#### How to Cite:

Murti, G. T., & Mulyani, S. (2022). The determinant of business intelligence systems quality on Indonesian higher education information center. *Linguistics and Culture Review*, 6(S1), 581-595. https://doi.org/10.21744/lingcure.v6nS1.2104

# The Determinant of Business Intelligence Systems Quality on Indonesian Higher Education Information Center

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**Abstract**---PDDIKTI Feeder as a business intelligence application is used as an information center in higher education, containing master data of each student and lecturer, learning process data, reporting graduate data and lecturer activities in teaching for decision making. Paradoxically, through the empirical data there are many problems in implementing business intelligence systems in private universities, related to the maturity of information technology, data quality and information culture. Addressing this gap, we present a descriptive verification analysis research on 40 private universities in Bandung city, Indonesia, using the Partial Least Square Model. We conclude there is a positive influence of information technology maturity, data quality and information culture on the quality of the business intelligence system.

**Keywords**---business intelligence, data quality, information culture, information technology, maturity, systems quality.

#### Introduction

Theoretically, the implementation of a business intelligence system as an information system is influenced by many factors, and information technology is useful as a platform for other information system components to be placed. (Laudon & Laudon, 1996). Blanton et al. (1992) stated that other components of an accounting information system require effective support from information technology. In order for the use of accounting information systems to be effective, an understanding of the organization, management, and information technology that forms the system is needed (Loudon & Laudon, 1996). The main reason for the use of information technology in business is to support information systems in order to carry out their roles O'Brien & Marakas (2010), so that existing

information technology must be mature (Azma & Mostafapour, 2012; Larson & Chang, 2016).

Data quality is also one of the determining factors for the successful implementation of a business intelligence system. Data quality can be ascertained through efficient data management and access to data sources. Business intelligence systems that have problems with data quality have limited credibility (Gaardboe & Svarre, 2018). Many respondents see data quality as a major problem in business intelligence implementation projects. The term data quality is a very important aspect, especially in business intelligence systems, but it should not be considered only during implementation but also afterwards (Eder & Koch, 2018). In fact, the implementation of the business intelligence system in private universities still has many problems, especially in utilizing the PDDIKTI Feeder application (Loudon & Laudon, 2012). Many problems occur. In 2018, around 633 out of 3,168 are in unhealthy condition, and most universities (4,529) are small scale, with the number of small-scale universities around 70% of the total universities. As many as 130 private universities until 2019 had been closed. The factors that cause private universities to close are problems that cannot be resolved, such as not having students and selling certificate.

The implementation of the business intelligence system in private universities that is not optimal results in problems in the performance of private universities. Based on the data, the quality of the majority of private universities is still below that of state universities (Igbaria & Tan, 1997; Mun et al., 2006). Until 2109, there were no private universities that were included in cluster 1 (top) in the ranking of the best non-vocational universities in the 2019 version of the Ministry of Research, Technology and Higher Education. Based on the theoretical phenomena and empirical facts previously described, it can be concluded that the quality of the business intelligence system in private universities is influenced by the maturity of information technology, data quality and information culture. The question in this study is how much influence exists from the factors that affect the quality of the intelligence system business, and how to measure the effects of these factors (Weidema & Wesnaes, 1996; Hazen et al., 2014).

#### Theoretical framework

## Information technology (IT) maturity

The concept of IT maturity is used to determine the extent to which managers use computer-based information systems (Karimi et al., 1996). According to IGI Global, it refers to an organization's capability to utilize its existing IT infrastructure to obtain business value. The concept of maturity is defined as a specific process to explicitly define, manage, measure and control the evolution of an entity's growth, or maturity is defined as a state in which an organization is able to achieve its own goals. The COBIT4 framework identifies IT processes in four main domains, namely: 1) Planning and Organization (PO), 2) Acquisition and Implementation (AI), 3) Delivery and Support (DS), and 4) Monitoring and Evaluation (ME) (Carolina, 2015).

### Data quality

Data quality is defined as the level of suitability of a dataset with contextual normality. Normality means compliance with user-defined and/or statistically derived rules. The contextual sense is that the rules reflect the logic of a particular business process, company knowledge, or environmental, social or other conditions. Dimensions and indicators of data quality in this study are: 1) Dimensions of effectiveness; indicators are accurate and consistent; and 2) Dimensions of usability; indicators are usability, accessibility and timely (Jaya et al., 2017; Zellal & Zaouia, 2017; Cai & Zhu, 2015; Debbarma et al., 2013).

#### Information culture

Choo et al. (2008), state that information culture is that where "the transformation of intellectual resources is maintained alongside the transformation of material resources. The primary resources for this type of transformation are varying kinds of knowledge and information. The output achieved is a processed intellectual product which is necessary for the material activities to function and develop positively". The dimensions of information culture used in this study are the dimensions proposed by Baltzan et al. (2008); Wang (2005), which include functional culture, sharing culture, inquiring culture and discovering culture (Cooper, 2000; Da Veiga & Eloff, 2010).

### Quality of business intelligence systems

A business intelligence system is a set of information systems and technology that support the decision-making process or control operations by providing information on internal and external operations. Gelinas Jr & Dull (2008) state that the "business intelligence system is the integration of statistical and analytical tools with decision support technologies to facilitate complex analyses of the data warehouse by managers and decisions makers". The dimensions of the quality of the business intelligence system in this study are the dimensions proposed by Stair & Reynolds (2010); Bocij et al. (2015); Romney et al. (2015); Fitriati & Fitriati & Mulyani (2015), integrated with other systems, reliable, ease of use, and provide the correct functions for end users (Lukman et al., 2016; Delgado et al., 2019).

#### Proposed hypotheses

# The effect of information technology maturity on the quality of business intelligence systems

Galliers & Leidner (2003), state "All of the approaches merit consideration, as do contingency theories which would suggest that the success of information systems (IS) in an organization depends upon the proper fit of IT to the organization's structure and design." Meanwhile, Baltzan et al. (2008), state that technology is the most significant enabler of business intelligence. Wright et al. (2013), states that "Information Technology is readily exploited as an enabler for effective information systems". These arguments suggest that IT maturity is likely

to affect quality of business intelligence systems. This leads us to formulate the first research hypothesis:

• H1: IT maturity is positively associated with quality of business intelligence systems.

### The effect of data quality on the quality of business intelligence systems

Gaardboe & Svarre (2018); Eder & Koch (2018), found that data quality is one of the keys to success in implementing a business intelligence system, while Zellal & Zaouia (2017); Sangar & Lahad (2013); Dawson & Van Belle (2013), found empirical facts that data quality is one of the critical success factors in a quality business intelligence system. These arguments suggest that data quality is likely to affect quality of business intelligence systems. This leads us to formulate the second research hypothesis:

• H2: Data quality is positively associated with quality of business intelligence systems.

# The effect of information culture on the quality of business intelligence systems

Laudon (2016), define "Organizational and management capital as the set of business process, culture and behavior required to obtain value from investments in information systems." Fitriati & Mulyani (2015) also states that information generated by the system at the company will be useful if this information can be communicated by every employee in the company. These arguments suggest that information culture is likely to affect quality of business intelligence systems. This leads us to formulate the third research hypothesis:

• H3: Information culture is positively associated with quality of business intelligence systems.

#### Methodology

### Sample collection and data collection

The participants selected for the survey were those who play a role in the use of business intelligence systems, namely the head of the academic department, the head of information technology, the academic staff, and the staff of the information technology department. A paper-based survey was conducted in Bandung, Indonesia. One hundred and sixty questionnaires were distributed. The respondents participated voluntarily. We received 146 responses (response rate 91%). Of the eligible respondents, 77 are female. The majority of the respondents were 40–49 years of age. The majority of the respondents were highly educated, 41 percent holding a graduate degree and 30 percent holding a post-graduate degree (Oviogun & Veerdee, 2020; Suwija et al., 2019).

# The results of data validity and reliability tests The result of data validity and reliability test of IT maturity variable

The IT Maturity Variable Measurement Model using partial least square-path modeling is shown in the following figure:

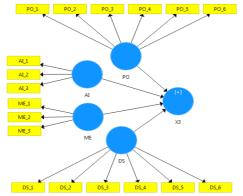


Figure 1. IT maturity variable measurement model (X1)

The results of the validity and reliability testing of the IT Maturity variable using partial least square-path modeling are shown in the following table:

Table 1
Test results it maturity variable (X1)

Variable	Dimension	Indicator	Loading Weight	T count (>1.96)_	Cronbach Alpha (>0.60)	CR (>0.7)	AVE (>0.5)
	Acquisition &	AI_1	0.573	3.390			
	Implementati	AI_2	0.773	8.663	0.666	0.767	0.528
	on	AI_3	0.812	8.312			
		DS_1	0.546	5.049			
		$DS_2$	0.687	9.367			
	Delivery & Support  Monitoring & Evaluation	DS_3	0.599	3.788	0.711	0.711 0.806	0.512
		DS_4	0.694	7.022	0.711 0.000	0.800	
		DS_5	0.562	3.470			
IT		DS_6	0.739	8.627			
Maturity		$ME_1$	0.751	5.264			
		$ME_2$	0.861	10.684	0.708	0.755	0.518
		$ME_3$	0.500	2.781			
		PO_1	0.526	3.859			
		PO_2	0.654	5.130			
	Planning &	PO_3	0.763	10.064	0.673 0.788	0.788	0.598
	Organization	PO_4	0.765	10.158		0.700	
		PO_5	0.652	5.912			
		PO_6	0.505	2.554			

## The result of validity and reliability test of data quality variable

The Data Quality Variable Measurement Model using partial least square-path modeling is shown in the following figure:

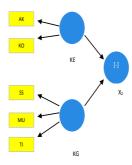


Figure 2. Data quality variable measurement model (X2)

The results of the validity and reliability testing of the Data Quality variable using partial least square-path modeling are shown in the following table:

Table 2	
Test results data quality variable (X2	2)

Variabl e	Dimension	Indicato r	Loadin g Weight	T Count (>1.96)_	Cronbac h Alpha (>0.60)	CR (>0.7	AVE (>0.5
Data Quality	Effectiveness	AK	0.461	6.059	0.671	0.78	0.52
		KO	0.800	11.751	0.857	0.94	0.55
		SS	0.726	10.454	0.842	0.93	0.54
	Usefulness	MU	0.961	12.513	0.878	0.96	0.61
		TI	0.600	9.567	0.759	0.82	0.53

### The result of validity and reliability test of information culture variable

The Information Culture Variable Measurement Model using partial least squarepath modeling is shown in the following figure:

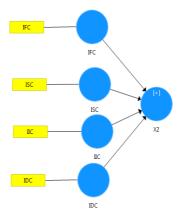


Figure 3. Information culture variable measurement model (X3)

The results of the validity and reliability testing of the Information Culture variable using partial least square-path modeling are shown in the following table:

Table 3
Test results information culture variable (X3)

Variable	Dimension	Indicator	Loading Weight	T count (>1.96)_	Cronbach Alpha (>0.60)	CR (>0.7)	AVE (>0.5)
	Discovering information culture	IDC	1.00	6.059	1.00	1.00	1.00
Information Culture	Functional information culture Collecting information culture Sharing information culture	IFC	1.00	11.751	1.00	1.00	1.00
		IIC	1.00	10.454	1.00	1.00	1.00
		ISC	1.00	12.513	1.00	1.00	1.00

# The result of validity and reliability test of the quality of business intelligence systems variable

The Quality of Business Intelligence Systems Variable Measurement Model (Y) using partial least square-path modeling is shown in the following figure:

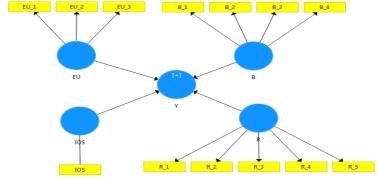


Figure 4. Quality of business intelligence systems variable measurement model (Y)

The results of the validity and reliability testing of the Quality of Business Intelligence Systems (Y) variable using partial least square-path modeling are shown in the following table:

Table 4
Test results quality of business intelligence systems (Y) variable

Variable	Dimension	Indicator	Loading Weight	T count (>1.96)_	Cronbach Alpha (>0.60)	CR (>0.7)	AVE (>0.5)
		B_1	0.822	12.843			_
	Usefulness	B_2	0.803	9.740	0.709	0.820	0.540
	Osciulitess	B_3	0.769	9.295	0.709	0.020	0.540
		B_4	0.500	3.371			
	Ease of use	EU_1	0.664	5.236			
O1:4f		EU_2	0.784	9.320	0.685	0.780	0.543
Quality of Business		EU_3	0.758	7.280			
	Integrated						
Intelligence	with other	IOS	1.000	7.857	1.000	1.000	1.000
Systems	systems						
	•	R_1	0.676	8.352			
		R_2	0.704	7.344			
	Reliability	R_3	0.755	6.669	0.656	0.782	0.523
	•	R_4	0.591	4.301			
		R_5	0.594	2.928			

Based on the table above, the overall loading factor or factor weight value for each indicator is >0.50, showing that all indicators are valid as a measuring tool for their respective dimensions. The Average Variance Extracted value in all dimensions is >0.50. It means that on average the information contained in the indicators is represented through their respective dimensions. The calculation results show that the cross-loading value of each indicator of the IT Maturity, Data Quality, Information Culture and Quality of Business Intelligence Systems variables is greater than the cross-loading value of the indicators on other latent variables. All the models tested did not have a problem in terms of discriminant validity (Jimenez & Garcia, 1989; Andersen & Jessen, 2003).

#### Result

In this study, quantitative analysis is carried out by quantifying research data. The analytical tool used in this study is the analysis using partial least square-path modeling (PLS-PM) using Smart PLS 2.0.M3 (Haris et al., 2021; Eljawati et al., 2021).

### The effect of IT Maturity to the quality of business information systems

The effect of IT Maturity on the Quality of Business Intelligence Systems is measured using the Spearman correlation of the measurement model for these two variables, as follows:

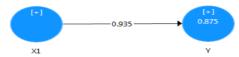


Figure 5. Measurement model of the influence of information technology maturity variables (X1) on the quality of business intelligence systems (Y)

From the picture above, it is concluded that the correlation coefficient value is 0.935. Based on the Spearman correlation table, the value of 0.90–1.00 has a very high correlation. The IT Maturity has a high correlation with the Quality of Business Intelligence Systems. The hypothesis testing is presented in the following table:

Table 5
Table of test results for calculating the effect of X1 on Y

	R-Square (R <sup>2</sup> )	T count	T table	Significance	Cond	clusion
X1 > Y	0.872	46.065	1.96	0.00	Positive effect	Significant

The table above shows the results of the calculation of the trimming method using Smart PLS 2.0.M3. The coefficient of determination (R2) is 0.872. It is in the range 0.81–1.00 in the Guilford table. This means the effect is very high. Based on the test results, IT Maturity affects the Quality of Business Intelligence Systems by 87.2%. This means that changes that occur in the Quality of Business Intelligence Systems are explained by changes in the IT Maturity. tcount > ttable (46.065 > 1.96) means that the IT Maturity has a positive and significant effect on the Quality of Business Intelligence Systems.

### The effect of data quality on the quality of business information systems

The effect of Data Quality on the Quality of Business Intelligence Systems is measured using the Spearman correlation. The measurement model for these two variables is as follows:



Figure 6. Measurement model of the influence of data quality variables (X2) on the quality of business intelligence systems (Y)

From the picture above, the correlation coefficient value is 0.853. Based on the Spearman correlation table, the value of 0.70–0.90 has a high correlation. It is interpreted that Data Quality has a high correlation with the Quality of Business Intelligence Systems. The hypothesis testing is presented in the following table:

Table 6
Table of test results for calculating the effect of X2 on Y

	R-Square (R <sup>2</sup> )	T count	T table	Significance	Conc	lusion
X2 > Y	0.720	14.755	1.96	0.00	Positive effect	Significan t

The table above shows the results of the calculation of the trimming method using Smart PLS 2.0.M3. The coefficient of determination (R2) is 0.720. The number is in the range 0.49–0.81 in the Guilford table. It means that the effect is high. The existence of Data Quality affects the Quality of Business Intelligence Systems by 72.0%. This means that changes that occur in the quality of a business intelligence system are explained by changes in data quality. Based on the t test, tcount> ttable (14.755 > 0.72), Data Quality has a positive and significant effect on the Quality of Business Intelligence System.

# The effect of information culture on the quality of business information systems

The effect of Information Culture on the Quality of Business Intelligence Systems is measured using the Spearman correlation table. The measurement model is as follows:



Figure 7. Measurement model of the influence of information culture variables (X3) on the quality of business intelligence systems (Y)

From the picture above, it can be concluded that the correlation coefficient value is 0.959, which is based on the Spearman correlation table that the value 0.90–1.00 has a high correlation. Information Culture has a high correlation with the Quality of Business Intelligence Systems. Furthermore, hypothesis testing is shown in the following table:

Table 7
Table of Test Results for Calculating the Effect of X3 on Y

	R-Square (R <sup>2</sup> )	T count	T table	Significance	Conc	lusion
X3 > Y	0.917	51.493	1.96	0.00	Positive effect	Significant

The table above shows the results of the calculation of the trimming method using Smart PLS 2.0.M3. The coefficient of determination (R2) is 0.917. The number is in the range 0.49–0.81 in the Guilford table. It means that the effect is high. Information Culture affects the Quality of Business Intelligence Systems by 91.7%. Changes that occur in the quality of business intelligence systems can be explained by changes in information culture. Based on the t test, tcount> ttable (51.493 > 1.96), Information Culture has a positive and significant effect on the Quality of Business Intelligence Systems.

#### **Discussion and Conclusion**

# Hypothesis testing the effect of IT maturity on the quality of business intelligence systems

Testing the effect of Information Technology Maturity on the Quality of Business Intelligence Systems using partial least square-path modeling shows significant results. Based on the results of the partial least square-path modeling test individually, it can be concluded that the H1 hypothesis which states that IT Maturity affects the Quality of Business Intelligence Systems is accepted. The results obtained in this study are in line with research conducted (Ismail & King, 2007; Alter, 1996). The largest companies today can create business intelligence systems that compute and monitor metrics on nearly every variable critical to managing a company. Baltzan et al. (2008), stated that this is made possible with

technology — the most significant business intelligence enabler, in this case IT maturity, which can create a quality business intelligence system.

# Hypothesis testing the effect of data quality on the quality of business intelligence systems

Testing the effect of Data Quality on the Quality of Business Intelligence Systems using partial least square-path modeling shows significant results. Based on the results of the partial least square-path modeling test individually, it can be concluded that the H2 hypothesis which states that Data Quality affects the Quality of the Business Intelligence Systems is accepted. These results are consistent with the research of Gaardboe & Svarre (2018); Eder & Koch (2018), who found that data quality is one of the keys to success in implementing a business intelligence system.

# Hypothesis testing the effect of information culture on the quality of business intelligence systems

Testing the influence of Information Culture on the Quality of Business Intelligence Systems using partial least square-path modeling shows significant results. Based on the results of the partial least square-path modeling test individually, it can be concluded that the H3 hypothesis which states that Information Culture affects the Quality of Business Intelligence Systems is accepted. These results are consistent with research (Svard, 2014; Mukred et al., 2013; Travica, 2008; Osubor & Chiemeke, 2015).

### Limitations and Suggestions for Future Research

The study has some limitations, which provide a direction for future research. Our research does not consider several other factors. A larger sample may strengthen the results obtained. To generalize the study to the other countries, researchers must validate other countries.

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