



# An Empirical Study on the Relationship Between Digital Level and Value Co-creation in Manufacturing Enterprises

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**Abstract.** Under the background of digital economy, the deep integration of digital technology and manufacturing industry, as well as the acceleration of the digital level, has a profound impact on the value co-creation BMI of enterprises. Based on the survey data of 280 manufacturing firms, this research studies the influence mechanism of manufacturing firms' digitalization level on value co-creation, and tests the mediating effect of BMI on the relationship between the two. The empirical results show that manufacturing firms' digitalization level positively influences value co-creation. BMI plays a intermediary role in the relationship between the digitalization level and value co-creation.

**Keywords:** Digitization · BMI · Value Co-creation · Digital Economy · Manufacturing Industry

## 1 Introduction

Digital economy accelerates the process of the manufacturing industry embracing digital technology, promotes the deep integration of the Internet, big data, artificial intelligence and other new generation of information and communication technologies with the manufacturing mode. The continuous improvement of the digital level reshapes the research and development mode, production mode, service mode and profit mode of the manufacturing industry. It breaks the boundaries of enterprises, deepens the interaction between stakeholders, promotes the optimal utilization of enterprise resources, gives rise to a number of new models, and endows the development of the manufacturing industry with new momentum.

Domestic and foreign researches on the relationship between digitalization level and value co-creation of manufacturing enterprises mainly focus on the behavioral perspective of value co-creation and the result of value co-creation. (1) The perspective of value co-creation behavior. [6] studied the impact of digitalization on user participation, interaction and resource integration value co-creation behavior, and believed that digital technology can promote the participation, interaction and resource integration between enterprises and users; [7] studied the impact of digital capabilities, including intelligence capabilities, connectivity capabilities, and analytical capabilities on value co-creation,

and believes that the digital capabilities of manufacturing enterprises enable enterprises and users to realize the integration and interaction of resources, processes, and results to create value together. (2) The perspective of value co-creation results. The research of [8] believes that manufacturing enterprises can create interactive situations for users through digital empowerment, realize value co-creation between enterprises and users, increase user experience value [5], and corporate relationship value [1]. Based on this, from the perspective of value co-creation, this research studies how the digitalization level of manufacturing enterprises affects the value co-creation between enterprises and users.

## 2 Theoretical Analysis and Research Hypothesis

### 2.1 The Digital Level and the Co-creation of Value

The digital level is changing the previous constraints that restricted users from participating in the entire process of product development, manufacturing and sales and the use of user resources by enterprises. It not only supports users to better meet their own consumer needs, but also enables them to serve other users and enterprises. Create greater value [9]. For users, the level of enterprise digitalization provides opportunities for new functions, higher performance, higher efficiency, and optimization possibilities, thereby exponentially increasing the value provided by manufacturing companies to users. On the one hand, it can provide users with higher-quality products and services that meet their needs, and enhance users' use value; on the other hand, it brings low-cost and multi-dimensional interaction opportunities, which increases the opportunities for enterprises to interact with users and provide users with Provide targeted services to enhance the perceived value of users' consumption and service experience [3]. For enterprises, the improvement of the level of enterprise digitization has greatly reduced the cost of obtaining ordinary user information for enterprises, making it possible for enterprises to use user resources [2]. The improvement of digital level enables users' needs, feedback and participation behaviors, and interactions and collaborations with other stakeholders to be recorded in the form of data, and the generated data has high commercial value [10], enterprises can maximize the use of existing resources, reduce costs, increase enterprise innovation output, and increase the profit value of the enterprise; In addition, instant communication and interaction with users can increase the user's interest to the enterprise. Trust and understanding, enhance user stickiness, establish a good brand image, and realize the enhancement of corporate brand value. Therefore, the following hypothesis is proposed.

H1: The digital level is positively acting on value co-creation.

H1a: Digitization level of manufacturing firms has a positive effect on users value.

H1b: Digitization level of manufacturing firms has a positive effect on enterprises value.

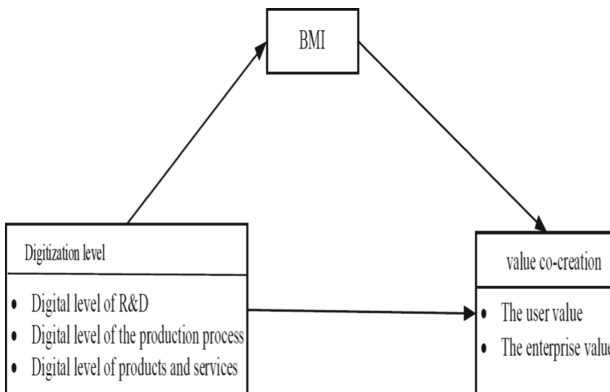
### 2.2 The Intermediary Role of BMI

The improvement of the digital level can enable enterprises to obtain new digital solutions, replace or integrate current working methods and related infrastructure to trigger

BMI [4]. The application of data and digital technology affects the inside and outside of the organization, and promotes manufacturing enterprises to integrate internal and external resources, innovate service models, and cultivate new models such as personalized customization, system integration services, and overall solutions. In the context of the level of corporate digitalization, the four key components of BMI: corporate value proposition, key business processes, value acquisition methods, and external network relationships have changed, and BMI has been realized. The value network reconstruction involved in BMI can establish true connection attributes in the value creation process, integrate different resources, and form value co-creation capabilities. BMI in the digital age has changed the relationship between enterprises and users, and has formed the co-creation of user communities and corporate value. In terms of user value, BMI takes users value as the starting point. What enterprises provide is not only the product itself, but more attention to the products and services required by the user’s needs. Users become an important part of the creation of corporate value. In addition to obtaining products and services that meet their needs, users also get a good service experience and the sense of belonging, satisfaction and honor brought about by participation, which increases the user’s use value and perceived value. In terms of corporate value, BMI can change the competition rules of the industry in which enterprises are currently located, introduce new value creation methods (key business processes) and value acquisition methods, increase new value growth points, and deepen the relationship between the company and user, to help the realization of corporate profit value and brand value. Therefore, the following hypothesis is proposed.

H2: BMI plays an intermediary role in the relationship between the digital level and value co-creation.

The conceptual model of this article is shown in Fig. 1.



**Fig. 1.** Conceptual model

### 3 Materials and Methods

#### 3.1 Variable Measurement

In order to ensure the reliability and validity of the measurement scale, the mature scales in the existing literature are used, and appropriate corrections are made according to the research purpose of this article, and the questionnaire is revised again through the results of the trial distribution to improve the accuracy of the measurement results. In this paper, except for the control variables, the Likert five-level measurement scale is used.

Measurement of the digitalization level of manufacturing enterprises: Based on the research of “Manufacturing Informatization Index Composition Program”, Song Yanyan, Zhou Jian, Wan Lun, etc. are revised based on the research perspectives of this article, and the digitalization level of manufacturing enterprises is formed. Likert five-level measurement scale. Including three dimensions: the digital level of R&D and design, the digital level of production process, and the digital level of products and services, a total of 9 items.

Measurement of business model innovation: Based on the scales compiled by scholars such as Zott, Amit, Wei, etc., and Sklen, etc., combined with the research perspective of this article, the Likert five-level measurement scale for business model innovation was formed, including 5 measurement items.

The measurement of value co-creation: Drawing on the scales of Song et al., Wang Qin, Jiang Jihai, etc., and revising them, a Likert five-level measurement scale for value co-creation was formed, including two dimensions of user value and enterprise value, totalling 8 item.

#### 3.2 Reliability Test

This article uses Cronbach’s Alpha coefficient to test the reliability of each scale. The test shows that the overall Cronbach’s Alpha value of each measurement scale is 0.801, the Cronbach’s Alpha value of the Digital Level Scale for Manufacturing Enterprises is 0.702, the Cronbach’s Alpha value of the BMI Scale is 0.710, and the Cronbach’s Alpha value of the Value Co-creation Scale 0.772, both are greater than 0.7, indicating that the scale has passed the reliability test and has good internal consistency.

### 4 Results and Discussion

#### 4.1 Validity Test

The Amos 21.0 confirmatory factor analysis was used to test the convergent validity, discriminative validity and aggregate validity of each scale. After testing, the chi-square freedom of each fitting index of the model was tested  $\chi^2/df$  is 1.491, RMSEA is 0.049, which is less than 0.5, IFI is 0.958, TLI is 0.901, and CFI is 0.963, all of which are greater than 0.9, indicating that the questionnaire structure is valid. The discriminative validity is shown in Table 1. The square root of AVE is basically greater than the corresponding correlation coefficient in the corresponding ranks, indicating that the questionnaire has better discriminative validity.

**Table 1.** Correlation coefficient matrix and square root of mean extraction variance among latent variables

	F1	F2	F3	F4	F5	F6
1						
F2	0.723					
F3	0.248	0.322				
F4	0.195	0.236	0.496			
F5	0.568	0.184	0.230	0.230		
F6	0.609	0.342	0.170	0.170	0.587	
AVE square root	0.580	0.515	0.652	0.608	0.665	0.630

**Table 2.** Results of hierarchical regression analysis

Variable	Value Co-creation						BMI
	Users value			Enterprises value			
	M1	M2	M3	M4	M5	M6	
Enterprise Property	-0.039	-0.032	-0.025	0.105	0.113	0.116	-0.139
Enterprise Scale	0.085	0.092	0.092	-0.018	-0.011	-0.010	-0.016
Enterprise Age	-0.196	-0.169	-0.169	-0.252	-0.222	-0.222	-0.002
Industry Status	-0.038	-0.044	-0.038	-0.103	-0.110	-0.107	-0.100
Digital level		0.288***	0.257**		0.316***	0.309***	0.304***
BMI			0.157*			0.123*	
R <sup>2</sup>	0.046	0.128	0.133	0.072	0.170	0.171	0.119
The adjusted R <sup>2</sup>	0.025	0.104	0.105	0.052	0.148	0.144	0.096
F value	2.262	5.499***	4.793***	3.642***	7.717**	6.418***	5.099***

Note: \*P < 0.05, \*\*p < 0.01, \*\*\*P < 0.001

### 4.2 Hierarchical Regression Analysis Results

This paper uses hierarchical regression analysis to test the main effect and the intermediate effect. The analysis results are shown in Table 2.

The first is the main effect test. As shown in the main effect hierarchical regression analysis results in Table 2, M1 is the impact of the nature of the company, company age,

company size, and industry status control variables on user value. M2 is added to the manufacturing company on the basis of M1. As for the independent variable of the digital level, the regression result shows that the digital level of manufacturing enterprises has a positive effect on user value ( $\beta = 0.288$ ,  $p < 0.001$ ), which proves that the hypothesis H1a is valid. Similarly, M4 refers to the impact of the nature of the company, the age of the company, the size of the company, and the influence of the industry status control variables on the value of the company. M5 adds the independent variable of the digital level of the manufacturing company on the basis of M4. The regression result shows that the digital level of the manufacturing company is positive Acting on the value of the enterprise ( $\beta = 0.316$ ,  $p < 0.001$ ), proves that the hypothesis H1b is valid. That is, assume that H1 holds. Secondly, it is the test of mediation effect. M7 shows that digitalization level has a positive effect on BMI. Meanwhile, the comparison between M3 and M2, M6 and M5 shows that BMI plays a partial mediating role in digitalization level and value co-creation ( $\beta = 0.157$ ,  $p < 0.05$ ;  $\beta = 0.123$ ,  $p < 0.05$ ), which proves hypothesis H2 is true.

## 5 Conclusion

Based on the above empirical analysis, the research results show that:

First, the digital level has a positive impact on the value co-creation of enterprises and users. Compared with user value, the digitalization level of manufacturing enterprises plays a more significant role in promoting the realization of enterprise value. Second, the level of digitalization of manufacturing enterprises is positively affecting BMI. Third, BMI plays a part of the intermediary role in the relationship between the digital level and value co-creation; The mediating role of business model innovation in the relationship between the digital level of manufacturing enterprises and users value is slightly stronger than the mediating role of business model innovation in the relationship between the digital level of manufacturing enterprises and enterprises value.

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