Reviewing the Interrelation Between Information Security and Culture: Toward an Agenda for Future Research

Sebastian Hengstler[1], Natalya Pryazhnykova[1]

[1] Chair of Information Security and Compliance, University of Goettingen, Germany
s.hengstler@stud.uni-goettingen.de, pryazhnykova@gmail.com

Abstract. The main goal of this paper is to provide a review of existing research on the interrelationships between information security and culture. The results of this study are based on a structured literature review of current research on the interrelationships between information security and culture, published between 2000 and 2020 (September). Our results show that current research has focused on four core themes: (1) the influence of culture on information security policy compliance behavior, (2) information security culture in organizations, (3) the influence of culture on information security awareness programs and (4) the effect of culture on information security governance. Our results show, that so far, the mentioned topics have been investigated from different perspectives. However, our results offer potential for future research, e.g. in the connections between information security and individual cultural values or in the area of information security awareness.

Keywords: Information Security and Culture, Literature Review, Information Security

1 Introduction

Information security represents a field of increasing scholarly interest from a practical and theoretical perspective and includes various critical dimensions, which need to be considered to ensure a high level of information security e.g. in organizations [1]. Important mechanisms to guarantee information security are technical measures, such as firewalls, to protect networks or various authorization measures for hardware protection [2].

However, it is a well-known fact that attacks on information security systems in private or professional usage start at the weakest point which is failure caused by an individual [3]. This is the reason, why measures to ensure compliant behavior of employees in various organizations are becoming increasingly crucial [4].

Existing studies analyze a variety of mechanisms that influence the compliance behavior of employees, such as the social environment of an individual, the use of informal and formal sanctions to ensure compliance or the use of threat and coping

16th International Conference on Wirtschaftsinformatik,
March 2021, Essen, Germany

appraisals [1]. Furthermore, existing research presents, that contextual differences are an essential factor to consider, when designing information security measures to achieve compliance behavior [5]. Besides the distinction between different types of information security breaches, culture is an important contextual component of current information security research [6].

Over the last two decades, culture has been analyzed from different angles in the context of information security and there are different approaches in research, which aim to explain how these two aspects relate. The results of existing literature reviews in the field of information security and culture show a variety of different outcomes. Mahfuth et al. (2017) analyzed existing research regarding information security, organizational culture and the relation of these two fields. [7]. Karlsson and Åström (2015) provide an overview of the research in the area of information security culture [6]. Hina and Dominic (2020) identify information security and culture as current trending topic in information security research [8]. In summary, there are recent approaches, which analyze the interrelations between information security and culture from different perspectives. However, we believe that a comprehensive overview that represents the different perspectives and top themes of information security culture research is still missing, but can help to provide a more complete view on the relation of culture and information security [9].

The aim of this paper is to summarize existing research about information security and culture in order to increase the understanding of the influence of culture and its relevance to information security. The scope of this paper is to identify the current research themes in this field, and to provide further directions for future research. In our analysis, we build on existing cultural concepts to identify interrelations between culture and information security research. We used the approach of Leidner and Kayworth (2006) to analyze the interrelations between culture and information security, in combination with the process for a structured literature analysis of Webster and Watson (2002) [9, 10].

With our research, we aim to contribute to current literature in providing a comprehensive view on the current state of the interrelation between information security and culture research. Our study provides an overview not only about analyzed cultural levels and artefacts, but also used research approaches (methods and theories). In addition to that, we identified overlapping and less analyzed aspects in existing research. We identified both major and minor gaps in the literature and provided implications for further research.

This study is structured as follows. In section 2, we defined the relevant concepts of culture we used in our literature analysis. In section 3, the literature analysis process is explained. We described outcomes of this paper and defined focus themes in information security and culture research in section 4. An overview about potential future research is presented in section 5. The paper concludes in section 6.

2   The Concept of Culture

In other research areas such as Social Studies or Psychology, culture is understood as a summary of ideologies, beliefs, basic assumptions, shared norms and values, that have an influence on the collective will [11, 12]. Other approaches analyze the construct of culture from a different perspective and focus on individual cultural dimensions, which describe the individual components of culture [13]. Schein's (1997) three-level model of culture shows a model to explain culture within organizations [14]. Due to these differences and the fact, that the concept of culture is characterized by its many meanings and possible interpretations, it is rather challenging to define an overall definition of the concept of culture [15]. The first modern interpretation was made by Edward Tylor, who described culture as the collection of all skills and habits such as knowledge, beliefs or laws, which are shaped by society [16]. Hofstede specified the shaping of behavior by society and defined culture as a collective coding of the mind by which the members of a group distinguish themselves from the members of other groups [12]. Because of the fact that culture includes all rules, norms and the code of conduct of a collective, it has an influence on the behavior of the individuals of a group and is consequently controlling behavior [17].

In the area of information systems, the extent to which these are related to the topic of culture was also investigated. Leidner and Kayworth (2006), for example, analyzed different approaches in the area of information systems and culture in terms of their underlying theoretical cultural artifacts. They pointed out, that a relation between information systems and these cultural artefacts can occur on several levels of culture. Examples of this are a connection in the context of IT culture, the IT adoption process and cultural dependencies in IT management. In their analysis they distinguish between the national, organizational, and individual levels of analysis and name several cultural artefacts, which are used in research to analyze the interrelation between culture and information systems [9]. The national unit of analysis is described as the analysis of cultural orientation, based on a samples nationality, where different countries are chosen as the object of the study [12]. At the organizational level, studies analyze cultural differences in different organizational units, e.g. in different companies [14]. The analysis of smaller groups or individuals describes the study of individual behavior or within social groups [18]. As a subdiscipline of information systems research, we can relate these findings to current topics in information security research [6, 7]. For example, topics such as security culture, compliance behavior or security management can also be identified in the security domain, which show similarities to existing information systems research in other research streams. To make the results of our analysis comparable to existing research, we adapt Leidner and Kayworth's (2006) approach and analyze the identified literature, based on used cultural artifacts and their level of analysis [9].

3   Literature Analysis Process

For the literature analysis we adapt the methodological approach established in the field of information systems research according to Webster and Watson (2002) [10], which provides a solution for the systematic identification and analysis of relevant literature. The following plan was used for the consistent implementation of the methodological approach in our literature analysis. Firstly, the subject area was defined and our target group for our research was specified. At this point, our intention was to determine the current state of the research about the influence of culture on information security. Therefore, we concentrated on research outcomes, that shed light on the connection between these two topics. The scope of our literature review is to identify central topics in the interrelation of these research areas. We address mainly specialized scholars analyzing the effect of culture on information security or scholars interested in cross-cultural research in the field of information security.

Secondly, we conceptualized the core elements that will be used for the systematic categorization of identified literature. In order to classify and analyze the identified literature with respect to our research purpose, we have transferred the common characteristics of this research area from existing literature reviews, namely the methodological approach, cultural level of analysis, underlying theories and considered cultural artefacts, and used them in the form of a concept matrix for the analysis of our identified literature [9, 12, 13].Thirdly, we specified characteristics, which we wanted to analyze, the databases selection and the definition of our search terms.

Since research in the field of information security and culture is published in conference proceedings as well as in international journals, we used different databases. The databases EbscoHost, Aisel and AbiInform were used to obtain a broad coverage of both international journals and conference proceedings in our research area. Forward and backward search was conducted with the database Web-of-Science. Generally, publications in relevant journals and conferences of information security research were considered in our analysis. Publications from other disciplines in our research area were also included if they were of high relevance (e.g. high citation rate). We followed the orientation of Karlsson and Åström (2015) and considered literature published since 2000 [6]. In order to identify potentially relevant literature, we analyzed the keywords, the abstract and the title of the respective studies. The use of the search queries in the different databases resulted in a list of 461 publications, including duplicates. After deleting duplicates and articles with incorrect content that were not in the focus of our analysis, we received a list of 103 articles to be analyzed. 53 of these articles were identified in the initial search, 37 in the forward search and 13 in the backward search. In total, 58 articles where published in information systems or computer science journals and 45 articles on related conferences. A list of our search terms and constructs used to classify the results is shown in Table 1.

Table 1. Search terms and analyzed concepts.

Search Terms	Analyzed Concepts
Information security culture	Theories
Information security AND culture	Cultural Dimensions
Information security AND organizational culture	Used Methodical Approach
Information security AND national culture	Cultural Level of Analysis (National,
Information security AND information security culture	Organizational, Individual/Subunit)

In a fourth step, we analyzed the identified literature according to the identified characteristics. We considered articles published between 2000 and 2020 (September). An Overview about the considered articles per journal/conference is shown in table 2.

Table 2. Identified articles by journal and conference

Journal Title	Amount
Organizational behavior Computers & Security	1
Information Systems Management	2
Information Management & Computer Security	9
Computers in Human Behavior	2
Information & Management	2
Computers & Security	15
Information and Computer Security	6
Information Systems Journal	2
Communications of the Association for Information Systems	2
Southern African Business Review	1
Computer Fraud Security	2
Journal of Theoretical and Applied Information Technology	1
South African Computer Journal	1
Journal of Enterprise Information Management	1
Electronic Markets	1
Journal of Global Information Management	1
Decision Sciences	1
MIS Quarterly	2
Journal of Computer Information Systems	1
Journal of Database Management	1
Information Technology and Management	1
Journal of Global Information Technology Management	1

Conference Title	Amount
International Conference on Research and Innovation in Information Systems (ICRIIS)	1
Pacific Asia Conference on Information Systems (PACIS)	5
American Conference on Information Systems (AMCIS)	6
European Conference on Information Systems (ECIS)	4
International Conference on Information Systems (ICIS)	1
Human Aspects of Information Security & Assurance (HAISA)	2
International Social Security Association (ISSA)	3
International Conference on Information Security and Cryptology (ICISC)	3
IEEE World Congress On Computer Applications and Information Systems (WCCAIS)	1
Australian Information Security Management Conference (AISM)	6
International Carnahan Conference on Security Technology (ICCST)	1
Conference on Information Security for South Africa (ISSA)	1
Hawaii International Conference on System Sciences (HICSS)	1
Wireless Internet Service Providers Conference (WISP)	4
International Information Management Association Conference (IIMA)	1
Mediterranean Conference on Information Systems (MCIS)	1
International Conference for Internet Technology and Secured Transactions (ICITS)	1
Workshop on Governance of Technology, Information and Policies	1
European Conference on Information Warfare and Security (ECIW)	1
International Conference on Availability, Reliability and Security	1

Finally, the identified topics of existing literature were discussed, and current trends and further research potential were presented. We describe the last two steps in the following chapters.

4   Results

A total of 103 articles were analyzed in this literature review. Among them, 28 articles examined culture at the national level in the context of information security and 63 examined culture at the organizational level. There were 8 studies that examined culture at the individual/subunit level in the context of information security. Over 71% of the studies on the national cultural level used Hofstede's culture dimensions [12]. The organizational level studies often do not use explicit cultural artifacts (68%). The most represented cultural artifact at the organizational level is Schein's (1992) model of organizational culture (12%) [14]. No explicit cultural artifacts were studied on the individual/subunit cultural level. Additionally, we categorized the articles by their

scientific approach. Overall, there are two trends which were identified for the methodological approaches. 23% of the articles rely on conceptual frameworks. 32% of the identified articles used a questionnaire-based, quantitative methodological approach. Other methodological approaches are less represented. In terms of used theories, many articles have a more theory generating nature and do not use an existing theory (66%) for their studies. The types of theories do not indicate a focus.

Furthermore, we were able to identify overall focus themes within the analyzed articles dealing with the interrelations between information security and culture: (1) the influence of culture on information security policy compliance behavior, (2) information security culture in organizations, (3) the influence of culture on information security awareness programs and (4) the effect of culture on information security governance. We were not able to assign three identified articles to the mentioned articles and did not consider them in more detail. The following chapters describe the identified focus topics in more detail. A list of the identified and characterized literature, based on our observed concepts of theories, methods, cultural artifacts, and cultural level of analysis is listed in the appendix (Tables 4-7).

4.1 The Influence of Culture on Information Security Policy Compliance Behavior

A total of 30 papers dealt with the influence of culture on information security policy compliance behavior. 18 of these studies focused on the national cultural level, 11 on the organizational cultural level, and one on the individual/subunit cultural level. The majority of the articles used a questionnaire-based, quantitative approach (18), whereas 7 articles chose a qualitative approach. Meta-analyses (1), commentaries (2) typologies (1), case studies (2), and mixed method approaches (1) are less represented. Most articles do not explicit use a theory and are more theory generating in nature (11). The most frequently used theories are the theory of planned behavior (3) and the deterrence theory (4). Other theories are represented sporadically. At the national cultural level, 13 of 18 articles used Hofstede's cultural dimensions as cultural artifacts [12]. At the organizational level, hardly any culture artifacts have been used.

The topic "influence of culture on information security policy compliance behavior includes articles that primarily focus on the analysis of cultural differences regarding information security compliance behavior of employees. There is only one study, which considers individual cultural values when analyzing information security compliance behavior with respect to cultural differences. On a national cultural level, the research focus lies in the analysis of the effectiveness of different theoretical mechanisms on compliance behavior along national cultures. In this area, different theories such as deterrence theory or the theory of planned behavior are analyzed [19–21]. The focus is mainly on the analysis of 7 different cultures and does not show a big variety [22]. On the organizational culture level, research in this topic area focuses on organizational concepts that positively influence information security behavior and thereby contribute to a positive security culture in organizations. For example, knowledge sharing [23], discipline and agility [24], and morale within an organization are examined in terms of their positive impact on behavior [25].

4.2 Information Security Culture in Organizations

A total amount of 39 papers have dealt with information security culture in organizations. 32 studies focused on the organizational cultural level, 6 on the individual/subunit cultural level, and one study on a national cultural level. Predominantly, conceptual frameworks were developed within the articles (14). There is also a focus on conducting literature reviews (5), qualitative studies and case studies (5), and questionnaire-based quantitative studies (7). Most articles do not use explicit theory and are more theory generating in nature (34). At the organizational cultural level, Schein's (1992) organizational behavior theory was frequently used (7) [14]. Most articles do not mention explicitly cultural artifacts (26).

The theme "information security culture in organizations" includes articles, focusing on concepts and influencing factors of an information security culture within organizations, namely conceptualization of cultural models, their validation and the analysis of factors influencing a security culture and their effects. At the individual or subunit level, the crucial point lies in identifying different cultural subgroups within an organization, e.g. through different professional backgrounds [26, 27]. Another aspect of an information security culture is the analysis of influencing factors on such cultural subgroups [28, 29]. On an organizational cultural level, some articles focus on the analysis of illusory concepts of an organizational culture and their application in the information security culture domain [30–32]. Another core issue is the analysis of factors that influence an information security culture [33–35]. Furthermore, similarities between the traditional view of organizational cultures and an information security culture are in focus of current research as well [36, 37]. Other articles concentrate on the managerial impact on information security culture, such as the role of CISO's [38] or managerial guidelines to lead in a security culture [31].

4.3 The Influence of Culture on Information Security Awareness Programs

The influence of culture on information security awareness (ISA) programs was covered by a total of 8 articles. There were two studies with a focus on organizational cultural level, one study on the individual/subunit cultural level and five studies on national cultural level. Predominantly, mostly questionnaire-based, quantitative studies were carried out (5). Two articles conducted an experiment for their study and one article used a qualitative approach. A total of four studies chose Hofstede's culture dimensions as culture artifacts [12]. Other cultural artifacts, such as the organizational behavior theory [14] and aspects from the competing value framework were used as well [39]. In the context of this topic, different ways of approaching information security and culture were identified. On the one hand, correlations between information security awareness measures and the security culture of an organization are analyzed. The authors show that the security culture can have an influence on the individual awareness behavior of employees [40]. On the other hand, there are studies which investigate the influence of different organizational factors on ISA from different cultural perspectives. This includes the analysis of the impact of factors, such as

security culture or competing values on the awareness of employees [41]. At the national cultural level, studies have been mainly conducted with the purpose to analyze the effectiveness of theoretical mechanisms, such as social norms and attitude values [41] or fear appeals [42] on information security awareness in different countries.

4.4 The Effect of Culture on Information Security Governance

The effect of culture on information security governance was analyzed by a total of 21 articles. There were 17 studies with a focus on organizational cultural level and 4 studies on national cultural level. Most of the analyzed studies focused on qualitative research approaches (5) and case studies (6). Most articles did not explicit outline mentioned theoretical approach or specific used cultural artefacts.
National cultural level studies in this theme focus on analyzing national cultural values on the effectiveness of security measures [43] and what national-level factors need to be considered while implementing them [44]. Other studies at the national level analyze the influence of national culture on corporate structure [45] and information security risk management [46]. At the organizational level of analysis, several focus themes can be identified.

On the one hand, current research is concerned with the relationship between culture and information security management. This includes the analysis of what effect management behavior can have on information security and its culture in the organization [47, 48] and the influence of culture on information security management itself [49]. Another element is the description of governance structures and their constituents for information security, considering cultural factors. This consists of the influence of culture on organizational structures, the implementation of information security measures [50] and the differences within these structures in different organizations [51]. Closely related are articles dealing with the design of information security policies, predominantly with the consideration of cultural differences [8, 52]. Another subtopic regarding the effect of culture on information security governance are Assessments. Articles describe not only the design and validation of assessment tools for information security culture, but also the implementation of monitoring methods for information security in a cross-cultural context [53, 54].

5 Directions for Future Research

Our study examined the current focus of analyses regarding the interrelation of culture and information security. In our literature review, we identified 103 relevant articles and were able to identify four focus themes concerning the interrelation between culture and information security. According to the outcomes of this study, the potential for further research can be identified.

Within the topic "the influence of culture on information security policy compliance behavior" there is a strong focus regarding the national cultural level of analysis and the testing of the effectiveness of various theories in respect of different national cultures. The focus lies mainly in theories established in security research, such as

deterrence theory or the theory of planned behavior. Additionally, the individual characteristics of the culture of individual employees have not yet been taken into account. Future research in the field of the relation of culture and information security behavior should include: (1) The investigation of further theoretical mechanisms and their cultural dependency regarding information security behavior, such as theories explaining the shaping process of behavior by social factors [6]. (2) A focus on the influence of individual manifestations of cultural artifacts on behavior, in order not to make assumptions about dependencies between culture and individual behavior based on only national cultural values [55].

The topic of information security culture in organizations includes articles about the structure of a security culture within organizations and its influencing factors. Research in this area could benefit from an increased use of established organizational culture theories or culture artifacts not only to validate the already developed information security culture frameworks but also to draw parallels to organizational culture [35]. Furthermore, previous studies have predominantly focused on looking at the whole organization and its security culture. Differences in individual sub-units, such as different professions or demographic or geographic factors are poorly represented The focus of future research in this area should therefore provide: (1) A validation of the previously developed frameworks in the security culture environment, taking into account established cultural artifacts in the organizational culture domain. (2) A more specific investigation of security culture in different sub-units of organizations and their factors influencing each other [26].

The theme about the influence of culture on information security awareness programs has been poorly established in current research, with only 8 articles published Overall, it is visible that the relationships between cultural artifacts and ISA have been lack of analysis. On a national cultural level, it is evident, that culture has an influence on ISA. Rather a few studies exist in connection with organizational factors, culture and ISA, as well as the influence of individual cultural values on ISA. Accordingly, our proposal for future research in this area broadly determined. We suggest that future research on the relationship between culture and ISA should focus on: (1) The interrelationships of culture at the national, organizational, and individual/subunit levels with ISA, taking into account established ISA approaches, in order to provide more insights into the interrelationships of these two aspects [40].

Articles examining the effect of culture on information security governance are characterized by the study of factors influencing culture on governance structures or structures of the organization itself. Likewise, a relatively large number of articles on the influence of culture on information security management can be identified. What has been less considered so far is the conceptualization and review of methods and tools for reviewing security measures under consideration of cultural differences in order to build an international, cross-cultural monitoring of the effectiveness of security measures [50]. Consequently, we suggest that future research focus on the relationship between cultural artifacts and the conceptualization and review of assessment and monitoring approaches. Our results are summarized in table 3.

Table 3. Research agenda.

Theme	We need to…	Limitations to Overcome
The Influence of Culture on Information Security Policy Compliance Behavior	(1) Further investigate theoretical mechanisms and their cultural dependency regarding information security behavior. (2) Analyze the influence of individual cultural values on behavior.	(1) A focus on quantitative studies (2) The consideration of cultural artefacts in studies about information security behavior and their relation to culture
Information Security Culture in Organizations	(1) Validate previously developed frameworks in the security culture environment, taking into account established cultural artifacts. (2) Investigate security culture in different sub-units of organizations and their factors influencing each other.	(1) Limitations of conceptual Frameworks (2) The distinction between different types of organizations
The Influence of Culture on Information Security Awareness Programs	(1) Analyze the interrelationships of culture at the national, organizational, and individual/subunit levels (2) Go beyond quantitative approaches and use a greater variety of qualitative and quantitative approaches.	(1) A focus on national cultural values (2) A focus on quantitative studies
The Effect of Culture on Information Security Governance	(1) Further analyze the relationship between cultural artifacts and the conceptualization and review of assessment and monitoring approaches. (2) Measure culture not only on organizational, but individual level to better understand the individual effect of culture on governance structures.	(1) The lack of theoretical approaches in this research stream (2) A focus on national cultural values

6   Conclusion

The purpose of this study was to analyze current research on the relationships between information security and culture. Our study focuses on the interrelationships between information security and culture and thus represents an extension to existing literature reviews in the security context. By applying a structural framework, it provides an overview of the current state of research and its core topics, as well as existing research gaps. Based on the literature we identified, we were able to identify open points in the identified core topics and highlight potential for future research. Overall, limitations

remain to be identified in the context of our study. Our findings are limited to the selected areas of outlets and keywords that we considered in our search for relevant literature. Future research in specific research areas, will need to be further elaborated to include a wider scope of other, IS conferences, and journals potentially relevant to the specific case.

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Appendix A: Analyzed Articles

Table 4. Concept matrix: The influence of culture on information security policy compliance behavior. **Note**: NA = Not Applicable

The Influence of Culture on Information Security Policy Compliance Behavior				
Paper	**Level of Analysis**	**Method**	**Theory**	**Cultural Artefact**
(Hovav and D'Arcy, 2012)	National	Survey	Deterrence Theory	Hofstedes Cultural Dimensions
(Yayla, 2011)	National	Survey	Institutional Theory	Hofstedes Cultural Dimensions
(Arage et al. 2015)	National	Survey	Rational Choice Theory	NA
(Connolly et al. 2019)	National	Qualitative	NA	Hofstedes Cultural Dimensions
(Flores et al. 2014)	Organizational	Mixed Method	NA	NA
(Harris et al. 2010)	National	Survey	NA	Hofstedes Cultural Dimensions
(Flores et al. 2015)	National	Survey	Theory of planned bevahior	Hofstedes Cultural Dimensions
(AlKalbani et al. 2015)	Organizational	Survey	Technology-organization-environment (TOE) Theory	NA
(Dan and Lindström, 2011)	Organizational	Case Study (Typology)	Theory of organizational behaviour	NA
(Menard et al. 2018)	Organizational	Survey	Protection Motivation Theory	Hostedes Cultural Dimensions
(Vroom and Von Solms, 2004)	Organizational	Conceptual Framework	NA	NA
(Dinev et al. 2009a)	National	Survey	Theory of planned behavior	Hofstedes Cultural Dimensions
(Da Veiga, 2015)	Organizational	Case Study (Quantitative)	NA	NA
(Crossler et al. 2013)	NA	Comment	NA	NA
(Cockroft and Rekker, 2016)	National	Survey	NA	Hofstedes Cultural Dimensions
(Connolly et al. 2017)	Organizational	Qualitative	Deterrence Theory	NA

(Dols and Silvius, 2010)	National	Survey	NA	Hofstedes Cultural Dimensions
(Warkentin et al. 2012)	National	Survey	Deterrence Theory	Hofstedes Cultural Dimensions
(Khaled and Lane, 2008)	Organizational	Framework	NA	NA
(Hwee-Joo Kam et al. 2014)	National	Comment	Neo Institutional Theory	Hofstedes Cultural Dimensions
(Hwee-Joo Kam et al. 2015)	National	Survey	Organizational Norm Theory	Cross-Cultural Framework (CVF)
(Arage et al. 2016)	National	Survey	Rational Choice Theory	Hofstedes Cultural Dimensions
(Chen et al. 2016)	National	Survey	Protection motivation theory	Hofstedes Cultural Dimensions
(Vance et al. 2020)	National	Survey	Deterrence, Moral Beliefs, Neutralization	Hofstedes Cultural Dimensions
(Lin et al. 2020)	National	Qualitative	NA	Organizational behavior theory (Schein)
(Cram et al. 2020)	National	Meta-Analysis	NA	NA
(Da Veiga, 2016)	Individual	Survey	ISCA questionnaire	NA
(Karjalainen et al. 2020)	National	Qualitative	NA	Hofstedes Cultural Dimensions
(Amankwa et al. 2018)	Organizational	Survey	Involvement theory	Organizational behavior theory (Schein)
(Dinev et al. 2009b)	National	Survey	Theory of planned behavior	Hofstedes Cultural Dimensions
(Alfawaz et al. 2010	Organizational	Case Study (Qualitative)	Classification Theory	NA

Table 5. Concept matrix: Information security culture in organizations.
Note: NA = Not Applicable

Information Security Culture in Organizations				
Paper	**Level of Analysis**	**Method**	**Theory**	**Cultural Artefact**
(Da Veiga and Eloff, 2010)	Organizational	Conceptual Framework	NA	NA
(Amjad et al. 2017)	Organizational	Literature Review	NA	NA
(Ashenden and Sasse, 2013)	Organizational	Qualitative	NA	NA

(Da Veiga and Martins, 2017)	Individual / Subunit	Survey	NA	NA
(AlHogail, 2015)	Organizational	Conceptual Framework	NA	NA
(Lim et al. 2010)	Organizational	Case Study (Qualitative)	NA	NA
(Van Niekerk and Von Solms, 2010)	Organizational	Conceptual Framework	NA	NA
(Dhillon et al. 2016)	Organizational	Case Study (Qualitative)	Dimensions of Organizational Culture	Theory of cultural message streams
(Ruighaver et al. 2007)	Organizational	Conceptual Framework	Organizational Culture Framework	NA
(D'Arcy and Greene, 2014)	Organizational	Survey	NA	NA
(Kolkowska, 2011)	Individual / Subunit	Case Study (Qualitative)	NA	NA
(Alnatheer et al. 2012)	Organizational	Survey	NA	NA
(Lacey, 2010)	Organizational	Literature Review	NA	NA
(Ramachandran et al. 2013)	Individual / Subunit	Qualitative	NA	NA
(Dojkovski et al. 2007)	Organizational	Case Study (Mixed Method)	NA	NA
(Martins and Da Veiga , 2015)	Organizational	Survey	NA	NA
(Shuchih and Chin-Shien, 2007)	Organizational	Conceptual Framework	NA	NA
(Van Niekerk and Von Solms, 2005)	Individual / Subunit	Conceptual Framework	NA	NA
(Van Niekerk and Von Solms, 2006)	Organizational	Conceptual Framework	NA	Organizational Cultural Framework
(Zakaria, 2006)	Individual / Subunit	Conceptual Framework	NA	NA
(Alhogail and Mirza, 2014)	Organizational	Literature Review	NA	NA
(Alhogail and Mirza, 2014)	Organizational	Literature Review	NA	NA
(Alnatheer and Nelson, 2009)	Organizational	Conceptual Framework	NA	NA

(Malcolmson, 2009)	Organizational	Qualitative	NA	NA
(Ramachandran et al. 2008)	Individual / Subunit	Qualitative	NA	NA
(Schlienger and Teufel, 2003)	Organizational	Conceptual Framework	NA	Organizational Cultural Framework
(Zakaria, 2004)	Organizational	Comment	NA	Organizational Cultural Framework
(Ruighaver and Maynard, 2006)	Organizational	Conceptual Framework	NA	NA
(Thomson et al. 2006)	Organizational	Conceptual Framework	NA	NA
(Martins and Eloff, 2002)	Organizational	Conceptual Framework	NA	NA
(Da Veiga et al. 2020)	Organizational	Survey	OISCM Model	NA
(Nel and Drevin, 2019)	Organizational	Qualitative	PMT	Organizational Cultural Framework
(Tang et al. 2016)	Organizational	Case Study	NA	Hofstedes Cultural Dimensions
(Da Veiga, 2018)	Organizational	Survey	ISCA Questionnaire	NA
(Connolly and Lang, 2013)	Organizational	Mixed Method	NA	NA
(Lim et al. 2009)	Organizational	Literature Review	NA	Organizational Cultural Framework
(Ngo et al. 2005)	Organizational	Conceptual Framework	NA	NA
(Van Niekerk and Von Solms, 2013)	Organizational	Design Science	NA	Organizational Cultural Framework
(Williams, 2009)	Organizational	Conceptual Framework	NA	Organizational Cultural Framework

Table 6. Concept matrix: The influence of culture on information security awareness programs
Note: NA = Not Applicable

The Influence of Culture on Information Security Awareness Programs				
Paper	**Level of Analysis**	**Method**	**Theory**	**Cultural Artefact**
(Lin and Hsien-Cheng, 2014)	National	Survey	Theory of planned behavior	Hofstedes Cultural Dimensions
(Plachkinova and Andrés, 2015)	National	Survey	NA	Hofstedes Cultural Dimensions

(Karjalainen et al. 2013)	National	Conceptual Framework	NA	NA
(Flores et al. 2016)	Organizational	Survey	NA	NA
(Pienta et al. 2017)	Organizational	Experiment	SETA	Competing Value Framework (Cameron & Quinn 2006)
(Chen et al. 2008)	National	Experiment	NA	Hofstedes Cultural Dimensions
(Schmidt et al. 2008)	National	Survey	NA	NA
(Wiley et al. 2020)	Individual	Survey	HAIS-Q	Organizational Security Culture Measure.

Table 7. Concept matrix: The effect of culture on information security governance
Note: NA = Not Applicable

The Effect of Culture on Information Security Governance				
Paper	**Level of Analysis**	**Method**	**Theory**	**Cultural Artefact**
(Da Veiga and Eloff, 2007)	Organizational	Conceptual Framework	NA	NA
(Werlinger et al. 2009)	Organizational	Qualitative	NA	NA
(Shaaban and Conrad, 2013)	National	Mixed Method	NA	Hofstedes Cultural Dimensions
(Tsohou et al. 2006)	National	Conceptual Framework	NA	NA
(Da Veiga and Martins, 2015)	Organizational	Case Study (Quantitative)	NA	NA
(Knapp et al. 2006)	Organizational	Mixed Method	NA	NA
(Da Veiga et al. 2007)	Organizational	Survey	NA	NA
(Bess, 2009)	Organizational	Case Study (Qualitative)	Structuration Theory	NA
(Martin and Eloff, 2002)	Organizational	Conceptual Framework	NA	NA
(Okere et al. 2012)	Organizational	Qualitative	NA	NA
(Von Solms and von Solms 2004)	Organizational	Comment	NA	Schein (1992)

(Ali and Brooks, 2009)	National	Conceptual Framework	Structuration Theory	Straub 2002
(Hu et al. 2012)	Organizational	Survey	TPB	NA
(D Arcy et al. 2007)	National	Survey	Deterrence Theory	Hofstedes Cultural Dimensions
(Lapke and Dhillon, 2008)	Organizational	Case Study (Qualitative)	NA	Circuits of Power (Clegg 2002)
(Hina et al. 2020)	Organizational	Literature Review	NA	NA
(Corriss, 2010)	Organizational	Case Study (Qualitative)	Broken Window Theory	NA
(Dojkovski et al. 2007)	Organizational	Conceptual Framework	NA	NA
(Ghernaouti et al. 2010)	Organizational	Case Study (Qualitative)	NA	NA
(Johnsen et al. 2006)	Organizational	Conceptual Framework	NA	Hudson (2002)
(Luo et al. 2009)	Organizational	Survey	NA	Hofstedes Cultural Dimensions

Appendix B: Identified Articles

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