divided into power generation enterprises, trading institutions, power grid enterprises, power sales enterprises and power users. Among them, the latter three market entities are closely linked to the market for electricity sales. Analysis of the competitiveness of the power sales enterprises is conducive to the long-term development of the enterprise.

2. Structural equation model for the competitiveness of power sales service

2.1. The influence factors of power sales service competitiveness
(1) Value-added services
In the market environment of the open sales side, the sales company will be positioned as a service-oriented company [3]. In addition to its own sales business, it should carry out differentiated value-added services according to its own characteristics and advantages to maximize the needs of different types of users [4]. High-quality value-added services can increase user stickiness and increase user's loyalty, thereby increasing the core competitiveness of power sales services.

(2) User stickiness
User stickiness refers to the degree of reliance and repurchase expectations of the user's loyalty, trust and benign experience of the brand or product. From the particularity of power commodities and energy dependence, power user stickiness refers to the degree of autonomy of a certain power user in a certain time domain to a certain seller [5]. For a power sales company, user stickiness can be measured by three indicators: conversion cost, power price and user preference. Improving user stickiness will help increase the competitiveness of sales companies.

(3) Corporate image

In the competitive market open to the power sales side, a good corporate image can increase the confidence of power users in product quality, increase the trust of enterprises, help retain old customers and attract new customers, and create direct economic benefits. The corporate image of a power sales company is measured by service level, asset size, universal service, and propaganda power.

(4) Market environment

Any enterprise entity exists in a macro external environment, and the market environment will have an important impact on the company's strategic decision-making and operational decisions. A good market environment is conducive to improve the competitiveness of power sales enterprises. Market concentration, information transparency and market entry barrier indicators can be used to reflect the market competition environment. In addition, the degree of support for the new power reform policy directly determines the success of market-oriented reform of the power market, especially the power sales side [6-7].

2.2. Model building

Structural Equation Model (SEM) is a multivariate statistical analysis technique based on the internal structure of factors to establish, estimate and test causality models. It is widely used in social science data analysis. Using the structural equation model, we can explore the path of action of each influencing factor [8]. The variables of the structural equation model include latent variables and measured variables, where the latent variables cannot be directly measured and can only be obtained by measuring and calculating the observed variables. Using structural equations not only constructs non-measured latent variables, but also estimates the relationship between latent variables that are unaffected by measurement errors.

Therefore, in order to study the impact of various factors on the competitiveness of power sales services, identify the key factors affecting the competitiveness of electricity sales services. Based on the influencing factors of the above analysis, this paper uses the structural equation model to construct the measurement index system, as shown in Table 1.

| Latent variables | observation index | Latent variables | observation index |
|------------------|-------------------|------------------|-------------------|
| Value-added services (VS) | Personalized service(vs1) | User stickiness (US) | Conversion cost(us1) |
| Energy saving low carbon service(vs2) | | User preference(us2) |
| Clean service(vs3) | | Electricity price(us3) |
| Networked service(vs4) | | Power Quality(us4) |
| Integrated service(vs5) | | Service level(ci1) |
| Market concentration(me1) | | Asset size(ci2) |
| Electric reform policy support(me2) | Corporate image (CI) | Universal service(ci3) |
| | | Propaganda power(ci4) |
| Market environment (ME) | | Power sales service | Market share(pssc1) |
Based on the selection of latent variables and their measurement indicators, a structural equation model for the analysis of the competitiveness of power sales services under the open power sales environment is constructed, as shown in Figure 1.

![Structural equation model for the competitiveness of power sales service](image)

Figure 1. Structural equation model for the competitiveness of power sales service

According to the relationship between variables shown in Figure 1, the regression equations between the latent variables in the SEM model of the competitiveness of the electricity sales service is as follows:

\[
\begin{align*}
PSSC &= \gamma_{pm} ME + \gamma_{pv} VS + \gamma_{pu} US + \gamma_{pc} CI + \xi_p \\
VC &= \gamma_{vm} ME + \xi_v \\
US &= \gamma_{vu} VS + \gamma_{vc} CI + \xi_u \\
\end{align*}
\]

(1)

Among them, \(\gamma_{pm}, \gamma_{pv}, \gamma_{pu}, \) and \(\gamma_{pc}\) respectively represent the impact of market environment, value-added services, user stickiness and corporate image on the competitiveness of power sales services. \(\gamma_{vm}\) represent the impact of market environment on the value-added services. \(\gamma_{vu}\) and \(\gamma_{vc}\) respectively represent the impact of vales-added services and corporate image on user stickiness. In addition, \(\xi_p, \xi_v, \) and \(\xi_u\) are the residual term of the regression equations. \(\phi\) represents the covariance between latent variables, indicating the correlation between the variables, but does not indicate the causal relationship. If \(\phi=0\), there is no correlation between the variables.
3. Fitting analysis of structural equation model of competitive power sales service

3.1. Fitting results of structural equation model

In the questionnaire survey, 325 questionnaires were distributed and 315 were recovered. The recovery rate was 97%, of which 309 were valid questionnaires, and the effective rate was 95%. To ensure the scientific and validity of the data, the sample data is tested for reliability and validity. The reliability of each variable reached 0.7 or higher, and the reliability of the overall sample reached 0.854, indicating that the questionnaire has good internal consistency. In addition, the value of the Kaiser-Meyer-Olkin test is 0.875 and is significant, indicating that the questionnaire has good validity and is suitable for the next study. Therefore, the structural equation model is used to analyze the competitiveness of the power sales service, and the structural model path coefficient map is obtained, as shown in Figure 2.

![Figure 2. The path coefficient of structural equation model for the competitiveness of power sales service](image)

3.2. Results and discussion

According to the fitting results of structural equation model, to improve the competitiveness of power sales service, the key lies in value-added services. Direct effect of value-added service is 0.745. In addition to direct effect, value-added services can also be through ascension user stickiness, thus improve the competitiveness and the indirect effect is 0.180. The total effect is 0.925. Besides, the influence of user stickiness is only the direct effect of 0.617. The direct effect of market environment is 0.359, the indirect effect is 0.130, and the total effect is 0.489. Corporate image of the direct effect is 0.538, the indirect effect is 0.242, and the total effect is 0.780.

It can be seen that in the market competition environment, it is not only considering the price and quality of power to improve competitiveness for power sales enterprises. In addition, many other influencing factors have a significant effect on improving competitiveness. In particular, high-quality power value-added services will become an important competitive focus among power sales enterprises. To meet the needs of power users from multiple perspectives, including personalized
services, energy-saving and emission reduction services, etc., it is conducive to expanding the market, increasing the number of users and providing competitiveness.

4. Conclusion
In the competition in the power sales market, the purchase and sale of electricity business is only the basic business of the power sales enterprises. Because of the indiscriminate nature of electricity itself, sales companies should focus more on expanding value-added services, increasing user stickiness, and establishing a company image. Through the SEM model analysis, the value-added service path coefficient is the largest, indicating that providing differentiated value-added services is more conducive to improving the competitiveness of the electricity sales service, thereby obtaining a higher market share.

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References
[1] Bai Y, Xie L, Xia Q, et al. (2015) Institutional Design of Chinese Retail Electricity Market Reform and Related Suggestions. Automation of Electric Power Systems, 39(14):1-7.
[2] Hu C, Du S, Su J, et al. (2016) Preliminary Research of Trading Approach and Management Modes of Chinese Electricity Retail Companies Under New Electricity Market Reform. Power System Technology, 40(11):3293-3299.
[3] Zhang J J. (2016) Dynamic Evolutionary Game Analysis on Innovation Value-added Services of Electricity. Coal Economic Research, 36(09):59-65.
[4] Xiao X Y, Ma Y Q, Mo W X, et al. (2016) Premium power based valued-added service model for power supply company under the opening electricity retail side. Journal of Electric Power Science and Technology, 31(04):4-10.
[5] Cao F, Li X N, Liu S J, Li S. (2018) Optimization of sales package for End-users Based on user stickiness and reference pricing decision of consumers. Automation of Electric Power Systems, 42(14):67-74.
[6] Pollitt M G, Brophy Haney A. (2014) Dismantling a Competitive Retail Electricity Market: Residential Market Reforms in Great Britain. The Electricity Journal, 27(1):66-73.
[7] Zhang X X, Xue S, Yang S, et al. (2016) International experience and lessons in power sales side market liberalization. Automation of Electric Power Systems, 40(9): 1-8.
[8] Wei Z Y. (2017) Research on Competitiveness of Cross-border E-commerce Logistics in China Based on Structural Equation Model. Logistics Engineering and Management, 39(04):121-123.