Innovation synergy and Corporations’ value: A study based on electricity corporations’ empirical data

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Abstract: Since the inadequate study concerning the synergy mechanism of technical innovation and management innovation as well as its impacts on enterprise value, based on theories of organizational ambidexterity and synergetics, this study has concentrated on the impacts of synergetic effect between management innovation and two types of technical innovation (exploratory and exploitative innovation) towards electric power enterprises’ financial performance and competitive advantage. Meanwhile, the moderating effect of strategic effect has also been tested in this paper. The study has found that the synergetic effects between management innovation and exploratory innovation and exploitative innovation can boost financial performance as well as competitive advantage. But the promotion effect of management and exploratory innovation’s synergy towards enterprises’ competitive advantage is much stronger than that of management innovation and exploitative one. While when comes to financial performance, synergetic effect between management and exploitative innovation can do better. Furthermore, strategic alignment plays a significant moderating role in the relationship between innovation synergy and enterprises’ value. It can strengthen the promotion effect of innovation synergy towards both financial performance and competitive advantage.

Keywords: technical innovation; management innovation; innovation synergy; enterprises value

1. Introduction
As the most important factor to advance electric power corporations’ sustainable development, new types of technology, for example, power electronic technology, information technology and intellectual management technology have called new demand have given out new direction for power corporations so as to meet the demand of the construction of energy internet composed of Distributed energy collection and storage devices and different types of electric loads. Since technology innovation activities are relatively independent and can promote corporations’ competition capability and performance to a higher level[1][2], this area has attracted enormous attention of scholars[3][4]. Under the integration effect coming from energy internet, power corporations have come into a world full of product competition and their products become more homogenized, corporations can no longer develop rapidly only rely on technology innovation[5] [6]. Decision makers begin to consider the importance of non-technological innovation such as management innovation[7][8] [9].

The relationship between technology and management has drawn so much concern around academic world these days. For example, Fit evolution theory and Partial-synergy theory have tried to explain the mechanism of the interactive effect between each other[10][11][12]. However, both of them have fallen into the trap of “fake synergy” because they consider the influence between these two types of innovation is “one-way” direction rather interactive one. To breakthrough this point, this paper tried explain the interactive effect and illustrate it impact on corporations’ value based on synergy theory[11][12]. This study has concentrated on the impacts of synergetic effect between management innovation and two types of technical innovation (exploratory and exploitative innovation) towards electric power enterprises’ financial performance and competitive advantage.

The contributions of this paper can be summed as following: Firstly, taking power corporations as example, this paper has broken through “one-way” synergy model of technology and management innovation, and tested the synergy effect between management innovation and exploratory innovation and exploitative innovation[10][11]. Secondly, this paper has tested the impact of two different types of synergy upon electronic power corporations’ value, and the result has completed the studies concerning the factors advancing corporations’ value and the studies of causes of corporations’ competitive advantage. Finally, we have discussed the functional border of the impact of innovation synergy towards power corporations’ value, based on which the practice to promote power corporations’ sustainable development are given out.

2. Literature review and research hypothesis
2.1. Dynamic synergy mechanism
Rather a “one-way” effect path, there exist interactive influence between technology innovation and management innovation. Some studies have shown sufficient evidence which proves management innovation is one of the most important factors influencing technology innovation [5][10][11]. Different management divisions, such as Corporations’ organization, culture, communication and operation process, can throw direct or indirect upon technology innovation. Vickery pointed out that organization structure have decided corporations’ power allocation and management institution. Therefore, it can influence corporations’ innovation decision and efficiency on one hand and provide organization insurance on the other[13]. Schilling considers that organization institution can promote internal communication and is good for knowledge integration and employees’ creativity[14]. While corporation culture with innovation spirit can also motivate employees’ innovative behavior so as to promote corporations’ innovation level as a whole.

On the other side, although management innovation can influence technology innovation, there is one way back. Technology can advance organization’s management level through organization revolution so as to adjust a higher level of technology. Some study considers management innovation as production of relation, while put technology innovation in the category of productivity and there exists dialectic synergy relationship between each other[11]. Therefore, under the support of organization management, technology can be promoted into a higher status and produce new products, which then can provide sufficient pressure for corporation to upgrade the existed market strategy and organization structure so as to guarantee the sales and benefits drawn from new products[15]. When management and technology realize a synergy effect, technology can be promoted to a higher level, which then can trigger a revolution to make management innovation possible.

Either management or technology innovation can be the fist mover. As far as the electric power corporations concerned, since energy internet project have come up with new demand for corporations’ technology, corporations often make the later one as first mover so as to meet the requirement of global energy market. Therefore, new technology makes power corporations have to upgrade their organization structure and governance structure from the world wide visual angle so as to promote the sales of new product. To sum up, under the background of construction of energy internet and global competition, technology innovation has become the driven factor of power corporations’ innovation synergy.

2.2. The impact of innovation synergy

In fact, technical innovation itself has a positive effect on promoting the electric power enterprise's short-term financial performance and its long-term competitive advantage. With the electric power enterprise joining in the global competition, the product competition is continuously intensified. On the one hand, the enterprise needs to strengthen the existing market (e.g. UHV Transmission Technology) by using the existing knowledge and technology. On the other hand, the enterprise needs to research and develop new technology forms such as the power electronic technology and the intelligent management technology, in order to meet the new requirements of energy Internet environment. Therefore, for both the pioneer and the defender, the electric power enterprise should extensively carry out the exploitative innovation and exploratory innovation to improve the financial performance [16]. The synergy of management innovation and technical innovation can provide the effective organization guarantee and system support for the enterprise's technical innovation, effectively improve the efficiency and quality of the organization's technical innovation, further meet the product demand of existing market or accelerate the market development, so as to promote the financial performance and the long-term competitive advantage.

Based on the established knowledge and technology, the exploitative innovation can expand the existing product line, improve and complete the product design and function by refining, extending, and popularizing the existing technology and knowledge, in order to meet the customer demand [17]. Accordingly, for the management innovation, the enterprise should improve the operation efficiency of existing products' distribution channels, optimize the organizational structure and marketing mode, enhance the quality of communication, and provide the product and service with a more stable performance and a higher added-value for existing customers; in order to achieve the interconnection and synergy with the exploitative innovation so as to promote the enterprise's performance growth. In contrast, the exploratory innovation can make the enterprise obtain new knowledge by means of searching, creating, and testing, and develop new products or services to meet the potential or new demand of the customers [18]. March thinks that, the exploratory innovation can lead the enterprise management mode such as the business process and the organization and production mode to change, help the enterprise continuously adapt to the dynamic changes in the external environment and timely position the market opportunity through the synergy of exploratory innovation and management innovation; and prepare conditions for expanding the market share and promoting the business growth [17]. Thus it can be seen that, the exploratory innovation has a higher integration of new knowledge and new technology experience. It emphasizes on the enterprise's break-through of existing knowledge and technology, and research, development and production of new products through a substantial and fierce technical innovation. At this time, under the influence of management innovation, the enterprise can carry on an effective organization innovation, open up new market segments, innovate the marketing mode, design the new brand strategy, so as to guarantee the marketing of new products, expand the enterprise's market share, and further achieve the improvement of the enterprise financial performance and competitive advantage.

Based on the paper, we put forward the following hypotheses:

**H1a:** The synergy of exploitative innovation and management innovation as well as the synergy of exploratory innovation and management innovation can significantly promote the enterprise's short-term financial performance.

**H1b:** The synergy of exploitative innovation and management innovation as well as the synergy of exploratory innovation and management innovation can significantly promote the enterprise's long-term competitive advantage.

### 2.3. Regulating effect of strategic consistency

Strategic consistency refers to the degree of consistency that the enterprise's different levels and departments can achieve for their understanding of strategic goal, thinking tendency, as well as the means, methods adopted in achieving the strategic goal [19]. Facing the fierce market competition, the higher level consistency towards the company's strategic understanding, their thinking consistency, and their action consistency will directly determine the success or failure of the enterprise [20]. When the strategic consistency is higher, the departments can achieve the consistency on the understanding of strategic goal and the concept thinking, and form the synergistic effect through the consistent strategic action, so as to develop the overall advantage of the organization and promote the achievement of the strategic goal. Therefore, the higher strategic consistency can avoid the waste of resources and the low efficiency of resource allocation caused by the misunderstanding of strategic goal and action differences. The promotion effect of strategic consistency on the business performance has been approved by many researches. Scott thinks that industry environment, strategic choice and strategy implementation are the core condition that affects the business performance. He also indicates that there is a close relationship between the enterprise profit level and the strategic consistency [21]. By the empirical research of 217 electronics companies, Bracker found that the organizational strategic consistency can significantly improve the financial performance of the enterprise [22].

In the process that the synergy of technical innovation and management innovation has an effect on the enterprise financial performance and competitive advantage, as the situation factor, the strategic consistency has a strong regulating effect. In the organization of an enterprise, management behaviors such as R & D and production, and marketing, come into being in different departments. Only when these departments achieve the consistent understanding of the company's strategic goal, and take the consistent strategic action, can they achieve the synergy between departments, promote the effective coupling of technical innovation and management innovation, and play the promotion effect on the enterprise value. When the strategic consistency is higher, the coordination cost between R&D Department and Management Department is lower, so it enhances the communication quality between departments and levels, and further promotes the synergy efficiency of technical innovation and management innovation. In addition, Dodgson et al consider the strategic synergy as an important prerequisite for an enterprise to get innovation resources, and indicate that the strategic synergy can enhance the organization' s environmental adaptability. In summary, through the impact on the business financial performance, or technical and management innovation synergy, the strategic synergy can regulate the value promotion effect of innovation synergy.

Based on the paper, we put forward the following hypothesis:

**H2a:** In the process that the two types of innovation synergy are effecting the enterprise's short-time financial performance, the strategic consistency has a positive regulating effect. When the strategy consistency is higher, the promotion effect of innovation synergy towards the financial performance is stronger, and vice versa.

### 3. Statistics and empirical research

#### 3.1. Samples and data

The paper uses the questionnaire survey to obtain research data. In order to improve the data quality, the screening and control of sample types have been adopted from the stage of sample selecting. The purpose of the research focuses on discussing the innovation synergy effect of technical and management to the enterprise value, so the sample enterprises need to have a certain growth period to realize the importance of management innovation and to stimulate the synergy effect of technical innovation and management innovation. At the same time, when the innovation synergy improves the enterprise value, there may exist a certain time lag. Therefore, we have selected companies with a establishment time of more than 2 years as the research samples.

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doi:10.12783/jss.1544-8053/13/7/245
The research samples of the paper are from 3 municipalities and 5 provinces of China, including Beijing, Tianjin, Shanghai, Shandong, Guangxi, Hebei, Guangdong, and Jiangsu. To ensure the data quality, the people who filled the questionnaires are familiar with the affiliated enterprise's innovation, financial performance, and strategic implementation. They are the CEO, general manager, deputy general manager, chief financial officer, members of the board of directors, or members of the strategy committee in the company. The questionnaires are sent and taken back by the means of email, mail, or on-site paper version, and shall be filled out anonymously. In order to improve the quality of questionnaires sent by email and mail, before sending, we made the telephone communication with the relevant people in charge of target enterprises to tell them our research purpose, and solicit their participation in the research and their cooperation. After sending the electronic questionnaire, we call the corresponding enterprise to remind every other week. In order to improve the data quality of the on-site paper questionnaire, there are relevant researchers distributed on the spot to supervise, who can explain the doubts and confusions at the same time.

We have sent 450 questionnaires in total, and actually received 230 questionnaires. Excluding the incomplete, non-rationally answered questionnaires, 182 valid questionnaires were obtained, and the questionnaire recovery rate is 40.4%. For the response bias, we adopted the method of Armstrong et al: we took the test of significance on the questionnaires of 25% early respondents and 25% late respondents about the nature of the company, growth period, company size, and industry attribute. We found no significant difference between the two at the 5% level. So, the research design has no significant response bias. Taking the research of Podsakoff and Organ as the reference, using the single factor test method of Harman, we analyzed all items in the questionnaire, and have gotten the first principal component without rotation. Through the analysis, we find that the load capacity of the first principal component is not in the majority, which shows that the effects of common method variance on the research is weak.

3.2. Measures

In order to measure variable management, after comparing Birkinshaw’s research and Vaccaro’s research, the later one can match our research design. We have used Lubatkin’s scale to measure explorative innovation and exploitative innovation, and according to Jiao Hao’s method, we times explorative and exploitative innovation data to get technology synergy variable. To be specific, since the product term can reflect the interaction effect between these two types technology innovation, we first standardized these two variables to avoid multicollinearity problem. Then timed each other and substituted them into regression equations. We have adopted Hu Zhaping’s scale to measure strategy alignment and used Li and Wu’s research to measure financial performance and competitive advantage.
3.3. Reliability and Validity

As we can see from table 1, the Cronbach’s α of variables of explorative and exploitative innovation, management innovation, strategic alignment, financial performance and competitive advantage are all above 0.7, with the maximum one is 0.899, the minimum one is 0.781, which manifest all the main variables have strong reliability. When comes to validity, all scales are referred from literatures of high quality, which proves they have content validity. According to the results of KMO and Bartlett's test, all scales meet the requirement of factor analysis, after which we deleted two item of explorative and exploitative innovation scales.

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<th>Table 3 Reliability and EFA of financial performance and performance and competitive advantage</th>
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<td><strong>Factors</strong></td>
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According to the results of explorative factor analysis, factor loads of each variable are all above 0.7, which manifests that the correlativity between items and variables are significant. Cumulative variances of each variable towards factors are all above 60%, which proves that the scales have strong convergent validity. Meanwhile, Average variance extracted of each latent variable should be bigger than the correlation coefficient between the variable and others. According to the results in table 4, all experiment variables’ AVEs are bigger than the correlation coefficients, which show that there exists strong discrimination validity between every constructs.

3.4. Hypothesis test

Table 5 reports the effect of two kind of innovation synergy on enterprise financial performance, and regression results on moderating effect of strategic congruence. From the test results on main effects, we find that exploitative innovation and management innovation synergy can significantly improve the short-term financial performance, the regression coefficient was 0.385 and the significance level was 0.01 (r=0.385,p<0.01). Exploratory innovation management innovation synergy also has a positive effect on short-term financial performance, but the contribution is less than the synergistic effect of exploitative innovation and management innovation, the regression coefficient was 0.189 and the significance level was 0.05(r=0.189,p<0.05). Hypothesis 1a was proved.

This research reveals that, first, the corporation of technology innovation and management innovation can promote the dynamic evolution of the two models of innovation, and realize the interact supportion and promotion of them each other, and therefore promote corporate financial performance. Second, as there exists difference of the characteristic of the two models of innovation, enterprise can improve product function, decrease production cost, and enhance customer’s satisfaction by using technology innovation and therefore to help enterprise consolidate market share. Meanwhile, the goal of explorative innovation is to exploit new production and enhance market share, as a result of comparison, the corporation of former innovation and management innovation can better enhance the short-term financial performance steadily.

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<th>Table 4 Correlation coefficients and ave</th>
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<td><strong>Variables</strong></td>
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<th>Table 5 Correlation test of innovation synergy, strategic consistency and financial performance</th>
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<td><strong>Main effect</strong></td>
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When strategic congruence is introduced into the regression model, it has a significant positive moderating effect on innovation synergy and financial performance, the regression coefficient were 0.376, 0.355, the significance level were 0.01 (r=0.376, T=2.353). It suggests that strategic congruence was higher, the two kinds of innovation synergy have a more strong promotion effect on financial performance. Hypothesis 2a was proved.

The study shows that when the strategic fit is high, the understand, recognition and execution of the corporate technology departments, R&D and function departments to the corporate strategy is up to a high degree of uniformity. It can also lower the coordinate cost between departments, higher the efficiency of communication and get sufficient motivation for mutual support. Therefore, the synergy effects between technological and management innovation are also significant, and then contribute to the improvement of the short-term financial performance.

Table 6 reports the effects of innovation synergy on long-term competitive advantage, and regression results on moderating effect of strategic congruence. The test results on main effects suggest, exploitative innovation and management innovation synergy can significantly improve the long-term competitive advantage, the regression coefficient of innovation synergy was 0.208, T value was 2.353 (r=0.208, T=2.353). Exploratory innovation management innovation synergy also has a significant positive effect on long-term competitive advantage, and its contribution over and above the former’s, the regression coefficient was 0.415 and T value was 5.260 (r=0.415, T=5.260). Hypothesis 1b was proved.

The result of research turns out that, first, the corporation of technology innovation and management innovation is helpful to improve rapid of reaction to market for enterprise, and to improve productivity and quality of production, and therefore optimize the reputation of the company and promote the long-term competition advantage. Second, the corporation of two models of technology innovation and management innovation can make different effect on company competition advantage, and the reason lies in difference of characteristic of two models of technology innovation. As explorative innovation is guided by developing new product and market, companies paying more attention to it usually need to expand market share quickly by improving productivity and quality of production, and by promoting
production and reputation. Therefore, with the help and guarantee of management innovation mechanisms such as company culture organization structure and inner communication, explorative technology innovation can enhance long time competition advantage obviously. However, even though that the exploitative innovation can improve financial performance by consolidating the market share, the low efficiency of new product development and productivity, serious internal product homogeneity and long run analysis can make the company lose its competition advantage easily in the latent market.

Strategic congruence has a significant positive moderating effect on two kinds of innovation synergy and enterprise competitive advantage, the regression coefficient of product term were 0.277, 0.311, and the significance level were 0.01(r1=0.277,r2=0.311,p<0.01). Hypothesis 2b was proved.

The test results show that the higher the strategic fit, the synergies of the technological and management innovation can promote the competitive edge more significantly. To the R&D and function department, their understanding and the consistency of the implementation on the corporate strategy can simultaneously enhance these sectors' emphasis on the corporate reputation and brand value, strengthening the mutual support among departments and mutually reinforcing synergy motive. Under the influence of the innovation mechanism such as the effective organizational structure, corporate culture and management system, it can also accelerate the speed of R&D, rapidly expanding the market share and enhancing the competitive advantage.

4. Conclusions and implications

According to rigorous scientific research paradigm, this research takes strategic consistency as a moderating variable, and also the energy internet background and electric power enterprise globalization strategy into account. We focus on how the analysis of the electric power enterprise's ambidexterity technological innovation and the synergistic effect of management innovation will impact on the organizational performance and try to find the boundary of it works. In order to exploring the way that Enhanced enterprise value by technological innovation and management innovation collaborative as the logic starting point, the research finds the relationship between the innovation in electric power enterprises collaboration, the relationship between strategy, the business performance and the competitive advantage. The research shows that the electric power enterprise can promote the short-term financial performance and the long-term competitive advantage of enterprise through constructing the exploratory and utilizable innovation and cooperative mechanism of the management innovation, so that it will enhance the enterprise value. Specifically, the synergy between the exploratory and utilizable innovation and management innovation will impact on corporate financial performance and competitive advantage. The contribution of the synergy of the exploratory innovation and management innovation to the competitive advantage of enterprises is higher than the utilizable innovation, and the contribution of the synergy of the utilizable innovation and management innovation to the financial performance of enterprises is higher than the exploratory innovation. Strategic consistency has a positive moderating effect on the relationship between innovation synergy and corporate financial performance and competitive advantage. The higher strategic consistency is, the innovation synergy will be more significant effect on financial performance and competitive advantage.

The managerial implication of this research is reflected in three aspects. Firstly, to fit the innovation requirements of the Energy Internet and globalization strategy, electric power enterprises should understand dynamic coordination of mechanism technologic innovation and management innovation, construct effective coordination mechanism. By pushing forward the reform of the organization structure, building the global governance structure, enhancing the innovative approach to enterprise culture, innovative marketing and brand strategy, to protect and support the technological innovation activities of enterprises. At the same time, make full use of China's electric power enterprises in UHV transmission technology and other technical accumulation of the management system, and constantly optimize the management functions, ultimately to achieve the dynamic synergy of the two. Secondly, according to the strategic objectives of the globalization, the electric power enterprises should distribute reasonably in the exploration and utilization of technology innovation activities of innovation resources, and constantly improve the technological level in distributed energy collection technology, information technology and intelligent management. By the means of construction of exploration and exploitation technology innovation synergy mechanism, to provide technical support for the electric power enterprise expanding global markets and promoting competitive advantage and reinforcing established market, and obtaining stable income, in order to achieve the unity of global competition environment adaptability and growth robust of electric power enterprises. Thirdly, in achieving strategic consistency between internal departments both in thought and implementation level, reducing the coordination costs, improving the willingness and motivation of inter departmental support, and enhancing the effective coordination of technology innovation and management innovation, the electric power enterprises can promote and achieve the globalization strategy in the context of Energy Internet.

Acknowledgements

This paper is periodical result of technology project of State Grid Corporation of China: A study on crucial issues of macro strategy during global energy internet construction process (SGSDDK00KJS1600067), and is a result of project of Shandong Social Science Association: Upgrade route of innovation financial strategy for corporations in Shandong province—From the perspective of debt governance(16-ZZ-GL-09).

References


