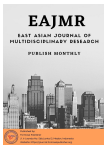


Journal title: East Asian Journal of Multidisciplinary Research (EAJMR) (/search/details?id=122650)
ISSN: 2828-1519 (online)
Country / Language: ID / EN
Publisher: PT FORMOSA CENDEKIA GLOBAL

MNiSW: N/D ICV 2024: E/P

ICV 2023: 95.25

Deposited publications: 1153 › Full text: 97% | Abstract: 100% | Keywords: 100% | References: 100%



Language
All
Title of the publication

The Role of Lecturer's Moral Hazard Behaviour on Utilization of Students's Information and Communication Technology in Education of Indonesia (/search/article?articleId=4438194)
Muchamad Syafruddin, Haryani Haryani
EAJMR 2025; 4 (5) : 1915-1934; DOI: 10.55927/eajmr.v4i5.147; Language: EN
Full text: No | Abstract: Yes | Keywords: 4 | References: 38

The Effect of Corporate Governance Mechanisms on Earnings Quality with Company Size as a Moderating Variable: an Empirical Study of Manufacturing Companies Listed on The Indonesian Stock Exchange in 2019-2021. (/search/article?articleId=4438195)
Afiya Nasywa Afma, Andrian Budi Prasetyo
EAJMR 2025; 4 (5) : 1935-1954; DOI: 10.55927/eajmr.v4i5.149; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 35

Implementation of Segmenting, Targeting, and Positioning (STP) in the "Agung Kaos" Confectionery Micro, Small, and Medium Enterprise (MSMEs) in Malang Regency (/search/article?articleId=4438200)
Salsabila Citra Devi, Dian Senly Andika, Mohammad Isa Wibisono, Rizma Fauziyah, Sudarmiatin Sudarmiatin, Naswan Suharsono
EAJMR 2025; 4 (5) : 1955-1964; DOI: 10.55927/eajmr.v4i5.144; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 20

The Influence of Workload, Work Stress, and Work Motivation on Turnover Intention Amongst Non-Civil Servant Nurses of the Mataram City Hospital, Indonesia (/search/article?articleId=4438196)
Diana Widia Wardani, Agusdin Agusdin
EAJMR 2025; 4 (5) : 1965-1976; DOI: 10.55927/eajmr.v4i5.160; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 3 | References: 18

Implementation of Green Entrepreneurship at PT Greenfields Indonesia (/search/article?articleId=4438197)
Dewi Ayu Dyah Ningrum, Aisya Ramadhani, Abdul Hamid, Sudarmiatin Sudarmiatin, Naswan Suharsono
EAJMR 2025; 4 (5) : 1977-1990; DOI: 10.55927/eajmr.v4i5.161; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 3 | References: 22

The Influence of Organizational Commitment, Job Satisfaction and Organizational Culture on OCB of Employees at the West Dompu Health Center (/search/article?articleId=4438198)
Ayu Suraya, Mukmin Suryatni
EAJMR 2025; 4 (5) : 1991-2006; DOI: 10.55927/eajmr.v4i5.157; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 4 | References: 21

Restoring Inner Peace: Transformative Healing Through Psychological Reconciliation for Victims of Armed Conflict and Human Rights Violations (/search/article?articleId=4438199)
Bryan M. Floro
EAJMR 2025; 4 (5) : 2007-2018; DOI: 10.55927/eajmr.v4i5.134; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 3 | References: 28

The Influence of Profitability, Liquidity, and Solvency on Company Value in the Technology Sector Listed on the Indonesia Stock Exchange (/search/article?articleId=4440595)
Alfina Salsabilla, Wisnu Panggah Setiyono, Herlinda Maya Kumala Sari
EAJMR 2025; 4 (5) : 2019-2038; DOI: 10.55927/eajmr.v4i5.158; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 40

The Effect of Intellectual Capital and Capital Structure on Financial Performance (A Study of Energy Companies Listed on the Indonesia Stock Exchange 2019-2023 Period) (/search/article?articleId=4457125)
I Made Krisna Dwi Satria Putra Adisu, I Nyoman Nugraha Ardana Putra
EAJMR 2025; 4 (5) : 2039-2054; DOI: 10.55927/eajmr.v4i5.170; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 10

The Influence of Green Marketing on Purchase Intention Mediated by Brand Image : Corkcicle Products (/search/article?articleId=4457130)
Imel Udayanti, Agus Maolana Hidayat, Arry Widodo, Nurafni Rubiyanti
EAJMR 2025; 4 (5) : 2055-2068; DOI: 10.55927/eajmr.v4i5.141; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 3 | References: 40

# EAJMR

# EAST ASIAN JOURNAL OF MULTIDISCIPLINARY RESEARCH

VOL 3, NO 6, JUNE 2024

Published by:
Formosa Publisher
Jl. Ir Juanda No. 56b,Lantai 2, Medan, Indonesia
Website: https://journal.formosapublisher.org

EAJMR
East Asian Journal of Multidisciplinary Research
E-ISSN 2828-1519
Email: admin@formosapublisher.org
WhatsApp: +62 878 -6950-2631
Office: Jl. Sutomo Ujung No 28D, Lantai 3 Medan, Indonesia
INDEXED BY:

# Editorial Team

**EDITOR IN CHIEF**

**Professor Jen Peng Huang, Ph.D**

Email: jenpeng.huang@gmail.com
Department of Information Management, Southern Taiwan University of Science and Technology

**Editorial Board**

Dosen tetap prodi manajemen universitas muhammadiyah makassar

**Assistant Editor**

**Marisa Yunita br Depari, S.Pd, MM**

Formosa Publisher

**Erika Abelia Br Sembiring**

Formosa Publisher

**Ivan Fernando Simanjuntak**

Formosa Publisher

**Nava Arbina Br Sembiring**

Formosa Publisher

**Sarah Hutabarat**

Formosa Publisher

**Esa Florida Br Depari**

Formosa Publisher

Supported by

UNIVERSITAS MTU
MAHKOTA TRICOM UNGGUL

IACR
International Association of Contemporary Researchers

Submit your Article

MENU

Copyright Notice

Publication Fee

Author Guideline

Plagiarism Policy

Archiving Policy

Forthcoming Articles

Jurnal EAJMR

**TEMPLATE**




**Formosa Publisher** collaborates with:

**Indexed By:**


**Office:**

**PT. FORMOSA CENDEKIA GLOBAL**

Jl. Sutomo Ujung No.28 D, Durian, Kecamatan Medan Timur, Kota Medan, Sumatera Utara 20235, Indonesia.

Website: http://formosapublisher.org

Phone: +62 877-1388-1007

Email: admin@formosapublisher.org

EAJMR
East Asian Journal of Multidisciplinary Research
E-ISSN 2828-1519
Email: admin@formosapublisher.org
WhatsApp: +62 878 -6950-2631
Office: Jl. Sutomo Ujung No 28D, Lantai 3 Medan, Indonesia
INDEXED BY:

# Vol. 3 No. 6 (2024): June 2024


**DOI:** https://doi.org/10.55927/eajmr.v3i6

**Published:** 2024-06-03

## Articles

Download PDF

### Shaping Visual Personality: the Role of Character Make-up and Body Shape in Visualizing Warrior Characters in Indonesia Silat Film

**Feny Puspitasari,** Program Doktor Seni dan Desain Fakultas Seni Rupa dan Desain Institut Teknologi Bandung, Jawa Barat, Indonesia
**Yasraf Amir Piliang,** Kelompok Keilmuan Ilmu Desain dan Budaya Visual, Fakultas Seni Rupa dan Desain, Institut Teknologi Bandung, Jawa Barat, Indonesia
**Kahfiati Kahdar,** Kelompok Keilmuan Kerajinan dan Tradisi, Institut Teknologi Bandung, Jawa Barat, Indonesia
**Dana Waskita,** Kelompok Ilmiah Literasi, Media dan Budaya, Institut Teknologi Bandung, Jawa Barat, Indonesia
2243-2260

Download PDF

### Development of Electronic Modules Using the Canva Application Assisted with Quizizz in Learning Achievements Basic Accounting Principles and Concepts

**Ayu Widiastuti,** Program Studi Magister Pendidikan Ekonomi Universitas Negeri Yogyakarta, Indonesia
**Ani Widayati,** Program Studi Magister Pendidikan Ekonomi Universitas Negeri Yogyakarta, Indonesia
2261-2270

Download PDF

### The Influence of Virtual Reality Technology on Purchase Intention through User Experience as an Intervening Variable in the Marketing Strategy of Samsung Products in the Virtual World: a Conceptual Paper

**Intan Lailya Afwa,** Universitas Telkom, Indonesia
**Nurafni Rubiyanti,** Universitas Telkom, Indonesia
**Arry Widodo,** Universitas Telkom, Indonesia
**Anita Silvianita,** Universitas Telkom, Indonesia
1997-2008

Download PDF

### The Effectiveness of Internal Control in Preventing Accounting Fraud in Financial Companies

**Jalilah Ilmiha,** Universitas Islam Sumatera Utara, Indonesia
**Amerruddin Shah Suboh,** Universiti Sains Malaysia, Malaysia
2181-2192

Download PDF

### Analysis of Stock Prices With Solvency as an Intervening Variable in Pharmaceutical Companies on the Indonesian Stock Exchange

**Ananda Wahyu Amarta,** Program Studi Manajemen, Fakultas Ekonomi dan Bisnis, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia
**Rahman Amrullah Suwaidi ,** Program Studi Manajemen, Fakultas Ekonomi dan Bisnis, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia
2229-2242

Download PDF

### Analysis of the use of Quick Response Code Indonesian Standard (Qris) on Parking Retribution in Mataram City

**Auliya Lestari,** Jurusan Akuntansi Fakultas Ekonomi dan Bisnis Universitas Mataram, Indonesia
**Lalu Muhamad Sopandi,** Jurusan Akuntansi Fakultas Ekonomi dan Bisnis Universitas Mataram, Indonesia
2379-2392

**Intan Rakhmawati,** Jurusan Akuntansi Fakultas Ekonomi dan Bisnis Universitas Mataram, Indonesia

Download PDF

### The Effect of Content Marketing on Customer Advocacy with Brand Trust and Customer Engagement as Intervening Variables in the TikTok Application in Medan City

**Erma Florentina Handayani,** Universitas Sumatera Utara, Indonesia
**Paham Ginting,** Universitas Sumatera Utara, Indonesia
**Arlina Nurbaity Lubis,** Universitas Sumatera Utara, Indonesia

2193-2202

Download PDF

### The Influence of Machiavellian Personality, Workload, and Love of Money on Dysfunctional Auditor Behavior with Emotional Spiritual Quotient as a Moderating Variable

**Ida Bagus Oka Suryawibawa,** Fakultas Ekonomi dan Bisnis, Universitas Udayana, Indonesia
**Made Gede Wirakusuma ,** Fakultas Ekonomi dan Bisnis, Universitas Udayana, Indonesia
**I Gusti Ayu Nyoman Budiasih,** Fakultas Ekonomi dan Bisnis, Universitas Udayana, Indonesia
**Ni Made Adi Erawati,** Fakultas Ekonomi dan Bisnis, Universitas Udayana, Indonesia

2393-2406

Download PDF

### Gender Differences on Stress and Coping Strategies Among Faculty of a University

**Lycel L. Pacheco,** Central Philippines State University, Philippines
**Jirec A. Bacongco,** Central Philippines State University, Philippines
**Noel M. Dayono,** Central Philippines State University, Philippines
**Mary Ann S. Dagunan,** Central Philippines State University, Philippines

2203-2218

Download PDF

### Comparative Analysis of Labor Productivity Coefficient Based on Standardization of Indonesian National Standard 7394:2008 and Regulation of the Minister of Public Works and Housing of the Republic of Indonesia No. 28 of 2016 on Column Fixing Work

**Gerry Geraldo Sombolayuk,** Plekhanov Russian University of Economics, Russian Federation
**Novita Tanjung,** Bauman Moscow State Technical University, Russian Federation

2369-2378

Download PDF

### The Influence of Price Fluctuations and Availability of Soybean Raw Materials on Tempe Home Industry Production Results in Mataram City

**Ayu Apriliani,** Universitas Mataram, Indonesia
**Herlina Pusparini,** Universitas Mataram, Indonesia

2153-2166

Download PDF

### The Effect of Current Ratio and Debt to Equity Ratio on Return on Assets in Food Sub Sector Companies and the Beverages Listed in Indonesian Stock Exchange 2018-2022

**Abdul Hamid Syarif,** Universitas Islam Negeri Maulana Malik Ibrahim, Indonesia
**Isnan Murdiansyah,** Universitas Islam Negeri Maulana Malik Ibrahim, Indonesia

2079-2088

Download PDF

### Analysis of the Influence of Financial Distress, Capital Structure, Complexity of Company Operations, Auditor Opinion and KAP's Reputation on Audit Delay

**Clara Liany Tampubolon,** Universitas Jambi, Indonesia
**Afrizal Afrizal,** Universitas Jambi, Indonesia
**Yuliusman Yuliusman,** Universitas Jambi, Indonesia

Download PDF

### Evaluation of Digital Economy Growth: the Validity of the Data Envelopment Analysis (DEA) Method

**Patrick Vivid Adinata,** Sanata Dharma Yogyakarta, Indonesia 2283-2294

Download PDF

### Analysis of the Application of Green Accounting in Waste Management in RSUD Lombok Barat

**Hairun Nihayah,** Jurusan Akuntansi Fakultas Ekonomi dan Bisnis Universitas Mataram, Indonesia
**Nur Fitriyah,** Jurusan Akuntansi Fakultas Ekonomi dan Bisnis Universitas Mataram, Indonesia 2353-2368

Download PDF

### Analysis of Factors Affeecting Original Local Government Revenue (PAD) on the Island of Sumatra

**Anggiat Marulitua Pangaribuan,** Program Studi Ekonomi Pembangunan Universitas Bengkulu, Indonesia
**Azansyah Azansyah,** Program Studi Ekonomi Pembangunan Universitas Bengkulu, Indonesia 2129-2152

Download PDF

UNIVERSITAS MTU
MAHKOTA TRICOM UNGGUL

IACR
International Association of Contemporary Researchers

**TEMPLATE**

# Article Template


**Office:**

**PT. FORMOSA CENDEKIA GLOBAL**

Jl. Sutomo Ujung No.28 D, Durian, Kecamatan Medan Timur, Kota Medan, Sumatera Utara 20235, Indonesia.

Website: http://formosapublisher.org

Phone: +62 877-1388-1007

Email: admin@formosapublisher.org

East Asian Journal of Multidisciplinary Research (EAJMR)
Vol. 3, No.6 2024: 2283-2294

# Evaluation of Digital Economy Growth: the Validity of the Data Envelopment Analysis (DEA) Method

Patrick Vivid Adinata
Sanata Dharma Yogyakarta
**Corresponding Author:** Patrick Vivid Adinata adinata8@usd.ac.id

A R T I C L E I N F O

*Keywords:* Digital Economy, Data Envelopment Analysis (DEA), Digital Infrastructure, Efficiency Measurement, Index Method, Scale Measurement, Urban Economic Growth

*Received : 21, April*
*Revised : 23, May*
*Accepted: 25, June*



A B S T R A C T

This research aims to provide methodological insights that can be used in related studies, as well as offer guidance for the development and improvement of urban digital economies. Gross Domestic Product (GDP)-based scale measurement methods and input-output methods show significant variations in the measurement of digitalisation and the contribution of the digital economy. While index techniques offer convenience in the calculation and expansion of indicators, their accuracy and scientific validity are often in doubt due to subjectivity in the weighting and selection of indicators. DEA offers great flexibility by allocating input and output weights endogenously, reducing the influence of subjectivity. DEA is able to identify fast-growing cities in the digital economy, assess effectiveness, and provide strong support for managerial decision-making, as well as provide guidance for the development of smarter and more efficient cities in the future. This research makes a practical contribution to the development of more appropriate and effective digital economy policies and strategies.

DOI prefix: https://doi.org/10.55927/eajmr.v3i6.9632
ISSN-E: 2828-1519 (Online)
https://journal.formosapublisher.org/index.php/eajmr

## INTRODUCTION

The G20 Digital Economy Development and Cooperation Initiative adopted at the 2016 Hangzhou Summit is an important milestone in the G20 innovation growth roadmap (Liu, Tian, et al., 2024). The digital economy is now the main driver of modern economic development with a focus on deep integration of digital technologies with the real economy, supporting the development of digital infrastructure, improving the governance structure of the digital economy, and supporting the transformation and upgrading of traditional industries (Ghimire et al., 2024; Song & Jiang, 2024; Xiao et al., 2024). The initiative also seeks to develop new industries, formats and models, and continuously expand, upgrade and strengthen the digital economy in cities (Dian et al., 2024; Liu, Xie, et al., 2024). However, the digital economy in cities still faces challenges due to its relatively small size and lack of strength. Therefore, research on the superior growth of the digital economy is becoming increasingly important in the modern era, especially at the urban level.

However, there is an important problem to be solved: how to measure the development of urban digital economy from a scientific point of view (Lin & Zhou, 2024; Smolinski, 2024). This research aims to review the benefits and drawbacks of commonly used metrics in measuring digital economy growth on a national and global scale (Xue et al., 2022). Furthermore, this article delves deeper into the scientific validity of using Data Envelopment Analysis (DEA) to measure the level of digital economic development in cities, as well as offering methodological insights for related studies.

Measuring the production value of the digital economy using the Gross Domestic Product (GDP) measurement principle is known as the "scale measurement method." Therefore, the production method and the expenditure method are the main approaches that can be applied (Ren et al., 2022). Some organisations with industry-representative researchers, such as the Academy of Information and Communication Technology, Tencent Research Institute, and the United States Bureau of Economic Analysis, have used the input-output approach to measure the degree of digitalisation of industries and the digital economy, as well as the contribution of Information and Communication Technology (ICT) to the value added of other economic sectors (Arnold, 2023; Balsalobre-Lorente et al., 2023). The level and scope of development can be reflected directly in this scale measurement approach, which is also capable of calculating the share of Gross Domestic Product (GDP). Its ability to examine the development of the digital economy across different businesses is another benefit (Gaglio et al., 2022). However, the disadvantages of this approach include difficulties in comparing and evaluating due to different domestic and international product classification rules for the digital economy. In addition, data may not be available for new types of digital economy (Shahidi Hamedani et al., 2024). While useful for examining the development of the digital economy, this method is difficult to compare due to differences in product classification rules and limited data for new types of digital economy.

The term "index method" refers to the process of selecting a number of indicators related to the digital economy, building a comprehensive indicator system, and using quantitative indicators to show the development level of the digital economy in (Dian et al., 2024; Ge et al., 2024). When assessing the growth rate of the digital economy at the urban level, benchmarks can be divided into categories such as innovation, coordination, openness, sustainability, and inclusiveness (Liu, Xie, et al., 2024; Ruban, 2024). Secondary indicators, such as human resources, industrial coordination, urban-rural relations, resource preservation, international trade, consumption level, and development scale, are used in the construction of indicators (Ding et al., 2022; J. Wang et al., 2022). This index technique has the advantage of being easy to calculate and can be expanded with various indicators, facilitating the future planning of the digital economy and making it easy to assess the development status of various dimensions (Li et al., 2022; Yi et al., 2022). However, the accuracy and scientific validity of this technique are often in doubt because the assignment, weighing and selection of indicators may be affected by subjectivity, and the results lack absolute significance (J. Wang et al., 2022).

This research examines the benefits and drawbacks of commonly used metrics in measuring digital economy growth at national and global scales. In addition, it explores the scientific validity of using Data Envelopment Analysis (DEA) to measure the level of digital economic development in cities and offers methodological insights for related studies.Data Envelopment Analysis (DEA) proved to be an effective tool in assessing the effectiveness of urban digital economic development and provided useful guidance for further improvement and development.

## THEORETICAL REVIEW

The G20 Digital Economy Development and Cooperation Initiative adopted at the 2016 Hangzhou Summit is an important milestone in the G20 innovation growth roadmap (Liu, Tian, et al., 2024). The digital economy is now the main driver of modern economic development with a focus on deep integration of digital technologies with the real economy, supporting the development of digital infrastructure, improving the governance structure of the digital economy, and supporting the transformation and upgrading of traditional industries (Ghimire et al., 2024; Song & Jiang, 2024; Xiao et al., 2024). The term "index method" refers to the process of selecting a number of indicators related to the digital economy, building a comprehensive indicator system, and using quantitative indicators to show the development level of the digital economy in (Dian et al., 2024; Ge et al., 2024).

## METHODOLOGY

### Overview of the Data Envelopment Analysis (DEA) Method

One of the assessment methodologies often used in efficiency evaluation is Data Envelopment Analysis (DEA). DEA is a popular assessment technique that combines several academic fields, including operations research, economics, econometrics and statistics. The basic idea is to obtain relative efficiency indicators for each decision unit by thoroughly analysing the input and output data of the Decision Making Units (DMUs) (Hu & Zhao, 2024). Relatively effective DMUs are identified through ranking all DMU efficiency metrics (Lyu et al., 2023; Zhang et al., 2022). The main advantage of this method is its suitability for comprehensive assessment of the effectiveness of various inputs and outputs. The projection technique can also be used by DEA to determine the causes of weakness or ineffectiveness as well as the scope and direction of improvements required. This technique is commonly used in various study domains as a tool to provide information to managers in making management decisions (Lutfi et al., 2022). DEA is able to provide comprehensive information that supports management decision-making.

This research lies in the following important aspects:

1. Use of Data Envelopment Analysis (DEA) for the Urban Digital Economy
   This research offers a new approach in measuring the level of digital economy development in cities by using Data Envelopment Analysis (DEA). DEA allows for a more flexible and objective assessment of efficiency as it can allocate input and output weights endogenously, reducing the influence of subjectivity in the determination of weights. This approach differs from traditional scaling methods based on Gross Domestic Product (GDP) and index methods which are often affected by subjectivity in the selection and weighting of indicators.
1. Comprehensive Evaluation of Digital Economy Measurement Methods
   This research not only evaluates one measurement method, but also compares various techniques used in measuring digital economic growth, including the scale measurement method and the index method. This evaluation provides a more complete picture of the strengths and weaknesses of each method, and provides a basis for developing better methodologies.
2. A Multi-Dimensional Approach to Efficiency Assessment
   By combining several academic fields such as operations research, economics, econometrics, and statistics, DEA is able to handle the complex interactions between different aspects of the urban digital economy. This provides stronger support for smarter and more efficient managerial decision-making and digital economy development planning.
3. Practical Application to the Indonesian Urban Context
   This research also emphasises the importance of adapting the DEA model to the local Indonesian context, taking into account the unique factors that influence digital economy development in urban Indonesia. This provides a practical contribution to the development of more appropriate and effective digital economy policies and strategies.

With these innovations, this research not only enriches the literature on digital economy measurement, but also offers new tools and insights that can be applied in developing the urban digital economy more effectively and efficiently.

**Benefits of Data Envelopment Analysis (DEA)**

The advantage of the data envelopment analysis method is its high flexibility as it does not process data directly, which means that the best indicators for decision-making units do not depend on the selection of the dimensions of input and output indicator values.In addition, by using optimisation techniques, the data envelopment analysis method endogenously assigns input and output weights to decision-making units, thereby eliminating the influence of subjectivity in weight determination.Since fewer people are involved in the process, the results are more unbiased and convincing.Data envelopment analysis can be used to find areas that need improvement, assess effectiveness, and the current level of development of the system, which provides excellent support for decision-making.

**The Concept of Using Data Envelopment Analysis (DEA) to Measure the Level of Development of the Urban Digital Economy**

In more detail, cities can be considered as decision-making units, and the basis of the valuation model consists of inputs related to the digital economy (such as development of urban digital infrastructure, investment in human resources, etc.) and outputs (such as production from the digital economy).Successful cities in digital economy growth can be identified using Data Envelopment Analysis (DEA) models.The DEA model can handle this concern perfectly because the influence of urban digital economy involves several complex dimensions, including economic, political, social, and cultural environments (Aly, 2022). As shown earlier, data envelopment analysis is able to assess the effectiveness of urban digital economy development, identify cities that are more successful in this regard, and measure the level of development based on its effectiveness. More importantly, Data Envelopment Analysis (DEA) can provide guidance for city development and improvement by comparing digital economy development in other cities and identifying inefficient relationships or input elements (Cacciolatti, 2024). This is important for formulating plans that focus on digital economy development and for integrating the digital economy with overall city development (Liu, Zheng, et al., 2024; L. Wang et al., 2024).

## RESULT AND DISCUSSION

This study aims to evaluate the techniques used to measure digital economic growth in urban Indonesia and investigate the validity of using Data Envelopment Analysis (DEA) for this purpose. The following are the main findings of this research:

### Differences in Measurement Techniques

a. Scale measurement techniques that use Gross Domestic Product (GDP) principles and input-output methods show that there is significant variation in how different organizations measure digitalization and the contribution of the digital economy.
b. Index methods that use a number of indicators related to the digital economy show a lack of scientific validity due to subjectivity in the weighting and selection of indicators.

### Weaknesses of Traditional Measurement Techniques

a. Scale measurement often has difficulties in comparison and evaluation due to differences in product classification rules as well as data limitations for new types of digital economy.
b. Index measurement has the advantage of ease of calculation and expansion of indicators, but its accuracy is questionable due to subjectivity in weighting.

### Application of DEA

a. DEA offers great flexibility and can assign input and output weights endogenously, eliminating the influence of subjectivity in weight allocation.
b. DEA can identify cities that are rapidly growing in the digital economy and assess the effectiveness and development level of the current system.
c. DEA models are able to address the complex interactions between different aspects of a city, providing excellent support for managerial decision-making.

### Analysis of the Advantages and Disadvantages of Measurement Techniques

a. Scale Measurement: Scale measurement using GDP principles and input-output methods is useful in determining the contribution of the digital economy to GDP. However, the main difficulty lies in comparisons between regions due to different classification rules and incomplete data for the new digital economy. For example, Tencent Information and Communication Technology Academy and BAE of the United States have implemented this approach, but face similar challenges.
b. Index Measurement: Index measurement with various indicators makes it easier to evaluate the dimensions of the digital economy. However, this technique is often affected by subjectivity in the selection of indicators and their weighting. Previous research shows that while this method is easily scalable, the validity and accuracy of the results are often questionable.

**Benefits of DEA in the Context of Digital Economy Measurement**

a. Flexibility and Weighting: DEA exhibits high flexibility in efficiency assessment by endogenously assigning input and output weights. This ensures that the influence of subjectivity in weight allocation is minimized. For example, in a study applied to major European cities, DEA successfully identified cities with rapid growth of the digital economy and reduced the impact of complex interactions between different aspects of the city.
b. Support for Decision Making: DEA analysis can be used to find areas that require improvement, assess effectiveness, and the current level of system development. It provides strong support for managerial decision-making, especially in planning for a smarter and more efficient future of the city.
c. Application in City Development: DEA measurements can be integrated with the coordinated long-term development of cities, providing a new perspective on how to measure the effectiveness of economic development in related studies. This is important for formulating more targeted and effective digital economic development plans.

This study aims to evaluate the techniques used to measure digital economic growth in urban Indonesia and investigate the validity of using Data Envelopment Analysis (DEA) for this purpose. The following are the main findings of this research:

**Differences in Measurement Techniques**

a. Scale measurement techniques that use Gross Domestic Product (GDP) principles and input-output methods show that there is significant variation in how different organizations measure digitalization and the contribution of the digital economy.
b. Index methods that use a number of indicators related to the digital economy show a lack of scientific validity due to subjectivity in the weighting and selection of indicators.

**Weaknesses of Traditional Measurement Techniques**

a. Scale measurement often has difficulties in comparison and evaluation due to differences in product classification rules as well as data limitations for new types of digital economy.
b. Index measurement has the advantage of ease of calculation and expansion of indicators, but its accuracy is questionable due to subjectivity in weighting.

**Application of DEA**

a. DEA offers great flexibility and can assign input and output weights endogenously, eliminating the influence of subjectivity in weight allocation.
b. DEA can identify cities that are rapidly growing in the digital economy and assess the effectiveness and development level of the current system.
c. DEA models are able to address the complex interactions between different aspects of a city, providing excellent support for managerial decision-making.

**Analysis of the Advantages and Disadvantages of Measurement Techniques**

a. Scale Measurement: Scale measurement using GDP principles and input-output methods is useful in determining the contribution of the digital

economy to GDP. However, the main difficulty lies in comparisons between regions due to different classification rules and incomplete data for the new digital economy. For example, Tencent Information and Communication Technology Academy and BAE of the United States have implemented this approach, but face similar challenges.

b. Index Measurement: Index measurement with various indicators makes it easier to evaluate the dimensions of the digital economy. However, this technique is often affected by subjectivity in the selection of indicators and their weighting. Previous research shows that while this method is easily scalable, the validity and accuracy of the results are often questionable.

**Benefits of DEA in the Context of Digital Economy Measurement**

a. Flexibility and Weighting: DEA exhibits high flexibility in efficiency assessment by endogenously assigning input and output weights. This ensures that the influence of subjectivity in weight allocation is minimized. For example, in a study applied to major European cities, DEA successfully identified cities with rapid growth of the digital economy and reduced the impact of complex interactions between different aspects of the city.
b. Support for Decision Making: DEA analysis can be used to find areas that require improvement, assess effectiveness, and the current level of system development. It provides strong support for managerial decision-making, especially in planning for a smarter and more efficient future of the city.
c. Application in City Development: DEA measurements can be integrated with the coordinated long-term development of cities, providing a new perspective on how to measure the effectiveness of economic development in related studies. This is important for formulating more targeted and effective digital economic development plans.

## DISCUSSION

This study examines several methods of measuring the digital economy, namely the Gross Domestic Product (GDP)-based scale measurement method and the input-output method, as well as the index method. Scale measurement methods using the GDP principle and the input-output method show significant variations in the measurement of digitalisation and the contribution of the digital economy. The advantage of these methods is their ability to directly reflect the level and scope of development of the digital economy and calculate its contribution to GDP. However, it faces challenges in inter-regional comparisons due to differences in product classification rules and data availability for new types of digital economy. The index method involves selecting a number of indicators related to the digital economy, building a comprehensive indicator system, and using quantitative indicators to show the level of development of the digital economy. This method facilitates the calculation and development of indicators, facilitates the future planning of the digital economy, and enables the assessment of the development status of various dimensions. However, the accuracy and scientific validity of this technique are often doubted due to the subjectivity in weighting and selecting indicators.

## CONCLUSIONS AND RECOMMENDATIONS

To conclude, scale measurement and index measurement are the two main categories on which digital economy measurement techniques are based, both at home and abroad. Although both approaches have their own advantages and disadvantages, they are not reliable enough to measure the extent of urban digital economy development. Therefore, this study suggests a new approach to measure the level of development of urban digital economies: Data Envelopment Analysis (DEA).

For example, the DEA model has been successfully applied in major European cities to measure the efficiency and development of the digital economy. Using DEA models, cities that are thriving in the digital economy can be identified, while helping to reduce the impact of the complex interactions between different aspects of the city. More importantly, the DEA model's measurement of the level of digital economy development can be integrated with the city's coordinated long-term development. This provides a new perspective on how to measure the effectiveness of economic development in related studies, and helps policy makers to make better decisions in planning for a smarter and more efficient urban future.

For future research, some recommendations that can be given are as follows:

1. Data Development and Product Classification: Conduct further research to develop more comprehensive and consistent data related to the digital economy, as well as harmonise domestic and international product classification rules to facilitate comparison between regions.
2. Index Method Improvement: Reduce subjectivity in weighting and indicator selection in index methods by developing a more objective and data-driven approach. The use of more sophisticated analytical techniques can help in improving the accuracy and validity of measurement results.
3. Adaptation of DEA to Local Context: Conduct additional research to adapt the DEA model to the local Indonesian context. This includes considering the unique factors that influence digital economy development in urban Indonesia, such as digital infrastructure, human capital investment, and government policies.
4. Longitudinal Research: Conduct longitudinal studies to monitor the development of the digital economy over time. This will provide deeper insights into the dynamics of change and the factors contributing to the growth of the digital economy in different cities.
5. Collaboration between Researchers and Institutions: Encourage collaboration between researchers, academic institutions, government and industry to collect richer data and share best practices in measuring and developing the digital economy.

With these recommendations, it is hoped that future research can overcome existing limitations and make a more significant contribution to the measurement and development of the urban digital economy.

## FURTHER STUDY

This study has several limitations that need to be considered. First, the use of scale and index measurement methods faces challenges in terms of inter-regional comparisons due to differences in domestic and international product classification rules and limited data for new types of digital economy. These limitations may affect the accuracy and validity of the research results. Secondly, subjectivity in determining weights and selecting indicators in the index method is also a major obstacle that can reduce the reliability of digital economy measurement results. In addition, the adaptation of the Data Envelopment Analysis (DEA) model to the local Indonesian context requires further research to ensure that the unique factors affecting digital economy development in urban Indonesia are properly accommodated.

## REFERENCES

Aly, H. (2022). Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or a blessing? *Review of Economics and Political Science*, *7*(4), 238–256. https://doi.org/10.1108/REPS-11-2019-0145

Arnold, S. (2023). Africa's roads to digital development: paving the way for Chinese structural power in the ICT sector? In *Review of International Political Economy* (pp. 1–25). Informa UK Limited. https://doi.org/10.1080/09692290.2023.2297363

Balsalobre-Lorente, D., Abbas, J., He, C., Pilař, L., & Shah, S. A. R. (2023). Tourism, urbanization and natural resources rents matter for environmental sustainability: The leading role of AI and ICT on sustainable development goals in the digital era. *Resources Policy*, *82*. https://doi.org/10.1016/j.resourpol.2023.103445

Cacciolatti, L. (2024). Public science and environmental sustainability: a national culture framework for innovation ecosystems en route to net zero. In *Digital Economy and Sustainable Development* (Vol. 2, Issue 1). Springer Science and Business Media LLC. https://doi.org/10.1007/s44265-024-00034-5

Dian, J., Song, T., & Li, S. (2024). Facilitating or inhibiting? Spatial effects of the digital economy affecting urban green technology innovation. In *Energy Economics* (Vol. 129, p. 107223). Elsevier BV. https://doi.org/10.1016/j.eneco.2023.107223

Ding, C., Liu, C., Zheng, C., & Li, F. (2022). Digital economy, technological innovation and high-quality economic development: Based on spatial effect and mediation effect. *Sustainability (Switzerland)*, *14*(1). https://doi.org/10.3390/su14010216

Gaglio, C., Kraemer-Mbula, E., & Lorenz, E. (2022). The effects of digital transformation on innovation and productivity: Firm-level evidence of South African manufacturing micro and small enterprises. *Technological Forecasting and Social Change*, *182*. https://doi.org/10.1016/j.techfore.2022.121785

Ge, Y., Xia, Y., & Wang, T. (2024). Digital economy, data resources and enterprise green technology innovation: Evidence from A-listed Chinese Firms. In *Resources Policy* (Vol. 92, p. 105035). Elsevier BV. https://doi.org/10.1016/j.resourpol.2024.105035

Ghimire, A., Ali, S., Long, X., Chen, L., & Sun, J. (2024). Effect of Digital Silk Road and innovation heterogeneity on digital economy growth across 29 countries: New evidence from PSM-DID. In *Technological Forecasting and Social Change* (Vol. 198, p. 122987). Elsevier BV. https://doi.org/10.1016/j.techfore.2023.122987

Hu, C., & Zhao, Y. (2024). Research on Optimizing 6G Data-Driven Decision-Making Using Wireless Cyber Enterprise Innovation Process Using Decision Tree Algorithm. In *Wireless Personal Communications*. Springer Science and Business Media LLC. https://doi.org/10.1007/s11277-024-11018-1

Li, J., Chen, L., Chen, Y., & He, J. (2022). Digital economy, technological innovation, and

green economic efficiency—Empirical evidence from 277 cities in China. *Managerial and Decision Economics*, *43*(3), 616–629. https://doi.org/10.1002/mde.3406

Lin, Q., & Zhou, P. (2024). Synergy of digital economy and green economy in sustainable development policy. In *Journal of Autonomous Intelligence* (Vol. 7, Issue 3). Frontier Scientific Publishing Pte Ltd. https://doi.org/10.32629/jai.v7i3.1299

Liu, Y., Tian, G., & Zhang, X. (2024). Digital economy and China's path to common prosperity. In *Digital Economy and Sustainable Development* (Vol. 2, Issue 1). Springer Science and Business Media LLC. https://doi.org/10.1007/s44265-024-00031-8

Liu, Y., Xie, Y., & Zhong, K. (2024). Impact of digital economy on urban sustainable development: Evidence from Chinese cities. In *Sustainable Development* (Vol. 32, Issue 1, pp. 307–324). IOP Publishing. https://doi.org/10.1002/sd.2656

Liu, Y., Zheng, M., & Shum, W. Y. (2024). On the linkages between digital finance and real economy in China: A cointegration analysis. In *Innovation and Green Development* (Vol. 3, Issue 1, p. 100109). Elsevier BV. https://doi.org/10.1016/j.igd.2023.100109

Lutfi, A., Alsyouf, A., Almaiah, M. A., Alrawad, M., Abdo, A. A. K., Al-Khasawneh, A. L., Ibrahim, N., & Saad, M. (2022). Factors Influencing the Adoption of Big Data Analytics in the Digital Transformation Era: Case Study of Jordanian SMEs. *Sustainability (Switzerland)*, *14*(3). https://doi.org/10.3390/su14031802

Lyu, Y., Wang, W., Wu, Y., & Zhang, J. (2023). How does digital economy affect green total factor productivity? Evidence from China. *Science of the Total Environment*, *857*. https://doi.org/10.1016/j.scitotenv.2022.159428

Ren, S., Li, L., Han, Y., Hao, Y., & Wu, H. (2022). The emerging driving force of inclusive green growth: Does digital economy agglomeration work? *Business Strategy and the Environment*, *31*(4), 1656–1678. https://doi.org/10.1002/bse.2975

Ruban, D. A. (2024). Contemporary Asian experience of digitalization and sustainable development in economy and management. A review of the book "Business and management in Asia: digital innovation and sustainability" (Springer, 2023). In *E-Management* (Vol. 6, Issue 4, pp. 125–130). State University of Management. https://doi.org/10.26425/2658-3445-2023-6-4-125-130

Shahidi Hamedani, S., Abdulaziz Bawazir, A., & Bin Annuar, A. (2024). The Impact of Working Environment, Salary, and Job Security on Job Satisfaction among Workers in Sarawak's Government Linked Company: The Case of Sarawak Digital Economy Corporation. In *Journal of Entrepreneurship and Business Innovation* (Vol. 11, Issue 1, p. 20). Macrothink Institute, Inc. https://doi.org/10.5296/jebi.v11i1.21623

Smolinski, J. (2024). Navigating the Digital Frontier: Emerging Trends in Digital Innovation Management for 2023 and Beyond. In *International Journal of Innovation and Technology Management*. World Scientific Pub Co Pte Ltd. https://doi.org/10.1142/S0219877024500329

Song, Y., & Jiang, Y. (2024). How Does the Digital Economy Drive the Optimization and Upgrading of Industrial Structure? The Mediating Effect of Innovation and the Role of Economic Resilience. In *Sustainability (Switzerland)* (Vol. 16, Issue 4, p. 1352). MDPI AG. https://doi.org/10.3390/su16041352

Wang, J., Dong, K., Dong, X., & Taghizadeh-Hesary, F. (2022). Assessing the digital economy and its carbon-mitigation effects: The case of China. *Energy Economics*, *113*. https://doi.org/10.1016/j.eneco.2022.106198

Wang, L., Lin, S., Zhang, M., Ding, J., & Zhang, L. (2024). Technological Innovation Through Complex Networks: a Study of 100 Listed Companies on China's Growth Enterprise Market. In *Journal of the Knowledge Economy*. Springer Science and Business Media LLC. https://doi.org/10.1007/s13132-024-01798-z

Xiao, D., Zhang, C., & Huang, Y. (2024). Digital economy policy and enterprise digital transformation: Evidence from innovation and structural effect. In *Managerial and Decision Economics* (Vol. 45, Issue 4, pp. 2348–2359). Wiley. https://doi.org/10.1002/mde.4144

Xue, Y., Tang, C., Wu, H., Liu, J., & Hao, Y. (2022). The emerging driving force of energy consumption in China: Does digital economy development matter? *Energy Policy*, *165*. https://doi.org/10.1016/j.enpol.2022.112997

Yi, M., Liu, Y., Sheng, M. S., & Wen, L. (2022). Effects of digital economy on carbon emission reduction: New evidence from China. *Energy Policy*, *171*. https://doi.org/10.1016/j.enpol.2022.113271

Zhang, J., Lyu, Y., Li, Y., & Geng, Y. (2022). Digital economy: An innovation driving factor for low-carbon development. *Environmental Impact Assessment Review*, *96*. https://doi.org/10.1016/j.eiar.2022.106821