

Lecture Notes in Networks and Systems 527

Leonard Barolli  
Hiroyoshi Miwa *Editors*

# Advances in Intelligent Networking and Collaborative Systems

The 14th International Conference  
on Intelligent Networking and  
Collaborative Systems (INCoS-2022)

 Springer

# Lecture Notes in Networks and Systems

Volume 527

## Series Editor

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences,  
Warsaw, Poland

## Advisory Editors

Fernando Gomide, Department of Computer Engineering and Automation—DCA,  
School of Electrical and Computer Engineering—FEEC, University of Campinas—  
UNICAMP, São Paulo, Brazil

Okyay Kaynak, Department of Electrical and Electronic Engineering,  
Bogazici University, Istanbul, Turkey

Derong Liu, Department of Electrical and Computer Engineering, University  
of Illinois at Chicago, Chicago, USA

Institute of Automation, Chinese Academy of Sciences, Beijing, China

Witold Pedrycz, Department of Electrical and Computer Engineering, University of  
Alberta, Alberta, Canada

Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland

Marios M. Polycarpou, Department of Electrical and Computer Engineering,  
KIOS Research Center for Intelligent Systems and Networks, University of Cyprus,  
Nicosia, Cyprus

Imre J. Rudas, Óbuda University, Budapest, Hungary

Jun Wang, Department of Computer Science, City University of Hong Kong,  
Kowloon, Hong Kong

The series “Lecture Notes in Networks and Systems” publishes the latest developments in Networks and Systems—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNNS.

Volumes published in LNNS embrace all aspects and subfields of, as well as new challenges in, Networks and Systems.

The series contains proceedings and edited volumes in systems and networks, spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution and exposure which enable both a wide and rapid dissemination of research output.

The series covers the theory, applications, and perspectives on the state of the art and future developments relevant to systems and networks, decision making, control, complex processes and related areas, as embedded in the fields of interdisciplinary and applied sciences, engineering, computer science, physics, economics, social, and life sciences, as well as the paradigms and methodologies behind them.

Indexed by SCOPUS, INSPEC, WTI Frankfurt eG, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

For proposals from Asia please contact Aninda Bose ([aninda.bose@springer.com](mailto:aninda.bose@springer.com)).

More information about this series at <https://link.springer.com/bookseries/15179>

Leonard Barolli · Hiroyoshi Miwa  
Editors

# Advances in Intelligent Networking and Collaborative Systems

The 14th International Conference  
on Intelligent Networking and Collaborative  
Systems (INCoS-2022)

 Springer

*Editors*

Leonard Barolli  
Department of Information  
and Communication Engineering  
Fukuoka Institute of Technology  
Fukuoka, Japan

Hiroyoshi Miwa  
School of Science and Technology  
Kwansei Gakuin University  
Sanda, Japan

ISSN 2367-3370

ISSN 2367-3389 (electronic)

Lecture Notes in Networks and Systems

ISBN 978-3-031-14626-8

ISBN 978-3-031-14627-5 (eBook)

<https://doi.org/10.1007/978-3-031-14627-5>

© The Editor(s) (if applicable) and The Author(s), under exclusive license  
to Springer Nature Switzerland AG 2022

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Welcome Message from the INCoS-2022 Organizing Committee

Welcome to the 14th International Conference on Intelligent Networking and Collaborative Systems (INCoS-2022), which is held from September 7 to September 9, 2022.

INCoS is a multidisciplinary conference that covers the latest advances in intelligent social networks and collaborative systems, intelligent networking systems, mobile collaborative systems, secure intelligent cloud systems, etc. Additionally, the conference addresses security, authentication, privacy, data trust and user trustworthiness behavior, which have become crosscutting features of intelligent collaborative systems. With the fast development of the Internet, we are experiencing a shift from the traditional sharing of information and applications as the main purpose of the networking systems to an emergent paradigm, which locates people at the very center of networks and exploits the value of people's connections, relations and collaborations. Social networks are playing a major role as one of the drivers in the dynamics and structure of intelligent networking and collaborative systems.

Virtual campuses, virtual communities and organizations strongly leverage intelligent networking and collaborative systems by a great variety of formal and informal electronic relations, such as business-to-business, peer-to-peer and many types of online collaborative learning interactions, including the virtual campuses and eLearning systems. Altogether, this has resulted in entangled systems that need to be managed efficiently and in an autonomous way. In addition, the conjunction of the latest and powerful technologies based on Cloud, mobile and wireless infrastructures is currently bringing new dimensions of collaborative and networking applications a great deal by facing new issues and challenges.

The aim of this conference is to stimulate research that will lead to the creation of responsive environments for networking and the development of adaptive, secure, mobile and intuitive intelligent systems for collaborative work and learning.

The successful organization of the conference is achieved thanks to the great collaboration and hard work of many people and conference supporters. First, we would like to thank all the authors for their continued support to the conference by submitting their research work to the conference, for their presentations and

discussions during the conference days. We would like to thank PC Co-Chairs, Track Co-chairs, TPC Members and External Reviewers for their work by carefully evaluating the submissions and providing constructive feedback to authors.

We would like to acknowledge the excellent work and support by the International Advisory Committee and our gratitude and acknowledgment for the conference keynotes for their interesting and inspiring keynote speeches.

We greatly appreciate the support by Web Administrator Co-Chairs. We are very grateful to Springer as well as several academic institutions for their endorsement and assistance.

Finally, we hope that you will find these proceedings to be a valuable resource in your professional, research and educational activities.

# INCoS-2022 Organizing Committee

## Honorary Chair

Makoto Takizawa

Hosei University, Japan

## General Co-chairs

Hiroyoshi Miwa

Flora Amato

Juggapong Natwichai

Kwansei Gakuin University, Japan

University of Naples “Frederico II”, Italy

Chiang Mai University, Thailand

## Program Co-chairs

Akihiro Fujihara

Lidia Ogiela

Jana Nowakova

Chiba Institute of Technology, Japan

AGH University of Science and Technology,  
Poland

VŠB-Technical University of Ostrava,  
Czech Republic

## International Advisory Committee

Vincenzo Loia

Albert Zomaya

Fang-Yie Leu

Masato Tsuru

University of Salerno, Italy

University of Sydney, Australia

Tunghai University, Taiwan

Kyushu Institute of Technology, Japan

## International Liaison Co-chairs

Aneta Poniszewska-Maranda

Xu An Wang

Lodz University of Technology, Poland

Engineering University of CAPF, China



Jakub Nalepa	Silesian University of Technology and Future Processing, Poland
Omar Hussain	UNSW Canberra, Australia

### **Award Co-chairs**

Tomoya Enokido	Rissho University, Japan
Marek Ogiela	AGH University of Science and Technology, Poland
Vaclav Snasel	VŠB-Technical University of Ostrava, Czech Republic

### **Web Administrator Co-chairs**

Phudit Ampririt	Fukuoka Institute of Technology, Japan
Kevin Bylykbashi	Fukuoka Institute of Technology, Japan
Ermioni Qafzezi	Fukuoka Institute of Technology, Japan

### **Local Arrangement Co-chair**

Yusuke Sakumoto	Kwansei Gakuin University, Japan
-----------------	----------------------------------

### **Finance Chair**

Makoto Ikeda	Fukuoka Institute of Technology, Japan
--------------	--

### **Steering Committee Chair**

Leonard Barolli	Fukuoka Institute of Technology, Japan
-----------------	--

### **Track Areas and PC Members**

#### **Track 1: Data Mining, Machine Learning and Collective Intelligence**

##### **Track Co-chairs**

Carson K Leung	University of Manitoba, Canada
Alfredo Cuzzocrea	University of Calabria, Italy

##### **TPC Members**

Fan Jiang	University of Northern British Columbia, Canada
Wookey Lee	Inha University, Korea

Oluwafemi A. Sarumi	Federal University of Technology, Akure, Nigeria
Syed K. Tanbeer	University of Manitoba, Canada
Tomas Vinar	Comenius University in Bratislava, Slovakia
Kin Fun Li	University of Victoria, Canada

## **Track 2: Intelligent Systems and Knowledge Management**

### **Track Co-chairs**

Marek Ogiela	AGH University of Science and Technology, Poland
Chang Choi	Gachon University, Republic of Korea
Daichi Kominami	Osaka University, Japan

### **TPC Members**

Hsing-Chung (Jack) Chen	Asia University, Taiwan
Been-Chian Chien	National University, Taiwan
Junho Choi	Chosun University, Korea
Farookh Khadeer Hussain	Technology of University Sydney, Australia
Hae-Duck Joshua Jeong	Korean Bible University, Korea
Hoon Ko	Sungkyunkwan University, Korea
Natalia Krzyworzeka	AGH University of Science and Technology, Poland
Libor Mesicek	J. E. Purkinje University, Czech Republic
Lidia Ogiela	AGH University of Science and Technology, Poland
Su Xi	Hohai University, China
Ali Azadeh	Tehran University, Iran
Jin Hee Yoon	Sejong University, South Korea
Hamed Shakouri	Tehran University, Iran
Jee-Hyong Lee	Sungkyunkwan University, South Korea
Jung Sik Jeon	Mokpo National Maritime University, South Korea

## **Track 3: Wireless and Sensor Systems for Intelligent Networking**

### **Track Co-chairs**

Do van Thanh	Telenor & Oslo Metropolitan University, Norway
Shigeru Kashihara	Nara Institute of Science and Technology, Japan

**TPC Members**

Dhananjay Singh	HUFS, Korea
Shirshu Varma	IIIT-Allahabad, India
B. Balaji Naik	NIT-Sikkim, India
Sayed Chhattan Shah	HUFS, Korea, USA
Madhusudan Singh	Yonsei University, Korea
Irish Singh	Ajou University, Korea
Gaurav Tripathi	Bharat Electronics Limited, India
Jun Kawahara	Kyoto University, Japan
Muhammad Niswar	Hasanuddin University, Indonesia
Vasaka Visoottiviset	Mahidol University, Thailand
Jane Louie F. Zamora	Weathernews Inc., Japan

**Track 4: Service-based Systems****Track Co-chairs**

Corinna Engelhardt-Nowitzki	University of Applied Sciences, Austria
Natalia Kryvinska	Comenius University in Bratislava, Slovakia
Takuya Asaka	Tokyo Metropolitan University, Japan

**TPC Members**

Maria Bohdalova	Comenius University in Bratislava, Slovakia
Ivan Demydov	Lviv Polytechnic National University, Ukraine
Jozef Juhar	Technical University of Košice, Slovakia
Nor Shahniza Kamal Bashah	Universiti Teknologi MARA, Malaysia
Eric Pardede	La Trobe University, Australia
Francesco Moscato	University of Campania “Luigi Vanvitelli”, Italy
Tomoya Enokido	Rissho University, Japan
Olha Fedevych	Lviv Polytechnic National University, Ukraine

**Track 5: Networking Security and Privacy****Track Co-chairs**

Xu An Wang	Engineering University of CAPF, China
Mingwu Zhang	Hubei University of Technology, China

**TPC Members**

Fushan Wei	The PLA Information Engineering University, China
He Xu	Nangjing University of Posts and Telecommunications, China

Yining Liu	Guilin University of Electronic Technology, China
Yuechuan Wei	Engineering University of CAPF, China
Weiwei Kong	Xi'an University of Posts and Telecommunications, China
Dianhua Tang	CETC 30, China
Hui Tian	Huaqiao University, China
Urszula Ogiela	AGH University of Science and Technology, Poland
Davinder Kaur	IUPUI, USA

## **Track 6: E-Learning and Web-based Systems**

### **Track Co-chairs**

Santi Caballe	Open University of Catalonia, Spain
Francesco Orciuoli	University of Salerno, Italy
Shigeo Matsubara	Kyoto University, Japan

### **TPC Members**

Soumya Barnejee	Institut National des Sciences Appliquées, France
David Bañeres	Open University of Catalonia, Spain
Nicola Capuano	University of Basilicata, Italy
Nestor Mora	Open University of Catalonia, Spain
Jorge Moneo	University of San Jorge, Spain
David Gañán	Open University of Catalonia, Spain
Isabel Guitart	Open University of Catalonia, Spain
Elis Kulla	Fukuoka Institute of Technology, Japan
Evjola Spaho	Polytechnic University of Tirana, Albania
Florin Pop	University Politehnica of Bucharest, Romania
Kin Fun Li	University of Victoria, Canada
Miguel Bote	University of Valladolid, Spain
Pedro Muñoz	University of Carlos III, Spain

## **Track 7: Cloud Computing: Services, Storage, Security and Privacy**

### **Track Co-chairs**

Javid Taheri	Karlstad University, Sweden
Shuiguang Deng	Zhejiang University, China

**TPC Members**

Ejaz Ahmed	National Institute of Standards and Technology, USA
Asad Malik	National University of Science and Technology, Pakistan
Usman Shahid	Comsats University Islamabad, Pakistan
Assad Abbas	North Dakota State University, USA
Nikolaos Tziritas	Chinese Academy of Sciences, China
Osman Khalid	Comsats University Islamabad, Pakistan
Kashif Bilal	Qatar University, Qatar
Javid Taheri	Karlstad University, Sweden
Saif Rehman	Comsats University Islamabad, Pakistan
Inayat Babar	Comsats University Islamabad, Pakistan
Thanasis Loukopoulos	Technological Educational Institute of Athens, Greece
Mazhar Ali	Comsats University Islamabad, Pakistan
Tariq Umer	Comsats University Islamabad, Pakistan

**Track 8: Social Networking and Collaborative Systems****Track Co-chairs**

Nicola Capuano	University of Basilicata, Italy
Dusan Soltes	Comenius University in Bratislava, Slovakia
Yusuke Sakumoto	Kwansei Gakuin University, Japan

**TPC Members**

Santi Caballé	Open University of Catalonia, Spain
Thanasis Daradoumis	University of the Aegean, Greece
Angelo Gaeta	University of Salerno, Italy
Christian Guetl	Graz University of Technology, Austria
Miltiadis Lytras	American College of Greece
Agathe Merceron	Beuth University of Applied Sciences Berlin, Germany
Francis Palma	Screaming Power, Canada
Krassen Stefanov	Sofia University “St. Kliment Ohridski”, Bulgaria
Daniele Toti	Roma Tre University, Italy
Jian Wang	Wuhan University, China
Jing Xiao	South China Normal University, China
Jian Yu	Auckland University of Technology, Australia
Aida Masaki	Tokyo Metropolitan University, Japan

Takano Chisa  
Sho Tsugawa

Hiroshima City University, Japan  
Tsukuba University, Japan

## **Track 9: Intelligent and Collaborative Systems for e-Health**

### **Track Co-chairs**

Massimo Esposito	Institute for High Performance Computing and Networking—National Research Council of Italy, Italy
Mario Ciampi	Institute for High Performance Computing and Networking—National Research Council of Italy, Italy
Giovanni Luca Masala	University of Plymouth, UK

### **TPC Members**

Tim Brown	Australian National University, Australia
Mario Marcos do Espirito Santo	Universidade Estadual de Montes Claros, Brazil
Jana Heckenbergerova	University Pardubice, Czech Republic
Zdenek Matej	Masaryk University, Czech Republic
Michal Musilek	University Hradec Kralove, Czech Republic
Michal Prauzek	VSB-TU Ostrava, Czech Republic
Vaclav Prenosil	Masaryk University, Czech Republic
Alvin C. Valera	Victoria University of Wellington, New Zealand
Nasem Badr El Din	University of Manitoba, Canada
Emil Pelikan	Academy of Sciences, Czech Republic
Joanne Nightingale	National Physical Laboratory, UK
Tomas Barton	University of Alberta, Canada

## **Track 10: Big Data Analytics for Networking and Collaborative Systems**

### **Track Co-chairs**

Miroslav Voznak	VSB-Technical University of Ostrava, Czech Republic
Akihiro Fujihara	Chiba Institute of Technology, Japan
Lukas Vojtech	Czech Technical University in Prague, Czech Republic

**TPC Members**

Nobuyuki Tsuchimura  
 Masanori Nakamichi  
 Masahiro Shibata  
 Yusuke Ide  
 Takayuki Shimotomai

Dinh-Thuan Do  
 Floriano De Rango  
 Homero Toral-Cruz  
 Remigiusz Baran  
 Mindaugas Kurmis

Radek Martinek

Mauro Tropea  
 Gokhan Ilk  
 Shino Iwami

Kwansei Gakuin University, Japan  
 Fukui University of Technology, Japan  
 Kyushu Institute of Technology, Japan  
 Kanazawa Institute of Technology, Japan  
 Advanced Simulation Technology Of Mechanics  
 R&D, Japan

Ton Duc Thang University, Vietnam  
 University of Calabria, Italy  
 University of Quintana Roo, Mexico  
 Kielce University of Technology, Poland  
 Klaipeda State University of Applied Sciences,  
 Lithuania

VSB-Technical University of Ostrava, Czech  
 Republic

University of Calabria, Italy  
 Ankara University, Turkey  
 Microsoft, Japan

**INCoS-2022 Reviewers**

Barolli Admir  
 Barolli Leonard  
 Bhed Bista  
 Bylykbashi Kevin  
 Cui Baojiang  
 Enokido Tomoya  
 Esposito Christian  
 Fenza Giuseppe  
 Ficco Massimo  
 Fujihara Akihiro  
 Fun Li Kin  
 Funabiki Nobuo  
 Hsing-Chung Chen  
 Hussain Farookh  
 Hussain Omar  
 Ikeda Makoto  
 Ishida Tomoyuki  
 Javaid Nadeem  
 Kashihara Shigeru  
 Kohana Masaki  
 Kromer Pavel  
 Kryvinska Natalia  
 Kulla Elis

Leu Fang-Yie  
 Leung Carson  
 Li Yiu  
 Maeda Hiroshi  
 Mangione Giuseppina Rita  
 Matsuo Keita  
 Messina Fabrizio  
 Miwa Hiroyoshi  
 Natwichai, Juggapong  
 Nalepa Jakub  
 Nowakowa Jana  
 Oda Tetsuya  
 Ogiela Lidia  
 Ogiela Marek  
 Orciuoli Francesco  
 Palmieri Francesco  
 Pardede Eric  
 Ponsizewska-Maranda Aneta  
 Rahayu Wenny  
 Sakaji Hiroki  
 Sakamoto Shinji  
 Shibata Masahiro  
 Snasel Vaclav

Spaho Evjola  
Sukumoto Yusuke  
Taniar David  
Takizawa Makoto  
Thomo Alex  
Tsukamoto Kazuya

Tsuru Masato  
Uchida Masato  
Uehara Minoru  
Venticinque Salvatore  
Woungang Isaac  
Xhafa Fatos



# **INCoS-2022 Keynote Talks**

# **Fundamental Model of Online User Dynamics Based on a Causal Framework**

Masaki Aida

Tokyo Metropolitan University, Tokyo, Japan

User dynamics in online social networks have come to have a great impact not only on online society but also on real life. Therefore, understanding online user dynamics is an important issue. Of course, it is difficult to understand all of the complex online user dynamics, but it may be possible to describe their characteristics in a particular way. This talk introduces an attempt to give a mathematical model of online user dynamics based on a causal framework in which the mutual influences working between users are propagated at finite speeds via an online social network. This model can theoretically explain various phenomena including the intensity of user dynamics diverges, such as online flaming phenomena, and the phenomenon that information propagation is restricted only within a specific community, such as polarization.

# **Big Data Analytics on COVID-19 Epidemiological Data**

Carson K. Leung

University of Manitoba, Manitoba, Canada

In the current era of big data, high volume of big data can be generated and collected from a wide variety of rich data sources at a rapid rate. Embedded in these big data are useful information and valuable knowledge. Examples include healthcare and epidemiological data such as data related to patients who suffered from viral diseases like the coronavirus disease 2019 (COVID-19). Knowledge discovered from these epidemiological data via data science helps researchers, epidemiologists, and policymakers to get a better understanding of the disease, which may inspire them to come up with ways to detect, control and combat the disease. This talk presents big data analytics solutions for analyzing COVID-19 epidemiological data. The solutions help users to get a better understanding of information about COVID-19 cases. Evaluation on real-life COVID-19 data across Canadian provinces shows the benefits of big data analytics in discovering useful knowledge from COVID-19 epidemiological data.

# Contents

<b>User’s Emotion Profiling in Web Browsing Behavior</b> . . . . .	1
Yusuke Yoshida, Kana Masuda, Kosuke Takano, and Kin Fun Li	
<b>A Comparison Study of FC-RDVM and LDVM Router Placement Methods for WMNs by WMN-PSOHC Simulation System Considering Different Instances</b> . . . . .	9
Shinji Sakamoto, Admir Barolli, Yi Liu, Elis Kulla, Leonard Barolli, and Makoto Takizawa	
<b>Stochastic Computing-Based Baseband Processing for Resource Constraint IoT Devices</b> . . . . .	20
Kazi J. Ahmed, Yang G. Kim, Bo Yuan, Myung J. Lee, and Kazuya Tsukamoto	
<b>Comparative Road State Decision Making Results by Various Environmental Sensors on Public Winter Road</b> . . . . .	35
Yoshitaka Shibata and Akira Sakuraba	
<b>A Movement Adjustment Method for DQN-Based Autonomous Aerial Vehicle Mobility: Performance Evaluation of AAV Mobility Control Method in Corner Environment</b> . . . . .	45
Nobuki Saito, Chihiro Yukawa, Kyohei Toyoshima, Tomoya Yasunaga, Yuki Nagai, Tetsuya Oda, and Leonard Barolli	
<b>Personalized Security Solutions in Dispersed Computing</b> . . . . .	58
Urszula Ogiela and Marek R. Ogiela	
<b>Obstacle Detection Support System Using Monocular Camera</b> . . . . .	62
Naoya Hayashida and Hiroyoshi Miwa	
<b>Chatbot at University, a Communication Tool to Increase Work Productivity</b> . . . . .	74
Dorota Kořecka, Peter Balco, and Sharon Cheronon Murgor	

<b>CoPoi: A Collaborative Framework to Optimize the Approach Towards Points of Interest</b> .....	85
Walter Balzano, Davide Pio Faicchia, and Silvia Stranieri	
<b>Self-positioning Method Based on Similarity Between Environmental Map and Information of Image and Point Cloud</b> .....	94
Hitoshi Kuwamura, Toru Ide, and Hiroyoshi Miwa	
<b>Fake Listing or Truth? Using Pre-trained Deep Learning Model with Data Augmentation to Detect the Imposter</b> .....	105
Nontakan Nuntachit, Prompong Sugannasil, and Rattasit Sukhahuta	
<b>Data Analytics for Parking Facility Management</b> .....	117
Deyu Deng, Carson K. Leung, and Adam G. M. Pazdor	
<b>OCR Error Correction for Vietnamese OCR Text with Different Edit Distances</b> .....	130
Quoc-Dung Nguyen, Nguyet-Minh Phan, and Pavel Kromer	
<b>A Fuzzy-Based System for Assessment of Fog Computing Resources in SDN-VANETs Considering Service Migration Speed as a New Parameter</b> .....	140
Ermioni Qafzezi, Kevin Bylykbashi, Admir Barolli, Makoto Ikeda, Keita Matsuo, and Leonard Barolli	
<b>Performance Evaluation Experiments of Bitcoin SV Scaling Test Network</b> .....	150
Akihiro Fujihara and Takaaki Yanagihara	
<b>The Emerging Challenges of Big Data Lakes, and a Real-Life Framework for Representing, Managing and Supporting Machine Learning on Big Arctic Data</b> .....	161
Alfredo Cuzzocrea, Carson K. Leung, Selim Soufargi, and Anifat M. Olawoyin	
<b>Data Ingestion for Data-Driven Service Platform: Royal Project Foundation Case Study</b> .....	175
Suphatchaya Autarrom, Kittayaporn Chantaranimi, Chanwit Chanton, Anchan Chompupoung, Pichan Jinapook, Waranya Mahanan, Pathathai Na Lumpoon, Juggapong Natwichai, Nontakan Nuntachit, Nitchanan Prapairakul, Rattasit Sukhahuta, Prompong Sugunsil, Sumalee Sangamuang, Titipat Sukhvibul, and Pree Thiengburanathum	
<b>A Study on an Autonomous Adaptive Mechanism for the Robustness of the User's Location-Aware Resource Assignment Against Demand Fluctuation</b> .....	187
Keita Tatebe and Yusuke Sakumoto	

**Mesh Routers Placement by WMN-PSODGA Hybrid Intelligent System Considering Stadium Distribution and RDVM: A Comparison Study for Different Crossover Methods . . . . .** 199  
Admir Barolli, Kevin Bylykbashi, Ermioni Qafzezi, Shinji Sakamoto, Leonard Barolli, and Makoto Takizawa

**Experimental Results of a Haptics Based Soldering Education System: A Comparison Study of RNN and LSTM for Detection of Dangerous Movements . . . . .** 212  
Kyohei Toyoshima, Tomoya Yasunaga, Yuki Nagai, Chihiro Yukawa, Tomoaki Matsui, Tetsuya Oda, and Leonard Barolli

**Semantic Network: A Brief Review of its Datasets . . . . .** 224  
Marcello Trovati and Suleman Awan

**Sentiment Analysis: A General Review and Comparison . . . . .** 234  
Tariq Soussan and Marcello Trovati

**A Simple Information Compression Algorithm for Directed Paths in Large Semantic Networks . . . . .** 239  
Marcello Trovati and Suleman Awan

**The Role of Religious Values to Drive Value Co-creation in Religio-Centric Market . . . . .** 243  
Ken Sudarti, Hendar Hendar, and Moch. Zulfa

**Blockchain Technology as Corporate Governance Innovation Model for SMEs . . . . .** 253  
Mutamimah Mutamimah, Suryani Alifah, and Made Dwi Adnjani

**Green Accounting Adoption Toward Sustainable Performance . . . . .** 264  
Maya Indriastuti, Anis Chariri, and Fuad

**Real Earnings Management in Family Firm . . . . .** 274  
Edy Suprianto

**Partnership Quality as a Strategy to Improve Partnership Performance: A Case Study of BPJS Healthcare in Indonesia . . . . .** 283  
Alifah Ratnawati and Sri Wahyuni Ratnasari

**The Role of Corporate Governance in Preventing Financial Distress . . .** 291  
Luluk Muhimatul Ifada and Indra Yulianto

**Profit Distribution and Islamic Value: A Conceptual Development of Al-Adl Profit Distribution Management . . . . .** 301  
Nunung Ghoniyah and Widiyanto bin Mislan Cokrohadisumarto

**The Importance of Information Technology Adoption and Fintech to Improve SMEs Performance During the Covid-19 Pandemic . . . . .** 308  
Sri Anik, Bedjo Santoso, and Sri Ayuni

<b>Conceptual Framework for Determining Sukuk Investment Intentions Among Millennials</b> . . . . .	319
Aftuqa Sholikatur Rohmania and Nunung Ghoniyah	
<b>Blockchain Model to Support <i>Waqf</i> Management</b> . . . . .	328
Bedjo Santoso and Moch. Zulfa	
<b>Impact of Dynamic Capabilities and ICT Utilization on Performance of SMEs and Moderating Role of Agile Leadership: A Case Study for Indonesia</b> . . . . .	339
Siti Aisyah Suciningtias, Heri Sudarsono, Sri Anik, and Sasti Anjana Widhyasti	
<b>Implementation of CSR and Family Governance in Increasing Competitiveness Through Agile Innovation in SMEs: A Conceptual Model</b> . . . . .	350
Winarsih, Chrisna Suhendi, and Kiryanto	
<b>Effect of Intellectual Capital on Firm Value Considering Dividend Policy as a Control Variable</b> . . . . .	356
Ibnu Khajar and Ahmad Hijri Alfian	
<b>Ihsan Digipreneurship Orientation: Religious Value for Managing E-Business</b> . . . . .	364
Ayatullah Sadali, Olivia Fachrunnisa, and Ardian Adhiatma	
<b>Impact of Chest X-ray Images Enhancement to COVID-19 Classification Using Vector Quantization and Fuzzy S-tree</b> . . . . .	371
Vojtěch Uher and Jana Nowaková	
<b>Simple Approach for Dynamics Evaluation of Scratch Wound Healing Assay</b> . . . . .	380
Markéta Vašínková, Michal Krumnikl, Zuzana Mikulková, Petr Gajdoš, and Eva Kriegová	
<b>Restriction Site Detection in Optical Mapping Data</b> . . . . .	393
Vít Doleží, Petr Gajdoš, Marek Běhálek, and Michal Vašínek	
<b>Driver Response Time and Behavior Profiles, Extracted from Sugeno Fuzzy Models by the Louvain Network Clustering</b> . . . . .	403
Martin Radvansky Jr., Martin Radvansky, Milos Kudelka, and Miroslav Jirgl	
<b>A Neural System for Acute Disease Detection from Facial Images</b> . . . . .	413
Radovan Fusek and Pavel Krömer	
<b>Image Enhancement in Retinopathy of Prematurity</b> . . . . .	422
Martin Hasal, Jana Nowaková, Daniel Hernández-Sosa, and Juraj Timkovič	

**Algorithms for Path Planning and Scheduling of Automated Guided Vehicles Iteratively Carrying Objects . . . . .** 432  
Sumihiro Yoneyama and Hiroyoshi Miwa

**A P4 Bmv2-Based Feasibility Study on a Dynamic In-Band Control Channel for SDN . . . . .** 442  
Kazumi Kumazoe, Masahiro Shibata, and Masato Tsuru

**Fungi Network Simulation for the Study of Communication Systems . . .** 452  
Nurdiansyah Sirimorok, Rio Mukhtarom Paweroi, Andi Arniaty Arsyad, and Mario Köppen

**Resource Allocation Method for Fairness and Efficient Utilization of Network and Computational Resources in Edge Networks . . . . .** 463  
Shota Akiyoshi, Yuzo Taenaka, Kazuya Tsukamoto, and Myung Lee

**A Comprehensive Analysis of Machine Learning-Based Intrusion Detection System for IoT-23 Dataset . . . . .** 475  
Yang G. Kim, Kazi J. Ahmed, Myung J. Lee, and Kazuya Tsukamoto

**Author Index . . . . .** 487





# Green Accounting Adoption Toward Sustainable Performance

Maya Indriastuti<sup>1,2(✉)</sup>, Anis Chariri<sup>1</sup>, and Fuad<sup>1</sup>

<sup>1</sup> Department of Accounting, Faculty of Economics and Business, Universitas Diponegoro, Jalan Erlangga Tengah, Semarang, Indonesia  
maya@unissula.ac.id, anis\_chariri@live.undip.ac.id,  
fuad@lecturer.undip.ac.id

<sup>2</sup> Department of Accounting, Faculty of Economics, Universitas Islam Sultan Agung, Jalan Raya Kaligawe KM 4, Semarang, Indonesia

**Abstract.** Small and medium enterprises (SMEs) play a strategic role in contributing to the environment, society, and surrounding communities. One of the SMEs is from the batik industry, identified by the Ministry of Environment as one of Indonesia's worst causes of river pollution. Excessive water, dye materials, and kerosene stoves cause environmental pollution. Several studies reveal that the batik industry produces quite high CO<sub>2</sub> emissions. If batik entrepreneurs do not immediately realize it, it has the potential to lower performance and environmental sustainability; thus, green accounting is expected to affect sustainable performance. This study examines green accounting on sustainable performance with financial performance as an intervening variable involving batik SMEs in Central Java, Indonesia. This research contributes to the literature on green accounting practices by looking at how SMEs in Central Java of Indonesia take their social roles thoughtfully.

**Keywords:** Green accounting · Financial performance · Sustainable performance · Central Java SMEs

## 1 Introduction

Currently, Batik SMEs in Indonesia is one of the SMEs that produce high enough CO<sub>2</sub> emissions, causing damage to the natural environment [1]. Most industries, especially SMEs, face environmental performance problems and low environmental awareness. It is due to the orientation of SME owners who only focus on profit. As a result, they cannot respond to the demands of stakeholders and the surrounding community. Moreover, during the company's movement toward a green company, the industry needs to consider waste processing and the needs of the consumer community. They also must focus on the production process of an item, from raw materials to the disposal of a product, and make sure that it does not harm the environment.

The study [2] confirms that organizations continue to seek legitimacy by aligning social values and norms with industry values and maintaining the alignment of these

two values. As long as industry values or standards align with social values, the industry will gain legitimacy and support from stakeholders [3]. [5] added that internally, the role of green accounting can motivate managers to reduce the environmental costs incurred, which will affect decisions. It also will form the basis of the company's existence in the future.

The concept of environmental accounting is a development of environmental management. In the mid-1990s, IASC (The International Accounting Standards Committee) developed the idea of international accounting principles. This principle includes the development of environmental accounting. Apart from being an economic institution, companies are also social institutions. Thus, it is hoped that companies can progress and develop with the community around the company. [6] explained that the green accounting concept is prepared to internalize various externalities due to industrial processes.

Green accounting activities can increase investor confidence to make sustainable investments [7] that are low-carbon and climate-resistant. It means, responsible and consistent investments with environmental ethics (such as reducing carbon emissions, green energy, green costs and green technology) will have an impact on increasing financial performance towards sustainable performance. However, this activity involves very high cost increases if the industry is in a period of financial uncertainty [8]. Several studies have also examined several factors that affect financial performance [6, 9–15]. Other studies also reinforce these findings [16–22]. Furthermore [23–31]; also researched factors that enhance financial performance. Meanwhile, a study on company reputation and consumer loyalty was conducted by [32]; and research on sustainable performance was observed by [33, 34].

This research contributes to the guidelines: (1) for investors to invest by considering the company's business continuity. A good company is a company that discloses all financial, social, and environmental information in subsequent company reports; (2) for SMEs, as a strategy to increase profits without harming the environment; and (3) for the Cooperatives and SMEs, as a reference for formulating regulations related to business and the environment.

## 2 Literature Review and Hypothesis Development

### 2.1 Literature Review

Green accounting includes the indirect costs and benefits of economic activities, such as environmental impacts and health consequences of business planning and decisions [35]. [36] stated that green accounting identifies, measures, presents, and discloses the costs associated with the company's activities related to the environment. Green accounting demands full awareness of companies and other organizations that benefit from the environment. Companies or other organizations must increase efforts to consider environmental conservation sustainably. The use of environmental accounting concepts for companies encourages the ability to minimize environmental problems [36]. [37] described that there are several types of activities that reflect green accounting practices in companies, namely: (1) the use of environmentally friendly raw materials, (2) the

waste management that does not cause pollution or damage to the surrounding environment, and (3) corporate social responsibility as the proof of the company's concern for the environment around the environment.

[38] defined financial performance as the real financial condition of a company by applying agreed standards and criteria to achieve the desired performance in a certain period. The company's financial performance is also the result of many individual decisions made continuously by management, where there is a determination of certain steps that can assess the success of a company in generating profits [39]. In other words, the company's financial performance can be seen from the level of company profitability [40, 41].

Sustainable performance is a balanced performance based on three aspects: people-planet-profit, also known as the Triple Bottom Line concept. [42] suggested that an organization's sustainable performance refers to its ability to meet the needs and expectations of customers and other stakeholders in the long term. It is balanced by effective organizational management through the awareness of the organization's staff by studying and implementing appropriate improvements and innovations.

## 2.2 Implementation of Green Accounting in Indonesian SMEs

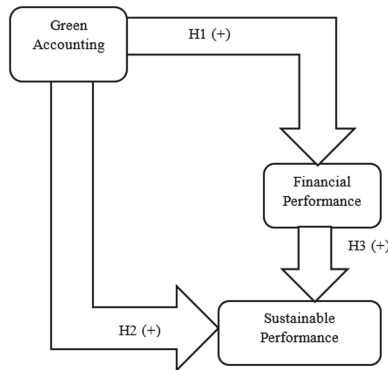
There is no legal regulation of green accounting applications specifically for SMEs. Only private companies have the regulation of green accounting applications, as explained in [43], which is a follow-up to [44]. The law states that every company that runs its business in fields related to natural resources has social and environmental responsibilities.

[45] showed two out of three batik SMEs in Jember Regency, East Java, already have a good understanding and concern for protecting the environment as a form of implementing green accounting. The lack of understanding and concern in some SMEs batik owners is due to the self-taught ability, low experience, and low level of education in managing business and environmental costs. [46] concluded that the batik industry in Kampung Batik Laweyan, Surakarta, Central Java, is categorized as moderate or good enough to the environment but did not have an environmental audit report to audit environmental programs, funds and performance. In addition, public awareness is still low, which is reflected in only ten batik companies participating in WWTPs (wastewater treatment plants) because capacity is still limited.

[47] stated that Lele Soy Sauce Factory in Pati, Central Java, has implemented green accounting for factory waste. However, there are no green costs to guarantee the green accounting funds. [48] found that the understanding of green accounting for tofu and tempeh SMEs in Bandar Lampung, Indonesia, is still low because the interests of tofu and tempeh SMEs are still focused on business profits, not on product quality and environmental quality. [49] added there was no different attention between large and medium-sized industries in Semarang regarding environmental problems. The differences were found in terms of environmental audits.

## 2.3 Empirical Research Model

The empirical model of this study is developed from a combination of studies on green accounting, financial performance, and sustainable performance (Fig. 1).



**Fig. 1.** Research model

## 2.4 Hypothesis Development

### 2.4.1 Green Accounting and Financial Performance

Green accounting measures the impact of human activities on the earth's ecological systems and resources, not just the financial impact of these activities but also including costs for environmental preservation [36]. Implementing green accounting in companies can improve their financial performance because financial performance will show whether the company's financial condition is good or bad. The measurement of the company's financial performance uses financial ratios that show changes in the company's financial condition and the company's potential in managing company assets. The study results [50] showed a positive relationship between environmental disclosure and ROA. It implies that companies with better financial performance prove it through environmental/CSR disclosures in annual reports. Several studies have shown the same results: [23, 51–55], stating that CSR carried out by companies is positively related to financial performance. [56] added that SMEs also carried out social responsibility in Ghanaians, where social responsibility can improve financial performance. In conclusion, financial performance can be improved through environmental management [22–30, 57], environmental accounting [58]; green investment and CSR investment [59].

The results of this study indicate that two of the three business actors who produce batik in Jember Regency, East Java Province, already have a good understanding and concern for protecting the environment as a form of implementing green accounting. Although they have not understood the details of business expenses and environmental costs, they have realized that environmental costs are their responsibility.

H1: The adoption of green accounting can improve financial performance.

### 2.4.2 Green Accounting and Sustainable Performance

Green accounting is a concept where the company prioritizes efficiency and effectiveness in using resources sustainably in its production process. It aims to align the company's development with environmental functions and benefit the community [60]. In ensuring the company towards sustainable performance, the company must build a relationship

with the environment by preserving the environment. The adoption of green accounting within the company is evidenced by social responsibility that must be carried out and supported through socially responsible investments. It is both through financial performance and non-financial criteria in environmental management and problem-solving in the social sphere [42]. [61] stated that companies must provide benefits to their stakeholders, such as the welfare of employees, customers, and the surrounding community. It seeks to establish good relations between the company and the surrounding environment to improve its sustainability performance. The company's sustainable performance can be improved by green investment activities [33, 35, 52, 62, 63], CSR investment [13, 31, 34, 64].

H2: The adoption of green accounting can enhance sustainable performance.

### 2.4.3 Financial Performance and Sustainable Performance

[65] defined financial performance as the company's efforts to earn revenue and growth. [66] added that financial performance in a period can be used to measure the achievement of company performance, decision-making by investors, and additional capital for company management. The better the company's financial condition, it can minimize internal risk because investors get good information from the financial performance. [67, 68] believed that financial performance could push companies towards sustainable performance. It is in line with the results of research [69] that there is a relationship between the level of disclosure of environmental information and the return on company assets.

H3: Financial performance can intensify sustainable performance.

## 3 Research Method

### 3.1 Population and Sample

The population in this study were all batik SMEs in Central Java, including Pemalang Regency, Pekalongan City, Semarang City, and Pati Regency. The sample of this research is the batik SMEs in four districts/cities in Central Java, namely Pemalang, Pekalongan, Semarang, and Pati, with 300 respondents. Sampling used a purposive sampling method based on the consideration of Batik SMEs operating for at least five years and still exist today.

### 3.2 Data Collecting Plan

Data collection planning includes primary data and secondary data. The primary data is collected using a questionnaire instrument, which contains questions/statements that reflect the dimensions and indicators of green accounting, financial performance, and sustainable performance of SMEs. Meanwhile, the secondary data is obtained from the Central Java Bureau of Statistics [70, 71]. Secondary data were taken from the number of batik SMEs and sales turnover.

### 3.3 Measurement Variable

The green accounting variable is measured by operational, waste recycling, and research costs [72]. Financial performance variables are measured by: sales, income, and profit [20]. Meanwhile, the variable of sustainable performance is measured by economic, environmental, and social [73] and [74] dimensions. All indicators of each variable are calculated using a Likert scale of 1 to 5, 1 for strongly disagree and 5 for strongly agree.

### 3.4 Data Analysis Plan

The data analysis technique of this study is processed using multiple linear regression analysis [75]. The regression equation of this research is as follows:

$$FP = \alpha + \beta_1 GA + e1 \quad (\text{model 1})$$

$$SP = \alpha + \beta_1 GA + \beta_2 FP + e2 \quad (\text{model 2})$$

in which:

FP: Financial Performance

SP: Sustainable Performance

$\alpha$ : Constant

$\beta_1$ – $\beta_2$ : Regression Coefficient

GA: Green Accounting

e1, e2: Error.

Meanwhile, the mediation hypothesis was tested using a procedure developed by Sobel [76] and known as the Sobel test. The Sobel test examines the strength of the indirect X to Y through I. The formula is as follows:

$$sab = \sqrt{b^2 sa^2 + a^2 sb^2 + sa^2 sb^2}$$

in which:

sab: the error standard of indirect influence

a: independent variable path (X) with intervening variable (I)

b: intervening variable path (I) with the dependent variable (Y)

sa: error standard coefficient a

sb: error standard coefficient b.

## 4 Conclusion

The batik industry is one of Indonesia's growing industries and contributes a lot to industrial waste. Unfortunately, there are no legal rules of green accounting specifically for SMEs. Therefore, it is necessary to adopt green accounting in Central Java Batik SMEs in Indonesia towards sustainable performance. This research implies adding a reference for Batik SMEs to care for and be aware of batik waste on the environment.

## References

1. [www.kemenperin.go.id](http://www.kemenperin.go.id)
2. Dowling, J., Pfeffer, J.: Organizational legitimacy, social values and organizational behavior. *Pac. Sociol. Rev.* **18**, 122–136 (1975)
3. Ashforth, B.E., Gibbs, B.W.: The double-edge of organizational legitimation. *Organ. Sci.* **1**(2), 177–194 (1990)
4. Donovan, G.: Environmental disclosures in the annual report. *Account. Audit. Accountabil. J.* **15**(3), 344–371 (2002). <https://doi.org/10.1108/09513570210435870>
5. Clarkson, P.M., Li, Y., Richardson, G.D., Vasvari, F.P.: Does it really pay to be green? Determinants and consequences of proactive environmental strategies. *J. Account. Public Policy* **30**(2), 122–144 (2011)
6. Galant, A., Cadez, S.: Corporate social responsibility and financial performance relationship: a review of measurement approaches. *Econ. Res. Ekon. Istraživanja* **30**(1), 676–693 (2017). <https://doi.org/10.1080/1331677X.2017.1313122>
7. Ganda, F., Ngwakwe, C.C., Ambe, C.M.: Profitability as a factor that spurs corporate green investment practices in Johannesburg Stock Exchange (JSE) listed firms. *Manag. Glob. Transit.* **13**(3), 231–252 (2015)
8. Doran, J., Ryan, G.: Regulation and firm perception, eco-innovation and firm performance. *Eur. J. Innov. Manag.* **15**(4), 421–441 (2012)
9. Kumarasiri, J., Jubb, C.: Carbon emission risks and management accounting: Australian evidence. *Account. Res. J.* **29**(2), 137–153 (2016)
10. Chariri, A., Bukit, G.R., Eklesia, O.B., Christi, B.U., Tarigan, D.M.: Does green investment increase financial performance empirical evidence from Indonesia companies. In: *E3S Web of Conferences. ICENIS*, pp. 1–7 (2018). <https://doi.org/10.1051/e3sconf/20183109001>
11. Chariri, A., Nasir, M., Januarti, I., Daljono, D.: Determinants and consequences of environmental investment: an empirical study of Indonesian firms. *J. Asia Bus. Stud.* **13**(3), 433–449 (2019). <https://doi.org/10.1108/JABS-05-2017-0061>
12. Eyraud, L., Clements, B., Wane, A.: Green investment trends and determinants. *Energy Policy Elsevier* **60C**, 852–865 (2013)
13. Khojastehpour, M., Johns, R.: The effect of environmental CSR issues on corporate/brand reputation and corporate profitability. *Eur. Bus. Rev.* **26**(4), 330–339 (2014)
14. Mangla, S.M.: Multi objective decision modelling using interpretive structural modeling for green supply chains. *Int. J. Logist. Syst.* **17**, 125–142 (2014)
15. Murovec, N., Erker, R.S., Prodan, I.: Determinants of environmental investment: testing the structural model. *J. Clean. Prod.* **17**, 265–277 (2012)
16. Uadiale, O., Fagbemi, T.: Corporate social responsibility and financial performance in developing economies: the Nigerian experience. *J. Econ. Sustain. Dev.* **3**(4), 44–54 (2012)
17. Wahba, H., Elsayed, K.: The mediating effect of financial performance on the relationship between social responsibility and ownership structure. *Future Bus. J.* **1**(1), 1–12 (2015)
18. Zhu, Q.F.: The role of customer relational government in environmental and economic performance improvement through green supply chain management. *J. Clean. Prod.* **155**, 46–53 (2017)
19. Manrique, S., Martí-Ballester, C.-P.: Analyzing the effect of corporate environmental performance on corporate financial performance in developed and developing countries. *Sustainability* **9**, 1957 (2017). <https://doi.org/10.3390/su9111957>
20. Turcsanyi, J., Sisaye, S.: Corporate social responsibility and its link to financial performance. *World J. Sci. Technol. Sustain. Dev.* **10**(1), 4–18 (2013). <https://doi.org/10.1108/20425941311313065>

21. Surroca, J., Tribó, J.A., Waddock, S.: Corporate responsibility and financial performance: the role of intangible resources. *Strateg. Manag. J.* **31**, 463–490 (2010). <https://doi.org/10.1002/smj.820>
22. Akisik, O., Gal, G.: The impact of corporate social responsibility and internal controls on stakeholders' view of the firm and financial performance. *Sustain. Account. Manag. Policy J.* **8**(3), 246–280 (2017). <https://doi.org/10.1108/SAMPJ-06-2015-0044>
23. Chtourou, H., Triki, M.: Commitment in corporate social responsibility and financial performance: a study in the Tunisian context. *Soc. Responsib. J.* **13**(2), 370–389 (2017). <https://doi.org/10.1108/SRJ-05-2016-0079>
24. Devie, D., Liman, L., Tarigan, J., Jie, F.: Corporate social responsibility, financial performance and risk in Indonesian natural resources industry. *Soc. Responsib. J.* (2018). <https://doi.org/10.1108/SRJ-06-2018-0155>
25. Feng, M., Wang, X., Kreuzer, J.: Corporate social responsibility and firm financial performance. *Am. J. Bus.* **32**(3–4), 106–133 (2017). <https://doi.org/10.1108/AJB-05-2016-0015>
26. Mahrani, M., Soewarno, N.: The effect of good corporate governance mechanism and corporate social responsibility on financial performance with earnings management as mediating variable. *Asian Journal of Accounting Research* **3**(1), 41–60 (2018). <https://doi.org/10.1108/AJAR-06-2018-0008>
27. Nyeadi, J., Ibrahim, M., Sare, Y.: Corporate social responsibility and financial performance nexus. *J. Glob. Responsib.* **9**(3), 301–328 (2018). <https://doi.org/10.1108/JGR-01-2018-0004>
28. Oware, K., Thathaiyah, M.: Corporate social responsibility investment, third-party assurance and firm performance in India The moderating effect of financial leverage. *Dept. Bus. Adm.* 303–324 (2019)
29. Salehi, M., Lari DashtBayaz, M., Khorashadizadeh, S.: Corporate social responsibility and future financial performance. *EuroMed J. Bus.* **13**(3), 351–371 (2018). <https://doi.org/10.1108/EMJB-11-2017-0044>
30. Sun, L.: Further evidence on the association between corporate social responsibility and financial performance. *Int. J. Law Manag.* **54**(6), 472–484 (2012). <https://doi.org/10.1108/17542431211281954>
31. Mishra, S., Suar, D.: Salience and corporate responsibility towards natural environment and financial performance of Indian manufacturing firms. *J. Glob. Responsib.* **44**(1), 44–61 (2013)
32. Lee, C., Chang, W., Lee, H.: An investigation of the effects of corporate social responsibility on corporate reputation and customer loyalty – evidence from the Taiwan non-life insurance industry. *Soc. Responsib. J.* **13**(2), 355–369 (2017)
33. Saxena, R.P., Khandelwal, P.K.: Greening of industries for sustainable growth: an exploratory study on durable and service industries. *Int. J. Soc. Econ.* **39**, 551–586 (2012)
34. Jain, R., Winner, L.H.: CSR and sustainability reporting practices of top companies in India. *Corp. Commun.: Int. J.* **21**(1), 36–55 (2016). <https://doi.org/10.1108/CCIJ-09-2014-0061>
35. Testa, F., Gusmerottia, N.M., Corsini, F., Passetti, E., Iraldo, F.: Factors affecting environmental management by small and micro firms: the importance of entrepreneurs' attitudes and environmental investment. *Corp. Soc. Responsib. Environ. Manag.* **23**(6), 373–385 (2015)
36. Cohen, N., Robbins, P.: *Green Business: An A-to-Z Guide*. SAGE Publications Inc., Thousand Oaks (2011)
37. Farouk, S., et al.: Green accounting and management for sustainable manufacturing in developing countries. *Int. J. Bus. Manag.* **7**(20) (2012). ISSN 1833-3850 E-ISSN 1833-8119. Canadian Center of Science and Education
38. Nor, N.M., et al.: The effects of environmental disclosure on financial performance in Malaysia. *Proc. Econ. Financ.* **35**, 117–126 (2016)



39. Epstein, M.J., Buhovac, A.R., Yuthas, K.: Managing social, environmental and financial performance simultaneously. *Long Range Plann.* **48**(1), 35–45 (2015). <https://doi.org/10.1016/j.lrp.2012.11.00>
40. Amacha, E.B., Dastane, O.: Sustainability practices as determinants of financial performance: a case of Malaysian corporations. *J. Asian Financ. Econ. Bus.* **4**(2), 55–68 (2017). <https://doi.org/10.13106/jafeb.2017>
41. Tabash, M.I.: An empirical investigation on the relation between disclosure and financial performance of Islamic banks in the United Arab Emirates. *J. Asian Financ. Econ. Bus.* **6**(4), 27–35 (2019). <https://doi.org/10.13106/jafeb>
42. Stanciu, A.-C., Constandache, M., Condrea, E.: Concerns about the sustainable performance of firm in the context of quality management systems implementation. *Proc. – Soc. Behav. Sci.* **131**, 340–344 (2014)
43. Peraturan Pemerintah Nomor 47: Government Regulation on Social and Environmental Responsibility of Limited Liability Companies (2012)
44. Undang-undang No 40: Perseroan Terbatas (2007)
45. Herlindawati, D., Kantun, S., Widayani, A., Tiara, T.: Understanding and concern in the implementation of green accounting by batik producers. *AKUNTABEL: J. Akuntansi Keuangan* **19**(1), 22–32 (2022). <https://journal.feb.unmul.ac.id/index.php/AKUNTABEL/article/view/10792/1724>
46. Pratiwi, D.N., Pravasanti, Y.A.: Analysis of the application of green accounting in the laweyan batik industry. *J. Account. Financ.* **3**(2), 536–549 (2018)
47. Yuliana, Y.K., Sulistyawati, A.I.: Green accounting: understanding and concern in application (case study on Lele Soy Sauce factory in pati regency). *SOLUSI: J. Ilmiah Bidang Ilmu Ekon.* **19**(1), 45–59 (2021). <http://journals.usm.ac.id/index.php/solusi>
48. Pentiana, D.: Understanding and concern to implementation of green accounting: a case study of SME Tempe Tofu in Bandar Lampung City. *J. Ilmiah ESAI* **13**(1), 38–50 (2019). <https://jurnal.polinela.ac.id/ESAI/article/view/1271>
49. Musyarofah, S.: Analysis of the application of green accounting in the city of Semarang. *Account. Anal. J.* **2**(3), 352–359 (2013). <https://journal.unnes.ac.id/sju/index.php/aaaj/article/view/2855/2646>
50. Chiu, C.L., Zhang, J., Li, M., Wei, S., Xu, S., Chai, X.: A study of environmental disclosures practices in Chinese energy industry. *Asian J. Sustainab. Soc. Responsib.* **5**(1), 1–21 (2020). <https://doi.org/10.1186/s41180-020-00036-1>
51. Najihah, N., Indriastuti, M., Suhendi, C.: The effect of corporate social responsibility and environmental cost on financial performance. In: Barolli, L., Ponsizewska-Maranda, A., Enokido, T. (eds.) *CISIS 2020. AISC*, vol. 1194, pp. 418–425. Springer, Cham (2021). [https://doi.org/10.1007/978-3-030-50454-0\\_42](https://doi.org/10.1007/978-3-030-50454-0_42)
52. Indriastuti, M., Najihah, N.: Enhancing financial performance through environment performance and corporate social responsibility. *Trikonomika* **19**(2), 70–75 (2020). <https://journal.unpas.ac.id/index.php/trikononika/article/view/2221/1584>
53. Gangi, F., Mustilli, M., Varrone, N.: The impact of corporate social responsibility (CSR) knowledge on corporate financial performance: evidence from the European banking industry. *J. Knowl. Manag.* **23**(1), 110–134 (2019)
54. Ho, A., Liang, H., Tumurbaatar, T.: The impact of corporate social responsibility on financial performance: evidence from commercial banks in Mongolia. *Adv. Pac. Basin Bus. Econ. Financ.* **7**, 109–153 (2019)
55. Ling, Y.: Influence of corporate social responsibility on organizational performance. *VINE J. Inf. Knowl. Manag. Syst.* **49**(3), 327–352 (2019)
56. Agyemang, O., Ansong, A.: Corporate social responsibility and firm performance of Ghanaian SMEs. *J. Glob. Responsib.* **8**(1), 47–62 (2017)

57. Nakamura, E.: The bidirectional CSR investment – economic performance relationship. *J. Glob. Responsib.* **6**(1), 128–144 (2015). <http://dx.doi.org/10.1108/JGR-05-2014-0021>
58. Najihah, N., Indriastuti, M.: Environmental accounting on financial performance and reputation of mining company in Indonesia. *Trikonomika*, **19**(1), 1–7 (2020). <http://dx.doi.org/10.23969/trikononika.v19i1>
59. Indriastuti, M., Chariri, A.: The role of green investment and corporate social responsibility investment on sustainable performance. *Cogent Bus. Manag.* **8**(1), 1960120 (2021). <https://doi.org/10.1080/23311975.2021.1960120>
60. Nga, N.T.H., Ha, H.T.V., Loan, N.T.T.: Green accounting and sustainable development of listed Vietnamese enterprises. *J. Asian Rev. Public Affairs Policy* **4**(1), 26–42 (2019)
61. Freeman, R.E.: *Strategic Management: A Stakeholder Approach*. Prentice-Hall (1984)
62. Berliner, D., Prakash, A.: Signaling environmental stewardship in the shadow of weak governance: the global diffusion of ISO14001. *Law Soc. Rev.* **47**(2), 345–373 (2013). <https://doi.org/10.1111/lasr.12015>
63. Minatti Ferreira, D.D., Borba, J.A., Rover, S., Dal-Ri Murcia, F.: Explaining environmental investments: a study of Brazilian companies. *Environ. Qual. Manage.* **23**(4), 71–86 (2014). <https://doi.org/10.1002/tqem.21374>
64. De Klerk, M., de Villiers, C., van Staden, C.: The influence of corporate social responsibility disclosure on share prices. *Pac. Account. Rev.* **27**(2), 208–228 (2015). <https://doi.org/10.1108/PAR-05-2013-0047>
65. Selvarajah, D., Murthy, D., Massilamani, U., Mathavi: The impact of corporate social responsibility on firm's financial performance in Malaysia. *Int. J. Bus. Manag.* **13**(3), 220 (2018). <https://doi.org/10.5539/ijbm.v13n3p220>
66. Schnieperjans, J.M.: *Information Technology Investment: Decision Making Methodology*. World Scientific (2013)
67. Bénabou, R., Tirole, J.: Individual and corporate social responsibility. *Economica* **77**(305), 1–19 (2010). <https://doi.org/10.1111/j.1468-0335.2009.00843>
68. Martin, P.R., Moser, D.V.: Managers' green investment and related disclosure decisions. *SSRN Electron. J.* (2012). <https://doi.org/10.2139/ssrn.1911589>
69. Pedron, A.P.B., Macagnan, C.B., Simon, D.S., Vancin, D.F.: Environmental disclosure effects on returns and market value. *Environ. Dev. Sustainab.* 0123456789 (2020). <https://doi.org/10.1007/s10668-020-00790-2>
70. <https://www.bps.go.id/>
71. <https://kemenkopukm.go.id/>
72. Solanki, A.: A study about green accounting: its importance and concept. *J. Res. Commer. Manag.* **5**(6) (2016). ISSN-2277-1166
73. GRI: Global Reporting Initiative (2016). <http://www.Globalreporting.org>
74. GRI: Global Reporting Initiative (2018). <http://www.Globalreporting.org>
75. Ghozali, I.: *Multivariate analysis application with IBM SPSS 23 program*. Diponegoro University Publishing Agency, Semarang (2016)
76. Abu-Bader, S., Jones, T.V.: Statistical mediation analysis using the sobel test and hayes SPSS process macro. *Int. J. Quantit. Quali. Res. Methods* **9**(1), 42–61 (2021)