Galuh Tresna Murti
PhD (Economics), Lecturer,
Program of Doctoral Studies in Accounting,
Faculty of Economics and Business,
Padjadjaran University;
Lecturer, Accounting Study Program,
School of Economics and Business,
Telkom University
1 Jl. Telekomunikasi Str., Terusan Buah Batu,
Kel. Sukapura, Kec. Dayeuhkolot Kabupaten,
Bandung, 40257, Indonesia
(Corresponding author)
galuht@telkomuniversity.ac.id
ORCID ID:
https://orcid.org/0000-0002-2081-1180

Srihadi Winarningsih
PhD (Economics),
Lecturer,
Program of Doctoral Studies in Accounting,
Faculty of Economics and Business,
Padjadjaran University
KM.21 Jl. Raya Bandung Sumedang Str.,
Hegarmanah, Kec. Jatinangor,
Kabupaten Sumedang,
Jawa Barat, 45363, Indonesia
srihadi.winarningsih@unpad.ac.id
ORCID ID:
https://orcid.org/0000-0002-6856-377X

Citra Sukmadilaga
PhD (Economics), Lecturer,
Program of Doctoral Studies in Accounting,
Faculty of Economics and Business,
Padjadjaran University
KM.21 Jl. Raya Bandung Sumedang Str.,
Hegarmanah, Kec. Jatinangor,
Kabupaten Sumedang,
Jawa Barat, 45363, Indonesia
citra.sukmadilaga@unpad.ac.id
ORCID ID:
https://orcid.org/0000-0003-3172-3407

Empirical study of business intelligence systems and their influence on innovation performance

Abstract. This study aims to empirically measure and test a conceptual model of the magnitude of the influence of organizational culture, IT Maturity Level, and data quality on the successful implementation of business intelligence systems and their implications for innovation performance.
The areas of our empirical study through the hypotheses testing were: the estimation of the effect of business intelligence on financial performance; the impact of business intelligence on innovation; the effect of business intelligence on brand success; the impact of innovation on brand success; the impact of innovation on financial performance. The study sample included 4 commercial banks and 58 conventional commercial banks in the category of national private commercial banks of Indonesia, hence, the total sample in this study was 62 banks.
This study used non-probability sampling techniques with purposive sampling techniques at conventional commercial banks in Indonesia. The data analysis method uses Covarian Based-Structural Modeling (CB-SEM) with programming tools that support primary data analysis in Lisrell 8.5.
The results of this study found that the higher the level of implementation of organizational culture, IT Maturity Level, and data quality, the higher the success rate of implementing business intelligence systems which have implications for improving innovation performance, while the higher the level of application of business intelligence systems, the higher the level of innovation performance.
The implementation of organizational culture is the factor that has the most significant influence on the success of implementing business intelligence systems compared to other factors studied in this study.
Keywords: Organizational Culture; IT Maturity Level; Data Quality; Business Intelligence Systems; Innovation Performance

Мурті Г. Т.
кандидат економічних наук, викладач,
програма докторантури з бухгалтерського обліку, факультет економіки та бізнесу,
Університет Паджаджаран;
викладач,
навчальна програма бухгалтерського обліку, Школа економіки та бізнесу,
Університет Телком, Бандунг, Індонезія

Вінарнінгсіх С.
кандидат економічних наук, викладач,
програма докторантури з бухгалтерського обліку, факультет економіки та бізнесу,
Університет Паджаджаран, Джава Барат, Індонезія

Сукмадилага Ц.
кандидат економічних наук, викладач,
програма докторантури з бухгалтерського обліку, факультет економіки та бізнесу,
Університет Паджаджаран, Джава Барат, Індонезія

Емпіричне дослідження систем бізнес-аналітики та їх впливу на ефективність інновацій

Анотація
Це дослідження спрямоване на емпіричне вимірювання та перевірку концептуальної моделі величини впливу організаційної культури, рівня зрілості ІТ та якості даних на успішне впровадження систем бізнес-аналітики та їх наслідки для ефективності інновацій. Вибірка дослідження містила 4 комерційні банки та 58 звичайних комерційних банків у категорії національних приватних комерційних банків Індонезії, отже, загальна вибірка в цьому дослідженні становила 62 банки.
Сферами нашого емпіричного дослідження шляхом перевірки гіпотез були: оцінка впливу бізнес-аналітики на фінансову діяльність; вплив бізнес-аналітики на інновації; вплив бізнес-розвідки на успіх бренду; вплив інновацій на успіх бренду; вплив інновацій на фінансові показники.
У цьому дослідженні використовувалися методи неімовірнісної вибірки з методами цілеспрямованої вибірки в звичайних комерційних банках Індонезії. Метод аналізу даних використовує коваріанське структурне моделювання (Covarian Based-Structural Modeling, або CB-SEM) із засобами програмування, які підтримують первинний аналіз даних у Lisrell 8.5.
Результати цього дослідження показали, що чим вищий рівень впровадження організаційної культури, рівень ІТ-зрілості та якість даних, тим вищий рівень успішності впровадження систем бізнес-аналітики, які мають вплив на покращення ефективності інновацій, тоді як чим вищий рівень застосування систем бізнес-аналітики, тим вищий рівень інноваційної ефективності.
Впровадження організаційної культури є фактором, який має найбільш значний вплив на успіх впровадження систем бізнес-аналітики порівняно з іншими факторами, вивченими в цьому дослідженні.

Ключові слова: організаційна культура; рівень ІТ зрілості; якість даних; системи бізнес-аналітики; продуктивність інновацій.

1. Introduction and Brief Literature Review

Advances in information technology are driving changes in customer behavior and needs for banking product innovation. The survey conducted by PwC's 11th Anniversary Digital IQ Survey conducted in 2018 in 60 countries with 2,268 respondents stated that digital banking services are starting to become a particular concern. Responding to advances in information technology and changes in customer behavior in banking financial services, The Financial Services Authority issued OJK Regulation, Number 12/PJOK.03/2018 concerning the Implementation of Digital Banking Services by Commercial Banks. The POJK encourages banks to improve the quality of service to customers more effectively and efficiently on an ongoing basis and take advantage of the digital banking era as an opportunity to improve overall banking performance. Based on data from the OJK, in 2018, 80 banks in Indonesia provided digital banking services for customers, and as many as 90 percent of customer transactions preferred to use electronic channels.

In literature, the performance of banking innovations is influenced by many factors. The more qualified the business intelligence system is the faster and more accurate decision-making for new thinking, innovation, and important decisions. This opinion is supported by Tightiz & Yoo (2022b), who state that a quality business intelligence system's capacity impacts

network learning and innovation. The performance of innovation must be supported by organizational culture. According to Chen, Huang, Liu, Min, & Zhou (2018), the linkage between specific types of innovation strategies and specific elements of organizational culture can improve innovation performance. This opinion is supported by Noman et al. (2023) that organizational culture and innovation indicators are closely related. A strong and more developed innovation culture results in better innovation performance. Innovation performance must be supported by a technology alliance of a company that has a statistically significant impact on innovation performance. In contrast, Berveno (2014) states that technology is an important contextual factor that can improve innovation performance. Innovation performance must be supported by data quality. Trang et al. (2022) explain that data is a significant resource across all organizations, and it is critical for managers and operations processes to identify related performance issues. In addition, high-quality data can increase the chances of achieving the best service in an organization.

However, the performance of innovations is still experiencing problems. The information generated by the business intelligence system has not been of high quality, resulting in a decline in banking performance. Business intelligence systems that process customer data for credit scoring fail to provide quality information. Another problem is related to the capacity of digital banking transactions, namely in M-Banking services which are caused by increased transactions on account services or virtual accounts that are not estimated by management. The need for virtual accounts that increased significantly beyond prediction caused customers to fail to transact.

The problematic organizational culture also hampered innovation performance. The crime cases that occurred came from two sources, namely credit distribution and the implementation of digital banking; the biggest fraud occurred when the process of providing credit was carried out by forging financial statements, documents, and sales data; from this credit fraud, the mode that is often used is to bankrupt yourself. An organizational culture that is not implemented correctly is one of the factors that fraud cases still occur. Weaknesses in bank information technology reflect mature information technology. Problems due to misreading coding in the core banking system repair carried out by Bank DKI where the application program cannot detect switching between ATMs, problems with immature information technology also occur in the BNI mobile banking application that cannot be accessed. This is because the application is undergoing a service improvement process, and maintenance is being carried out, so it cannot be used to access login or transfer money or make bill payments.

Innovation performance also experiences problems when banks do not have quality data and do not have quality awareness data. Awareness of the importance of security using transactions in digital banking is still not optimal, primarily to protect data, infrastructure, and applications. The security of customer data still has problems, where there is an account breach that began with the leak of OJK Financial Information Service System (SLIK) data. Customer data is not secure and has proven to be traded.

This study used the L&K model as in the study made by Daradkeh (2023). This L&K model is one of the latest models developed to overcome previous models and has been used in the Korean government's automation evaluation project for 11 years. The L&K model in this study analyzes the status of IT Maturity using the following dimensions:
1) Information technology vision,
2) Information technology infrastructure,
3) Rules and Organization of information technology,
4) Information technology support.

2. Data Quality

Data quality is defined as the degree of conformity of a data set with contextual normality. Meanwhile, according to Suprihono et al. (2022), data quality is data that is suitable for use and can meet the goals set by data users. This definition clearly shows that the quality of the data depends mainly on the context of the use of the data, the synergy with the customer's needs, and the ability to use and access the data.

Spruit & Van der Linden (2019) state that there is an interdependence between the characteristics of quality data and its impact on business. The research by Tightiz & Yoo (2022a)

shows that as a result of high-quality data management, there is a clear and strong relationship between data and system quality and its effect on organizational success. Xiang, Lee, & Kim (2013) conducted a study, and the results showed that better data quality positively influences sales, operating profit, and added value to improve company performance. Noman et al. (2023) stated that data quality is one of the determining factors for success and affects the success of information systems.

Business analytics can improve business and decision-making processes to improve business performance.

3. Business Intelligence System

The definition of a business intelligence system, is an approach that includes processes and systems for the transformation of raw data into meaningful and useful information that allows effective, systematic, and targeted analysis of an organization and its competitive environment. In general, a business intelligence system is a set of concepts, methods, and processes that not only improve business decisions but also support organizational strategies that help users recognize and solve problems, detect business risks and opportunities, predict market processes, forecast competitors' activities, better understand business needs and manage clients and better relationships among suppliers. Using such a system, managers can more quickly respond to problems and correctly estimate conditions against competitors, which leads to a competitive advantage for the company.

Measurement of the success of the implementation of the business intelligence system in this study using measurements used by Daradkeh (2023), which use models that have been widely used by researchers from EUCS (End-User Computer Satisfaction) and the development of the DWBS (Data Warehouse Balanced Scorecard) and D&M IS Success Model approaches with the following dimensions:
1) Dimensions User satisfaction (user satisfaction),
2) Dimensions of Technical functions.

4. Innovation Performance

The definition of innovation performance is the achievement of innovation through organizational activities according to the desired targets that can be measured by various financial, technical, and non-financial methods and can be understood as the level of success achieved by the company in achieving goals related to new products, services and other new solutions in business processes or management. Innovation performance can be understood as the ability to convert innovation inputs into outputs and thus the ability to transform innovation capabilities and efforts into market implementation. Another notion of innovation performance is put forward that innovation performance is seen as the dissemination of innovation capabilities within the enterprise, the use of ideas or creativity to improve products, processes, and procedures that increase the significance, and performance of products and services.

The measurement of innovation performance in this study comes from the innovation framework provided by Eurostat and the Economic Development Organization (EOCD, 2018), namely:
1) Product innovation,
2) Business process innovation.

Hence, the research hypotheses are considered as follows:
Hypothesis 1: The business intelligence affects financial performance;
Hypothesis 2: There is an impact of business intelligence on innovation;
Hypothesis 3: The business intelligence affects brand success;
Hypothesis 4: There is an impact of innovation on brand success;
Hypothesis 5: There is an impact of innovation on financial performance.

5. Research Method

The research method used is a descriptive method and explanatory research. This research was designed using the Non-Probability method using purposive sampling techniques. The

study sample was 4 commercial banks and 58 conventional commercial banks in the category of national private commercial banks, hence, the total sample in this study was 62. This study aims to test the hypothesis that has been stated above using the Covarian Based-Structural Modelling (CB-SEM) data analysis method with programming tools that support primary data analysis in the form of Lisrell 8.5. The analysis unit in this study is banking in Indonesia based on data in 2021, while the observation unit of the Human Resources Development Unit, Information Technology Unit, Customer Care Unit, and Research and Development Unit in conventional commercial banks.

The data collected consists of primary data using documentation study techniques, limited interviews and questionnaires, and secondary data using data available either from the Financial Services Authority's data publications or general data in various prints, report books, or electronics, including the bank's website. The data collection method uses a survey method using questionnaire instruments and ordinal data measured using a 5-scale Likert approach. The test method of the research instrument is carried out by testing the reliability and validity.

6. Results

Average Variance Extracted was used to verify the validity of the measurement tool. In order to determine the reliability of the questionnaire, Cronbach's alpha coefficient and composite reliability coefficient were used. In Table 1, the results of composite reliability, convergent validity, and Cronbach's coefficient are presented in full

Based on the mentioned contents and the results of the software outputs in Table 3, the measurement tool has good validity and reliability.

In the next step, the fit of the model is checked, which shows the relationship between the variables of the research, and by using it, the effect of different factors can be checked. In Table 2 and Table 3 the results of model fitting can be seen

Table 1:
Reliability and convergent validity coefficients

Variables	Cronbach's alpha	Composite reliability	Convergent validity
Technology	0.80	0.90	0.74
HR/staff	0.80	0.89	0.72
Competitors	0.55	0.74	0.55
costumers	0.75	0.88	0.71
Finance	0.88	0.91	0.63
Innovation	0.87	0.90	0.79
Brand Success	0.77	0.86	0.60

Source: Authors' own research

Table 2:
Model fit (significance value)

	Brand	Customers	Competitors	Financial	Innovation	HR	Technology
Brand success				2.25			
Business intelligence	0.55	25.01	14.33	2.88	13.21	25.02	41.98
Innovation	5.60			2.91			

Source: Authors' own research

Table 3:
Model fitting results

Factors	Chi-square criterion	A predictive model
Brand success	0.65	-0.03
Customers	0.79	0.52
Competitors	0.67	0.31
Financial performance	0.66	0.22
Innovation	0.75	0.55
human resources	0.77	0.52
Technology	0.89	0.65

Source: Authors' own research

Table 4:
The results of path coefficients and significance level of the research model

Hypothesis	Path coefficient	Significance (T statistic)	Result
H1	0.88	2.77	Confirmed
H2	0.85	13.21	Confirmed
H3	0.06	0.55	Rejected
H4	0.49	6.7	Confirmed
H5	0.64	2.91	Confirmed

Source: Authors' own research

The implementation of business intelligence systems in conventional commercial banks has not achieved success in terms of user satisfaction and technical functioning aspects. Maximum improvement steps and efforts are needed from the leadership of conventional commercial banks. The effort is in the form of a better understanding of organizational culture and improving data quality. The implementation of organizational culture is the factor that has the most significant influence on the success of implementing business intelligence systems compared to other factors studied in this study. In Table 4, the results of the path coefficients and significance level of the research model are presented

Based on the findings, it was found that business intelligence has a direct and positive effect on financial performance and innovation, while there was no significant effect between business intelligence and brand success (P=0.07; relation factor=0.55).

Considering that branding and brand success in the market is a complex process and collective decisions are more effective than advertising and media space, in the sequence of this complex process, the influence of effective variables in more preliminary stages such as psychological and theoretical approaches is reduced. From another point of view, it can be said that probably due to the traditional nature of the marketing system in these banks and prioritizing approaches such as word-of-mouth advertising, the success of the brand is more influenced by non-personal factors. Managers need useful and relevant data and facts in order to make timely and correct decisions in various conditions, such as conditions of confidence, conflict, uncertainty (risk), etc., predicting customer behavior and understanding market demand. In this regard, business intelligence can help the organization to achieve its goals through the analysis and processing of input data. In other words, managers should be able to make correct and immediate decisions in different situations in order to preserve and maintain the reputation of the organization's brand, maintain brand value, customer loyalty to the organization's brand, and maintain and increase this intangible asset.

7. Conclusion

The purpose of this research was to investigate the effect of business intelligence on financial performance through innovation and brand success in the field of financial services.

This research is based on the importance of business intelligence as the strategic thinking of managers, innovation as a dynamic process of quality and service improvement, brand success as a part of marketing maturity in financial performance as the main aspect of organizational effectiveness and productivity, to explain and determine the relationship between these Variables in the banking and payment finance industry.

It can be concluded that the maturity of information technology can be improved at the highest level by paying attention to IT infrastructure that uses server virtualization technology to reduce the use of physical servers, lower server maintenance costs and the use of electrical power and IT network coverage, network infrastructure updates.

References

1. Berveno, O. V. (2014). The Excessive Income Inequality Impact on Quality of Life. The Problems of Economy, 1, 304-308. https://cyberleninka.ru/article/n/vliyanie-chrezmernogo-neravenstva-dohodov-na-kachestvo-zhizni (in Russ.)
2. Daradkeh, M. (2023). The nexus between business analytics capabilities and knowledge orientation in driving business model innovation: the moderating role of industry type. In Informatics, 10(1), 19-25. https://doi.org/10.3390/informatics10010019

3. Noman, M., Maydybura, A., Channa, K. A., Wong, W. K., & Chang, B. H. (2023). Impact of cashless bank payments on economic growth: Evidence from G7 countries. Advances in Decision Sciences, 27(1), 01-20. https://doi.org/10.47654/v27y2023i1p1-22

4. Suprihono, A. E., Raharjo, T., Handoko, S., Setiana, & Mallaleng, H. R. (2022). Transmedia effects on business, aesthetics and production of a traditional cultural product on the example of shadow puppet shows in Indonesia. Economic Annals-XXI, 199(9-10), 48-57. https://doi.org/10.21003/ea.V199-06

5. Tightiz, L., & Yoo, J. (2022a). A Review on a Data-Driven Microgrid Management System Integrating an Active Distribution Network: Challenges, Issues, and New Trends. Energies, 15(22), 8739. https://doi.org/10.3390/en15228739

6. Tightiz, L., & Yoo, J. (2022b). Towards Latency Bypass and Scalability Maintain in Digital Substation Communication Domain with IEC 62439-3 Based Network Architecture. Sensors, 22(13), 4916. https://doi.org/10.3390/s22134916

7. Trang, L. N. T., Nhan, D. T. T., Phuong, D. N. T., & Wong, W. K. (2022). The effects of selected financial ratios on profitability: An empirical analysis of real estate firms in Vietnam. Annals of Financial Economics, 17(01), 2250006. https://doi.org/10.1142/S2010495222500063