

External Information Network Diversity and Production Management Capability in IT SMEs in the Age of Digital Convergence: The Mediating Effect of Manufacturing Capability

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디지털 융합시대에 IT 중소기업의 외부정보네트워크의 다양성과 생산관리능력: 제조능력의 매개효과를 중심으로

허용석

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Abstract The production management is one of the essential capabilities of the small and medium-sized enterprises (SMEs) in the information technology sector (IT). Therefore, this study empirically analyzed the effects of such important factors as external information network diversity and manufacturing capability on IT SMEs' production management capability. Based on the 310 data collected from Korean SMEs in the IT sector, the ordinary least squares regression results from this study by using the SPSS version 22 have empirically shown that IT SMEs' external information network diversity has a positive and significant effect on their production management capability and this effect is fully mediated by their manufacturing capability. These findings provide a meaningful implication that the positive impact of IT SMEs' external information network diversity is linked to their production management capability through their manufacturing capability.

Key Words : Digital Convergence, External Information Network Diversity, IT SMEs, Production Management Capability, Manufacturing Capability

요약 생산관리능력은 IT 중소기업의 가장 필수적인 역량 중 하나이다. 따라서, 본 연구는 외부정보네트워크의 다양성 및 제조능력과 같은 주요 요인들이 IT 중소기업의 생산관리능력에 미치는 영향을 실증 분석하였다. 한국의 310개 IT 중소기업으로부터 수집된 데이터를 바탕으로 SPSS 버전 22를 사용한 최소자승 회귀분석 결과, 외부정보네트워크의 다양성은 IT 중소기업의 생산관리능력에 유의한 정(+)의 영향을 주며, 이러한 정(+)의 영향은 IT 중소기업의 제조능력에 의해서 완전 매개 되는 것으로 나타났다. 이러한 실증 분석 결과는 IT 중소기업의 외부정보네트워크의 다양성이 제조능력을 통해 생산관리능력에 정(+)의 영향을 미친다는 의미 있는 시사점을 제공한다.

주제어 : 디지털 융합, 외부정보네트워크의 다양성, IT 중소기업, 생산관리능력, 제조능력

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1. Introduction

Small and medium-sized enterprises (SMEs) play an important role as the cornerstone for economic development in every nation [1]. Therefore, they have been drawing a lot of attention from economic policy makers, scholars and businessmen, which has resulted in various studies about SMEs so far. However, there have been few empirical studies that shed a light on the impact of the external information network diversity on the production management capability of the SMEs in the information technology (IT) sector and the mediating effect of their manufacturing capability on this impact. So, this research tries to answer the two research questions as follows:

- (i) What effect does IT SMEs' external information network diversity have on their production management capability?
- (ii) How does IT SMEs' manufacturing capability mediate the effect of the external information network diversity on their production management capability?

This article is composed of five sections including this introductory section. The second section presents the research model and hypotheses for this study. The third and fourth section cover the research methodology and empirical analysis results, respectively. The last section provides the conclusion of this research.

2. Research Model and Hypotheses

Knowledge-based theory points out that knowledge is of importance to developing capabilities which can create sustainable competitive advantages of firms [2, 3, 11, 12]. Especially in today's knowledge and information-intensive economy in the age of digital

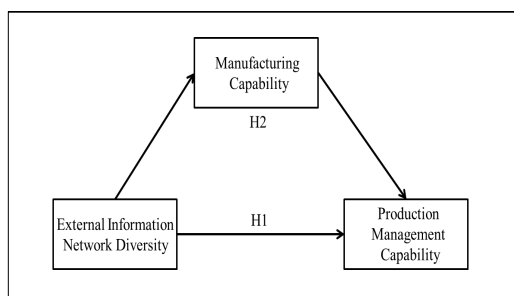
convergence, it is not easy for IT SMEs which is lack of internal resources to develop their important capability such as production management capability by using only their own internal knowledge base. Therefore, in order for IT SMEs to effectively increase their production management capability, it is important to use various external information sources. In other words, IT SMEs can extend their limited internal knowledge base and develop their production management capability by obtaining useful external knowledge from various external information sources such as universities, research institutes, customers, suppliers, and so on in their external information network [5], which generates the hypothesis 1 in the research model in the [Fig. 1].

H1: IT SMEs' external information network diversity has a positive effect on their production management capability.

Today, knowledge is one of the important inputs for manufacturing products [4]. Various knowledge from diverse external information sources can help firms to manufacture more innovative products [5, 6, 13, 14, 15, 16]. Furthermore, IT SMEs' manufacturing capability is one of the critical factors to determining their production management capability. For example, IT SMEs' capability of manufacturing innovative products effectively can make their production management capability more fruitful. Therefore, this study generates the following hypothesis 2.

H2: IT SMEs' manufacturing capability mediates the positive effect of the external information network diversity on their production management capability.

The [Fig. 1] illustrates the hypothesis 1 and 2 in the research model in this study.



[Fig. 1] Research Model

3. Research Methodology

For empirically testing the hypotheses in the research model, the 2013 SMEs' Technology Statistics (2013 SMETS) was used. It was a kind of the national survey carried out by the Korea Federation of Small and Medium Business (KBIZ) and the Small & Medium Business Administration in 2013. The 310 data in the IT sector from the 2013 SMETS was analyzed and the following <Table 1> summarizes the characteristics of them in terms of the variables related to the research model.

<Table 1> The characteristics of the analyzed samples

Category	Max	Min	Average	Standard Deviation
External Information Network Diversity	8	0	1.874	1.393
Manufacturing Capability	100	0	60.425	33.968
Production Management Capability	100	0	60.693	32.937

Considering the research context for this study, the measurement for the external information network diversity was adapted from Watson (2007)[7]. IT SMEs may use various external information sources to develop their technology for product and process innovation: (1) domestic or international seminars,

conferences, and expositions (2) domestic or international journals or books in their area of expertise (3) competitors in the same field (4) suppliers (5) private research institutes or consulting firms (6) customers (7) universities (8) public research institutes. If an IT SME obtained idea or information from all of these 8 external information sources from 2011 to 2012 to develop its technology for product and process innovation, then its external information network diversity was measured as 8. But, it took the value of 0 if an IT SME did not obtain idea or information from any of the external information sources. Compared to the world-best level, IT SMEs' technology-related manufacturing and production management capabilities were gauged based on a 100 % - point scale as of the end of June in 2013. They were gauged as 100 % when they were evaluated to be the world-best level. The difference between this world-best level and an IT SME's level lower than 100 % represented the degree of deficiencies in its manufacturing and production management capabilities.

SPSS version 22 was used to perform the ordinary least squares regression analysis for testing the two hypotheses in the research model.

4. Empirical Analysis Results

This study applied Baron and Kenny (1986)[8]'s conditions for testing single mediator model to the research model and also performed the Sobel test [9] to confirm the significance of the mediating effect. According to Baron and Kenny (1986)[8], a variable proves to be a significant full mediator if the following four conditions are satisfied:

- (i) The dependent variable should be significantly influenced by the independent variable
- (ii) The presumed mediator should be significantly influenced by the independent variable

- (iii) The dependent variable should be significantly influenced by the presumed mediator when the effect of the independent variable is controlled.
- (iv) If the significant impact of the independent variable on the dependent variable in the condition (i) becomes insignificant in the condition (iii), the presumed mediator proves to be a full mediator.

The ordinary least squares regression results by using the SPSS version 22 have shown that the mediating model in this study satisfies the Baron and Kenny (1986)[8]'s conditions to test the mediating effect and the manufacturing capability is a full mediator at the significant level of 0.05. Related to the condition (i), The external information network diversity has a significant and positive effect on the production management capability (regression coefficient = 3.456, *t*-value = 2.594). Regarding the condition (ii), the external information network diversity has a significant and positive impact on the manufacturing capability (regression coefficient = 4.272, *t*-value = 3.124). With regard to the condition (iii) and (iv), the effect of the external information network diversity on the production management capability becomes insignificant (regression coefficient = -0.226, *t*-value = -0.358) when the impact of the manufacturing capability is controlled (regression coefficient = 0.862, *t*-value = 33.249).

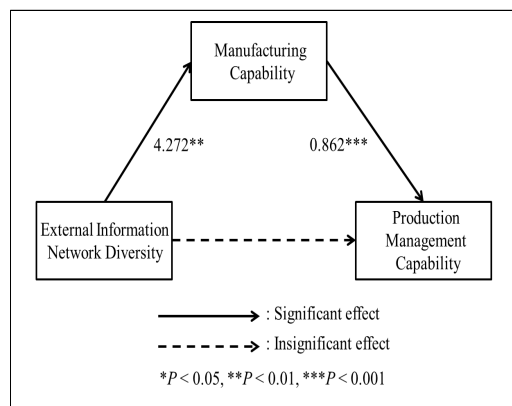
The Sobel test [9] result has confirmed the significant mediating effect of the manufacturing capability in the research model at the significant level of 0.05. The *z*-value calculated by the following formula [9] is 3.111, proving that the manufacturing capability is the significant mediator.

$$Z = \frac{\beta_1 \times \beta_2}{\sqrt{\beta_1^2 SE_2^2 + \beta_2^2 SE_1^2}}$$

- β_1 : The unstandardized regression coefficient of the external information network diversity on the manufacturing capability
- β_2 : The unstandardized regression coefficient of the manufacturing capability on the production management capability when the effect of the external information network diversity is controlled

SE1: The standard error of the β_1

SE2: The standard error of the β_2



[Fig. 2] Empirical Analysis Results

The [Fig. 2] sums up the empirical analysis results of this research.

5. Conclusion

5.1 Implications

The empirical analysis results of this research provide a meaningful finding that the positive impact of IT SMEs' external information network diversity is linked to their production management capability through their manufacturing capability. This finding is expected to provide useful theoretical and practical implications. With regard to the theoretical implication, this study sheds a new light on the positive effect of IT SMEs' external information network diversity on

their production management capability which few prior studies have covered up to now. The external information network of SMEs has drawn a lot of attention because it can play an important role in extending the knowledge landscape for the innovations of SMEs which is lack of internal resources [5, 6, 10]. So, previous studies have concentrated mainly on the role of SMEs' external information network as the source of innovations. However, this study is expected to widen the research streams in the role of SMEs' external information network by empirically showing that IT SMEs' external information network diversity contributes to increasing their production management capability. Furthermore, the empirical analysis results of this research is expected to deepen the research streams in the role of SMEs' external information network by revealing that IT SMEs' manufacturing capability fully mediates the impact of the external information network diversity on their production management capability.

In terms of the practical implication, this study empirically shows that it is desirable for the CEOs in IT SMEs to try to use more various external information sources in order to develop their production management capability. The empirical analysis results of this research have confirmed that IT SMEs' external information network diversity has a positive impact on their production management capability through their manufacturing capability. This means that IT SMEs' strategic efforts to use more various external information sources are beneficial to their crucial capability such as production management capability.

5.2 Limitations

Although this study provides the meaningful theoretical and practical implications for scholars and IT SMEs' CEOs at practice, this study has a few limitations. First, this research performed the empirical analysis based on the data from the SMEs only in the IT sector, which makes it difficult to provide useful

implications for the SMEs in the non-IT sector. Second, this study focused only on the effects of the external information network diversity and manufacturing capability on IT SMEs' production management capability in the research model. It will be better for future studies to consider more various antecedents to IT SMEs' production management capability in their research model. Third, the effects of IT SMEs' external information network diversity and manufacturing capability on their production management capability can change as time flows. But, this research is a cross-sectional study, so it is not possible to analyze the changing effects of them over time.

REFERENCES

- [1] R. K. Singh, S. K. Garg, and S. G. Deshmukh, Strategy development by SMEs for competitiveness: a review. *Benchmarking: An International Journal*, Vol. 15, No. 5, pp. 525-547, 2008.
- [2] R. M. Grant, Toward a knowledge-based theory of the firm, *Strategic Management Journal*, Vol. 17, Winter Special Issue, pp. 109-122, 1996.
- [3] R. M. Grant, The knowledge-based view of the firm: Implications for management practice, *Long Range Planning*, Vol. 30, No. 3, pp. 450-454, 1997.
- [4] W. G. Nickels, J. M. McHugh, and S. M. McHugh "Understanding Business. McGraw Hill", 2012.
- [5] H. W. Chesbrough "Open Innovation - The New Imperative for Creating and Profiting from Technology. Boston: Harvard Business School Press", 2006.
- [6] H. W. Chesbrough, The era of open innovation, *MIT Sloan Management Review*, Vol. 44, No. 3, pp. 35-41, 2003.
- [7] J. Watson, Modeling the relationship between networking and firm performance, *Journal of Business Venturing*, Vol. 22, No. 6, pp. 852-874, 2007.

- [8] R. M. Baron, and D. A. Kenny, The Moderator-Mediator Variable Distinction in Social Psychological Research : Conceptual, Strategic, and Statistical Considerations, *Journal of Personality and Social Psychology*, Vol. 51, No. 6, pp. 1173-1182, 1986.
- [9] M. E. Sobel, Asymptotic confidence intervals for indirect effects in structural equation models, *Sociological Methodology*, Vol. 13, pp. 290-312, 1982.
- [10] V. van de Vrande, J. P. J. de Jong, W. Vanhaverbeke, and M. de Rochemont, Open innovation in SMEs: Trends, motives and management challenges, *Technovation*, Vol. 29, No. 6-7, pp. 423-437, 2009.
- [11] B. Kogut, and U. Zander, Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology, *Organization Science*, Vol. 3, No. 3, pp. 383-397, 1992.
- [12] N. J. Foss, Knowledge-Based Approaches to the Theory of the Firm: Some Critical Comments, *Organization Science*, Vol. 7, No. 5, pp. 470-476, 1996.
- [13] H. W. Chesbrough "Open Business Models - How to Thrive in the New Innovation Landscape. Boston: Harvard Business School Press", 2006.
- [14] H. W. Chesbrough, and M. M. Appleyard, Open Innovation and Strategy, *California Management Review*, Vol. 50, No. 1, pp. 57-76, 2007.
- [15] L. Huston and N. Sakkab, Connect and Develop, *Harvard Business Review*, Vol. 84, No. 3, pp. 58-66, 2006.
- [16] H. W. Chesbrough, K. Sohyeong, and A. Agogino, Chez Panisse: BUILDING AN OPEN INNOVATION ECOSYSTEM, *California Management Review*, Vol. 56, No. 4, pp. 144-171, 2014.

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