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## **A Study on the Effect of CEO Discovery DNA on Productivity**

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### **Abstract**

This study starts with the question of what is the manager's ability to innovate and tries to confirm its effect on productivity from the point of view of discovery DNA. Research into managers' innovation, which has been conducted in previous studies, focuses on the learning and ability development of managers, so there were many discussions from the perspective of responding to changes in the corporate environment. However, this study was approached from the viewpoint of the competency that is inherent in managers. Discovery DNA was suggested by Dyer et al. (2011) while explaining the difference between innovative entrepreneurs and ordinary entrepreneurs, and refers to five abilities: 'questioning', 'observing', 'networking', 'experimenting' and 'associating'. The data in this study were collected from 277 companies headquartered in Korea, which were classified by size, with 62 (28%) being large companies and 149 (71%) small companies. As a result of the analysis, it was found that "questioning" and "networking" were statistically significant components of discovery DNA, which is the manager's innovation ability, and had a positive (+) effect on productivity.

### **Keywords**

Innovation, Discovery DNA, Productivity, CEO

## **Introduction**

From the point of view of incremental innovation, Hamel (2006) declared that CEO innovation is not a short-term form of innovation but rather it generates the company's value in a state of evolutionary innovation. In addition, Lecler and Kinghorn (2014) found that the variables of innovation that impact corporate performance are the CEO's ability to recognize opportunity, the realization of opportunity, and competency in problem-solving strategies. These studies claimed that innovation starts with the characteristics of CEOs and are based on entrepreneurial spirit, which has been discussed for a long time (S. Kim & D. Kim, 2016). Entrepreneurship theory focuses on the basic framework of innovation which fundamentally starts from a CEO perspective.

There are countless studies and debates on CEO characteristics being the beginning of innovation, and yet there is one important issue that is overlooked. What is the CEO's role in innovation? Numerous studies, based on entrepreneurship, have identified theoretical logic by including the abilities of risk-taking, initiative, the pursuit of new things, autonomy, etc. (S. Kim, 2015). However, CEO innovation has not been explained fully due to the fact that prior research on entrepreneurship has mainly focused on the actions of CEOs along with situational factors, which include the capability of learning and developing. When considering how this context applies to the atmosphere of a company, we can see that the CEO constantly strives to achieve the fundamental goal of the survival of the enterprise when entering a new business or developing new products. In other words, the main idea of CEO innovation is to adapt to the dynamic business environment and this is achieved as a result of learning.

Despite this logic, there is no clear answer to the question of what CEO innovation is. CEO innovation should therefore be discussed from the viewpoint of discovery DNA. Entrepreneurship theory defines a CEO's risk-taking capability and challenging spirit as being key to the start of innovation. And yet, numerous studies related to entrepreneurship are mainly focused on the capability of a CEO to learn and develop skills in response to the changing business environment. It is also pertinent to discuss CEO competency. The study will thus approach the topic of CEO innovation from the perspective of CEO competency. This is not derived from acquired learning, as it can be possessed and utilized by anyone.

The concept of competency was first introduced by Boyatzis (1982) in an organizational context and is completely different from competencies. Competencies are a set of features that are effective in a particular job with excellent performance and are a set of underlying characteristics that are developed from an individual's potential, experience, motivation, and other factors. In contrast, competency is an act initiated from a competent performance (Wickramasinghe & De Zoyza, 2011), which is a combination of the knowledge,

attitude and ability that affects the individual's unique ability to execute the CEO's job. The purpose of this study is to present an empirical analysis of the CEO's innate ability and the related productivity of the manufacturing enterprise.

## **Background**

### **CEO discovery DNA**

In the book 'Theory of Economic Development' (Theorie der wirtschaftlichen Entwicklung), written by the Austrian economist Schumpeter in 1912, he emphasized the importance of innovation, which has been interpreted in various fields of study, as well as in practice. The word innovation originated from the Latin word 'innovatio,' meaning 'to make new,' or 'to make changes to existing things,' in around 1540 (S. Kim, 2015). Max (2008) comprehensively defines innovation from the viewpoint of the radical or gradual change of things, thoughts, progress or services, and then argues that being innovative should be something significantly different from the previous position.

Many corporate organizational studies see the impetus for innovation as coming from leaders and the CEO. Previous studies of innovative leadership are based on entrepreneurship. Nonetheless, the previous definition of entrepreneurship only focused on the CEO's learning skills, and was limited in explaining the entrepreneurial tendencies and the source of innovative behavior. Recently, there have been a number of studies that metaphorize the concept of DNA from the perspective of the CEO's innovative leadership ability (Dobni, 2008). In 2009, *Harvard Business Review's* cover story of their winter issue elaborated on the basic concepts of the innovation discovery DNA that global leaders have, which is an approach to the fundamental capability of the CEO (D. Kim 2016). Dyer et al. (2009) introduced the term Discovery DNA and explained its components. The five major components are the CEO's ability to question, observe, network, experiment, and associate as a cognitive ability. The systematic combination of these five components leads to innovation.

Specifically, 'questioning' means to explore new fields by asking questions about certain phenomena, 'observing' refers to observing a product or service that has new inventive ideas, and 'networking' is the solving of problems by obtaining ideas from other industries. Additionally, 'experimenting' is to examine new products and services that could be improved, and 'associating' is to create new ideas from different points of view or industries.

Dyer et al. (2011) claimed that Discovery DNA is expressed through a combination of discovery and cognitive skills. These start with the CEO having the courage to innovate, combined with their discovery skills, and this accelerates the cognitive processes needed for innovative ideas. This will create corporate value by inventing new products or ideas.

Having the courage to innovate means accepting the challenge and then taking risks. Discovery skills refer to a combination of four key elements, which are questioning, observing, networking, and experimenting, and the cognitive process that is promoted by these discovery skills refers to 'connecting the dots' from various perspectives. The outcome of this innovation is the result of both continuous effort and the habit of consolidated thinking.

Dyer et al. (2011) argued that there is a difference between Discovery DNA and innovative entrepreneurs and ordinary entrepreneurs. To prove this, he conducted in-depth interviews with 100 global innovative entrepreneurs. As a result, the study found that innovative entrepreneurs spend more time on Discovery DNA than ordinary entrepreneurs, and they systematically execute management by asking questions, observing, networking, experimenting, and associating things. Thus, this study examines the CEO's ability to innovate using the concept of the Discovery DNA presented by Dyer, which is a combination of improving productivity and the output of innovative enterprise.

### **CEO Discovery DNA and productivity**

Klein (2008) argued that an innovative thinker tends to discover more opportunities for new businesses or products than an ordinary thinker. As a result, they achieve a competitive advantage and give an outstanding performance. The outstanding performance of an enterprise derives from having an innovative CEO and it has led to the development of new products, as well as further improvements to make them even better. Newey and Zahra (2009) claimed that the dynamic capability of an innovative CEO can lead to the innovation of products and eliminate negative factors such as the defect rate. This means that an innovative CEO has the ability to search for new products and develop them to meet the needs of consumers. Zanga et al. (2014) stated that, unlike ordinary CEOs, CEOs with higher rates of discovery DNA are also skilled at close monitoring and achieving their goal.

An enterprise's competitive advantage is derived from being innovative in terms of products, technology, and production (Koc & Ceylan, 2007). After all, a competitive advantage refers to the elements that enable a company to achieve the fundamental goal of survival. In addition, the productivity of a company allows it to continue its business by actively producing, improving, and performing throughout the process (Utterbak & Abernathy, 1975). Production performance refers to creating new or adjusted products in order to meet consumer needs and manufacturing performance refers to improving the quality of products or introducing new methods to reduce costs (Freeman, 1997; Hwang, 2014).

## Empirical Analysis

### Hypothesis and research model

The CEO's ability to innovate affects both a company's competitive advantage and performance (Klein, 2008). It also leads to the innovation of products and eliminates negative factors such as defect rates (Newey & Zahra, 2009).

CEOs with higher discovery DNA rates can increase their productivity by enhancing the production process, reducing unnecessary movements, and modifying the facilities (Zanga et al., 2014). Based on these previous studies, a CEO's ability to innovate affects the company's productivity, which is part of the enterprise's performance. In this context, the following assumptions have been established:

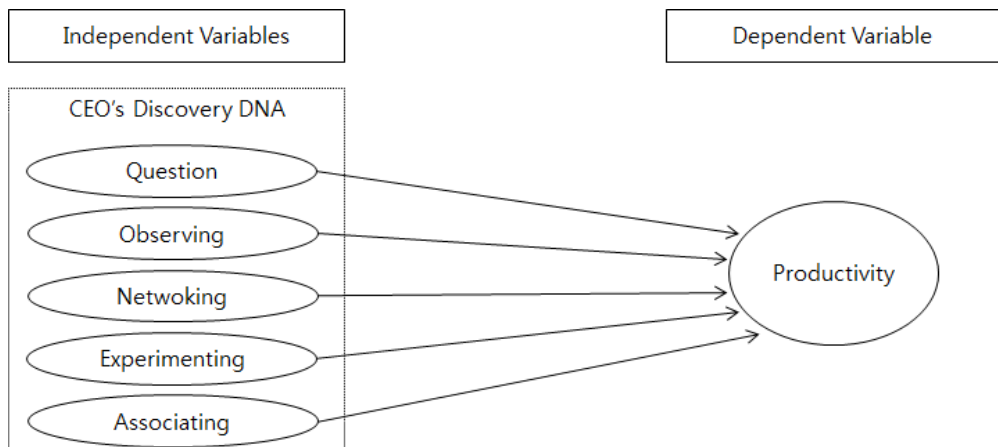
H-1. Questioning as part of CEO Discovery DNA will affect Productivity

H-2. Observing as part of CEO Discovery DNA will affect Productivity

H-3. Networking as part of CEO Discovery DNA will affect Productivity

H-4. Experimenting as part of CEO Discovery DNA will affect Productivity

H-5. Associating as part of CEO Discovery DNA will affect Productivity



**Figure 1** A research model was designed to identify the impact of Discovery DNA (CEO's innovation ability) on productivity

**Measurement**

To measure the rate of Discovery DNA, we created 10 questionnaires in five points using five components given by Dyer et al. (2008): questioning, observing, networking, experimenting, and associating. Productivity was measured in the four categories of cost reduction, defect rate, delivery rate, and production volume used by Schroeder et al. (2002).

The measurement items of the variable are as follows:

**Table 1** Construct Validity (Exploratory Factor) Analysis Result

Variables	Measurements
Productivity	<ul style="list-style-type: none"> <li>· Production cost is low</li> <li>· Defect rate of products is low</li> <li>· Average delivery rate of the product is fast</li> <li>· Fixed amount of the production rate is high</li> </ul>
Associating	<ul style="list-style-type: none"> <li>· The perspective or idea of the CEO is different from ordinary people</li> <li>· CEO obtains new ideas from customers, suppliers or other companies</li> </ul>
Questioning	<ul style="list-style-type: none"> <li>· CEO asks a question that challenges the status quo</li> <li>· CEO explores new fields by asking questions</li> </ul>
Networking	<ul style="list-style-type: none"> <li>· CEO applies a solution found in other industries to a problem</li> <li>· CEO participates in various meetings in order to meet new people and see what problems they have</li> </ul>
Experimenting	<ul style="list-style-type: none"> <li>· CEO experiments to find new methods</li> <li>· CEO communicates with people in diverse fields to explore and shape the new idea</li> </ul>
Observing	<ul style="list-style-type: none"> <li>· CEO comes up with a new idea by observing the products and services of other people</li> <li>· CEO puts their effort into the following new trend by reading books, papers, magazines, blogs etc.</li> </ul>

**Data**

On-site visits, postal mails and e-mails were utilized to collect the data. The targeted CEO was the CEO and directors of production-related businesses of major conglomerates and small-medium companies headquartered in Korea. When the CEO or director was

unable to answer, department heads who had been working in production-related fields for more than 10 years were surveyed to enhance the reliability of the response. The survey was conducted twice in four months, between March and June of 2019, and a total of 1,000 copies were distributed and a total of 277 cases were collected. Overall, the final 211 copies were accepted for the study. The survey, therefore, resulted in responses from 62 major companies (28%) and 149 small-medium companies (71%).

**Verifying the validity and reliability of the composition concept**

Table1 (below) To verify the validity of the variables, Exploratory Factor Analysis (EFA) by R-type was set up for this study.

**Table 1** Construct Validity (Exploratory Factor) Analysis Result

Variables	Components					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Productivity2	<b>.836</b>	.184	.163	.021	-.031	.211
Productivity5	<b>.827</b>	.131	.151	.190	.113	.120
Productivity1	<b>.781</b>	.253	.220	-.013	.280	.063
Productivity3	<b>.767</b>	.188	.033	.290	.117	.089
Productivity4	<b>.765</b>	-.032	.053	.258	.354	.147
Associating1	.182	<b>.840</b>	.165	.194	.173	.192
Associating2	.314	<b>.682</b>	.304	.260	.244	.137
Questioning1	.161	.258	<b>.853</b>	.206	.133	.155
Questioning2	.269	.144	<b>.616</b>	.232	.510	.201
Networking1	.231	.148	.272	<b>.775</b>	.212	.249
Networking2	.238	.393	.170	<b>.709</b>	.197	.204
Experimenting1	.274	.276	.167	.309	<b>.744</b>	.202
Experimenting1	.236	.390	.348	.129	<b>.579</b>	.319
Observing1	.242	.174	.130	.223	.239	<b>.845</b>
Observing2	.211	.295	.433	.328	.147	<b>.595</b>
<b>eigenvalue</b>	8.176	1.691	.736	.680	.567	.541
<b>Dispersal Rate(%)</b>	24.9	12.8	11.8	11.7	10.9	10.1

Variables	Components					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
<b>KMO</b>	.950					
<b>Bartlett Test of Sphericity</b>	2098.942					
<b>p-value</b>	.000					
<b>Cronbach' α</b>	.927	.821	.822	.790	.850	.725

A total of 15 questions were classified as 6 factors that exceeded 1 eigenvalue and confirmed the correct classification system for each variable set. By using KMO (Kaiser-Meyer-Olkin), we obtained a number above .5, which confirms that there is no possibility of a problem regarding whether the correlation between a pair of variables is explained by other variables. In addition, the Bartlett sphericity test approximation chi-square value was shown to be 2098.942, which indicates the suitability of the factor analysis with a significant level of .000. The use of factor analysis is appropriate and common factors exist, and the variance is 82.2%. In addition, a reliability analysis was conducted to determine the consistency of the respondents in the questionnaire. The result of this was that the Cronbach's α value was .70 or higher, so the reliability of the items was satisfied.

**Table 2** Correlation Analysis Result

	Associating	Questioning	Networking	Experimenting	Observing	Productivity
Associating	1					
Questioning	.750**	1				
Networking	.703**	.740**	1			
Experimenting	.722**	.792**	.769**	1		
Observing	.692**	.757**	.698**	.723**	1	
Productivity	.621**	.670**	.656**	.655**	.586**	1



\* p<.05, \*\* p<.01

The results of the correlation analysis between the variables and the descriptive statistics of the variables are shown in Table 2. In this study, Pearson’s correlation analysis was conducted to verify the degree of causality between major variables based on the analysis model. Pearson’s correlation analysis indicates the degree of correlation when two variables are measured on an equal or ratio scale under the assumption that the variables follow a normal distribution. Correlation values range from -1 to +1, and the sign of the coefficient represents the direction of the relationship and the absolute value indicates the strength of the relationship.

The analysis shows that there is a significant correlation between all the variables, especially the correlation between Questioning and Experimenting. This was .792, which shows the strongest relationship. Question and Associating follows next (r=.750), Experimenting and Networking (r=.769) was next, and Observing and Question (r=.757) showed a strong correlation.

**Results and hypothesis test**

To analyze how the dependent variables, such as Associating, Questioning, Networking, Experimenting, and Observing, impact on the independent variable of Productivity, a multi-regression analysis was conducted.

**Table 3** Multiple Regression Analysis Result

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta(β)			Tolerance	VIF
(constant)	.459	.210		2.184	.030		
Associating	.139	.089	.138	1.567	.119	.363	2.757
Questioning	.242	.101	.245	2.382	.018	.264	3.794
Networking	.247	.096	.235	2.573	.011	.334	2.992
Experimenting	.179	.109	.165	1.644	.102	.279	3.590
Observing	.022	.086	.022	.253	.801	.359	2.788

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta( $\beta$ )			Tolerance	VIF
<b>R2</b>	.525						
<b>adj_R2</b>	.511						
<b>F(p)</b>	37.580(.000)						

As a result, the overall explanatory power is 51.1% and the F value of the analytical model is statistically significant at the .01 level, indicating that the regression model is highly appropriate. In addition, we diagnosed the multicollinearity problem to test the linear relationship between the variables and it showed that the value of Variance Inflation Factor (VIF) is less than 10, which confirms that the multicollinearity problem does not exist.

According to the results, Questioning and Networking show significant results at a 99% level of significance but Associating, Experimenting and Observing are not statistically significant. The regression coefficient ( $\beta$ ) standardized the relative influence of the independent variables on Productivity, Questioning ( $\beta=.242$ ) and Networking ( $\beta=.247$ ) and has a positive impact on the variables.

The results of the hypothesis test are as shown in <Table 4>.

**Table 4** Summary of Hypothesis Test Results

Category	Hypothesis	Positive or Negative	Accept or Reject
H 1	Question of CEO Discovery DNA will affect Productivity	P(+)	Accept
H 2	Observing of CEO Discovery DNA will affect Productivity	-	Reject
H 3	Networking of CEO Discovery DNA will affect Productivity	P(+)	Accept
H 4	Experimenting of CEO Discovery DNA will affect Productivity	-	Reject
H 5	Associating of CEO Discovery DNA will affect Productivity	-	Reject

## Conclusion

### Summary and limits

The study was conducted to determine the effect of Discovery DNA, which is the CEO's ability to innovate to improve the productivity of manufacturing enterprises. According to the empirical analysis, among the CEO Discovery DNA, Questions, and Networking both had significant impacts on productivity. On the other hand, Observing, Experimenting, and Associating did not affect productivity.

More specifically, according to hypothesis 1, Questioning showed a significant positive effect on productivity, among the five factors of Discovery DNA. This means that when a CEO puts more effort into asking questions to solve problems or exploring new fields, the productivity of the company increases. For example, when the CEO continuously asks questions about the high incidence of product defects, it can eventually reduce the incidences of product defects, as a result of the issue being explored and the area addressed.

Secondly, Networking has a positive effect on productivity. This refers to exchanging ideas or solutions to solve problems in various fields, as well as improve the atmosphere of production sites. Since the task or team supervisor does not have the authority to change the method or process of the production facility, the effort that the CEO puts into networking can potentially have a positive effect on delivery rates and reduce costs etc. As a result, the importance of Questioning and Networking can be presented as being the more important factors that improve the CEO's ability to innovate and increase productivity and company performance.

The implications of this study are as follows.

First, a series of research studies by Dyer et al. (2008) stated that it is necessary to strengthen the CEO's Discovery DNA for company innovation. The fact that it is significant in Korean companies shows that it has a direct impact on productivity, especially on a CEO's ability to Question and Network, which are the most important for productivity.

Second, it is important to expand research into innovation that focuses on either learning ability or innate ability, such as entrepreneurship. Discovery DNA is not a specialized ability but the fundamental ability of a CEO. In this respect, the study uses a different approach to the CEO innovation ability.

Lastly, the study confirmed that Questioning and Networking both have positive effects on productivity. The results can be used to identify the areas where CEOs need to make an intensive effort to improve productivity.

The limitations of this study are as follows.

First, the number of samples was limited to enterprise-level research. The empirical research used 211 major and small-medium companies located in the country. However, the number of these samples was limited in order to generalize them across the enterprise.

Second, there is a limit to the generalization of the empirical research results due to the data collection being limited to just Korean companies.

Third, this study dealt with Discovery DNA by using an individual-level approach and dealt with productivity by using an enterprise-level approach. However, a company's productivity can be greatly affected by the external environment, such as international law and international affairs. It will be necessary to take a multidimensional approach during further research that involves both the internal and external environment of the enterprise to ensure the research will be in-depth.

Fourth, it is necessary to consider how the CEO's choice of approach affects a company's competitive strategy, enterprise performance and productivity. The CEO selects, maintains, and changes the competitive strategy that is operated by an entity. In this respect, further studies on the impact of Discovery DNA on competitive strategy or the mediating effect between Discovery DNA and company performance need to be addressed.

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