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Complex, Intelligent and Software Intensive Systems

Proceedings of the 19th International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS-2025), Volume 2

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Leonard Barolli · Tomoya Enokido ·
Isaac Woungang
Editors

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Software Intensive Systems (CISIS-2025),
Volume 2

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Welcome Message of CISIS-2025 International Conference Organizers

Welcome to the 19th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS-2025), which will be held from July 2 to July 4, 2025, in conjunction with the 19th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS-2025) at Fukuoka Institute of Technology, Japan.

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 systems, 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 their 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.

Research in the field of intelligent systems, robotics, neuroscience, artificial intelligence (AI) and cognitive sciences are very important factors for the future development and innovation of software intensive and complex systems.

This conference is a forum for in-depth scientific discussions amongst 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.

We are very proud and honored to have two distinguished keynote talks by Prof. Winston K.G. Seah, Victoria University of Wellington, New Zealand, and Prof. Kangbin Yim, Soonchunhyang University, South Korea, 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 technical program and conference proceedings. First, we would like to thank all 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 Chair Prof. Makoto Takizawa, Hosei University, Japan, for his guidance and support.

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

We hope you will enjoy the conference proceedings.

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CISIS-2025 Keynote Talks

Machine Learning in Network Anomaly Detection

Winston K. G. Seah

Victoria University of Wellington, Wellington, New Zealand

Abstract. Network anomaly detection is a broad research area that goes beyond security-related issues, like intrusion and malware detection, and encompasses detecting faulty network devices, usual traffic patterns, misconfigurations of network devices and so on. Very broadly, it refers to finding patterns in network data that do not conform to expected behaviour. The statistics community has been studying the anomaly/outlier detection problem from as early as the nineteenth century. More recently, machine learning has taken an increasing significant role in anomaly detection in general, not just within the domain of networks. In this talk, we will discuss two approaches in applying machine learning to detect network anomalies. Firstly, we derive a network graph from the individual routers' data and then apply machine learning to detect the occurrence of Border Gateway Protocol (BGP) hijacking. We validated this approach using real network data and demonstrated the ability to detect impending anomalous events prior to their occurrences. To deal with ever-changing normal network conditions, we propose a hybrid online-offline framework that enables online and offline methods to work together in order to deal with changing normal conditions. New anomalies that emerge can then be successfully detected while new normal conditions are not erroneously identified as anomalous.

HILS-Based Anatomical Security and Safety Analysis for Distributed Collaborative SW on Automotive Platforms

Kangbin Yim

Soonchunhyang University, Asan, South Korea

Abstract. A car is a collection of embedded firmware based on collaboration that is distributed and installed on multiple heterogeneous controllers. Moreover, since these software are developed and supplied by different third-party companies, verification and evaluation of the software is becoming a very important issue in terms of supply chain security. Especially in a situation where the European Economic Union's cybersecurity regulations for automobiles have become a reality, it is important for automobile manufacturers to have a cooperative approach with suppliers for the numerous software-embedded components included in the automobiles they produce. But such collaboration is not easy and is becoming a major challenge. In this context, in this talk is introduced a HILS-based data-driven testing method for distributed software in heterogeneous controllers embedded in automobiles, related to the research being conducted in LISA Laboratory at Soonchunhyang University, South Korea. In relation to a specific research on detecting abnormal behavior of heterogeneous controller firmware in an environment where not only source code but also binary code is not disclosed, LISA members each introduce their individual research items including deep learning-based vehicular data analysis based on the HILS testbeds they constructed by themselves using commercial vehicular components as well as the real cars that they actually have for their research. In addition, they share their experiences gained from the automotive data analytics hackathon they ran by themselves for developers to provide training on automotive security.

Contents

The Ethical Culture Framework as a Fraud Reduction Strategy: An Approach Using the Social Cognitive Theory and Social Identity Theory

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Abstract. The social cognitive theory provides an overview of the nature and function of organizations in terms of their cognitive, self-reflective, and self-regulatory roles. In this way, all members can contribute to improving moral awareness and ensuring a moral environment, particularly in terms of fraud prevention and reduction. This study combines the social cognitive theory with the social identity theory and religious values to reduce fraud. The social cognitive theory has some weaknesses that lead to natural, physical, and material ramifications. This study examines the role of an ethical culture framework in fraud reduction. Indeed, fraud can be reduced by framing an ethical culture as an organizational one. Moreover, organizational culture can be a result of the existing moral awareness and the spiritual framework of the work environment. The data used herein were obtained from 220 cooperatives in Central Java, Indonesia, as well as a questionnaire, all of which were analyzed using structural equation modeling. The results show that the ethical culture framework has a positive and significant effect on reducing fraud, in that an anti-fraud culture was proven to exist due to the influences of moral awareness and workplace spirituality, thereby reducing fraud.

Keywords: anti-fraud culture · ethical culture framework · fraud reduction · moral awareness · workplace spirituality

1 Introduction

Fraud has been a problem since ancient times, threatening individuals, organizations, and society [1]. In modern times, technology has progressed, but the dark side of this is that it can increase fraud and make fraud detection complex. Indeed, criminals involved in scams often use sophisticated and misleading strategies to trick victims. In the business world, fraud can cause significant financial damage to organizations' reputations and

customer trust, and it can even lead to bankruptcy. In addition, victims of fraud often experience personal, financial, and emotional loss. Fraud has been recognized as a major constraint and impediment to rapid economic growth and development. This study uses the theory of cognitive social and theoretical identity social intervention with marking spiritual value to develop methods to reduce fraud.

The cognitive theory social emphasizes role moderation in self-efficacy. In a team setting, every member interacts with one another and exploits the strength of the source organization in similar ways when working on the same task. Moreover, individuals' beliefs (i.e., spirituality) and their motives of being (i.e. their ethics and perception of their contexts) are used as a basis when they evaluate their decisions and as a foundation for their morality. The social identity theory plays a role in forming an organization's culture, especially concerning an individual's motivation and psychological involvement in terms of whether they feel positively or negatively about joining an organization. [2] state that there is a trend in terms of choosing and engaging in appropriate activities according to social identity and the supportive organizational identity of a social individual.

Fraud exists in various sectors, including finance, banking, insurance, trade, investment, e-commerce, tax, government services, and the social sphere. Cooperatives are institutions that are vulnerable to fraud. These are business organizations that work towards achieving a common economic movement and are based on the principle of kinship, and there are many opportunities for fraud in this sector. One of the indications is cooperatives' weak regulation, in that there are no laws regulating the appointment of management positions; management skills, knowledge, and experience; and the operation and mastery of information and communication technology [3]. As for the roles of these organizations, social capital in cooperation is the heart of cooperative bodies, given the role that cooperatives play as business entities engaged in the economic sector. Cooperatives aim to improve the welfare of their members and society, in that an individual who volunteers becomes a member of the cooperative based on their social identity. That is, they share the same purpose, with each member supporting one another.

Efforts to reduce and prevent fraud have become a priority for many organizations and governments worldwide, including cooperative bodies. The control theory approach has been employed to determine that the implementation system still has many shortcomings and that control is only based on tools [4–7]. Fraud and breaches in investment management and the financial industry are frequent consequences of financial advisors' and investment managers' behavior. Various steps have been taken to counteract this fraud, such as increasing supervision and regulation [7, 8] developing systems with better security and application technology, and sophisticated analytics to detect fraud patterns. However, the core problem of fraud lies in people who do not question procedures, policies, or internal mandates. In addition, normative approaches such as ethics and religious values are still rare. At the same time, the moral and ethical context is important [9]. Thus, further research is needed on the human aspect as a fraud controller.

One element of human interaction is organizational culture. The organizational culture proposed in this study is oriented towards law enforcement to prevent fraud. Moral awareness is viewed as being mainly derived from social capital [10]. Therefore, workplace spirituality can be a framework for ensuring an appreciative work organization [11] that encourages employees to transcend their cultural experience through the work

process, thereby facilitating a sense of connectedness with others and ensuring their positive feelings and joy.

This study contributes to reducing the fraud committed by cooperative management through a cognitive social theory and social identity theory approach that is embodied in moral awareness, workplace spirituality, and culturally defined organizations within the framework of an ethical culture. Previous research using a theoretical approach of control, agency, and the fraud triangle has not been able to provide maximum results to help solve the fraud problem in cooperatives. Therefore, this study aims to test the ethical culture framework that results from moral awareness and workplace spirituality and that results in the formation of a culture that encourages an organization to reduce fraud. We argue that the existence of a manager's moral awareness, supported by spirituality and good work, will drive the formation of a cultured and ethical organization, thereby lowering the potential for fraud in cooperatives.

2 Literature Review

2.1 Moral Awareness, Workplace Spirituality, and an Anti-fraud Culture

Moral awareness is the degree to which a person identifies with the possibility of a situation being classified as morally wrong and harmful to another person, a group of people, or society [12]. Morality requires an individual to possess certain attributes, such as being able to empathize with the pain and suffering of others. Consciousness plays a functional role in humans making the majority of their moral decisions. The social cognitive theory can be used to describe how humans understand consciousness and the ways in which they perceive it to play a broad role in their decision-making, including moral decisions. People who are easily influenced by factors such as economics (money) or politics (power) tend to show intentions without ethics [13, 14]. Indeed, an individual's morals can be one of the causes of their committing fraud. Fraud is a core problem in humans, in that there are no procedures, policies, or internal controls [15].

Workplace spirituality is created by organizations through their implementation of a creative culture that is established by work routines [11]. It is necessary for organizational performance and directly reflects corporate culture [16, 17]. It can be defined as the recognition that employees' lives nourish and are nourished by meaningful work within an organization [18, 19]. Thus, individuals in organizations no longer work solely for money but grow and develop their ideals through their work [1, 20], ensuring a high-quality life [21]. When individuals work to not only earn money, the possibility of fraud decreases. Therefore, large companies have widely adopted spirituality in the workplace to align the individuals' passion with the organizations' strategies.

The workplace spirituality approach can moderate the relationship between work cynicism and organizational performance [22], and it can be implemented on the individual and organizational levels [23]. If every individual implements a routine, it affects the entire organization. This condition ensures an anti-fraud culture through organizational performance. [24] define consciousness as a human being with a growing mind that is nurtured by meaningful work, which takes place in a community context. Bringing spirituality to the workplace will lead to a sense of value, a more humanistic sense

of greatness, and a change in organizational culture, thereby improving the relevant organization's performance.

In this study, workplace spirituality is perceived as management and employees working enthusiastically to complete work and earn achievements. Analyzing organizations necessitates a deep understanding of aspects of life that cannot be measured materially using the following indicators: alignment with values, meaningful work (experience), and caring. This study posits that workplace spirituality can influence organizational culture, leading to the following hypotheses.

H1: Moral awareness positively influences an anti-fraud culture.

H2: Workplace spirituality positively affects an anti-fraud culture.

2.2   An Anti-fraud Culture and Fraud Reduction

Fraud is an act that is intended to cause wrongful access to someone, causing their loss, either by hiding facts or vice versa. Fraud is a serious threat to business interests around the world, and it mostly affects small businesses in terms of misappropriation of assets, with these businesses accounting for 71% of all fraud cases. The theories that have been used to reduce fraud include business ethics [25, 26], agency theory [27], control theory [4, 8], fraud risk management [28], and the fraud triangle theory. To support the development of Indonesian cooperatives, the Ministry of Cooperatives and Small and Medium Enterprises (SMEs) implemented the Cooperative Reform to improve the quality of cooperatives in terms of business and financial institutions. In this study, fraud reduction is defined as implementing actions, strategies, and practices to minimize and reduce fraudulent activity within cooperatives through determining policies, procedures, and awareness of violations [29].

One of the functions of a cultural organization is to provide an organizational identity to its members, and a strong organizational culture allows employees to refuse bribes on the spot and contributes to reducing fraud [30]. Individuals who consider themselves highly involved in work will acknowledge the importance of an organization's identity. Furthermore, a conducive organizational culture has been identified as an important stabilizer and promoter of organizational growth. Organizational culture represents the assumptions, beliefs, and norms of an organization in which members share and support each other [31]. Thus, an organization's performance will improve if its ethical culture is realized [32].

This study uses the social identity theory to address anti-fraud culture. This is a theory that is rooted in organizational studies [33, 34], with culture being seen as an identity in the approach. In this study, anti-fraud culture is founded on the assumptions, values, beliefs, and norms developed and maintained by a cooperative's management and members to avoid fraudulent acts. The indicators of an anti-fraud culture include innovation that considers fraud risk and control, a results-oriented approach, members who are welfare-oriented, and aggressive work. This leads to the following hypothesis.

H3: Anti-fraud culture positively affects fraud reduction.

2.3   The Mediating Role of an Anti-fraud Culture

Cultural organizations' roles vary, as there are factors that impact their performance [7, 35, 36]. In this study, anti-fraud culture is taken as an intermediate mediator of moral and environmental awareness and deep spiritual efforts in the workplace to reduce fraud.

Moral awareness can influence people's behavior in companies, thereby reducing fraud. Behavior, moral norms, and tendencies all work together in the development of an atmosphere that is laden with a work ethic and spiritual values, which can inspire members of organizations to display desirable behavior and cultural ethics. Moreover, a culture formed on not enough answers, mutual feelings of profitability, and alignment between business and society can stimulate employees to behave according to the emerging needs of the company and society.

In an organization with an ethical culture, employees are expected to behave cooperatively [37] in an effort to support the workplace's spirituality. Moreover, moral and environmental awareness are forms of spirituality that can lead to fraud reduction in the workplace. Thus, the role of an anti-fraud culture as a mediator emerges when moral awareness and workplace spirituality have become an individual's habit. In addition, individuals' behaving in a consistent way contributes to the formation of their respective organizations' identities. Thus, employees who are aware of this participate in sharing the load of reducing fraud. Furthermore, these employees are incentivized to stay in the organization, as they feel as though their identity aligns with that of the organization. Their honesty and responsibility also contribute to fraud reduction. This leads to the following hypotheses.

H4: Anti-fraud culture is a mediating influence between moral awareness and fraud reduction.

H5: Anti-fraud culture mediates a spiritual workplace's influence on fraud reduction.

3   Research Methodology

3.1   Research Setting and Participants

This research was conducted at cooperatives in Central Java, Indonesia, with a questionnaire being used to collect data. The respondents in this study are cooperative managers who manage in a way that ensures that the cooperatives positively impact their members' welfare and reduce fraud. Managers of cooperatives are responsible for engaging with members and managers of the cooperatives to complete their work successfully. In addition, they must be highly aware of the cooperatives' wills, visions, and desires to work in terms of morality.

After discussions with the Office of Cooperatives and the MSMEs in Central Java, 220 cooperative administrators were identified as suitable participants for this research. They were asked to complete the questionnaire, for which a response rate of 96.49% was attained. The average age of the respondents was 36–45 years, with their average tenure as a manager being four to six years. Of these respondents, 58% were male and 42% were female. In terms of the participants' education levels, 34% had a high school education, 17% had earned diplomas, 42% had bachelor's degrees, and 7% had earned postgraduate qualifications. This indicates that most of the cooperative administrators in the Central

Java region are productive. Herein, this is seen as a positive influence on cooperatives' ability to prevent fraud. The data also illustrate that men are more often entrusted with the role of cooperative administrator. Men have more free time than women. Cooperative administrators can serve in this role for a maximum of two consecutive terms, with the frequency distribution herein indicating that this translates to four to six years. This is important to note as term limits are one of the rules put in place to prevent and reduce fraud.

All of the variables were measured with specific questions, which the participants answered using a seven-point Likert scale ranging from "Strongly disagree" to "Strongly agree." The steps are described below, along with the calculation of the results that were analyzed using Cronbach's alpha. When one measure was determined to be a discrete dimension, the item average was used to develop the deep equivalence structure of the model. Moreover, statistical tools and structural equation modeling (SEM) were used to analyze the influence between the variables.

4 Results and Discussion

The results from this analysis are delineated in Table 1, which also indicates that all of the research hypotheses were accepted as true. This is due to the p-values being less than 0.05 and the critical ratio values being above 1.64. Thus, moral awareness was found to have an influence on organizational culture and reduce fraud, a spiritual workplace was determined to have an impact on organizational culture and reduce fraud, and organizational culture was also found to influence fraud reduction.

Table 1. Hypothesis Testing

				Estimates	SE	CR	p-value
H1	Anti-fraud culture	<---	Moral awareness	0.388	0.056	6,910	***
H2	Anti-fraud culture	<---	Spiritual workplace	0.451	0.061	7,398	***
H3	Fraud reduction	<---	Organizational culture	1.175	0.107	10,947	***

Table 1 indicates that the first hypothesis was accepted, in that moral awareness was proven to have a significant positive influence on an anti-fraud culture. This demonstrates that H2 was also accepted. Similarly, a spiritual workplace was also proven to have a significant positive influence on an anti-fraud culture, thus proving H3. This indicates that an anti-fraud culture positively and significantly influences fraud reduction. The analysis also demonstrates that workplace spirituality has the largest influence on an anti-fraud culture, as shown in Fig. 1.

Table 2 shows anti-fraud culture's role as a mediating variable. The results indicate that moral awareness will have a bigger impact on fraud reduction if an individual is part of an anti-fraud culture. Likewise, moral awareness will have a bigger impact on fraud reduction in an anti-fraud culture. In cooperative bodies, moral awareness and workplace spirituality were not found to be as immediately impactful in reducing fraud.

Table 2. Anti-Fraud Culture's Mediating Role

	Moral awareness		Workplace spirituality		Anti-fraud culture	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Anti-fraud culture	0.485	0.000	0.563	0.000	0.000	0.000
Fraud reduction	0.261	0.490	0.360	0.570	0.492	0.000

However, moral awareness and workplace spirituality in cooperatives will reduce fraud. Therefore, the findings indicate that an ethical culture positively impacts fraud reduction, as indicated by the SEM results in Fig. 1.
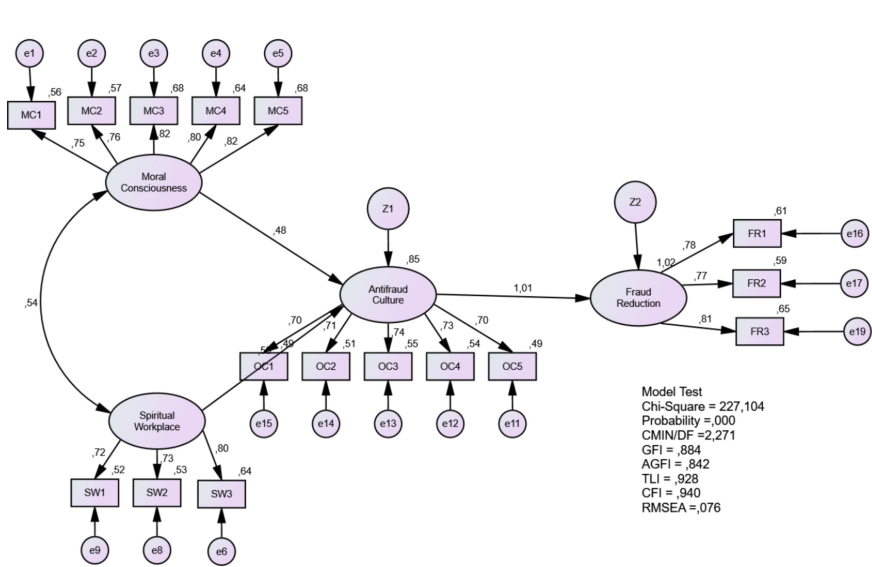

Fig. 1. Structural Model

The social cognitive theory can be used to analyze the nature and function of human agency according to its central role in cognition, self-reflection, and self-regulation. This was pertinent herein as cooperative managers act as interactive agents. Thus, every cooperative manager can contribute to motivating their staff and improving the environment. In this model of mutual causation, action; cognitive, affective, and other personal factors; and the environment interact and support one another.

An organizational culture that is free from fraud will reflect a system of shared beliefs and attitudes that are developed and adhered to by all managers and members of cooperatives. This anti-fraud organizational culture will be reflected in these actors' daily activities, starting from their interactions with other people and stretching to their working methods and future expectations. Furthermore, the system of beliefs and attitudes shared by the board and members of the cooperative will set these cooperatives apart from other groups or organizations, thus demonstrating the role of the social identity

theory. Workplace spirituality was also found to reduce fraud. This is an ideal condition in which individuals perceive their involvement in cooperatives as a valuable experience and in which they feel as though their values align with those of the organization.

This study supports [15] statement that fraud is due to human behavior, as well as the lack of implementation of procedures, policies, or internal controls. Fraud also negatively affects developing countries' morals, as a developing country that is more successful in reducing fraud than a developed country typically has a social spirit and serves the community. Fraud also precludes the advancement of culture [38] as one element forms culture: a human being with a moral conscience. Organizations developing a culture in which work is seen as a journey can ensure members' personal growth and development through enabling them to achieve their greater aspirations [1, 20]. This demonstrates the importance of workplace spirituality. This study supports [11] findings that the spiritual workplace plays a role in shaping the framework that characterizes the organization by creating a culture-based work routine.

This study contributes to the social cognitive theory by employing it in a team setting, in that each member interacts with one another, draws on the strengths of similar organizational resources, and cooperates on relevant tasks herein [39]. Likewise, the cognitive social theory is combined with the social identity theory to determine that adherence to rules and critical thinking are not enough to account for members' consistent personal behaviors and their ability to understand the prevailing norms: They need to align with the organization's existing concerns, undergo meaningful experiences, and adhere to the organizational presence. Therefore, an organizational culture that constantly innovates while considering risk, control, a results-oriented approach, and shared welfare needs to be curated in order to reduce fraud by establishing policies and procedures and increasing individuals' awareness of violations. These results can be implemented to reduce fraud in organizations, cooperatives, and institutions. Managers can also reduce fraud by having good cooperation skills, recognizing the difference between right and wrong actions, and being responsible and accountable for the actions they take. Fraud can also be reduced if management and the members work enthusiastically to complete their work and earn achievements.

5   Conclusion

The ethical culture framework developed herein can be implemented to reduce fraud. This is reflected in the evidence that moral awareness and workplace spirituality positively and significantly affect corporate culture, with corporate culture also having a positive and significant effect on reducing fraud. An anti-fraud culture within an organization was also determined to have a mediating role in this relationship. Furthermore, the ethical culture framework can be implemented to reduce fraud in conjunction with the social cognitive and social identity theories. Indeed, these two theories are mutually sustainable and play a role in reducing fraud.

Although this research provides many benefits for both managerial theory and policy development, this study has some limitations. The research models used herein resulted in a deviation of 39.1% outside of the ethical culture framework. Therefore, this study can be further developed by adding other variables that have the potential to reduce fraud, such as leaders acting as role models, as well as being responsible and charismatic.

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