Advances in Intelligent Systems and Computing 993

Leonard Barolli
Farookh Khadeer Hussain
Makoto Ikeda *Editors*

Complex, Intelligent, and Software Intensive Systems

Proceedings of the 13th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2019)

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Editors

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

Makoto Ikeda
Department of Information
and Communication Engineering
Fukuoka Institute of Technology,
Faculty of Information Engineering
Fukuoka, Japan

Farookh Khadeer Hussain
School of Software
University of Technology Sydney (UTS)
Ultimo, NSW, Australia

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Welcome Message of CISIS-2019 International Conference Organizers

Welcome to the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019), which will be held from July 3 to July 5, 2019, at University of Technology Sydney (UTS), Sydney, Australia in conjunction with the 13th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2019).

The aim of the conference is to deliver a platform of scientific interaction between the three interwoven challenging areas of research and development of future ICT-enabled applications: software intensive systems, complex systems, and intelligent Systems.

Software intensive systems are systems, which heavily interact with other systems, sensors, actuators, devices, other software systems, and users. More and more domains are involved with software intensive systems, e.g., automotive, telecommunication systems, embedded systems in general, industrial automation systems, and business applications. Moreover, the outcome of Web services delivers a new platform for enabling software intensive systems. The conference is thus focused on tools, practically relevant and theoretical foundations for engineering software intensive systems.

Complex systems research is focused on the overall understanding of systems rather than its components. Complex systems are very much characterized by the changing environments in which they act by their multiple internal and external interactions. They evolve and adapt through internal and external dynamic interactions.

The development of intelligent systems and agents which is each time more characterized by the use of ontologies and their logical foundations build a fruitful impulse for both software intensive systems and complex systems. Recent researches in the field of intelligent systems, robotics, neuroscience, artificial intelligence, and cognitive sciences are very important factor for the future development and innovation of software intensive and complex systems.

CISIS-2019 is aiming at delivering a forum for in-depth scientific discussions among the three communities. The papers included in the proceedings cover all aspects of theory, design, and application of complex systems, intelligent systems,

and software intensive systems. The conference received 166 papers and accepted 45 papers (about 27% acceptance rate), which were selected after a careful review process.

We are very proud and honored to have two distinguished keynote talks by Prof. Wanlei Zhou, University of Technology Sydney, Australia, and Dr. Nadeem Javaid, COMSATS University Islamabad, Pakistan, who will present their recent work and will give new insights and ideas to the conference participants.

The organization of an international conference requires the support and help of many people. A lot of people have helped and worked hard to produce a successful CISIS-2019 technical program and conference proceedings. First, we would like to thank all the authors for submitting their papers, the Program Committee Members, and the reviewers who carried out the most difficult work by carefully evaluating the submitted papers. We are grateful to Honorary Co-Chairs Prof. Makoto Takizawa, Hosei University, Japan, and Prof. Jie Lu, University of Technology Sydney, Australia, for their guidance and advice.

This year in conjunction with CISIS-2019 we have seven international workshops that complemented CISIS-2019 program with contributions for specific topics. We would like to thank the Workshops Co-Chairs and all Workshops Organizers for organizing these workshops.

Finally, we would like to thank Web Administrator Co-Chairs and Local Arrangement Co-Chairs for their excellent and timely work.

We hope you will enjoy the conference and have a great time in Sydney, Australia.

Leonard Barolli
Farookh Khadeer Hussain
CISIS-2019 General Co-Chairs

Omar Hussain
Hiroaki Nishino
Kin Fun Li
CISIS-2019 Program Committee Co-chairs

Welcome Message from CISIS-2019 Workshops Co-chairs

Welcome to the Workshops of the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019), which will be held from July 3 to July 5, 2019, at University of Technology Sydney, Sydney, Australia.

We are pleased that for this edition of CISIS International Conference we have seven international workshops. Some of these workshops are in 9th, 10th, 11th, 12th, and 13th editions. The objective was to complement as much as possible the main theme of CISIS-2019 with specific topics of different workshops in order to cover topics from the three challenging areas of ICT-enabled applications: software intensive systems, complex systems, and intelligent systems.

The list of workshops is as follows:

1. The 13th International Workshop on Engineering Complex Distributed Systems (ECDS-2019)
2. The 12th International Workshop on Intelligent Informatics and Natural Inspired Computing (IINIC-2019)
3. The 10th International Workshop on Frontiers in Complex, Intelligent and Software Intensive Systems (FCISIS-2019)
4. The 10th International Workshop on Virtual Environment and Network-Oriented Applications (VENOA-2019)
5. The 9th Semantic Web/Cloud Information and Services Discovery and Management (SWISM-2019)
6. The 6th International Workshop on Hybrid/Cloud Computing Infrastructure for E-Science Application (HCCIEA-2019)
7. The 1st International Workshop on Knowledge Creation and Innovation in Digital World (IKIDW-2019)

These workshops bring to the researchers conducting research in specific themes the opportunity to learn from this rich multidisciplinary experience. The Workshop Co-Chairs would like to thank CISIS-2019 International Conference Organizers for their help and support. We are grateful to the Workshops Organizers for their great

efforts and hard work in proposing the workshops, selecting the papers, the interesting programs, and the arrangements of the workshops during the conference days. We are grateful to Web Administrator Co-Chairs for their excellent work and support.

We hope you enjoy the workshops program and proceedings.

Mohammad Alshehri
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Welcome Message from ECDS-2019 International Workshop Co-chairs

It is our great pleasure to welcome you to the 13th International Workshop on Engineering Complex Distributed Systems (ECDS-2019), which will be held in conjunction with the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Sydney, Australia.

In the past, this field included technology concerns related to middleware solutions, dealing with the heterogeneity of the miscellaneous hardware and software environments and computing infrastructure. These technologies have been used to address the integration of existing legacy applications and improve the interoperability between applications across enterprises. The advances in wireless communication and pervasive computing extend this traditional wired area of distributed systems and make the new advanced application possible. The complexity of today's applications requires additional approaches to be able to realize an enterprise application time- and cost-saving. This includes the ability to model business processes, business policies, and event-oriented aspects of large systems and express these models through design solutions to address the complexity of enterprise applications and ease software design efforts. In addition, the engineering of complex distributed systems also requires a good understanding of the problem areas of concern for information systems and business administration, such as process management, supply chain management, security issues, and electronic business. These topics need to be addressed in order to deal with the complexity of today's increasingly dynamic, mobile, cross-organizational, and cross-jurisdictional systems.

In this workshop, various aspects of the design and implementation of distributed systems will be discussed. The scope of the presented papers ranges from engineering approaches and techniques to applications.

This workshop would not have been possible without the help of many people. First of all, we would like to thank all the authors for submitting their papers to our workshop. We also like to thank the Program Committee Chair, Program

Committee Members, and additional reviewers, who carefully evaluated the submitted papers.

We hope that you find the ECDS-2019 program inspiring and that the workshop provides you with the opportunity to interact, share ideas with, and learn from other distributed systems researchers from around the world. We also encourage you to continue to participate in future ECDS workshops, to increase its visibility, and to interest others in contributing to this growing community.

Leonard Barolli
Makoto Takizawa
ECDS-2019 Workshop Co-chairs

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Message from IINIC-2019 International Workshop Organizers

Advanced information processing technologies have the potential to significantly accelerate research in different fields. In particular, techniques from artificial intelligence, machine learning, and data mining can assist researchers in the discovery of new knowledge for next-generation applications. This workshop aims to attract state-of-the-art solutions and novel attempts in this direction.

The 12th International Workshop on Intelligent Informatics and Natural Inspired Computing (IINIC-2019) will provide a platform for researchers to meet and exchange their thoughts. IINIC-2019 will be held in conjunction with the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Sydney, Australia.

Many people contributed to the success of IINIC-2019. We wish to thank the Program Committee Members for their great effort. We also would like to express our gratitude to the main organizers of CISIS-2019 for their excellent work in organizing the conference. Last but not least, we would like to thank and congratulate all the contributing authors for their support to the workshop.

Takahiro Uchiya
Leonard Barolli
IINIC-2019 Workshop Co-chairs

IINIC-2019 Organizing Committee

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Message from FCISIS-2019 International Workshop Organizers

It is our great pleasure to welcome you for the 10th International Workshop on Frontiers in Complex, Intelligent and Software Intensive Systems (FCISIS-2019). The workshop will be held in conjunction with the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Sydney, Australia.

The objective of FCISIS Workshop is to foster the discussion in a rich inter-disciplinary context of the three challenging areas of ICT-enabled applications: software intensive systems, complex systems, and intelligent systems. FCISIS-2019 is conceived in terms of special papers, which were also carefully selected, from the organizers.

We would like to thank all participants of the workshop for submitting their research works and for their participation and look forward to meet you again in forthcoming editions of the workshop.

Leonard Barolli
FCISIS-2019 Workshop Chair

FCISIS-2019 Organizing Committee

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Message from VENOA-2019 International Workshop Organizers

Welcome to the 10th International Workshop on Virtual Environment and Network-Oriented Applications (VENOA-2019), which will be held in conjunction with the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Sydney, Australia.

The past eight workshops were very successful, and many high-quality papers were presented and published in these workshops. We are pleased to announce the continuation of this workshop for serving as a forum for the exchange of information and ideas in the field of 3D computer graphics, virtual reality (VR), augmented reality (AR), mobile communications, IoT, and Web and network applications. We again received many unique and high-quality paper submissions in this workshop. We strictly followed the CISIS review procedures and finally selected excellent papers for publication and presentation. The program shows a variety of research activities with high relevance to the scope of the workshop.

This workshop cannot be organized without hard and excellent work of CISIS-2019 conference organizers. We would like to express our sincere appreciation to VENOA-2019 Program Committee Members and reviewers for their cooperation in completing their efforts under a very tight schedule. We also give our special thanks to all authors for their valuable contributions. We hope that these papers will have significant impacts and stimulate future research activities.

Yong-Moo Kwon
Hiroaki Nishino
VENOA-2019 Workshop Co-chairs

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Hiroaki Nishino	Oita University, Japan

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Message from SWISM-2019 International Workshop Organizers

Welcome to the 9th International Workshop on Semantic Web/Cloud Information and Services Discovery and Management (SWISM-2019), which is held in conjunction with the 13th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Sydney, Australia.

SWISM-2019 will bring together scientists, engineers, computer users, and students to exchange and share their experiences, new ideas, and research results about all aspects (theory, applications, and tools) of intelligent and semantic methods applied to Web- and Cloud-based systems, and to discuss the practical challenges encountered and the solutions adopted.

The program of SWISM-2019 includes papers related to information retrieval, ontologies, intelligent agents, intelligent techniques for management and programming of Cloud services and business processes. The program for the conference is the result of the excellent work of reviewers and Program Committee Members. We hope you will find the final program enriching and stimulating.

We believe that all the papers and topics will provide novel ideas, new theoretical and experimental results, and will stimulate the future research activities in this area.

The papers collected in this international workshop were carefully reviewed by reviewers. According to the review results, the Program Committee Members selected high-quality papers to be presented in this workshop.

We would like to express our sincere appreciation to all Program Committee Members for their cooperation. We are thankful to Honorary Co-Chairs, General Co-Chairs, Program Committee Co-Chairs, and Workshops Co-Chairs of CISIS-2019 for excellent conference organization. It was a great pleasure in working with them.

Last but not least, we are grateful to all authors for their valuable contributions and attendees who contributed to the success of the program with their papers and speeches on their research results, and with their participation in the conference.

We hope you will enjoy the workshop and conference and have a great time in Sydney, Australia.

Beniamino Di Martino
Salvatore Venticinque
Antonio Esposito
SWISM-2019 Workshop Co-chairs

SWISM-2019 Organizing Committee

Workshop Co-chairs

Beniamino Di Martino	University of Campania Luigi Vanvitelli, Italy
Salvatore Venticinque	University of Campania Luigi Vanvitelli, Italy
Antonio Esposito	University of Campania Luigi Vanvitelli, Italy

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Welcome Message from HCCIEA-2019 International Workshop Chair

On behalf of the Organizing Committee, we would like to welcome you to the 6th International Workshop on Hybrid/Cloud Computing Infrastructure for E-Science Application (HCCIEA-2019) which will be held in conjunction with the 13th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2019) from July 3rd to July 5th, 2019, at University of Technology Sydney (UTS), Australia.

The workshop aims to promote research and development activities focused on E-science applications using distributed computing infrastructure, such as grid, Cloud computing, and hybrid system. With the rapid emergence of software systems and their applicability, the amount of data is growing exponentially. Existing computing infrastructure, software system designs, and use cases must take into account the enormity in volume of requests, size of data, and computing load. A complementary goal is to identify the open issues and the challenges to fix them, especially on security, flexibility, reliability, and privacy aspects.

Cloud computing has become a scalable services consumption and delivery platform in the field of services computing. Cloud is a platform or infrastructure that allows execution of code in a managed and elastic way. We want to put the emphasis of scientific and technologies progress on Cloud solutions and infrastructures, in particular concerning research activities on scalability and adaptability using effective scheduling for the virtualization.

All people involved in this workshop (authors and PC members) are researchers with high expertise, working on related research areas and projects. We are really grateful for their support, and we thank them for contributing their knowledge toward a successful event.

We would like to thank CISIS organizers for giving us the opportunity to organize HCCIEA Workshop series. We hope that the results of this event will advance the related research in multifold ways.

Olivier Terzo
HCCIEA-2019 chairs

HCCIEA-2019 Organizing Committee

Workshop Chair

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Leonard Barolli	Fukuoka Institute of Technology, Japan
Vincenzo Romano	INGV, Italy

Welcome Message from IKIDW-2019 International Workshop Co-chairs

Welcome to the 1st International Workshop on Knowledge Creation and Innovation in Digital World (IKIDW-2019). The workshop will be held in conjunction with the 13th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2019) at University of Technology Sydney, Australia, from July 3rd to July 5th, 2019.

The value of most organizations today greatly exceeds their net tangible assets. The IKIDW-2019 workshop aims to address contemporary issues in managing knowledge, intellectual capital, and other intangible assets in the digital world with the help of IT application. The digital era contributes to the amount of knowledge available in various qualities. This is a challenge for business people in strategic decision making. IT application is expected to reduce knowledge ambiguity so that it will improve the quality of organizational decisions. Beginning with a view that knowledge becomes strategic assets, the workshop will discuss the fundamentals of managing knowledge and intellectual capital, understanding some of the measurement issues, processes, and cycles involved in their management and the specific issues in managing knowledge, especially with the availability of big data and with the help of IT application.

We would like to express our sincere gratitude to the members of the Program Committee for their efforts. We thank the 13th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2019) for co-hosting IKIDW-2019. Most importantly, we thank all the authors for their submission and contribution to the workshop.

We hope all of you will enjoy IKIDW-2019 and find this a productive opportunity to exchange ideas with many researchers.

Olivia Fachrunnisa
Ardian Adhiatma
IKIDW-2019 Workshop Co-chairs

IKIDW-2019 Organizing Committee

Workshop Co-chairs

Olivia Fachrunnisa	UNISSULA, Indonesia
Ardian Adhiatma	UNISSULA, Indonesia

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Shu-Ling Chen	National Dong Hwa University, Taiwan
Farookh Hussain	University of Technology Sydney (UTS), Australia
Omar Hussain	University of New South Wales, Canberra, Australia

CISIS-2019 Keynote Talks

Trust, Security and Privacy in Low-Cost RFID Systems

Wanlei Zhou

University of Technology Sydney, Sydney, Australia

Abstract. Radio Frequency Identification (RFID) enables the automatic identification of objects using radio waves without the need for physical contact with the objects. RFID has been widely used in various fields such as logistics, manufacturing, pharmaceutical, supply chain management, healthcare, defense, aerospace and many other areas, apart from touching our everyday lives through RFID enabled car keys, ePassports, clothing, electronic items and others. However, the wide adoptions of RFID technologies also introduce serious security and privacy risks as the information stored in RFID tags can easily be retrieved by any malicious party with a compatible reader. In this talk, we will introduce some trust, security and privacy challenges in RFID technologies, and based on our research, we will outline a number of schemes for authentication, ownership transfer, secure search and grouping proof in Low-cost RFID systems.

Intelligent Context Awareness in Internet of Agricultural Things

Nadeem Javaid

COMSATS University Islamabad, Islamabad, Pakistan

Abstract. Variability in climate and recession in water reservoirs, diminishing the agrarian sector ecosystem production day by day. There is an imperative requirement to restore robustness and ensure high production rate with the use of smart communication infrastructure. Moreover, the farmers will be able to make resource efficient decisions with the availability of modern monitoring systems like Internet of agricultural things (IoAT). However, the data generated through IoAT devices is disparate which needs to be handled intelligently to bring artificial intelligence (AI), machine learning (ML) and data analytic (DA) techniques into play. In this talk, we will recommend the intensive use of coordination between AI, ML and DA at middleware to optimize the performance of IoAT system along with context awareness. Additionally, it will enable horizontal functionality for diverse services to mitigate the problem of inter-operability. An analysis is carried out using TOWS matrix to consider the effects of internal and external factors on the performance of automation techniques collaboration. This analysis points out various opportunities to innovate the livelihood of agrarian society around the globe.

Contents

The 10th International Workshop on Virtual Environment and Network-Oriented Applications (VENOA-2019)

The 1st International Workshop on Knowledge Creation and Innovation in Digital World (IKIDW-2019)

Fraud Prevention on Village Government: The Importance of Digital Infrastructure Supervision

Provita Wijayanti(✉), Nurhidayati, and Rustam Hanafi

Economics Faculty, Universitas Islam Sultan Agung, Semarang, Indonesia
{provita.w, nurhidayati, rustam}@unissula.ac.id

Abstract. This paper aims to develop a framework of digital infrastructure supervision to optimize fraud prevention in village government, Indonesia. Village is the smallest area in the country of Indonesia. The village government carries out the tasks of village management which is assisted by the facilitator and the village supervisor to account for village funds. Digital infrastructure supervision is used to detect and reduce the opportunity of fraud. The infrastructure of village government supervisors includes Regional Inspectorate, village community empowerment agency, village representative agency, village assistant, and digital supervision system. These infrastructures become a benchmark to increase accountability and transparency of village fund management. Future research will include validating the proposed framework using an empirical data.

Keywords: Fraud prevention · Digital infrastructure supervision

1 Introduction

Government promises to realize an equitable welfare of rural communities by the issuance of Law No. 6 of 2014 concerning Village which includes Village Funds which is started in 2015. Village funds are intended to help building infrastructure in villages that can facilitate economic activities in the countryside. Village funds can also be used to help rural poor communities to have a decent place or environment to live.

It is known that basically everything that is related to funds (money) should be intended to the public, but it is mostly misused for the fulfillment of the desires of certain individuals or groups. The misappropriation of village funds in the past three years has been widely reported that the funds were misused by the authorities mandated to allocate the funds. The village fund (fraud) cases began to be widely reported and occurred in almost every district in Indonesia. The report of (*Indonesian Corruption Watch* 2018) states that the number of village corruption cases has doubled and more from year to year. The total cases in 2015–2017 reached 154 cases. The number of losses donated reached Rp. 47.56 billion (*Indonesian Corruption Watch* 2018).

Fraud prevention is a necessity. One of the efforts taken is the appointment of village assistants. The main task of the village facilitator is to facilitate village

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development and financial planning, implementation of village development, village financial management, and evaluation of village development implementation.

Digital infrastructure can be interpreted as the use of ICT in government or commonly referred to *e-government* according to Siau; while according to Gupta and Debashish Jana, *E-government* is the application of IT in government which aims to simplify the work process in the government to be more accurate, responsive and to form a transparent government (qtd. in Tyas et al. 2016). As a result of rapid technological development and information growth the government is required to provide services to the community in accordance with developing technology and with e-government the government can reduce the possibility of fraud because the system that has been implemented in e-government must be carried out according to procedures and difficult to deceive.

In these tasks, the village facilitator is contained in the role of the village government supervisor and the internal control system. These two aspects are expected to minimize the possibility of fraud that will be carried out by irresponsible parties. The improvement of both village government supervisor and internal control system will be the most suitable method to prevent fraud (Omar and Bakar 2012; Othman *et al.* 2015).

In the process of supervising, village government supervisor and the internal control system, in today's era where everything can be facilitated by digital advancement, a digital system for supervision is proposed. The system of infrastructure can be altered to digital infrastructure. By having the digital infrastructure supervision, the access to detect and prevent fraud will be able to be done by protecting the software or application that is related to the infrastructure (Bierstaker et al. 2006; Rahman and Anwar 2014).

Based on the background, the purpose of this study is to find out whether digital infrastructure supervision will be able to moderate the internal control system and village management supervisor in order to prevent fraud.

2 Literature Review

According to the Legal Dictionary, legally, fraud is deliberate deception to secure unfair or unlawful profits or to eliminate victims from legal rights (Lawrence and Wells 2004).

Such problem must be fought by both the public and private sectors, especially in Indonesia. Internal auditors who are competent in evaluating financial statements and are able to make organizational operations effectively are needed to minimize fraud risk (Wilopo 2006). Strengthening the internal control structure, optimizing control activities, as well as effective internal audit functions, are fraud prevention strategies (Wuysang *et al.* 2016).

Ground theory to underline this research is the agency and GONE theory. Agency theory (Jensen and Meckling 1976) in Sudarma and Putra (2014) defines the relationship between principal and agent in detecting fraud. This theory aims to solve the problem in the agency relationship between principal and different agents called agency problems (Kusumastuti and Meiranto 2012). A GONE theory is described as follows: *Greed*, *Opportunity* to commit fraud, *Need* (the need to support life), and *Exposure* of

actions or consequences for perpetrators of fraud if the perpetrator is proven to commit fraud. Exposure is related to the learning process of fraud because it is considered a sanction that is classified as mild. Greed and need are personal and difficult to eliminate, so they tend to violate regulations, while the Opportunity and Exposure factors are related to victims (communities, institutions, and organizations) who feel disadvantaged by fraud.

The components of the agency and GONE theory mentioned above can be minimized through the role of the village government supervisor and internal control systems including the management of the resources. The government's oversight function which is still minimal is also a factor causing fraud in village fund. Institutions such as Village Consultative Agency (BPD) have not been fully optimal in carrying out budget oversight in the village. BPD should be able to play an important role in preventing corruption of village funds, including encouraging other citizens to jointly monitor development in the village (*Indonesian Corruption Watch* 2018).

The functions of supervision on fraud prevention have been frequently published. Qualitative study (Wibisono and Purnomo 2017) reports that weak village fund management or the tendency of fraud in village fund is due to the non-functioning role of village facilitators, elements of coaching and supervision from the sub-district and also from the Government Guard and Development Team (TP4) are weak, lack of community participation in supervision of village funds, high non-budgetary costs, as well as the lack of ability of village fund managers and village heads. Qualitative studies conducted by (Wida et al. 2017) in Rogojampi, Banyuwangi Regency, reported the supervision phase of village fund allocations that had run well and was expected to prevent fraud.

Meanwhile the supervision includes internal control system and quality of village management supervisor especially the human resource. Atmadja et al. (2017) report that the internal control system influences the fraud prevention in Buleleng district in Bali and Widiyarta (2017) reports that the internal control system has a positive influence on the fraud prevention in village fund management in the village government in Buleleng district. (Wijayanti et al. 2018; Shanmugam et al. 2012) state that in order to have a better internal control system, internal parties including the village facilitators as the people who are mandated to account for the village funds, should be improved; because the fraud tends to be done by the internal people who have direct access to the funds. Henceforth, the improvement of effective internal control system will be able to combat fraud.

To ease the village government supervisor in performing supervision, digital advancement is launched to assist the program. According to Suryanto (2016), the involvement of information technology in the management of a community will help increasing the performance. Even though it may need many tasks to carry out the method, digital infrastructure supervision with the digital government technology is supposed to be able to mildly reduce the practice of fraud (Ojha et al. 2008).

3 Proposed Framework

In order to develop the framework of digital infrastructure supervision to optimize fraud prevention in village government through improving the quality of village government supervisor and the internal control system, here is the research model (Fig. 1).

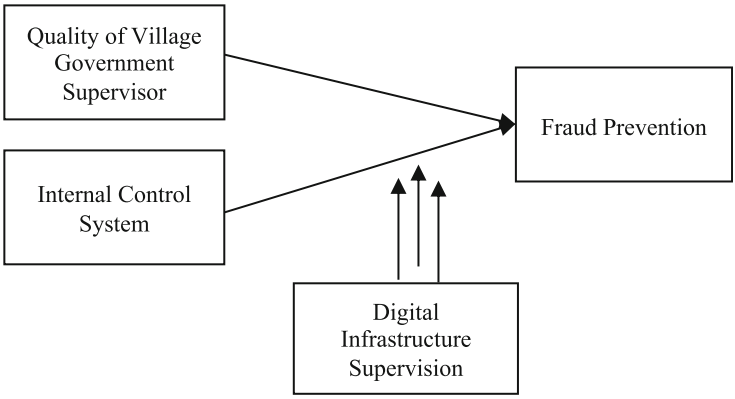

Fig. 1. Research model

Digital Infrastructure Supervision is the implementation of the grand design of village financial supervision strategies that are the priority of the Indonesian government which refers to Presidential Regulation number 54 of 2018 concerning the national strategy for preventing corruption in 2019–2020 (Merdeka.com 2018). According to Braa et al. (2007) and Tilson et al. (2010) the definition of digital infrastructure is a collection of combination of components between technology and human such as the networks, the systems and the processes which contributes to the information systems' functioning (qtd. in Sharma 2017). In addition, according to Ben et al. digital infrastructure consists of approach to ICT and level of internet use, the enthusiasm and skill in gaining access to the ICT and internet services. Digital development is affected by the industrial trends such as internet of things (IoT) and artificial intelligence (AI), development of consumption patterns and acceptance of new devices and applications such as smart phones, tablets and smart TVs (2017). Sharma supplements a concept of hierarchy of digital infrastructure which consists of three points, there are policy level, program level and project level. The policy level relates to the planning of policy and finding resources. The program level includes preparation in strategy and prioritizing as well as the structures and procedures. While the project level covers the arrangement, the conceptualization and the technology (2017).

Village government supervisor has the role to supervise the account of village funds and should be responsible in the accountability of the funds' usage. The quality of village government supervisor should be improved to have better governance and keep it safe from the misappropriation of the use of village funds. In order to do that, internal control system should be improved simultaneously.

There are two types of internal controls: preventive and detective controls. Preventive control is a control that can help prevent fraud happened. These control activities prevent reimbursement of costs without review or knowledge of leaders. Detective control is a control that can help reveal fraud schemes. This control is generally less popular than preventive control because this control is known to work after fraud occurs. Those two types of internal control also apply in two phases of the different fraud cycle (Ramamoorti and Dupree 2010). There is a proactive stage, which uses preventive controls to minimize opportunities for fraud. There is also a reactive stage, which relies on the detective's control to find fraud after that happens. After fraud occurs or control deficiencies have been discovered, compensation control can be applied to reduce the effects of adverse financial reporting (Gramling et al. 2010). Compensation control can be a preventive or detective control applied to businesses when there is a deficiency of control and work as a support.

For example, previous preventive controls that require lead reviews on reimbursement of costs before being processed are useless because management has never taken the time to authorize daily reimbursement, so strong compensation controls will require a receipt to be attached to the replacement form. In this way, the person responsible for reimbursement can verify that the expenditure is legal and available. As seen in this example, compensation control is generally used when actual controls are too expensive or time-consuming to set, but they are less desirable than preventive controls because they usually occur at the reactive stage of the fraud cycle.

The internal control system in this research can also be included in detective internal control where internal control is carried out after fraud has occurred. Related to the agency theory, internal control should be carried out from the beginning of the village government apparatus to compile a budget plan for the use of village funds to the end result of the realization of the village funds usage, so that the implementation of the internal control system carries out in all these stages can prevent self-interest and cause individuals to not be bounded rationality and strive for risk-averse. Regarding GONE theory, the internal control system at each stage of village fund allocation will limit a person to being greed, limiting opportunities for cheating (opportunity), not dare to act to enrich themselves (needs) and fear that fraud is known so that they will face sanctions or penalties obtained (exposure).

This is also in accordance with previous researches that the weak village fund management or the tendency of fraud in village fund was due to the non-functioning role of village facilitators, elements of coaching and supervision from the sub-district and also from the Government Guard and Development Team (TP4) are weak, lack of community participation in supervision of village funds, high non-budgetary costs, as well as the lack of ability of village fund managers and village heads (Wibisono and Purnomo 2017). In addition, the qualitative study conducted by Wida et al. (2017) in Rogojampi, Banyuwangi Regency also reported that the supervision phase of village fund allocation that had run well could prevent fraud.

When the accountability and responsibility of the use of village funds are in the right path after the improvement in internal control system and the quality of village government supervisor, digital infrastructure supervision has moderating role to support and to facilitate the supervision process with an integrated system in digital technology. By using this digital infrastructure supervision, facilitators of the village

can oversight the condition in the village and take immediate action to prevent any kinds of fraud.

4 Conclusion

Thus in implementing the concept of the research, the mechanism is to improve the internal control system and village management supervisor by fixing the facilitators of the village i.e. the human resource. So, digital infrastructure supervision acts as moderating factor to support the effort in preventing fraud.

For future research this paper is still in the form of concept on fraud prevention and digital infrastructure supervision in village government, therefore it is necessary to test the concept's model by conducting empirical research related to the topic. This paper is a solution to fraud prevention and still needs to be developed in term of digital infrastructure supervision model.

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