Measurement of Enterprise Smart Business Performance on a Smart Business Management

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SUMMARY Smart business management has been built to efficiently carry out enterprise business activities and improve its business outcomes in a global business circumstance. Firms have applied their smart business to their business activities in order to enhance the smart business results. The outcome of an enterprise's smart business fulfillment has to be managed and measured to effectively establish and control the smart business environment based on its business plan and business departments. In this circumstance, we need the measurement framework that can reasonably gauge a firm's smart business output in order to control and advance its smart business ability. This research presents a measurement instrument for an enterprise smart business performance in terms of a general smart business outcome. The developed measurement scale is verified on its validity and reliability through factor analysis and reliability analysis based on previous literature. This study presents an 11-item measurement tool that can reasonably gauge a firm smart business performance in both of finance and non-finance perspective.

key words: smart business, smart business performance, measurement factors and items, measurement instrument

1. Introduction

In the fourth industrial revolution, enterprises have executed their management activities with various information technologies in a global management environment. Firms fulfill their business activities through partially or fully using smart technologies such as smart device, network, solutions and systems in a smart business environment [1]-[4]. Smart business technology is a significant expedient to extend and grow up a firm's business outcome in the changeable business environment. Firm smart business ability connects to its business output in a smart management environment [5]. Management of enterprise smart business results needs to reinforce their business durability and competitiveness in a sudden-change business world. That is, we have to manage its smart business outcomes, the overall results of smart business executions, and to efficiently build a firm's smart business infrastructure and perform its smart business works. Through looking after its smart business consequences, firm should improve its smart business works and outputs in order to effectively reinforce its management ability and competitiveness in a smart business circumstance. The measurement method for a firm smart business outcome

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is asked to systematically manage and upgrade it. Namely, we have to gauge its smart business results with utilizing a scientific and practical measurement scale in order to establish and raise an efficient smart business capability for the management activities and business fields. Firm smart business outcome should be managed by reasonable criteria based on the measurement results of its smart business outcome in terms of a general smart business output. Enterprise smart business performance represents the business outcomes that a firm executes its smart business activity in a smart management circumstance. But a general measurement model for a firm smart business outcome has not been studied in previous literature. This research develops a reasonable framework that can properly measure an enterprise smart business outcome in both of finance and non-finance perspective. This research firstly presents the measurement framework for a firm smart business performance that has not studied in the previous literature. This has also a crucial signification as presenting the research results in terms of a comprehensive measurement methodology including both of finance and non-finance in a firm smart business outcome.

Therefore, this study provides a generic and practical instrument that can efficiently gauge an enterprise smart business performance in terms of a general smart business outcome, based on both standpoints of finance and nonfinance. Our findings contribute to establishing and improving a firm smart business environment appropriate for its smart business activities and business fields in order to reasonably strengthen the firm smart business competitiveness, and the academic research and development of a practical measurement scale for a firm smart business performance in an entire smart business outcome perspective.

2. Previous Studies

Smart business has been considered as the crucial medium to efficiently advance a company's business result and competitiveness, and to effectively arrange for a future business environment with progress of smart technology in previous literature [1]. Smart business can be defined as a method to enhance the competitiveness of organizations by improving management activities through using smart technology, such as smart devices, smart networks, and smart solutions [2]– [5]. Smart business can be explained as a business process that utilizes the smart technology expedient as a conduit to fulfill business transactions [2]. That is, this research defines smart business (SB) as a methodology to effectively

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fulfill the enterprise's business works by utilizing the smart technologies, applications and solutions, and systems for its business activities in a smart management circumstance.

In previous literature, enterprise performance was researched from a variety of perspectives [6]-[15]. Previous studies researched on financial and non-financial perspectives in general. In financial research, the measurement of firm performance was studied in terms of sale growth, earning growth, market share, return on assets (ROA), return on sales (ROS), and market value [10]. The enterprise outcome comprises three factors such as improvement of customer satisfaction, enhancement of organizational competition power, and advancement of organizational image [11]. In non-financial research, the performance of a firm was examined by efficiency, effectiveness, profitability, quality of service, client satisfaction, and productivity [6]–[9], [11], [12], [15]. This is their satisfaction level about their firm's outcome in terms of growth in sale, increase in profits, and expansion in market share [12]. With investigating these studies, this research describes a firm outcome as the effectiveness and efficiency of its business activities that can be upgraded by applying firm business ability to its business activities. We can describe enterprise smart business performance by transforming firm outcome into a type of firm performance based on a smart business perspective. Namely, enterprise smart business performance can be defined as the business outcome that a firm can get by utilizing the smart business ability for its business activities in a smart business circumstance. Enterprise smart business outcome indicates an entire smart business output that a firm can gain from using its smart business ability for its business works in smart business fields.

With investigating these previous studies, this research generates the measurement factors and items to gauge enterprise outcome in terms of a smart business (SB) as follows: SB execution performance (quality of services, efficiency of business process, and client satisfaction), SB increase performance (sale increase, sale revenue increase, market increase), SB benefit performance (increase of gain in annual profit, net income increase, and cash turnover ratio), and SB competitiveness performance (sale increase rate and customer share) [6], [7], [9], [10], [12]–[15]. Our research utilize these articles as measures to gauge the enterprise SB performance through the verification process of validity analysis and reliability analysis according to the criterion of previous literature.

3. Methods

This research firstly developed 17 measurement items for enterprise SB performance based on definitions and components of enterprise performance in previous literature [1], [5], [6], [8]–[20]. The developed items were reviewed and modified by the expert group in our IT research center: a postdoctoral researchers, professors, and IT developers. The modified 17 measurement items are presented in Appendix. This study analyzed the construct validity of the developed items to ensure that enterprise SB performance was efficiently measured by the items. This was proved by presenting that the framework was a suitable operational definition of the construct it purported to measure. Many studies presented various methods to verify the validation of a model structure [21]-[24]. Generally, most studies present two methods of model validation: correlations between total scores and item scores, and factor analysis [21]-[24]. The former assumes that the total score is valid, and the extent to which the item correlates positively with the total score is indicative of the construct's validity for the items [21], [22]. Each item score was subtracted from the total score to exclude spurious part-whole correlation [21], [22]: the result was a corrected item-total that was then correlated with the item score. The latter, factor analysis, analyzes the underlying structure or components of the instrument [23], [24]. This helped identify factorially pure items that would facilitate the testing of more specific hypotheses, and to identify the components that make up the total measure [23]. The items being factor analyzed were selected, since they were closely related to each other [23]. This research also examined a measure of criterion-related validity to identify items that may not be closely concerned with enterprise SB outcome. The generalized item to efficiently measure enterprise SB performance was used as a criterion scale. The scale provided a measure of criterion-related validity to the extent that each item was correlated with this. Items should indicate a favorable or unfavorable attitude toward the object in question. When the item is ambiguous or appears to indicate a neutral attitude, it should be deleted [24].

Our measurement questionnaire used a five-point Likert-type scale as presented in previous studies; denoting, 1: not at all; 2: a little; 3: moderate; 4: good; and 5: very good. The questionnaire is composed of three major domains. The first domain describes the backgrounds and objectives, the major contents, and response methods of this questionnaire. The second domain requires respondents to provide general information, such as their business department and professional position, their academic qualifications, gender, age, and years of experience in their firm within a smart business environment. The last domain refers to the measurement items for the respondents. This research obtained data from a variety of industries and firms so that the results can be generalized. This study used two kinds of survey methods: direct collection and e-mail. The respondents either directly mailed back the completed questionnaires or research assistants collected them 3-4 weeks later. The collected questionnaires represented 39.7 percent of the respondents.

3.1 Sample Characteristics

In this questionnaire survey, we obtained 139 usable questionnaires from 350 target respondents in five kinds of industries and smart business fields.

This research excluded seven incomplete or ambiguous responses from the collected questionnaires responses,

 Table 1
 Demographic characteristics of the respondents.

Division	Total	Percentage
Degree		
Humanities & Sociology	24	18.2
Management & Economics	36	27.3
Science	31	23.5
Engineering	41	31.0
Total	132	100.0
Industry		
Manufacturing	22	16.7
Banking & Insurance	36	27.3
Logistics	39	29.5
Communication & Services	35	26.5
Total	132	100.0
Business Department		
Planning & Programming	27	20.5
Research & Development	24	18.2
Business Application	56	42.4
Administrative Support	25	18.9
Total	132	100.0
Business Position		
Executive	14	10.6
Department Manager	37	28.0
worker	81	61.4
Total	132	100.0
Job Experience		
>= 5 Years	59	44.7
5 = < 10 years	31	23.6
10 = < 15 years	28	21.2
>= 15 years	14	10.6
Total	132	100.0

leaving 132 proper questionnaires for our reliability analysis and factor analysis. The responses in terms of degree, industry, and business department and position were presented in Table 1. The respondents represented on 8 years of average experience (S.D. = 1.015) in their work fields, their average age was 34.3 years old (S.D. = 5.011), and their gender was male (65.2%) and female (34.8%). Our questionnaire survey was focused on various industries and business fields, and workers with business experience above the 5 years within their firms. Because we looked forward to get the reasonable questionnaire responses in order to raise the objectivity and practicality of our research. That is, the respondents can effectively present the reasonable responses for our measurement questionnaire.

3.2 Analysis and Discussion

From the results of reliability analysis and factor analysis, the 17 measurement items were firstly reduced to 11 items with 6 items were deleted, through applying the criterion of previous literature [14]–[16], [19], [20]. This elimination was sufficiently considered to ensure that the survived items were proper measurement items of enterprise SB outcome. This research verified the validity and reliability of the developed framework by reliability analysis and factor analysis. They were used to identify the underlying factors or components that include the firm SB performance framework. The 11 measurement items had factor loadings were more than 0.614. The four potential factors had the

 Table 2
 Reliability, validity, and factor loading of enterprise SB performance structure.

	Item description	Corrected item-total correlation	Correlation with Criterion	Factor loading
V01	Quality of service in customer SB service department?	0.691	0.735*	0.747
V02	Efficiency of SB process in management activities?	0.627	0.811*	0.713
V04	Customer satisfaction in client SB service department?	0.574	0.749*	0.631
V06	Market increase in domestic and oversea SB market department?	0.746	0.728*	0.837
V08	Sale increase and profit range in SB sale department?	0.658	0.689*	0.786
V10	Sale revenue increase in SB sale revenue department?	0.637	0.702*	0.712
V12	Increase of gain in annual SB profits output department?	0.742	0.819*	0.873
V13	Cash turnover ratio in SB sale revenue department?	0.646	0.723*	0.801
V14	Net income increase in annual SB income department?	0.611	0.678*	0.724
V16	Customer share in domestic and oversea SB customer department?	0.703	0.712*	0.745
V17	Sale increase rate in domestic and oversea SB sale department?	0.613	0.633*	0.614

* Significant at $P \le 0.01$

 Table 3
 Correlation matrix of enterprise SB performance measures.

V02	0.52										
V04	0.51	0.43									
V06	0.31	0.29	0.49								
V08	0.32	0.26	0.51	0.53							
V10	0.34	0.31	0.44	0.47	0.50						
V12	0.29	0.31	0.37	0.31	0.28	0.54					
V13	0.32	0.27	0.32	0.28	0.34	0.47	0.49				
V14	0.24	0.29	0.34	0.30	0.28	0.51	0.44	0.53			
V16	0.29	0.31	0.23	0.32	0.37	0.29	0.36	0.32	0.48		
V17	0.31	0.29	0.32	0.33	0.37	0.30	0.33	0.28	0.51	0.52	
	V01	V02	V04	V06	V08	V10	V12	V13	V14	V16	V17
Mean	3.02	2.85	2.59	3.12	3.03	2.89	2.87	3.06	2.68	2.83	2.79
S.D.	1.48	1.32	1.35	1.29	1.30	1.27	1.26	1.31	1.30	1.34	1.28

reliability coefficients (Cronbach's alpha) were higher than 0.794 based on the criterion recommended from previous exploratory researches [21]–[24].

Our research gauged the corrected item-total correlations between each measurement item and its conformity to objectively confirm the validity and reliability of the developed items. Most corrected item-total correlations were higher than 0.611. It means that the measurement items are reasonable scales of their corresponding factors. Table 3 represents these correlations along with alpha coefficients of each factor. These coefficients present the relative effect of a measurement item to the structure of a scale for examining a particular factor of the developed measurement framework. The presented articles comprise reliability and validity in terms of a measurement framework according to the measurement results as shown in Table 2 and Table 3. These findings can be reasonably accomplished by accumulating many research results and practical studies in industrial fields. With assessing the measurement outputs of many case studies, the measurement instrument can be upgraded to better objective and proper scale appropriate for the utilization of industrial areas. Table 3 presents the correlation matrix of enterprise SB performance measures.

4. Framework of Measurement Instrument

This research developed the 11 measurement items appropriate for measuring firm smart business outcome in a smart business circumstance. We categorized four factor groups from the factor analysis on the developed measurement items. The factor groups represent the potential factors of the developed framework as crucial measurement components to gauge firm SB outcome.

With examining the measurement items of each factor group, our research identified the significant measurement factors of the developed instrument as follows: factor 1: SB execution performance; factor 2: SB increase performance; factor 3: SB benefits performance; and factor 4: SB competitiveness performance. The factors include the entire measurement contexts for enterprise SB performance from SB execution outcome to SB competitiveness performance based on both of finance and non-finance perspective. We utilize as the 4 crucial measurement factors of our measurement framework. Figure 1 shows structure of the developed measurement instrument, and measurement factor and items.

The meaning of each factor in our measurement framework can be represented as follows. SB execution performance presents the operation efficiency and effectiveness upgraded by the utilization of smart business for its business activities in terms of a firm business execution with the measurement items of V01, V2, and V04. The execution performance refers to the output that a firm can get from its smart business works in a business execution perspective. It contains the smart business outcomes for quality of service in customer SB service department, efficiency of SB process in management activities, and customer satisfaction in client SB service department. SB increase performance means the business progress improved with utilizing the smart business for its management activities in a firm advance perspective with the measurement items of V06, V8, and V10. It includes the smart business outcomes re-



Fig. 1 Framework of the developed measurement instrument.

lated to market increase in domestic and oversea SB market department, sale increase and profit range in SB sale department, and sale revenue increase in SB sale revenue department. SB benefit performance indicates the business profit upgraded by utilizing smart business for its business activities in a company benefit perspective with the measurement items of V12, V13, and V14. It comprises the smart business outcomes related to increase of gain in annual SB profits output department, cash turnover ratio in SB sale revenue department, and net income increase in annual SB income field. Finally, SB competitiveness performance represents the business competitiveness upgraded by applying the smart business to its business activities in a competitiveness perspective with the measurement items of V16 and V17. It has the smart business outcomes for customer share in domestic and oversea SB customer department and sale increase rate in domestic and oversea SB sale department. Measurement of firm SB outcome presents a crucial methodology to analyze the entire SB outcome of an enterprise. Our findings provide a structural framework that can reasonably measure enterprise SB performance in terms of a whole SB outcome from SB execution performance to SB competitiveness performance with including 4 measurement factors and 11 items. The developed tool is a crucial theoretical framework to efficiently gauge the whole SB output that a firm can gain by applying its smart business to its management activities in a smart business circumstance.

Therefore, understanding the structure of enterprise SB outcome is significant to measure the success of firm SB output that explains the entire SB results to effectively try out for its business activities. We can use the structural instrument to gauge an enterprise SB performance across all kinds of industrial fields and business domains, and perhaps even as a general practical measurement scale.

5. Reviews of the Instrument's Application

The 11-item instrument can be used to manage and advance the enterprise SB performance as entire SB performance that a firm can obtain with applying smart business to its management activities in a smart business environment. This measurement framework can provide the directions and methods to reasonably improve enterprise SB performance. We can grasp the outcomes of enterprise smart business through this measurement framework designed to control or predict the enterprise SB performance. Even if this framework has additional limitations in measuring specific aspects of enterprise SB outcome, the instrument is general in nature, relates to an enterprise SB execution performance, SB increase performance, SB benefit performance, and SB competitiveness performance. We can use this measurement framework for a variety of enterprises and across industrial fields. Table 4 presents percentile scores for the 11-item instrument. These measurement items may be useful to more precisely measure enterprise SB performance across a variety of industries and firms. This framework may also be used in research departments related to the measurement of

 Table 4
 Percentile scores for the enterprise SB performance instrument.

	Perc	entile								Mean
	10	20	30	40	50	60	70	80	90	
11-Item Scale	19	24	27	33	37	39	42	48	56	34.89

Table 5Correlation matrix.

		(2)	(3)	(4)	(5)
Enterprise SB Performance	(1)	0.42	0.54	0.43	0.41
SB Execution Performance	(2)		0.49	0.44	0.40
SB Increase Performance	(3)			0.39	0.43
SB Benefit Performance	(4)				0.38
SB Competitiveness Performance	(5)				

enterprise SB outcome in a smart business circumstance. The enterprise SB performance structure is a crucial variable to explain or predict its SB performance that the firm can reasonably get with utilizing smart business for its management activities.

And, this research analyzed the correlation between the measurement factors, and the correlation between each factor and enterprise SB performance in the developed measurement framework. Because the measurement factors influence enterprise SB performance, understanding their correlation is very crucial for systematically improving firm SB outcome and for efficiently applying the developed instrument to industrial fields. Their correlation is also compound and may be influenced by other components. Our research investigated how they were correlated in order to grasp the interrelation between SB execution performance, SB increase performance, SB benefit performance, and SB competitiveness performance, and enterprise SB performance, as shown in Table 5. We can efficiently grasp the analysis results and explain the mutual influence among each factor, and each factor and enterprise SB performance through the utilization of correlation matrix analysis.

The 11-item instrument measured enterprise SB performance for this analysis. Other variables were measured through single-item global scales used in previous research [25]. These items were as follows: SB execution performance, "Overall, how much does your quality of SB service, efficiency of SB process, and customer SB satisfaction influence your enterprise SB performance?"; SB increase performance, "Overall, how much does your market increase, sale increase, and sale revenue increase with smart business affect your enterprise SB performance?"; SB benefit performance, "Overall, how much does your increase of gain in annual SB benefit, cash turnover ratio in SB sale revenue, and net income increase in annual SB income have an effect on your enterprise SB performance?"; and SB competitiveness performance, "Overall, how much does your customer share in SB customer departments, and sale increase ratio in SB sale departments influence your enterprise SB performance?". All measures used a five-point scale, where 1 denoted not at all; to 5 denoting a great deal. In this analysis results, SB increase performance has the highest correlation with enterprise SB performance as indicated in Table 5. This means that SB increase performance mostly influences enterprise SB performance. First of all, we have to consider this measurement factor to efficiently advance enterprise SB performance in terms of a systematic SB outcome advancement. The SB execution performance was more highly correlated with SB increase performance. This indicates that both measurement factors have more influence for each other. These results suggest that the enterprise SB performance structure is a significant instrument to measure and explain firm SB outcome from SB execution performance to SB competitiveness performance.

6. Conclusions

In the 4th industrial revolution, most enterprise has utilized the smart technology for all kinds of business fields. The utilization capability of smart technology heavily influences the firm's performance and competitiveness in a smart technology environment. The management of enterprise SB performance is crucial to develop and advance its smart business ability that a firm can utilize for its management activities. This research presents a generic and structural instrument that can measure firm smart business outcome in terms of both of finance and non-finance departments. This provides the 11-item scale that can apply it to firm business fields and can also utilize for practical research purposes. Through performing a lot of case studies and applying it to firm smart business fields, the developed instrument can be became as more reasonable measurement framework for enterprise SB outcome. The developed framework that is confirmed with proper reliability and validity denotes a foothold for researching a reasonable measurement framework on firm SB performance in industrial field. This study also adduced a new original research domain related to the measurement framework of enterprise SB performance that has never been conducted in previous literature. Our findings will support for development of an improvement measure on enterprise outcomes in firm smart business fields.

Hence, this study presents a reasonable instrument that can practically measure enterprise SB performance that a firm can obtain with using its smart business for its business activities in a smart business circumstance. Henceforward, our research will present the utilization and usefulness of the measurement instrument with presenting their measurement consequences through utilizing it for many case studies in real industrial fields.

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Appendix: Measurement Items for Enterprise Smart Business Performance

01. Quality of service in customer smart business service domain?

02. Efficiency and effectiveness of smart business process in business works?

03. Inventory turnover and accounts in business works?

04. Customer satisfaction in client smart business service fields?

05. Market value in whole smart business market area?

06. Market increase in whole smart business market fields?

07. Return on sale in smart business sale revenue domain?

08. Sale increase and profit range in smart business sale fields?

09. Capital structure in enterprise total assets?

10. Sale revenue increase in smart business sale revenue fields?

11. Market share in entire smart business customer market?

12. Increase of gains in annual smart business gains outcome fields?

13. Cash turnover ratio in smart business sale revenue domains?

14. Net income increase in annual smart business income fields?

15. R&D cost in entire smart business management expenditure?

16. Customer shares in entire smart business customer market?

17. Sale increase rate in whole smart business sale fields?



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