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Preface

This volume contains papers presented at 2018 2nd International Conference on E-Commerce, E-Business and E-Government (ICEEG 2018), which was held in The Hong Kong Polytechnic University, Hong Kong during June 13-15, 2018.

ICEEG 2018 provides a great opportunity for the academics and researchers along with industry people who work in all aspects of E-Commerce, E-Business and E-Government to get together and share your research experiences and research outcomes. In addition to the contributed papers, we also invited five internationally known experts (Prof. Eldon Y. Li from National Chengchi University, Taiwan; Prof. Kun-Huang Huarng from Feng Chia University, Taiwan; Prof. Cheol Park from Korea University, South Korea; Prof. Young-Chang Hou from Tamkang University, Taiwan; Assoc. Prof. Vincent TY Ng from The Hong Kong Polytechnic University, Hong Kong) to deliver keynote speeches at ICEEG 2018.

The volume includes 19 selected papers which were submitted to the conference from universities, research institutes and industries. Each contributed paper has gone through a rigorous blind peer-review process. They were reviewed by at least two experts who are qualified within the field of E-commerce, E-business and E-government. The proceeding tends to present to the readers the new research results and findings in the related fields.

The reviewers made great efforts in providing constructive feedback to authors to ensure the quality. The chairperson of each session played an important role in guiding the sessions in a timely and efficient manner. With the support from all participants, this conference got a great success. On behalf of the conference committee, we'd like to express our sincere appreciation to them for their contribution.

We truly believe the participants will find the discussion fruitful, and will enjoy the opportunity for setting up future collaborations.

Best Regards

ICEEG 2018 Conference Chair

Assoc. Prof. Vincent TY Ng

The Hong Kong Polytechnic University, Hong Kong

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ICEEG 2018
E-Business and Business Management

The Development of Collaborative Model between Fintech and Bank in Indonesia

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ABSTRACT

This paper aims to explore any possibilities or any chance the happening collaborative and disruptive between financial technology (Fintech) and bank with the focus on Peer to Peer (P2P) model. We describe how financial innovations P2P model may have the possibility to disturb the financial system and analyze the collaborative model between bank and Fintech in Indonesia. The method of this study is literature review in which we combine the theoretical perspective, lesson learned from some countries and Indonesia's experience. We find that the collaboration model is feasible with some requirement.

CCS Concepts

• General and reference → Document Types → General conference proceedings

Keywords

Fintech; Bank; P2P; Financial system.

1. INTRODUCTION

Nowadays, the bank as a traditional financial institution is being subjected to enormous pressure to reduce cost in an environment of low - interest rates which is squeezing margins [1]. The clients are demanding a new portfolio of products which is more suited to their needs, along with new ways communicating and completing the transaction. With this point of view, a new type of company has emerged: financial services specialist who has proven that they are much more in tune with customer's needs and that they

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are capable of offering more effective, quicker and more competitively priced services, which is popularly known as financial technology (fintech).

Opportunities for the development of fintech in Indonesia seem inevitable but the level of cash-based banking services is inefficient. On the contrary, the rate of penetration of information technology is growing fast.

Figure 1 below shows that 85% of banking transactions in Indonesia are still with cash. While Malaysia and Singapore have reached 42% and 39% [2].

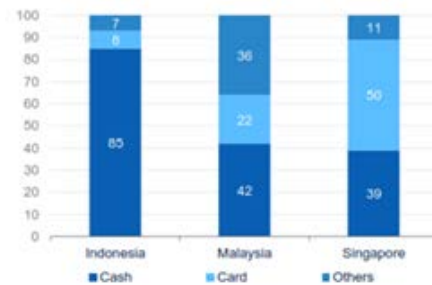


Figure 1. Share of retail payment instruments in 2015 (%Share)

Source: BBVA Research, Bloomberg, CEIC, World Bank

Whereas the rate of penetration of mobile phone in Indonesia has reached 99.7% as shown in Figure 2 below [3].



Figure 2. Indonesia's Untapped Digital Potential Indonesia's untapped digital potential

Source: BBVA Research, Bloomberg, CEIC, World Bank

The above opportunities seem to be exploited by fintech. So, the question arises here whether the emergence of fintech in Indonesia will undermine banking operations or it will open up opportunities for collaboration between the two.

2. LITERATURE REVIEW

The emergence of thousands of start-ups globally got lately a new twist in the financial sector in the term of digitalization. Payment service and lending, market e-commerce and the last is investment and risk management are the focus of fintech companies, it is appropriate with the common perception of fintech business models. In addition, new business areas on a consecutive basis explored by fintech, the disruption in the financial system is one of the possibilities caused by some of those financial innovations [4].

The fintech business has now expanded into loans and payments, known to peer-to-peer (P2P). Debt financing that allows people to take for temporary use and lend money without use from the authorized financial institution as a mediator is the P2P loan [5]. This process is to remove the intermediary, which has been taking more time, risk, and effort as illustrated in figure 3 below [6].

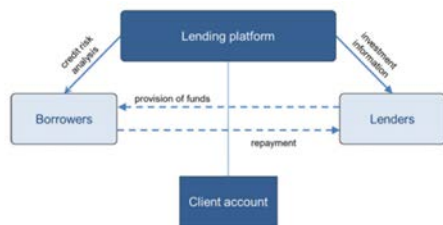


Figure 3. Stylized traditional P2P lending model

Source: Committee on the global financial system, bank for international settlement

2.1 The Description of P2P and Emerges of FinTech Globally

The global phenomenon is the suitable words for the emerge of fintech. Data provided in figure 4 exhibit that since 2013 most fintech investments mostly were made in the United States of America [7]. On the other hand, since 2014 fintech investments in the Asian region increased.



Figure 4. Investments in Fintech and Number of Deals

Source: KPMG, CBIInsight

Some of the small financial technology currently propose financial services that frequently offered by traditional banks. What makes the difference between fintech and traditional banks is that some fintech in many cases don't have a banking license. some of fintech initiated to propose additional financial service experienced rose to a critical size, it is necessary for fintech to be

licensed as credit institution/bank, for example, Alibaba in China and N26 in Germany [8].

Compared with traditional banks, fintech which mostly are small start-up argued that they offer highly standardized and economical financial services internet based and thus offer less geographical robust, lesser regulation of financial services, change the consumer behavior, almost lower risk of financial services/products for example maturity risk and borrower default risk. But actually, fintech only propose one specific financial service, compared with banks. Generally, the financial service which provided by fintech can be standardized hence its resulted relatively low variable cost [9].

2.2 Fintech in Indonesia with Special Focus Payment Service and P2P Lending

In spite of being late starters, Indonesia has seen left behind in the past three years to adapt to the nature of fast technology development regarding fintech especially in term of payment service and P2P lending [10].

In figure 5, we provide the infographic about payment entrance in Indonesia from simple online shopping facilitators to fronting a store.



Figure 5. Payment entrance in Indonesia

Source: BBVA Research

The aim of fintech payment gateway in Indonesia is to combine the broad variation of merchants, and transaction volume by congregating countless payment methods in one [11].

Small businesses are the primary focus or the target market of Indonesia's leading P2P business lending platform [12]. From the research known that small businesses in Indonesia contribute more than 60% of GDP. So, this is such a promising playground for fintech to develop a system to help the small business entrepreneur run their business. Table 1 show us the fintech investment in Indonesia.

Table 1. Fintech Investment in Indonesia

Players	Modalku, Gandengtangan, Koinworks, Crowdo, Investree
Industry Insight	<ul style="list-style-type: none"> The estimation of Indonesian Financial Service Authority (OJK) that the certain need of business financing in Indonesia would be about Rp 1,600 trillion (USD 116 billion) In fact, only Rp 600 trillion (USD 43 billion) could be distributed yearly through the capital market, banking, and multi-finance In fact, only 11 million out of 60 million SME's could get loans from banks, means that the disparity is quite high. Sixty percent of that number are

	<p>located on the island of Java.</p> <ul style="list-style-type: none"> 2020 is the year when Indonesia predicted to see \$54 million SMEs financing gap, with further than 57 million possibly bankable micro businesses
Funding Increased	<ul style="list-style-type: none"> Singapore based funding society and its sister company of Modalku, on August 2016 increased USD 8.37 million from VC Sequoia India and Bank Sinarmas. Investree raised series A funding assurance from VS firm Kejora on July 2016

Source: BBVA Research

As we said above that fintech in Indonesia being a late starter, we will still have the courage how society reacts the emerge of fintech. Whether fintech disrupt or can collaborate with the bank will be discussed in the section 4 analysis.

3. METHODOLOGY

The method of this study is literature review in which we combine the theoretical perspective, lesson learned from some countries and Indonesia's experience.

4. ANALYSIS

4.1 P2P Disruptive Vs Collaborative

Some executive believed that the emerge of digital disruption will disappear. But it's different with banker's point of view, more than 90% bankers seen that fintech will have a powerful impact on banking future's landscape [13]. Nearly a third project which fintech take will win an equal share or alike dominate the market. While obviously worried, banks do not make any further action to face the challenge. Disruption is such a hot topic to some majority of bankers (54%). They see that even if disruption happened but there is no sign of bank making changes. The 59% percentage of fintech executives agree with them, it's even larger percentage [14]. Fintech is a fusion of technology and financial service, it will change the business model and the main characteristics is less barrier to entry [15]. Figure 6 showed that fintech offer benefits not only for the customer but also to financial system and economy.

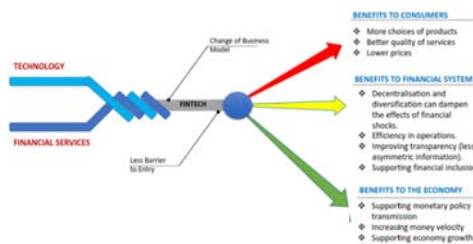


Figure 6. The Benefits of Fintech

Source: Bank Indonesia

Foregoing study shows that engagement strategy can be done with doing collaboration and it is considered as preferable [16]. By doing collaboration it gives an opportunity for banks to make innovation in new technology standard that they can use in the future.

Internal product development is the concern of large banks in the Asia-Pacific compared with those other regions, specifically in the

digital payment in order to serve the underbanked customer segment, it can be seen in figure 7 [17].

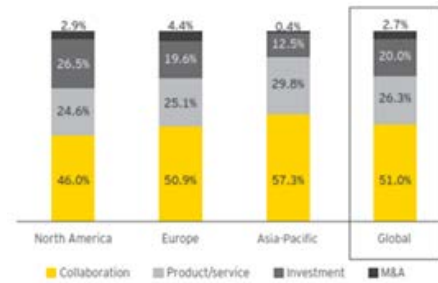


Figure 7. Engagement model by region

Source: EY Analysis

About one-quarter of the 45 global banks are broadly engaging with fintech by doing the collaboration, developing their own fintech products, then investing in innovative companies or buying them. Different region has a different approach, North American banks preferably investments over product development and many of major banks already invested in fintech start-up [18]. While European banks have commonly taken a balanced approach, and they are willing to make mergers and doing acquisitions part of their fintech strategy [19].

4.2 How Fintech Disrupt the Nature of Financial Services Especially Bank

There are some examples of disruption and collaboration P2P between Banks and fintech in some countries. Here they are:

From the global head of trading at Schroders to fintech consultancy, New York. An executive left Schroders in New York as part of the broader shake-up of its trading team that led many senior executives to depart earlier this year. Trading roles, even on the buy-side, are becoming increasingly technology led and McGrath has moved from leading a team of 38 traders globally to running a fintech advisory firm as the only current employee. He is at the helm of ZigIQ, which offers fintech advisory services to start-ups.

From private equity to a serial fintech entrepreneur, London, and Berlin. An executive left his private equity role in 2014 to found Spotcap, a Berlin-based alternative lender, but the business that he built up over the past two years is in new hands. He left his role as Spotcap's CEO in September and as of last month is back in London as the CEO of a new, currently under wraps, fintech firm in the UK capital.

In the different case of disruption that's also happens in Indonesia, it appears in BRI (Bank Rakyat Indonesia). Currently, the banking transaction lives only 20%. The 80% is using the financial digital service. BRI respond this condition by doing the transformation in order to survive and compete either with banks or fintech. BRI launched a satellite to support the service network to the far corners. One of which is successfully presented BRI is banking services in the middle of the sea. BRI was known as the bank with the traditional system in Indonesia, but now it becomes the most modern bank with advanced technology.

The future of bank will eliminate the function of teller and customer service [20] in all of their offices which is spread in Indonesia, as a replacement BRI provide smart-table. Through smart-table, customers can get up-to-date information on investment products, storage facilities, and other BRI information

with one touch. Currently, there are 13 branch offices that implement this technology. This transformation is an effort of BRI to continuously improve banking services to its customer.

4.3 Collaboration between Fintech and Bank

4.3.1 Collaboration between OnDeck and JPMorgan Chase

Service provided by OnDeck's will allow JPMorgan Chase to get, process and acclaim the small business loan application fastly, rather than the days the process it takes, giving the signify return over their competitors, returns that are greatly visible to the consumer. The technology which offered by OnDeck for JPMorgan Chase called "OnDeck Score", it will develop a similar scoring tool for Chase [21].

4.3.2 Collaboration between TransferWise and LHV (Estonia's Largest Bank)

TransferWise cooperates with LHV (Estonia's Largest Bank) to build an integrated system which will give convenience to LHV customers. TransferWise and LHV doing the collaboration to serve their customer in order to send international payments directly from LHV without intermediary cost. The system they build is about integrating TransferWise right into the LHV experience both on website and LHV App.

4.3.3 Capital One build innovation Lab to build new Fintech

Over hundreds of employees work in the banking giant's innovation division in innovation labs owned by the Capital One. This Innovation lab located in Washington DC, New York City, and San Francisco. Starting with a deep understanding of the consumer, Capital One called them self as human-centered methodology, that allows people coupled with a fail-fast attitude to quickly identify, build, and doing trial and error to test their way to success [22]. Means that it saves time planning, more time action. Design thinking is their go-to method for making the products and experiences, so that can be useful for the consumer.

4.3.4 Apple Pay collaboration with Mastercard and Sberbank (Russia's Largest Bank)

It is very easy to set up apple pay in Sberbank Online Apps, which is common to all Sberbank card owners. The benefits that can be perceived by users not only continuing to get from utilizing credit and debit cards but also able to enjoy contactless payment service. In the outlet or store, apple pay partnered with apple watch, iPhone SE, iPhone 6 and later.

Users don't need to manually write down lengthy account from or doing regularly type in freight and billing information. Users just need to tap the finger with touch ID, online shopping with Apple pay in apps and on the website can be simple as like that.

4.4 Collaborative Model

From the various discussions above, the development of fintech can't be unstoppable, because the development of technology is a necessity [23]. The challenge is how banks which have weak innovation culture to select the right or the most appropriate fintech to collaborate in order to successfully implement a new standard technology [24]. To deliver change, fintech need to better shout out the clear benefits of their technology and doing the collaboration with the bank

1. Fintech offer not only the digitizing money but also monetizing data. The system is how they can capture the value-add from data.
2. Fintech provides us different approach which makes them offer limitless data, specifically with the emergence of social media which advanced algorithms can rapidly investigate and convert into new services and products.
3. Fintech is one of the solutions for SME's to develop their business. The common problem which faced by small and medium-sized enterprises (SME's) it's about difficulties in securing the financial needs to survive and prosper. As we know that SME's is important for economic growth and jobs. Fintech's role is needed, fintech provide effective and efficient innovative products for SME's it gives to a more varied option of funding, such as e-commerce finance and merchants, marketplace peer to peer lending, online supply chain finance, invoice finance and online trade finance.

Fintech saw as the positive disruption that makes Indonesia's economy successfully transitioned [25]. The government should consider that fintech sector recognizes as a vital role in helping positive transition that is existing in the economy of Indonesia.

A bank is an institution which handles money. Banks withdraw overplus money from the people who are the consumption is lesser than their income, that is a form of a loan to the bank and in turn, they have to pay interest on it for loans of those who already deposited or saved their money [26]. Presently, the banking system has been acquainted with an organized organization. Being settle organized organization is not enough if banks want to go hand in hand with the development of technology [27]. So, the better choice to address that issue is developing the collaborative model between Fintech and Bank. Based on that we have four Fintech models to be offered:

4.4.1 Channeling

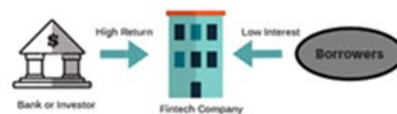


Figure 8. Channeling Model

Source: Model created by the creator

As we can see in the figure 8, channeling model is the most suitable when a fintech company is used as a financial channel in-between investor and borrowers. They will choose to invest their money in the fintech company because it has the higher return than most other investment companies. The borrowers prefer to borrow money from fintech company because it has the lower interest that other competitors [28]. This means that the fintech company has changed their function to be a channel of financial distribution.

The example of this model in Indonesia is Investree, this company business is focusing on invoice financing and employee unsecured loans but it only applies to the partnered companies only. One of the partnered companies of Investree is bank Danamon. Another fintech company that had exclusively applied this model is Modalku, the pioneer of the P2P lending company that has a financial technology based in Indonesia. Modalku had offered a non-collateral loan with interest rates between 15% - 20%. As a custodian, Modalku had cooperated with Sinarmas Bank in Indonesia. As the custodian of Modalku, Sinarmas Bank has to

relocate the money of lenders to ensure its transparency. The collaborations between Modalku and Sinarmas Bank comprise of the escrow account, custody services, loan channeling, and loan referrals.

4.4.2 Incubator Model



Figure 9. Incubator Model

Source: Model created by the creator

Figure 9 show us about the incubator model. Before a business or entrepreneur enter the market. They will need a lot of knowledge, skill, and understanding to start with. With a lack of experience, a newly established business can cause it to fast collapsing. Therefore, beforehand there is some precaution to prepare that newly established business to avoid such incidents to happen. This makes the incubator model works to educates the business the entrepreneurs wanted to established in the desired period of time. This has made the fintech company as an organization to conduct a market test to newly established business.

The growth of Indonesian start-ups is the second biggest ASEAN after Singapore. This has made Bank Mandiri made a fintech start-up to do this model. Bank Mandiri collaborating with Telkom Indonesia to build business incubator named Indigo Incubator.

By applying this model, Bank Mandiri had given a program that provides the participants with a technical skill and the knowledge of business management, the ability to make strategy and to know their opportunity in the market.

4.4.3 Acquisition Model

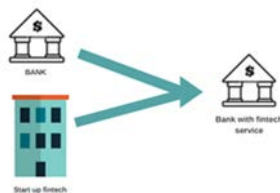


Figure 10. Acquisition Model

Source: Model created by the creator

Figure 10 show us about acquisition model. Acquisition becomes one of the strategies that can be considered to do the collaboration between start-up fintech company and bank, this strategy will bring the advantages to two parties, start-up fintech will be helped by the bank to perform its service, the bank will take over the modal capital of start-up fintech. There is no example yet or case this collaboration model in Indonesia.

4.4.4 Vendor Model

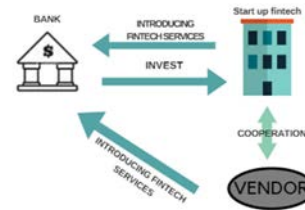


Figure 11. Vendor Model

Source: Model created by the creator

As we can see in the figure 11, vendor model requires the third party between the bank and start-up fintech, which is vendor. The vendor provides a platform for users to use as a service provider. Platforms service offers to include new distribution channels, new processing capabilities, and new origin of data to support create platforms in banking. Start-up fintech is cooperated with the vendor to create platform service providers for banks.

Fintech in Indonesia is very new, and this innovation is still on the introduction stage. Based on the research which was done by JakPat, 80% respondent put quite interest with the promo which offered by digital payment service provider. Users expect a discount promo, product incentive, lottery prize, and top-up extra bonus. About the digital payment service provider, 32% respondent claimed to be sufficient with the service currently in use, so reluctant to try other services. In addition, because users find it rare to find a place or service that received payment with the digital service.

While fintech P2P lending has the distinct advantage of being able to run the interface function through the balance sheet outside the balance sheet. P2P lending services are also more flexible and can allocate capital or funds almost to anyone, in any amount, effectively and transparently, and with a mild interest [29].

Financial services such as P2P lending are very relevant and a breath of fresh air for Indonesia who is still working hard to complete some homework, namely:

First, Indonesia still needs to improve the level of financial inclusion of its people. The association of fintech Indonesia reports that there are still 49 million non-bankable SME's in Indonesia, which are mainly due to business capital loans requiring collateral. P2P lending can bridge the credit-worthy borrower SME's by providing loans without collateral.

From the models above, we choose incubator model is the appropriate P2P lending which can be continued in Indonesia. The future of incubator model P2P lending in Indonesia is quite promising because it will help SME's to plan and prepare their self before open the business. SME's in Indonesia is huge and need treatment in order to compete and have a competitive advantage. It is like a collaboration between Bank Mandiri and Telkom Indonesia build Indigo Incubator.

And the second we choose is channeling model for appropriate P2P lending in Indonesia. Channeling model will give both advantages for fintech and bank. How they work is bank provide the client network which has been built for decades to the collaborated fintech. As a reciprocal, fintech offer the system which will help bank to operate more efficient and effective. It is like the collaboration between Bank Danamon and Investree.

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Rethinking Modes of Evaluation of Market Dominant Power for Multi-Sided Platforms

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ABSTRACT

As mobile internet is currently proliferating, multi-sided platform operators such as Google and Apple mediating transactions between customer groups play a major role in forming market environment. In this regard, traditional tools of evaluating market dominance are required to reflect features of multi-sided platforms. Thus, existing judging factors of assessment of market dominant position such as market share and entry barrier should be modified to fit in with multi-sided platform market. In addition, special features of multi-sided platform market such as indirect network effects, multi-homing, dynamic innovation should be considered. The Korea Fair Trade Commission (hereafter the KFTC) and Korean courts heavily rely on market share based on the provision of presumption of market dominant position in evaluating market dominant power. However, there are some cases reflecting features of multi-sided platforms such as indirect network effect multi-homing and market dominance leveraging theory. As multi-sided platform business is developing continuously, competition authorities and courts are required to mirror changing market environment to secure fair competition and consumer welfare. Furthermore, as the importance of personal customer data with regards to market dominance leveraging phenomenon is increasing, market dominant power of platform operators should be examined more comprehensively.

CCS Concepts

• General and reference → Document types → General conference proceedings

Keywords

Market dominant power; multi-sided platform business; multi-sided market

1. INTRODUCTION

With the advent of internet, chances of mediating transactions between customer groups are significantly increasing. This leads to magnify the importance of multi-sided platforms. Multi-sided platform can be defined as “a firm that acts as a platform and sells different products or services to different groups of customers, taking account that the demand from at least one group of

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customers depends on the demand from the other group of customers.” [1] In this regard, traditional tools of assessment of market power can be applied if it is implemented considering the multi-sidedness of the market such as cross externality, indirect network effect, existence of interdependence of demand. [2] In multi-sided market, the comparison between price and marginal cost does not mean too much due to asymmetric price structure resulting from demand characteristics of each customer group and network effect. Thus, it is necessary to modify general factors such as market share and entry barrier. In addition, special features of multi-sided platform market such as indirect network effects, multi-homing, dynamic innovation and data should be considered in evaluating market power. In this regard, I will examine some special factors for evaluating market power in multi-sided platform market and analyze related EU and Korea cases.

2. MARKET DOMINANT POWER INVOLVING MULTI-SIDED PLATFORM IN EU

2.1 The Modification of General Judging Factors

Lerner index has little importance in two-sided market because price structure depends on features of demand and indirect network effects. [3] Therefore, in practice, other indicators such as market share and entry barrier are used as indicators for market dominant power. In Microsoft/ Skype merger case and Facebook/ WhatsApp merger case, European Commission stated that “market share is not the best proxy of competitive strength for dynamic markets.” And each service easily can be in competitive relation since new services can be adopted in multi-sided platforms. By way of example, Twitter recently added ‘buy button’ to change own characteristics. [4] In this regard, Patterson claims that market dominance should be evaluated not based on market share but on ‘capacity’ i.e. if there is any unused or expanded capacity, competitors can challenge the market dominant company in the search engine market. [5] However, it is undeniable that market share, in practice, gives an initial starting point for the market power assessment and it should be considered in terms of legal certainty to companies and alignment with article 101 TFEU and mergers. [6] Therefore, market share should be understood as mere indicators of dominance rather than rigid rules. And with regards to entry barrier, the interdependency between customer groups also influences on the likelihood and success of new entry in two-sided markets. [7] In multi-sided market, new entrants face a form of the chicken-and-egg problem i.e. new entrants should secure customers of both sides at the same time even if they provide high quality products on the one side of platform. [8] That is, economies of scale have been considered as entry barriers to market and incur the market dominance of incumbent dominant undertakings and it plays an additional role

to strengthen the self-reinforcing positive feedback loop. [9] In addition, “commoditization” of data in both search and advertising market induces a risk that search engines strategically use users’ data to block market entry and it triggers ‘market tipping.’ [10] However, in the market where innovation is indispensable, the importance of scale of competitors is relatively low because an undertaking holding low market share can get market share in a short time due to the network effect. According to article 102 TFEU guidance paper, “the longer the period of time over which it is held, the more likely it is that it constitutes an important preliminary indication of the existence of a dominant position.” In multi-sided platform cases, time scale factor also is considered as an important indicator for market dominance. For example, in recent Google Search shopping case, the Commission stated that Google had held its dominant position for nearly ten years. OECD suggests five years as maximum paradigm shift in hearing on the Digital Economy. [11]

2.2 Special Considerations for Multi-sided Platforms

2.2.1 Free Service and Network Effects

With regards to free service, it is required to consider “the economic interrelationships between services in multi-sided market.” [11] In addition, other indicators such as quality, consumer choice and information costs need to be considered instead of considering only revenues from free goods. [6] And indirect network effects should be considered. Its effect depends on the type of platforms. Firstly, indirect network effect can reinforce market dominant position of incumbent platforms operators. European Commission, in Google/DoubleClick case, considered indirect network effect as a ‘reinforcing factor’ rather a preventive factor with regards to advertising mediation service. Currently, European Commission, in Google search shopping case, found the existence of high barriers to entry resulting from network effects. However, in a related investigation by the US FTC has not made any additional sanctions except for some modifications accepting opinions that it is necessary to encompass search-driven advertising market reflecting network effects of two-sided market. On the other hand, indirect network effect can ‘control market dominant position’ of multi-sided platforms. Thus, a platform operator with high market share in social network service market is required to maintain the quality of social network service to stay competitive in online advertising market. [8] In addition, with regard to indirect network effects, switching costs should be considered. Currently, with regards to customer information leakage case, users still stay in Facebook due to concerns about losing networks.

2.2.2 Platform Differentiation and Multi-homing

Multi-homing refers to the phenomenon that plural platforms are available to platform users. Thus, multi-homing reduces the lock-in effect and new entrants easily can enter the market. [12] Thus, it serves rather as deterrence factor to market dominance than as reinforcing factor. Therefore, market entry barrier can be lowered with active multi-homing. And in terms of securing customers, a relatively high degree of multi-homing situation may indicate a low level of concentration than single-homing situation. [13] At the same time, multi-homing may lower the relevance of indirect network effects i.e. if all customers of one group are present on all platforms, the number of these customers does not affect the choice between platforms made by members of other groups. And in multi-sided platform market, multi-homing should be considered from both sides of customer groups. In internet shopping mall cases, internet shopping mall operators with market

dominance can force sellers to accept unfair terms and condition of business because buyers tend to choose internet shopping mall with many buyers although they are subscribed in many internet shopping mall sites. [14]

2.2.3 Market Dominance Leveraging Effect from Obtaining Customer Data

Multi-sided platform operators such as Google can induce their customers to move into neighboring markets. Furthermore, their business scope can be expanded to different areas such as map, health, social networking, even camera technologies by means of using consumer preferences data. [8] According to joint paper by the Autorité de la concurrence and the Bundeskartellamt on data 2016, access to data sources is a factor indicating market power. [15] In this respect, transparency of using customer information can be used as an index of market-dominating power of online platform operators. In addition, the possession of user data can be regarded as an entry barrier. Users’ data can be used not only for another service in the same company (intra-company versatility) but also other companies (inter-company versatility). [16] French and Belgian national competition authorities decided that customer data collected by firms holding a legal monopoly cannot be replicable to be used for the launch of other services. [17] On the contrary, in Google/DoubleClick case, European court considered that the combination of data would not give a competitive advantage to the merged entity in light of availability and replicability of data. And in assessing market power concerning data, the economies of scale and scope of data, the time depreciation value of the data and the possibility and the costs to collect or buy data should be considered. [18] Recently, in Booking.com case, the French, Swedish and Italian Competition Authorities have determined that data of platform provides a competitive advantage over any other new platforms and acts as a market entry barrier.

2.2.4 Other Indicators

If multi-sided markets are formed based on high technological innovation, high margins not always indicate market power considering the cost of unsuccessful R&D. In addition, its dominance can be temporary unless market dominant undertakings cannot adapt to new circumstances intelligently. [9] However, the existence of market dominance cannot be denied just because such positions can be challenged by the innovative power because technological innovation can affect market power positively or adversely. [12] Therefore, competition law enforcement should be conducted only when the market dominance is used in an abusive manner such excluding other competitors or harming consumer welfare. [6]

3. MARKET DOMINANT POWER INVOLVING MULTI-SIDED PLATFORMS IN KOREA

3.1 Regulations of Korea

In Korea, according to Article 2(7) of Monopoly Regulation Act, market dominant undertakings can be described as “an undertaking who can determine, maintain and change the price, quantity, quality and other terms and condition of business of goods or service separately or with different operators.” And there is a provision of presumption of market dominant undertaking i.e. if the market share of an undertaking is over 50% or total market share of top 3 undertakings is over 75%, these undertakings are presumed to be market dominant undertaking, and an undertaking with less than 10% of market share or with annual turnover or

purchase amount of less than 4 billion Korean won are exempted from the provision of presumption (Article 4 of Monopoly Regulation Act). It was just one case that the KFTC did not apply the provision of presumption of market dominant undertaking in terms of abuse of market dominant position. In Korea, market share is a primary element in terms of establishment of market dominant position. However, ‘development of changes of market share’ should be considered. The KFTC put more emphasis on the market share based on turnover than other factors such as sales volume and production capacity. Meanwhile, there is no mention of indirect network effect in the Korean Guidelines for the Abuse of Market Dominant Position (hereafter, Korean guidelines). In this regard, some claim that indirect network effect can be considered as entry barrier of new entry which reinforces market-dominating power, while indirect network effect can also be a mitigating factor of market-dominating power, because it acts as competitive pressures from the other side. [19]

3.2 Korean Cases

There are already several cases involving multi-sided platforms in Korea. In eBay/Gmarket merger case, the KFTC did not establish market dominance considering brisk market entry by late starters and dynamic competitive environments, although the sum of market share of these two firms is 87.5% (KFTC Decision No.2009-146). It seems to be the first case that market dominance of undertakings with high market share was denied in light of dynamic competition environment. [19] And in Naver case, Naver was presumed to be a market dominant undertaking on the basis that Naver holds 48.5% of market share (as of late December 2016) based on turnover in whole ‘internet portal service market’ and the sum of market share of top 3 undertakings amounts to 80.8%. (KFTC Decision No.98-251) And other factors such as entry barrier from huge entry costs for providing IS-4C services, already saturated market situation and continuously increasing market share of top 3 undertakings were also considered. However, Korean courts defined relevant market as ‘contents supply market’ on the basis that it is possible to mediate contents providers and contents users without covering all IS-4C services. Thus, Naver’s market share based on advertisement sales amounts to 68.6%. However, market dominance of Naver was not established considering brisk multi-homing and fierce competition environment. And even if market dominance of Naver in internet portal service market can be established, Korean courts found that market dominance in ‘internet portal service market’ cannot be leveraged to ‘contents supply market.’ (Supreme Court Case 2009 Du 20366) And in T-broad Gangseo Broadcasting case, the KFTC established market dominance of T-Broad Gangseo Broadcasting based on market share in light of the number of households in Gangseo-gu region and entry barrier resulting from authorization of Korean Government. The Seoul High Court also established market dominant position ‘in the program send market’ and found that market dominance in ‘program send market’ between system operators and charged subscribers is leveraged to ‘program send service market’ between system operators and program providers. However, the Supreme Court of Korea did not establish market dominant position in the ‘program send service market’ where channels were changed (market dominance was abused) and market dominance in the ‘program send market’ is not leveraged to ‘program send service market.’ In short, Korean courts made it clear that assessment of dominating power should be determined on the side where its dominance was abused, since the market situations of each side of multi-sided platform are different. Supreme Court Case 2007 Du 25183) And in Gmarket case, Gmarket was presumed to be a market dominant undertaking on

the grounds that its market share is 29.5% as of turnover in 2006 and sum of market share of top 3 open market amounts to 91.4%. In addition, considering market share of 3rd open market operator (just 3%), the gap of market share among competitors also was considered. And infrastructure cost such as business know-how, business organization, operating program and awareness and reliability were considered as de facto entry barrier. In special, in this case, indirect network effect was considered as reinforcing factor of market dominant power. However, the Supreme Court of Korea did not establish abuse of market dominant position on the grounds that the period of exclusive dealing is short and the amount affected is small (Supreme Court Case 2008 Du 16322).

4. IMPLICATIONS AND CONCLUSION

Two-sided market theory suggests several factors to limit market dominant power. However, in many cases, some platform operators holding multiple customers are easily able to abuse market dominant power and to increase prices monopolistically. Therefore, general methods for assessing market dominance should be modified to fit in with multi-sided platform market rather be abandoned. In this paper, I dealt with modification of general indicators of market power such as market share and entry barrier. For this, features of multi-sided market should be reflected. Then, some particular indicators for multi-sided market such as indirect network effects, multi-homing, data sources were examined. Market dominant power is closely connected with relevant market definition. And market power is also linked to specific abusive behaviors. Thus, comprehensive approaches are required to deal with abuse of market dominant power. There are many new approaches to tackle such issues in the EU and the US. In Korea, there are already several cases involving multi-sided platforms. However, in many cases, the KFTC and Korean courts heavily rely on market share in evaluating market dominant power. It was just one case that the KFTC did not apply the provision of presumption of market dominant undertaking in terms of abuse of market dominant position. However, the KFTC and Korean courts try to reflect indirect network effects and review market dominance leveraging theory. As multi-sided platform business is developing continuously, competition authorities and courts are required to mirror changing market environment to secure fair competition environment and consumer welfare.

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The Impact of Information System Implement on Innovation Value Chain: A Case Study of Solen Electric Company's Product Integration Services

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ABSTRACT

This study explored the innovation value chain in Solen Electric's product integration services case study to better understand the impact of information system implementation. This study uses a case study method and collects secondary data to understand the impact of the introduction of information systems during 2013-2014. This study found that product integration services and collaborative design method are valuable and analyze the innovation value chain on a case. Finally, this study proposes Key success factors for Solen electric company. Moreover, the study identifies practical implications and proposes practical suggestions for government policy and Small and medium-sized enterprises.

CCS Concepts

• Information systems → Information systems applications → Process control systems.

Keywords

Information System Implement, Innovation Value Chain, Product Integration Services.

1. INTRODUCTION

Hansen & Birkinshaw [1] proposed innovation value chain theory to encourage business innovation, create value through innovation, and view innovation as a complete process. Therefore, this study adopts the form of "An Integrated Flow" and analyzes the cases of implement information systems to analyze the value of cases and brand companies. The research object is Solen Electric Company, discussing the impact of product integration services implement information system. This information system integrates product processes and is funded by the Taiwan government and subsidized for two years.

In light of these concerns, the purpose of this study is to use innovation value chain to analyze the impact of Solen Electric Company's product integration services implement information system.

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Research questions are as follows: 1.What is product integration services? 2.What is the collaborative design method for product integration services? 3.What is the innovation value chain of product integration services ? What are the key success factors?

2. LITERATE REVIEW

The literature discusses the innovation value chain and product integration services separately. This research is mainly presented in the form of individual cases.

Hansen & Birkinshaw [1] pointed out that innovation value chain is an integrated process that treats innovation as an end-to-end process instead of focusing on parts, allowing you to discover the weakest and strongest links. To improve innovation, managers need to turn ideas into commercial output instead of Michael Potter transforming raw materials into finished product value chains. The first step in the three phases of the chain is to generate ideas; this may happen within the unit, within or outside the company unit. The second stage is to switch ideas and to choose financing concepts and develop them into products or practices. The third is the dissemination of these products and practices. Roper et al. [2] pointed out that modeling a complete innovation value chain highlights the structure and complexity of the process of converting knowledge into business value, emphasizing the role of skills, capital investment, and other company resources in creating value. Golla and Pedroza [3] believe that organizations must rely on external resources to meet their innovation needs. Interactions between companies, stakeholders, and organizations provide organizations with opportunities for innovation because organizations are now forced to embrace new technologies, globalization, and markets. In the context of decentralization, innovation is carried out while continuing to actively guide competition.

In order to improve the quality of foundry services and save customers' time and money. TSMC provides Product integration service systems to help customers. The system will provide this data from wafer parameters, assembly, final testing, etc. In-situ data, process flow, target delivery time, and delivery logic can also be accomplished by these systems [4].

3. METHODOLOGY

3.1 Subjects

This study uses case study to collect case company data. Yin [5] points out that case studies are a practical way of investigation. When the line between the phenomena studied and real life is not clear, investigate the status quo through multiple sources of evidence. This research uses secondary data collection to obtain relevant data and information from a total investment of 20 million NTD programs during 2013 and 2014. The secondary data

includes the two-year plan report. During the study, informal interviews were also conducted to ask the company manager and the person responsible for the project.

Solen Electric Company specializes in manufacturing solenoids, motors and valves developing equipment for medical, health, entertainment, automotive, home appliances, POS, HVAC purposes. Solen is headquartered in Taoyuan, Taiwan, with headquarters responsible for sales, research and development, designing, operations, purchasing, quality, engineering, logistic, human resource and finance are managed. Numerous model and low volume products, prototyping and sample are produce in this location. This study is based on the concept of collaborative design, adopting the product integration package service model, based on the existing design knowledge, and combining the supply chain members in Taiwan to develop the product integration service model for finished products, leading the design, development, production, packaging and shipping of finished products, allowing brand owners to focus on marketing promotion activities, increase customer conversion costs, and accumulate the company's ability to create its own finished brand.

3.2 Data Analysis

This study refers the model for evaluating the innovation value chain, proposed by Hansen & Birkinshaw [1] and verify the conceptual framework developed for assessing the impact of Solen Electric Company's product integration services implement information system. Based on the three process: idea generation, conversion and diffusion. Data analysis model is shown in Table1.

Table 1. The Innovation Value Chain: An Integrated Flow

	Idea generation			Conversion		Diffusion
	In-house	Cross-pollination	External	Selection	Development	Spread
Key Questions	Do people in our unit create good ideas on their own?	Do we create good ideas by working across the company?	Do we source enough good ideas from outside the firm?	Are we good at screening and funding new ideas?	Are we good at turning ideas into viable products, businesses, and best practices?	Are we good at diffusing developed ideas across the company?
Source: Hansen & Birkinshaw [1]						

4. RESULTS

4.1 Product Integration Services and Collaborative Design Method

Product integration services and collaborative design methods integrate manufacturing service information, establish product integration service modules, design simulation service modules, information coordination center modules, product data management modules, and proprietary technology management modules to provide a full range of real-time services for domestic and foreign customers. Effectively increase customers' conversion costs and company core values. The system effectively saves the problem tracking, analyzes and processes data, continuously refines its own R&D energy, masters market opportunities, and actively promotes brand customers' understanding of letter and smart solutions planning and available solutions through marketing. Then, the plan triggered the development and implementation of new customer product ideas. Or when the customer has a new product plan, Unicom can provide a smart solution plan and conduct feasibility analysis and specification confirmation operations in various ways.

After customers confirm product planning specifications, the company will actively provide modular design solutions and seek Taiwanese suppliers to develop related components and prototypes for testing services to help customers reduce the use of components. Expect production, shorten development time, reduce costs, and accelerate the market for new products. This innovative service model is based on vertical and horizontal integrated service mechanisms. It shifts from general specification components to intelligent component steering models, solves problems encountered by brand owners, increases the value of end products, and increases the learning barriers to competition.

The model transparent project progress information, collects plans for each stage, validates and verifies documents, and serves as a reference for customer specification validation. During the project process, you can propose improved solutions by tracking problems and solutions. Accumulate research and development technology and integrate it into knowledge management systems to enhance the energy of intelligent integrated packaging services. See figure1.

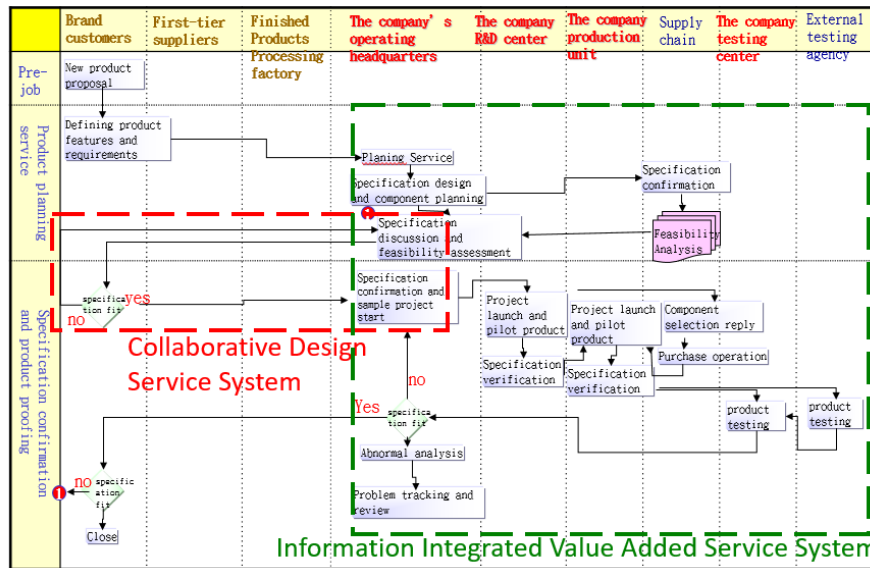


Figure 1. Process of product integration services

Consumer product integration service scenario:

1. By the company's initiative to recommend brand new product design solutions for brand customers reference.
2. After identifying the specifications and solutions, the brand customer directly appoints the company to plan and produce samples of new finished products.
3. After receiving the instructions from the brand customers, the company began to conduct a feasibility assessment analysis, and proposed specification confirmation and sample project startup, and related operations such as component selection and procurement for the cooperation system supplier.
4. The supplier completes the production of related components and responds to relevant information to the company for specification verification.
5. Collect the test data of the batch through the internal system to the external product verification service unit (or the company's certification laboratory).
6. After all specifications and validations are completed, provide relevant specification information to the brand vendor for confirmation.

Summarize the value of product integration services. The service content includes product specification design, parts development and testing, agent design and packaging preparation. Based on years of accumulated experience, the company not only has research and development capabilities, but also has certain advantages in vertical integration of upstream and downstream industries and integration of various industries. By providing the company's turnkey services, brand owners and suppliers can control the number and quantity of items for each batch of orders based on the flexibility of the services provided by the company, and can shorten cargo tracking time. In the past, it changed the model of branded customer-specified materials, established a service mechanism that was completely dominated by Taiwanese industry, and provided services for leading international companies in

vertical and horizontal integration and turnkey services. This is innovative in industrial operations.

4.2 Analysis Results for Innovation Value Chain

According to the innovation value chain: an integrated flow, this study attempts to answer with product integration services as an example.

1. Do people in our unit create good ideas on their own? Yes, because product integration services are designed to solve the gap between design and manufacturing.
2. Do we create good ideas by working across the company? Yes, in the absence of systematic assistance in the work, the product integration service was proposed to include several modules to promote product design and development.
3. Do we source enough good ideas from outside the firm? Yes, this case is based on the U.S. ORBIT fourth-generation sprinkler.
4. Are we good at screening and funding new ideas? Yes, this case is to get government subsidies for the second year.
5. Are we good at turning ideas into viable products, businesses, and best practices? Yes, after the design department has assisted with this system, product development is rapidly diversified and external relationships have increased.
6. Are we good at diffusing developed ideas across the company? Yes, the participants in this case include various departments of the company.

The above 6 questions can be analyzed in three stages: idea generation, conversion, diffusion. Q1 and Q2 answer the idea generation because product integration services are designed to address the gap between design and manufacturing. Q3, Q4 and Q5 answered the conversion because the internal and external communications of the company have good performance. Q6 pointed out that diffusion is the proliferation of product integration services concept to the company.

The value of product integration services to customers can be illustrated in terms of the process and customer value of consumer product brands, and is divided into six stages. Stage 1: Needs investigation for Market / Consumer, Stage 2: New product function design, Stage 3: Specification verification, Stage 4: Product proofing, Stage 5: Product formal production and inventory control, Stage 6: Service. See table 2.

In order to improve the dominant position of product development, the company will promote the development of smart components, that is, to integrate electronic sensing functions into components of common specifications. This will not only increase the value of the overall assembly, but will also reduce the use of branded materials. The proportion of products sold by smart components is mainly concentrated on the motor and water valve components. The company performs component services based on customer needs. The company completed product development and manufacturing, and ultimately completed the final product assembly through the brand manufacturer. Under this model, it is expected that the profit of each project can increase to 30-45%.

Table 2. The value of product integration services to customers

	Process	Customer Value for Consumer Product Brands
Stage 1: Needs investigation for Market / Consumer	Customers conduct market and consumer surveys. Then discuss new product features with the company's design team.	
Stage 2: New product function design	The overall design of the product appearance, internal component specifications and configuration drawings led by the company.	Based on past experience, this period shortened the time required for confirmation of product specifications from 8 weeks to 4 weeks.
Stage 3: Specification verification	Through the simulation system of the company's back-end, we work with customers on specification verification and design changes.	Based on past experience, before this stage, you need to open the mold to confirm the specifications. It can now be shortened from 6 weeks to 2 weeks.
Stage 4: Product proofing	The company bears the risks and costs of mold opening and mold modification (the average mold replacement and mold replacement is approximately NTD 400,000). Brand	

	customers do not have to bear
Stage 5: Product formal production and inventory control	In the past, brand owners were required to bear the inventory cost of finished products/semi-finished products. The inventory holding cost of a product item was approximately NT\$3 million, but the brand customers did not have to bear the burden through this service model.
Stage 6: Service	Through the company's product integration products (such as the use of sprinklers), the product life can be guaranteed to use for 4 years (valve recession), higher than the brand owner's own development and manufacture of 3 years.

4.3 Key Success Factors for Solen Electric Company

The analysis of motor products, produced by the company: The analysis of value from high to low is as follows.

Low-level specifications are applied to daily necessities, and their characteristics are low price and low durability.

Intermediate specifications are commonly used for 3C, home appliances, machinery, and other operational auxiliary functions. The characteristic is that the damage to the component does not cause the entire product to fail to operate.

Higher-order specifications are used in core operating functions such as 3C, home appliances, and automobiles (frequency conversion without brush). The characteristic is that the component damage may cause the finished product to fail to work properly, and the reliability and reliability requirements are high.

The key success factor in this case is the only integrated manufacturer that combines Solenoid+ electromagnetic (air, water, oil, refrigerant) valves with variable frequency brushless motors.

1. Take the largest small company as its business strategy, emphasizing the reputation of flexibility and integration services in the industry.

2. Relying on years of experience in international high-end first-line brands (home appliances, automobiles), we can meet the specifications of the final consumer products.

3. One European company and two Japanese brand companies commissioned the company to carry out product integration services.

5. DISCUSSION AND CONCLUSIONS

Product integration services and collaborative design methods complement each other. This study points out that the most important part of the system integration framework for product integration services is collaboration design. Through external collaboration design, product integration services create value.

Because the core knowledge of product integration services is collaborative design, collaborative services through this system can quickly and efficiently promote product integration services. On the one hand, the above model can benefit brand owners. On the other hand, the company can also increase efficiency and save costs under the innovative value chain model.

The specific suggestion is that in the mode of operation, the company will actively recommend brand new customer design solutions. Brand customers directly specify the company's planning and production of new finished products. After conducting the feasibility assessment analysis, the company put forward the specification confirmation and sample project start-up, and collected the test data of the batch of samples through the internal system to the external product verification service unit. After all specifications and verification confirmations are completed, provide relevant specification information to the brand manufacturer for confirmation.

In terms of information applications, the relevant samples and specifications were confirmed through the product planning service. The company aggregates new product planning specifications through internal systems to external laboratory units for testing.

In terms of management mechanism, we focused on the integration of product specifications and design information, and carried out the control of the production consistency of the production and design of the organization. Inter-system (outsourcing production, main and auxiliary materials suppliers, and the company) production and assembly information integration. Improve production and shipping operations time, reduce client communication and agency costs.

The final benefit analysis can capture the needs of customers. The company is responsible for the specification of finished products, verification, mold-opening, procurement, sample and packaging

activities, etc., as well as the adjustment of the localized specifications of the customer's marketing locations after the listing. Effectively reduce client's communication and agency costs.

The innovative value chain of this research proposes six stages of customer service theory. The services from the first phase of the need to the final phase are in accordance with the innovation value chain integration process proposed by Hansen & Birkinshaw [1]. The most important point of the key success factor is that Solen electronic company's ability is a hidden champion.

In addition, this study has determined the practical implication of the information systems impact in conjunction with innovative product service processes. This case is available for future government policies and other Small and medium-sized enterprises.

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Detecting Spamming Reviews Using Long Short-term Memory Recurrent Neural Network Framework

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ABSTRACT

Some unethical companies may hire workers (fake review spammers) to write reviews to influence consumers' purchasing decisions. However, it is not easy for consumers to distinguish real reviews posted by ordinary users or fake reviews post by fake review spammers. In this current study, we attempt to use Long Short-Term Memory (LSTM) Recurrent Neural Network (RNN) framework to detect spammers. In the current, we used a real case of fake review in Taiwan, and compared the analytical results of the current study with results of previous literature. We found that the LSTM method was more effective than Support Vector Machine (SVM) for detecting fake reviews. We concluded that deep learning could be use to detect fake reviews.

CCS Concepts

• **Computing methodologies** → **Machine learning** → **Machine learning approach** → **Neural networks**

Keywords

Fake Review; Deep Learning; Neural Network; Long Short-term Memory (LSTM); Recurrent Neural Network (RNN).

1. INTRODUCTION

Word-of-mouths play an essential role during consumers' purchase decision process. Before purchasing, consumers may consult word-of-mouths from the Internet to reduce the risk of decision making. Positive word-of-mouths will raise the level of attention to the product and build a positive image in the mind of consumers.

After purchasing or consuming product, some consumer will share their consumption experience by providing product reviews. When the consumption experience is higher than the expectation, consumers will generate positive word-of-mouths. However, if the consumption experience is lower than expected, they will generate

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negative word-of-mouth[1]. To earn reputation from consumers and obtain positive word-of-mouths, companies should improve the quality of their product and service. However, some unethical companies may find that writing positive fake reviews is a short cut to "earn" reputation. They may hire workers to write fake reviews to mislead consumers.

Machine learning is common used to detect one thing from the others. Recently, the low cost GPU computing power makes deep learning a feasible analysis approach. Therefore, this study will use deep learning to detect fake reviews.

The current study using Long Short-term Memory (LSTM) that is a kind of neural network to detect fake reviews. This paper aims to compare the effectiveness of LSTM, a deep learning method, and Support Vector Machine (SVM), a traditional machine learning method, in detecting fake reviews.

2. LITERATURE REVIEWS

Fake reviews are posted deliberately to mislead consumers [2]. Fake reviews come in many forms and are hard to identify. Followings are literature that focused on detecting fake product review.

2.1 Supervised, Unsupervised, and Semi-supervised Learning

Spam detection approaches can be divided into supervised learning techniques, unsupervised learning techniques, and semi-supervised learning techniques methods.

Supervised learning refers to the use of labeled data. Before conducting supervised learning, researchers have to label reviews as fake or non-fake reviews. However, it is not easy to label fake reviews. Thus, literature had developed several approach to labeled fake reviews. Content repeatability can be used as a cue to detect and label spam or fake review[2]. Hiring workers to write fake reviews is another way to label fake reviews. Ott et al. [3] hired workers from Amazon's Mechanical Turk to write fake reviews. Algur et al. [4] used cosine similarity on product feature and considered the repeated or close to repeated review as a fake review. When labeled fake reviews are available, researchers can use supervised learning to detect fake review. For examples, Jindal and Liu used logistic regression to detect spam. Chen and Chen [5] used SVM as a classifier to detect fake reviews. Chen and Chen adopted some features, like content characteristics, post time and sentiment on brands. Wang et al. [6] used SVM classifier and social network analysis to detect spam. The literature

mentioned above are all using supervised learning methods but using different features and classifiers.

Unsupervised learning techniques refer to the use of unlabeled data. Lau et al. [7] collected Amazon review dataset and analyze content semantic by WordNet, used cluster analysis to classify reviews.

Semi-supervised learning techniques are between supervised learning and unsupervised learning. Semi-supervised learning uses a small amount of labeled data, and a large number of unlabeled data for training and classification. Ren et al. [8] used Ott’s hotel review dataset [3], by some truthful reviews and lots of unlabeled reviews to build a classifier and identify deceptive reviews.

2.2 Deep Learning and Neural Network

Deep learning, also known as Deep Neural Network, was proposed by Hinton and Salakhutdinov [9]. Deep learning allows computers to make predictions more effective through in-depth learning. Deep learning is a deep (multilevel) neural network. There are some frequently used models for deep learning, such as convolution neural network (CNN), recurrent neural network (RNN) and long short-term memory (LSTM). This work adopts the LSTM method.

RNN is expert in dealing with sequential issues, such as natural language processing. As time continues to pass, however, RNN will gradually lose the ability to learn long distance memories called gradient vanishing or gradient exploding [10]. To solve this issue of RNN, Hochreiter and Schmidhuber [11] put forward LSTM architecture which a kind of RNN. LSTM has three more controllers than the RNN: Input gate, forget gate, and output gate. Thus, LSTM can remember long-term memory and is better than RNN.

There is an issue of over fitting in the training model of deep learning. The solutions to the over fitting issue include adding data sets, early stopping, normalization, and adding dropout. This study used dropout [12] which give up neurons randomly during the training process. The drop out neurons will be skipped in training, but may work in the next round. When adding dropout, results of the training model may be better than without dropout.

3. METHODOLOGY

3.1 Data Corpus

There are several ways to obtain fake reviews: Marking fake reviews manually, treating reviews with similar contents as fake, hired writers to write fake reviews, and use a ground truth of real case of fake reviews. Obtaining a real case of fake review as ground truth is the most difficult one. Nevertheless, this study got an opportunity to get the real case of fake reviews.

We used a real case of fake review in Taiwan as source of fake reviews. In this case, a Korean based international mobile phone company’s Taiwan branch company hired full-time or part-time staffs to write fake reviews in an attempt to enhance the brand image and influence purchase decision of Taiwanese consumers. In April 2013, a hacker posted several internal confidential documents which mentioned details about how the company hired workers to write fake reviews and the detailed list of fake reviews and spammers. The company recognized this fact. This case became the first confirmed case of fake review spamming, and the company was fined by Fair Trade Commission, Taiwan.

Based on the leaked confidential documents, we crawled the data from Mobile01.com, a large product review website in Taiwan, to get the fake reviews as well as regular reviews. We also collect list of reviews authors and distinguish them as spammers and general users. Review authors were marked as spammers when they were hired workers that mentioned in internal confidential documents. Review authors were marked as general users when they were not in the list of hired workers.

The data corpus is similar as that of Chen and Chen [6]. Table 1 shows the number of reviews we collected. The Data collected 8363 posts: 458 fake review posts and 7905 regular review posts. Also, the data consisted of 111,065 replies that included 5,245 fake review replies and 105,820 regular review replies.

Table 1. Collected fake and normal reviews

	Fake Reviews	Normal Reviews	Total
Post	458	7905	8363
Reply	5245	105820	111065

Figure 1 shows the distribution of length (number of Chinese characters) for posts and replies. Based on Figure 1, we found that the length of most replies were less than 100 characters. Nevertheless, the length of most posts was longer than 100 characters. We focus on detect fake posts rather than fake reply since replies are usually shorter than posts.

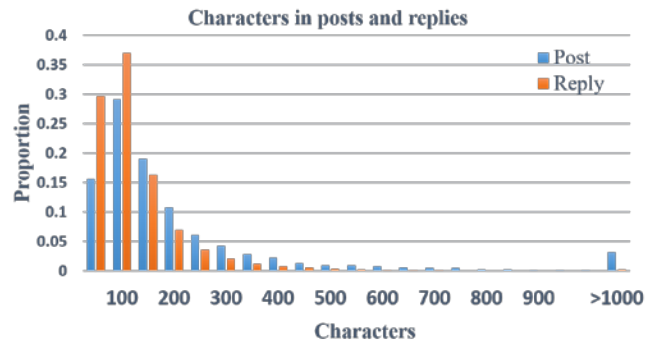


Figure 1. Characters in posts and replies

3.2 Analysis Methods

This study used LSTM methods to build deep learning model. Accuracy, precision, recall, and F-score were used to evaluate the deep learning models. This study belongs to supervised learning; we labeled spam data to 1 and labeled non-spam to 0. Our experimental process is shown in Figure 2. The first step for this study is Chinese word segmentation. To cut the Chinese sentence, we used Jieba (https://github.com/ldkrssi/jieba-zh_TW) which is open source tools for python. After segmentation, we established a dictionary based on the number of occurrences and sort from more to less.

To use the LSTM model, we have to convert review post as a vector with the same length. However, the review length is not the same to each review. Thus, we need to convert each review as the same length vector. According to Figure 1, most posts were less than 500 Chinese characters. We set the size of the vector as 500. The max length of the review should be 500. If the length of a review was longer than 500 words, only the first 500 words were included. If the length of a reviews is less than 500, we filled up 0 until the length equals 500.

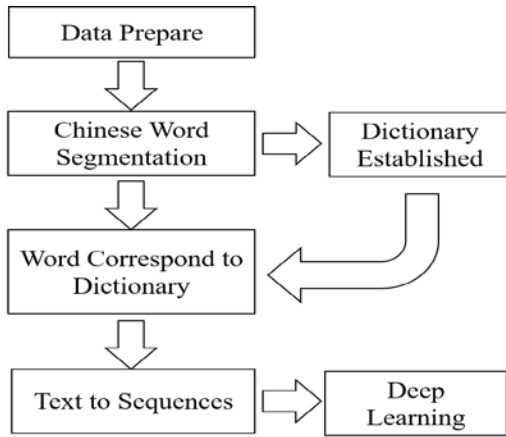


Figure 2. Research Produce for Fake Review Detection

We established multilayer perceptron which included input layer, hidden layer, and output layer. Input layer will receive data as a neuron, add a layer of LSTM after input layer, next is dimension reduction by the hidden layer, and output layer output one neuron. The neuron equal to 1 means that the reviewer is predicted to a spammer, equal to 0 means the reviewers is predicted to a regular user.

Table 2. Architecture of multilayer for deep learning

Layer	Output Shape	Units
Embedding	(None,500,32)	128000
LSTM	(None,128)	82432
Dropout	(None,128)	0
Dense	(None,64)	8256
Dropout	(None,64)	0
Dense	(None,32)	2080
Dropout	(None,32)	0
Dense	(None,1)	33

Table 2 shows the architecture of multilayer this research used. The input dimension is 4000, output dimension is 32, and length equal to 500. LSTM connect after embedding layer and set the shape equal to 128. Dropout was added after every dense layer to avoid over fitting. We try to set dropout from 0.2, 0.3, 0.4, 0.5 and 0.6 for each model. The total number of units trained is 220,801.

There are many parameters in the model that can be adjusted, like numbers of neuron on each layer, activation function, loss function, optimizer, and dropout. In this work, we use three kinds of activation function included Sigmoid, Tanh and Relu, two kinds of loss function included MSE and MSLE, three kinds of optimizers included Adam, RMSprop and AdaMax, and set dropout equal to 0.2, 0.3, 0.4, 0.5 and 0.6. We adjusted different parameters to get the best model.

Table 3. Imbalanced dataset

	Spam Post	Normal Post	Spam ratio
Training set	320	5533	5.46%
Testing set	138	2372	5.46%

Table 4. Balance dataset

	Spam Post	Normal Post	Spam ratio
Training set	320	960	25.00%
Testing set	138	414	25.00%

4. DATA ANALYSIS AND RESULTS

We spilt post to the training set and testing set with the ratio of 7:3, and divide into two part, the imbalanced data set presented in Table 3 and the balanced dataset presented in Table 4. We compare the results of the balanced dataset and imbalanced data set.

According to Table 3, the original data set is imbalanced; the spam ratio is 5.46%. After neural network training, we select the best five models, as shown in Table 5. We find that the accuracy of Table 5 quite high, the highest point is 0.972, the precision much higher than recall, and the highest of F-score is 0.691.

Table 5. Results of imbalanced dataset

Activation Function	Loss Function	Optimizers	Dropout	Accuracy	Precision	Recall	F-score	Time(s)
Relu	MSLE	AdaMax	0.5	0.969	0.79	0.61	0.688	2709
Relu	MSLE	AdaDelta	0.3	0.970	0.83	0.59	0.689	2833
Relu	MSLE	AdaDelta	0.6	0.969	0.81	0.58	0.675	2844
Relu	MSE	AdaDelta	0.5	0.966	0.72	0.64	0.677	2816
Sigmoid	MSE	AdaMax	0.6	0.972	0.88	0.57	0.691	2781

Table 6. Results of balanced dataset

Activation Function	Loss Function	Optimizers	Dropout	Accuracy	Precision	Recall	F-score	Time(s)
Sigmoid	MSLE	Adam	0.3	0.887	0.75	0.83	0.787	1327
Sigmoid	MSLE	Adam	0.5	0.893	0.78	0.79	0.784	1322
Sigmoid	MSLE	AdaMax	0.6	0.891	0.76	0.82	0.788	1325
TanH	MSLE	AdaMax	0.4	0.889	0.75	0.85	0.796	1331
TanH	MSLE	AdaMax	0.5	0.893	0.77	0.81	0.789	1332
Relu	MSLE	AdaMax	0.4	0.894	0.80	0.78	0.789	1322

Table 4 indicates the analysis results of the balanced dataset (spam ratio is 25.00%). We selected the best five models as shown in Table 6. We used two kinds of loss function and found

the best loss function was MSLE, the highest accuracy is 0.894, precision and recall overall performance is good, and the highest of F-score is 0.796.

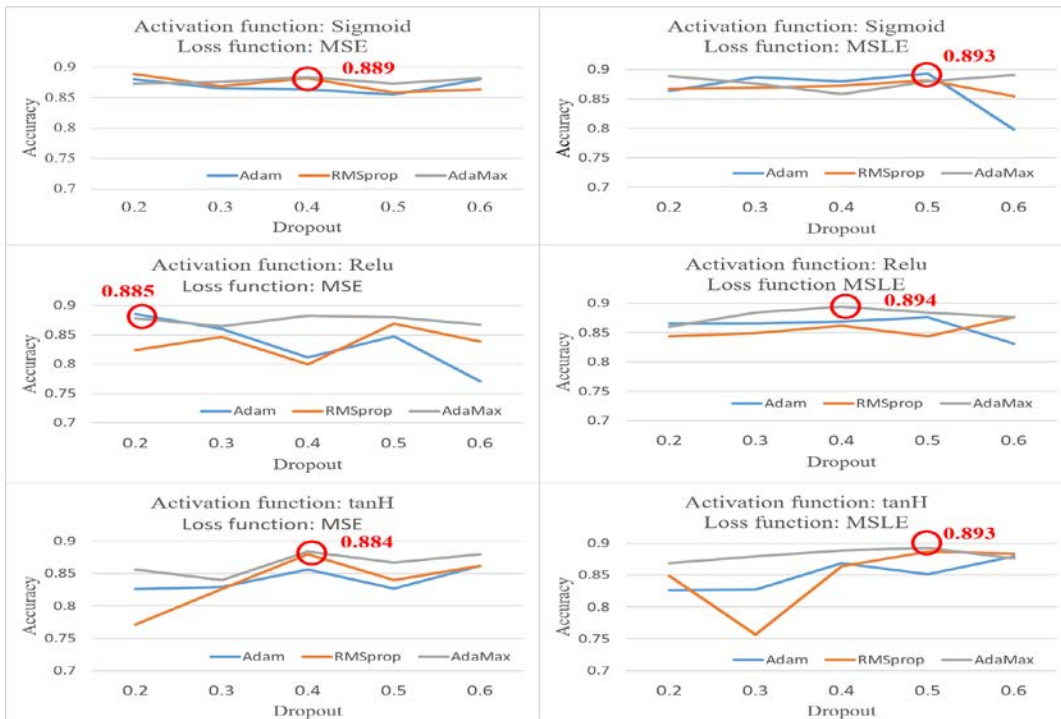


Figure 3. Accuracy of each model

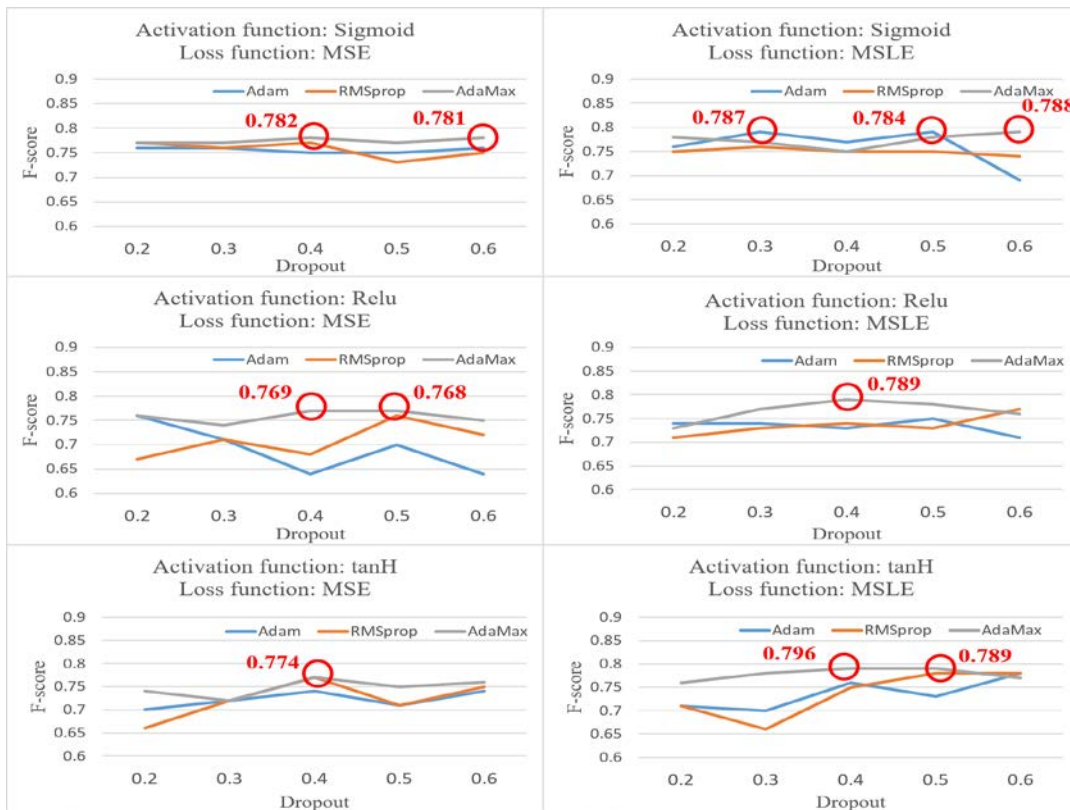


Figure 4. F-score of each model

Compared Table 5 and Table 6, we can find that the accuracy in Table 6 is smaller than that in Table 5. Thus, the accuracy for balanced data set is lower than the balanced data set.

However, when we calculated F-score, we got the opposite result: the F-score in Table 6 is better than that in Table 5. F-score for balanced data set is higher than that for balanced data set.

Figure 3 and Figure 4 provide accuracy and F-score of models of different activation function, loss function, optimizer, and dropout. We mark the models with the best accuracy. We found that MSLE is always better than MSE. The best accuracy for all models is 0.894.

Figure 4 shows that the best F-score of the models is 0.796 (MSLE model). It seems that MSLE gets better results in this study. It can also be observed AdaMax have better results in this experiment.

We also compared the results of the current study with previous literature. Table 6 shows the precision, recall, and F-score of Chen and Chen [5] and this study. We found that the precision, recall, and F-score of the current study is better than that of Chen and Chen [5]. Overall, the method used in this study was indeed effective than Chen and Chen [5].

Table 6. Comparison of previous study

Model	Spam ratio	Precision	Recall	F-score
Chen and Chen [4]	4.99%	0.6667	0.5714	0.6154
Best model on Table 5	5.46%	0.79	0.61	0.688
Best model on Table 6	25.00%	0.75	0.85	0.796

5. CONCLUSIONS

Fake reviews mislead consumers to make the wrong purchase decision. However, it is not easy to check if a review is an ordinary review or fake review. Detecting fake review is essential.

The current study used a real case of fake review in Taiwan to test the possibility of using deep learning to detect a fake review. The current study detected spam reviews using long short-term memory. We used a variety of parameters included activation function, loss function, optimizers and dropout to test the detection performance. We found the loss function of MSLE got the best performance.

We also found that deep learning methods (LSTM) got better performance than traditional machine learning method of SVM. The detection performance of the current study is better than that of literature.

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An Analysis of Customer Satisfaction towards Online Clothing Shopping Based on the Social Support Theory

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ABSTRACT

Customer satisfaction (CS) is an essential factor determining the success of online clothing retailing. This document tries to analyze factors affecting CS towards online clothing shopping through a systematic study, in a bid to help online clothing retailers improve CS for higher sales. Based on the social support theory, we created a model of factors affecting CS towards online clothing shopping, and conducted a questionnaire survey to obtain customer feedback which was then analyzed through a structural equation model. The analysis results indicate that perceived convenience (PC), social relationship (SR), perceived value (PV), and information interaction (II) exerted favourable effects on CS towards online clothing shopping, and finally CS, as a mediating variable, affected customer loyalty (CL) and purchase intention (PI) positively.

CCS Concepts

• Information systems → Information retrieval → Users and interactive retrieval → Personalization.

Keywords

Perceived convenience; Perceived value; Social relationship; Information interaction; Customer satisfaction.

1. INTRODUCTION

Recent years saw an increasingly growing size and penetration of the online clothing market. In 2017 alone, China's online clothing market was reported to be 632.011 billion RMB. Online clothing shopping attracts consumers with its obvious convenience; however, it still has some disadvantages. For example, consumers cannot try clothes on, watch and feel their quality, obtain them right after payment, or communicate with the sellers face to face. What's more, different consumers have different requirements on

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online clothing shopping, and their degree of satisfaction thus varies from one to another. Through analyzing factors affecting CS towards online clothing shopping, this document puts forward solutions to increasing CS and therefore is of significant practical significance. Based on an online CS model, previous studies, and the social support theory, this document creates a new mechanism of action model for CS towards online clothing shopping to study how it affects CL. At last, this document proposes some thoughts and strategies about how to increase online CL and CS.

2. RESEARCH MODEL AND HYPOTHESES

As a type of particular goods, clothing carries unique attributes which determine its untraditional online marketing model. Researchers worldwide have conducted many studies on CS towards online clothing shopping, and created well-established measurement models according to various measurements, indexes and theories. Based on previous studies and the unique attributes of clothing, this document proposes four factors (PV, PC, SR and II) that affect CS towards online clothing shopping. Then, relevant elementary propositions and hypotheses are raised and proved through a questionnaire survey and quantitative research. Based on relevant theories, the following suggestions and hypotheses have been proposed:

2.1 The Effects of PC on CS towards Online Clothing Shopping

In the context that consumers now have increasingly diversified demands for services, aside from functional experience, emotional experience has become another focus of service provision[1]. Trust experience, website design experience, service experience, and product experience are the four key customer experience indexes in e-commerce[2]. Ruchi et al. found that convenience, employees, online functional elements, and service scape are critical for measuring customer experience (CE)[3]. Emotions come along with consumption, and service experience will directly or indirectly affect emotions positively[4].

Given the above, this document raises the hypothesis that "*PC has positive effects on CS towards online clothing shopping.*"

H1: PC has positive effects on CS towards online clothing shopping.

2.2 The Effects of PV on CS towards Online Clothing Shopping

During online clothing shopping, value experience delivered to consumers mainly cover their expertise on sellers, websites, delivery service, and products, any of which will affect their repeat purchase intentions. PV, growing from psychologist Adams' Theory of Justice, is determined by consumers through comparing what they gained and paid after purchases[5] based on product functions and CE[6]. Customer PV, which significantly affects PI and CS, is determined by various experiment factors. Therefore, online clothing retailers should have a good understanding of how these factors work, to develop personalized marketing strategies.

Given the above, this document raises the hypothesis that “*social support has positive effects on CS towards online clothing shopping.*”

H2: PV has positive effects on CS towards online clothing shopping

2.3 The Effects of Interactive Experience on CS towards Online Clothing Shopping

Nowadays, consumption experience research has expanded from traditional topics like the components of consumption experience, perspectives of consumption experience study, customer emotions, and personal emotional experience, to consumption experience in social networks. Tynan and Mckechnie (2009) discovered that consumption experience is not a kind of individual experience but shared experience[7]. Gainer (1995) held that experiential value might be jointly created by consumers and others, like their friends or families, in the course of interactive collective consumption[8]. Experiential value is derived from particular brand experiences closely related to consumers. During interaction with other people or valuable objects, consumers will have consumption experience, and thereby obtain an experiential value related to SR[9]. Csikszentmihalyi describes “Flow” as a mental state of complete absorption in the current experience, and the occurrence of “Flow” comes along with extreme excitement and fulfillment[10]. “Flow” experience focuses more on consumer psychology, like what forms CE, how CE occurs, and how to create CE, and is thus valuable in providing practical guidance to e-commerce and e-entertainment businesses.

Given the above, this document proposes the hypothesis that “*interactive experience has positive effects on CS towards online clothing shopping*” which can be divided into the following two hypotheses:

H3a: SR has positive effects on CS towards online clothing shopping

H3b: II has positive effects on CS towards online clothing shopping

2.4 The Effects of CS towards Online Clothing Shopping on CL and PI

CS and CL are the focuses of consumer behavior research; therefore, how to improve CS and maintain CL are the core missions of enterprises. The term of “customer satisfaction” was first proposed by American researcher Cardozo who pointed out that CS would lead to repeat purchases[11]. Since then, “customer satisfaction” has been commonly recognized as a crucial variable for building CL[12]. CL is a behavioral tendency to favor one brand over all others and thereby purchase repeatedly. It creates

powerful word of mouth[13]. CS is a prerequisite for the formation of CL, and that is why most existing studies analyze CL based on an extend CS model. Satisfaction with products or services will encourage repeated purchases, and also promote word-of-mouth recommendations[14]. Consumers are willing to communicate with friends or families about products or services they bought, and recommend such products or similar ones to them.

This document thus proposes the following hypotheses:

H4a: CS towards online clothing shopping has positive effects on CL.

H4b: CS towards online clothing shopping has positive effects on PI.

Based on the customer experience theory and social support theory, a model of factors affecting CS towards online clothing shopping is created as shown in Fig. 1:

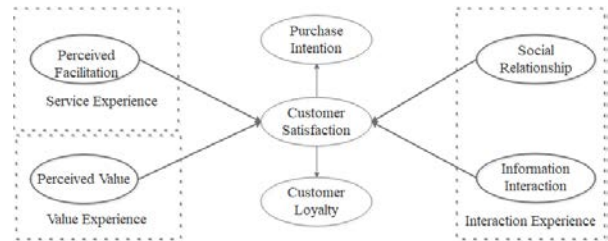


Figure 1. Model of Factors Affecting CS towards Online Clothing Shopping

3. RESEARCH APPROACHES

3.1 Data Collection

Based on literature review results, a questionnaire survey was developed and distributed online to collect research data. Items regarding product experience, service experience, value experience, interactive experience, and social support are included. The questionnaire is divided into two parts: seven questions on the respondents' personal information, and seven items comprised of 29 sub-items, each of which is a statement. A seven-point Likert scale is adopted in the questionnaire survey. The scaling is bipolar with 7 points for strongly agree and 1 point for strongly disagree. A pilot questionnaire survey involving 20 postgraduates from an e-commerce laboratory of a Project 985 university was executed, and the structure and way of expression of the questionnaire were adjusted according to the results.

Through www.wjx.cn, official questionnaires were distributed to Microblog users with the experience of buying clothes online. A total of 400 questionnaires were collected, including 313 valid ones who accounted for 89.42% of the total. female and male respondents account for 59.04% and 40.96% of the total respectively, and respondents aged below 35 accounts for 74.44% of the total, indicating that most online buyers are young people. Among the respondents, technicians and senior managers account for a significant proportion of 54.52%. 62.56% of the respondents buy clothes online once per month, and 36.75% of the respondents have a monthly income of RMB5,001-8,000. There is no significant difference among the percentages of different types of clothing, but tops and pants are still the first choices for online buyers.

3.2 Reliability & Validity Test

This document adopts SPSS to test the reliability and validity of

the scales and latent variables. The reliability coefficient (Cronbach's Alpha) of the questionnaire was 0.946, and those of the variables all exceeded 0.7 (see Table 1). The internal consistency of the questionnaire has been verified. Questions were designed by reference to mature scales and have been confirmed by experts, which ensured their content validity.

The construct validity was obtained through KMO and Bartlett's Test. KMO was 0.943 and Bartlett P was less than 0.001. According to Lu et al. (2008), when KMO is greater than 0.5[15], it is ideal for factor analysis. Totally five main factors were analyzed using the principal component analysis method, and

varimax (orthogonal factor rotation) method. Extracted main factors cumulatively explained 57.68% of the total variance. The validity of the questionnaire has been verified.

Table 1 shows that the factor loadings of observed variables all fall between 0.5 and 0.9, is higher than 0.50 and less than 0.95. It indicates that the basic fit indices of the scales are relatively ideal. The composite reliability values of latent variables are in the range of 0.8-0.9, more significant than the evaluation standard of 0.60. The AVE of latent variables falls between 0.5 and 0.7, making them more significant than the evaluation standard of 0.50. Evidently, the reliability of these scales is high.

Table 1. Factor Analysis Results

Dimension	Item	Loading	Reliability coefficient	Average variance extracted (AVE)	Construct reliability
PF	PF1	0.801	0.806	0.570	0.869
	PF2	0.778			
	PF3	0.758			
	PF4	0.720			
	PF5	0.715			
PV	PV1	0.802	0.784	0.608	0.861
	PV2	0.777			
	PV3	0.772			
	PV4	0.767			
SR	SR1	0.798	0.732	0.556	0.833
	SR2	0.761			
	SR3	0.730			
	SR4	0.688			
II	II1	0.762	0.703	0.501	0.812
	II2	0.710			
	II3	0.668			
	II4	0.650			
	II5	0.608			
TR	TR1	0.851	0.809	0.647	0.880
	TR2	0.834			
	TR3	0.787			
	TR4	0.742			
RE	RE1	0.811	0.760	0.587	0.850
	RE2	0.768			
	RE3	0.759			
	RE4	0.724			
PI	PI1	0.822	0.743	0.569	0.840
	PI2	0.778			
	PI3	0.741			
	PI4	0.669			
CS	CS1	0.850	0.770	0.597	0.854
	CS2	0.809			
	CS3	0.762			
	CS4	0.655			
CL	CL1	0.836	0.843	0.619	0.890
	CL2	0.814			
	CL3	0.814			
	CL4	0.739			
	CL5	0.725			

Note: ^a All standardized factor loadings were significant at $p < 0.001$

Table 2. Square Roots of Latent Variable Correlations and AVE

Latent variable	PF	PV	SR	II	PI	CS	CL
PF	0.755						
PV	0.308	0.779					
SR	0.294	0.298	0.746				
II	0.255	0.249	0.292	0.708			
PI	0.325	0.338	0.336	0.268	0.754		
CS	0.327	0.341	0.339	0.270	0.404	0.773	
CL	0.392	0.408	0.406	0.323	0.483	0.487	0.787

The discriminant validity of latent variables indicates low correlation or significant difference between observed variables and latent variables. In this document, discriminant validity was tested based on the AVE of each latent variable, and the squared value of the correlation coefficient is quantifying the statistical relationship between the latent variable and other latent variables. The discriminant validity values of latent variables are listed in Table 2. The values on the diagonal in Table 2 are the square roots of AVE of latent variables, while those off the diagonal are the squares of correlation coefficients reflecting correlations among latent variables. All the values on the diagonal are higher than those off the diagonal, indicating excellent discriminant validity for the latent variables. To sum up, the questionnaire survey scales are satisfactory in reliability and discriminant validity, which lay a solid foundation for further analyses.

4. DATA ANALYSIS AND RESULTS

Amos23 software was used to analyze the structural equation model. Then, maximum likelihood estimation was adopted to verify the hypotheses raised in the theoretical model based on collected questionnaire survey data.

4.1 Parameter Estimation

Before estimating the overall fit of the model, we tested the reasonability of parameter estimation to see whether the model violates the estimation or not. In the model designed, the estimated values of standardized parameters all remained below 0.90; the variances of measurement errors were between 3.768 and 11.303 (no negative variation); and the correlation coefficients reflecting correlations among estimated covariances of latent variables all fell between 0.048 and 0.158 (less than 1). The reasonability of parameter estimation indicates that the covariance matrix or related matrix was positively defined. The model estimation results show that there was no violation of the estimation, which allowed the overall fit test.

4.2 Hypothesis Verification

As shown in Table 3, the estimates obtained based on the structural equation model indicate that nine hypotheses have been verified by the significance test, and are in agreement with theoretical analysis results and expectations. Test results suggest that SR had the most significant effects on CS towards online clothing shopping, PC produced the minimal impact on CS towards online clothing shopping, and CS affected PI significantly.

Table 3. Model Verification Results

Hypothesis	Relationship	Path coefficient (p)	S.E.	C.R.	Results
H1:	PC→CS	0.180***	0.048	3.768	Correct
H2:	PV→CS	0.369***	0.058	6.320	Correct
H3a:	SR→CS	0.378***	0.089	4.327	Correct
H3b:	II→CS	0.488**	0.158	3.095	Correct
H4a:	CS→CL	1.207***	0.107	11.302	Incorrect
H4b:	CS→PI	0.969***	0.086	11.303	Correct

Note:*** $p<0.001$; ** $p<0.01$; * $p<0.05$

Estimates obtained based on the structural equation model (see Fig. 2) show that the path coefficient from PC to CS towards online clothing shopping is 0.180, higher than the significant value of 0.001. Hypothesis H1 ($\beta=0.180$, $p<0.001$) has been verified, indicating that delivery speed, packaging, courier service, and shipping fee have positive effects on CS.

The path coefficient from PV to CS towards online clothing shopping is 0.369, greater than the significant value of 0.001. Hypothesis H2 ($\beta=0.369$, $p<0.001$) has been verified, indicating that product price and cost-performance have positive effects on CS.

The path coefficient from SR to CS towards online clothing shopping is 0.378, greater than the significant value of 0.001. Hypothesis H3a ($\beta=0.378$, $p<0.001$) has been verified, indicating that online sharing and the opinions of friends and families have positive effects on CS.

The path coefficient from II to CS towards online clothing shopping is 0.488, greater than the significant value of 0.001. Hypothesis H3b ($\beta=0.488$, $p<0.001$) has been verified, indicating that II has positive effects on CS.

The path coefficient from CS towards online clothing shopping to CL is 1.027, greater than the significant value of 0.001, but hypothesis H4a has not been verified (see the dashed line). The path coefficient from CS towards online clothing shopping to PI is 0.969, greater than the significant value of 0.001. Hypothesis H4b ($\beta=0.969$, $p<0.001$) has been verified, indicating that the CS of online clothing buyers has positive effects on CL.

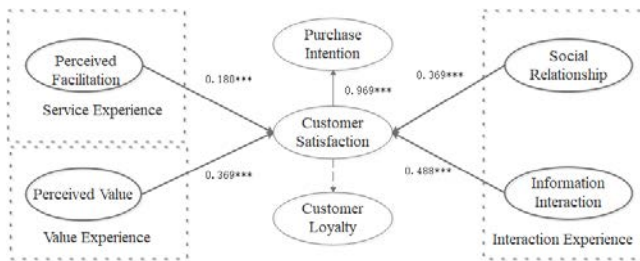


Figure. 2 Simulation Model of Factors Affecting CS towards Online Clothing Shopping

5. DISCUSSION AND CONCLUSION

Our research results are valuable in providing practical guidance to online clothing retailers in optimizing product design, developing personalized products, formulating marketing strategies, and increasing customer satisfaction and loyalty.

First, product quality control should be a focus of online clothing retailing. Second, consistent CE and PC should be created for consumers to enhance customer trust. Specifically, when consumers ask about products, retailers should answer their questions quickly with enthusiasm, providing them with objective and correct information. When consumers decide to buy, convenient payment modes should be offered. After payment, retailers should send order confirmation and shipping messages promptly to increase consumers' sense of reality, and provide consumers with convenient return/exchange service. Online clothing retailers shall also provide personalized recommendations according to customer needs and preferences based on big customer data collected, thereby increasing customer viscosity through lowering searching cost, ensuring recommendation quality horizontally and vertically, and providing high-quality service and CE. Lastly, given the importance of the social relations of online clothing buyers, retailers shall build online communities and organize discussion groups, to increase product acceptance among consumers during online and offline communication.

6. LIMITATIONS AND FUTURE DIRECTIONS

Based on the customer experience theory and social support theory, this document proposes four factors (PV, PC, SR and II) affecting CS towards online clothing shopping, and discusses the relationship between CS and these factors. Further, the relationships of CS with CL and PI are analyzed through an empirical study. Research results show that PV, PC, SR and II had positive effects on CS towards online clothing shopping.

Aside from the above, there are still other problems needing to be solved in future studies. First, since this document only aims at online clothing shopping, whether the conclusions drawn herein apply to other markets or not is still a question. Second, the small number of respondents is also a limitation of this document. In the future, more respondents varying in age, occupation, and income will be involved to improve the external validity of research conclusions. Third, the CE of online clothing buyers lies in many aspects which are just partly covered by items provided in the seven-point scale. Therefore, a complete verification scheme

needs to be developed to verify the functions of different types of CE.

7. ACKNOWLEDGMENTS

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Study on the Impact of Secondhand House Online Information on Consumers' Online Viewing

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ABSTRACT

[Objective] This study aims to explore the influence of on-line second-hand housing online attention, distance to subway and length of construction on the offline viewing of second-hand houses by consumers, and provide guidance for the second-hand housing marketing of real estate agency websites. [Method] Based on the data of second-hand house in 2505 Beijing and 2343 Chengdu areas in Chain House, the linear regression model combined with behavioral decision-making theory was used to verify the online attention, the distance to the subway and the construction time. Impact. [Conclusion] The second-hand housing online second-hand housing online attention to the distance to the subway and the length of construction will have a significant impact on consumer choice offline showings. Therefore, the real estate agency website in the display of second-hand housing information should try to show such information to attract consumers offline view second-hand housing listings.

CCS Concepts

• Information systems → Information systems application → Mobile information processing systems

Keywords

online attention; distance to subway; length of construction; linear regression; behavior decision theory

1. PREFACE

Residential consumption is an indispensable part of our national economy and plays a decisive role in the national economy of our country [1]; at the same time, the growth of residential consumer demand is the guarantee of sustainable economic development [2]; in addition, it is not just a market economy but also the result of cultural integration and reconstruction [3]. In recent years, many first-tier cities and some second-tier cities in China have seen the phenomenon of increasingly scarce land use in central urban areas. The scarcity of land resources has resulted in the replacement of second-hand housing with first-hand housing. Under the influence of macroscopic policy such as too high commodity price, national restriction and consumers' rational choice of housing thought, the second-hand housing market with obvious price Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyright for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

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advantage began to rise gradually. Second-hand housing market as an important part of China's real estate market for second-hand housing purchase behavior, give the real estate market some helpful guidance.

At present, many scholars at home and abroad have made researches on the factors that affect the price of second-hand houses. Chen [4] show that the price of second-hand houses is greatly affected by the geographical location through regression analysis. Liu [5] The effect of income, regional GDP, first-hand housing price and second-hand housing transaction volume on the second-hand housing price change is significant. Portnov [6] finds that the environmental variables, building characteristics and property value all affect the market value of second-hand housing. Han [7] They found the negative impact of price risk on the time and scale of family purchases but had a positive impact on households with strong hedging motives. In second-hand housing consumption, there are many factors affecting consumers to buy, Zhang [8] through empirical analysis of the questionnaire pointed out that the national policy, external transport, second-hand housing intermediary is the high price of second-hand housing consumption of public housing influence; Zheng [9] pointed out the impact of urban rail transit on the consumption of second-hand houses by using the threshold regression analysis; Zhang [10] regression analysis showed that the smaller the housing area, facing south, the fifth only housing higher unit price, school district housing, and downtown Tiananmen Square The closer the second-hand housing more popular. These second-hand housing line explore the factors that underpinning the study of China's second-hand housing provides a good direction. However, most of these studies focus on the offline factor research of second-hand housing, and rarely involve online factors.

At present, my internet has developed rapidly. According to CNNIC in June 2017 released the 40th "China's Internet development status

Accounting Report "shows that as of June 2017, the number of netizens in China reached 751 million, accounting for one fifth of the total number of Internet users in the world. China's Internet penetration rate was 54.3%. This also continues to promote the development of network marketing in China, many online second-hand housing intermediary platform also followed the birth, continue to show the importance of online information channels [11], understand the attitudes and behavior of online users is also very necessary. Therefore, China's second-hand housing industry should be combined e-commerce and traditional marketing [12]. In the website "1 +4" mode [13], to explore the market situation and prospects of online second-hand housing, the factors that affect consumers to buy second-hand housing and how to design real estate website construction and development of the main strategic direction, are worth our in-depth Research and discussion.

According to CNNIC released "2016 Chinese Internet users search behavior survey" shows that the current size of China's comprehensive search engine users up to 602 million with a utilization rate of 82.4%. Consumers are also increasingly dependent on the Internet for information search. Now most of the second-hand housing intermediaries will show listings online, but because of the current flood of information, the higher the search results, resulting in the use of online information is not well, so how to use existing information for second-hand housing Online marketing is particularly important. This article studies the online second-hand housing information through the study of consumer behavior of online viewing, through the collection of information online second-hand housing information, the establishment of linear regression model to study the online information on the consumer influences.

2. PAGE SIZE

Through consulting a large number of documents found that at present our country's scholars on the second-hand housing market is mainly in the analysis of the impact of its price factors, while the impact on consumer purchase of second-hand housing less research. Second, the Internet information resources is the main way for the buyers to obtain information. Now, the information of the second-hand housing that is scored is displayed through the Internet, which plays an important role in the decision-making of consumers. Therefore, Very necessary, and in the study of consumer behavior to buy second-hand housing seldom online and offline to explore. Therefore, based on the analysis of the influencing factors of second-hand housing purchase behavior, this article will combine the existing relevant literature, from the online attention, the completion time of second-hand housing and the distance of second-hand housing from the subway distance, taking into account the second-hand housing area Size, price and size and other factors, the impact of consumer inquiry into the purchase of second-hand housing online factors.

2.1 Behavioral Decision Theory

Behavioral decision theory started with the introduction of the Arles Paradox and the Edwards Paradox [14], developed against the difficult problem of rational decision theory. In 1961, Professor Edwards [15] put forward the idea of "decision-making weight" and was widely used in consumer behavior analysis later. The theoretical study also has three main features [16]: (1) the starting point is the decision maker's decision-making behavior; (2) the research focuses on the cognitive and subjective psychological processes of decision-makers, focusing on the psychological explanation behind the decision-making behavior, not on (3) From the perspective of cognitive psychology, this paper studies the mechanism of decision makers' decision-making and their influence on internal and external environment, and then extracts the factors which are not considered in rational decision theory Behavioral Variables, Amend and Improve Rational Decision Models. Now the theory of decision-making behavior has been widely used in the stock market [17], marketing [18] and management [19] aspects.

When consumers demand to buy second-hand housing, will be in the show before a large number of second-hand housing information collection to support their own decisions, which deal with the most basic area price, etc., will also consider second-hand online popularity, Traffic conditions and old and new situation of second-hand housing, so the use of behavioral decision-making theory can better study the impact of consumer behavior with offline factors.

2.2 Online Attention

Online second-hand housing price, area and apartment layout and other basic information in the second-hand housing line marketing has a crucial role to a certain extent, reflect the quality of housing and other information is that consumers understand the basic information of housing. However, this information does not reflect the popularity of online second-hand housing. Therefore, the chain home site often show details of second-hand housing second-hand housing subways, buses and other traffic information, transaction attribute information, in addition to show the source of attention and other system-generated information. System-generated information [20] refers to the information generated by the online system based on the user's browsing behavior and data. This part of information plays a crucial role in the field of network marketing and e-commerce. For example, in the experience-based products, the number of reviews and sales of the products significantly affects consumers' willingness to buy [21], such as movie recommendation [22] and books [23]; the demand for digital products [24] Such as online music [25]. Therefore, when consumers choose second-hand online online more need this part of the system to generate information for decision-making.

The concern of online second-hand housing is generated by many consumers concerned about the second-hand housing, which indirectly reflects the popularity of the second-hand housing. Now research has shown that the online review [26] will have a significant impact on the popularity of the goods. Housing concern is generated by the behavior of consumers, the same credibility is higher. So put forward the hypothesis:

H1: The amount of attention that online second-hand housing has had has a significant positive impact on the number of offline listings.

2.3 Second-hand Housing Old and New and the Distance of the Subway

Second-hand housing marketing is affected not only by the amount of online attention, but also by a number of factors such as traffic[27], population[28] and financial environment[29], which have profound implications for housing prices in the region. This economically developed areas are often easily accessible, subway stations more convenient for people to travel. However, housing prices in this area are correspondingly higher, and most of them are often people with a certain economic strength to buy. So although the traffic is convenient, but the popularity is lower; on the contrary, those second-hand houses that are farther away from the subway and cheaper prices are more popular. Therefore, we put forward the hypothesis:

H2: Second-hand housing is a far more positive influence on the offline viewing frequency of consumers than the subway

Construction time significantly affects the price of second-hand housing [30], and construction time to a certain extent, can determine the level of new and existing housing. However, at present, most of the researches only consider the influence of subway distance and construction time on the price of second-hand houses, and seldom consider the impact on consumer purchasing decision-So put forward the hypothesis:

H3: Constructing a longer interval has a significant negative impact on the number of offline listings

3. EMPIRICAL ANALYSIS

3.1 Data and Variable Descriptions

The experimental data from the chain home, chain home is a real estate transaction service platform, chain home website will provide more comprehensive information second-hand housing availability, including the basic properties and transaction attributes of housing, housing features, the amount of attention and look Frequency and other information. Therefore, we choose the chain network for data collection. We conduct online data collection through a Python-based crawler. Among the major

provinces and cities in the country, real estate in first-tier cities such as Guangzhou and Shenzhen in the north is developing rapidly, and second-hand housing transactions are relatively large in scale. At the same time, new tier-1 cities such as Chengdu and Wuhan have also been on the rise. In order to study the data of different cities, we chose two cities in Beijing and Chengdu for data collection. After removing some of the missing data, as table 1 and table 2, we finally got 2505 second-hand housing data in Beijing and 2343 second-hand housing data in Chengdu, with 4848 data in both regions.

Table 1. Data Characteristics

variable	Observations	Average value	Standard deviation	Minimum	Maximum	VIF
Ln(times)	4,848	2.85	1.44	0	6.259	--
Ln(attention)	4,848	3.51	1.26	0	7.04	1.53
Ln(subway)	4,848	9.81	3.75	1	13	1.09
Ln(interval)	4,848	2.37	0.68	0	7.61	1.36
Ln(square)	4,848	4.55	0.40	3.11	5.89	3.44
Ln(price)	4,848	5.76	0.76	3.14	8.1	1.71
Ln(room)	4,848	2.50	0.89	1	9	2.69
Ln(date)	4,848	2.50	2.41	1	13	1.42

Table 2. Correlation test of variables

variable	Times	Attention	Subway	Interval	Square	Price	Room	Date
Times	1.0000							
Attention	0.7451*	1.0000						
Subway	0.3176*	0.1853*	1.0000					
Interval	0.1424*	0.2469*	-0.0965*	1.0000				
Square	-0.0615*	-0.1049*	-0.0314*	-0.1519*	1.0000			
Price	0.2709*	0.2937*	-0.0258	0.3735*	0.3790*	1.0000		
Room	-0.1047*	-0.0961*	-0.0066	-0.1137*	0.7831*	0.2004*	1.0000	
Date	0.5007*	0.4714*	0.2085*	0.0726*	0.1882*	0.2571*	0.1294*	1.0000

3.2 Model Estimation

Consumers' changes in the frequency of looking at the line are often influenced by several factors. Therefore, the use of multivariate linear regression model to test the online attention, the distance to the subway and the length of construction have an impact on the number of times consumers look offline. In this study, the second-hand housing with the number of times as a dependent variable to reflect the degree of conversion of second-hand housing; independent variables for the second-hand housing online attention to the distance to the subway and the length of construction time, and second-hand Housing size, price, size and release time as a control variable into the model for analysis. In order to avoid the multicollinearity between the data and to facilitate the analysis, all the data, we take the logarithm into the model calculation. As table 3.

Table 3. Description of variables

Variable category	Variable name	Variable Description	measurement method
Argument	Look at the frequency	Consumers look at the number of offline	Look at the frequency with the line
Argument	Online attention	The number of people following this listing on the site	Online followers for this listing
	Subway distance	This listing is away from the	The length of the distance

nearest subway station
 Time interval Completion time The current year to the current length of time minus the year built
 Control variables Size area size area
 Price The total price of housing The total price of housing
 Huxing Number of bedrooms The number of bedrooms
 Time Release time The current month minus the released month

$$\text{Ln}(\text{times}) = \beta_0 + \beta_1 \text{Ln}(\text{room}) + \beta_2 \text{Ln}(\text{2date}) + \beta_3 \text{Ln}(\text{square}) + \beta_4 \text{Ln}(\text{price}) + \beta_5 \text{Ln}(\text{attention}) + \beta_6 \text{Ln}(\text{interval}) + \beta_7 \text{Ln}(\text{subway})$$

Times said that the line of housing consumers to look at the frequency of the line can reflect the line to the extent of the line conversion; room that the number of bedrooms in the house, with the second-hand housing to reflect the size; date said the second-hand housing Online release time length, respectively, said 13, 1 said the release time in less than a month, 2 said the release time of more than a month but not more than two months and so on; square that is the area of the source; price Said that the total price of the second-hand housing; attention that the second-hand housing online concern how much; interval said the completion of the time from the current length of time; subway is the second-

hand housing from the nearest subway station distance, respectively 1 to 13 tables

Show, within 1 km with 1 said that within two kilometers beyond a kilometer with 2 said, and so on. These data are in the chain second-hand housing details page is displayed.

4. ANALYSIS CONCLUSION

Due to the possible inter-variable correlation among the regression models, this paper uses stepwise regression to test the possible multicollinearity in the model. After Stata statistical software analysis. Regression model online second-hand online second-hand housing concern, distance to the subway and the length of construction calculations, the final ² and t test are to meet the requirements, the specific results as table 4:

Table 4. Empirical results

variable	Model 1	Model 2
Constant term	3.01*** (11.44)	-1.057*** (-4.78)
Ln(attention)		0.701*** (56.05)
Ln(subway)		0.063*** (18.02)
Ln(interval)		-0.949*** (-4.31)
Ln(square)	-0.685*** (-9.22)	-0.718 (-1.20)
Ln(price)	0.434*** (17.45)	0.153*** (7.02)
Ln(room)	-0.107*** (-3.44)	-0.166*** (-7.10)
Ln(date)	0.290*** (39.50)	0.101*** (15.96)
Adjust-R	0.324	0.620
F	580.56	1128.39
N	4,848	4,848

*** indicates a significant level of 1%, ** indicates a significant level of 5%, * indicates a significant level of 10%

As shown in Table 3, the regression coefficient of comprehensive attention of the two regions (B = 0.701, T = 56.05, P <0.01) is significant. H1 is verified that the amount of attention already paid by online second- The number of rooms had a significant positive impact. At the same time integrate the two areas second-hand housing to the subway distance (B = 0.063, T = 18.02, P <0.01) is also significant. It verifies that Hypothesis H2, that is, the second-hand housing is far from the subway and has a significant positive impact on the number of offline viewing times. The coefficient of time interval (B = -0.949, T = -1.31, P <0.01) is also significant, which shows that the construction time interval has a significant negative impact on the number of offline viewing times. In addition, among the results, the price of second-hand housing, apartment layout and other information on the number of offline viewing has a negative impact on consumers.

5. DISCUSS AND SUGGEST

Table 5 Analysis Results by Region

variable	Beijing		Chengdu	
	Model 1	Model 2	Model 1	Model 2
Constant term	3.811*** (11.56)	-0.670*** (-2.98)	3.813*** (8.51)	-0.695* (-1.81)
Ln(attention)		0.283*** (19.38)		0.780*** (39.99)
Ln(subway)		0.249*** (61.30)		0.271*** (60.13)
Ln(interval)		-0.046** (-2.23)		-0.065* (-1.82)
Ln(square)	-0.269*** (-2.99)	-0.056 (-0.19)	-0.362** (-2.41)	-0.267** (-2.28)
Ln(price)	0.425 (0.75)	0.125*** (4.20)	-0.094 (-1.06)	0.431*** (5.89)
Ln(room)	-0.104*** (-2.72)	-0.70*** (-3.30)	-0.024 (-0.49)	-0.153*** (-3.97)
Ln(date)	0.244*** (30.63)	0.047*** (2.23)	0.352*** (26.90)	0.102** (8.59)
Adjust-R	0.275	0.811	0.235	0.547
F	238.03	1542.67	181.01	405.51
N	2505	2505	2343	2343

As table 5, in addition to the combined results of the two regions, it can also be seen from the above table that the online attention of online second-hand houses in two districts of Chengdu and Beijing,

The distance to the subway and the length of construction time have also had a significant impact on the number of offline viewing of second-hand housing. Beijing area of concern (B = 0.283, T = 19.38, P <0.01) and online attention in Chengdu (B = 0.780, T = 39.99, P <0.01) On the number of consumers offline showings have a significant positive impact; in second-hand housing to the subway, Beijing area (B = 0.249, T = 61.30, P <0.01) and Chengdu (B = 0.271, T = 6.13, P <0.01) The coefficients were also significant and also validated the hypothesis that H2, The number of houses surveyed in the last two districts showed a significant positive impact on the number of houses surveyed in the last two districts in Beijing (B = -0.046, T = -2.23, P <0.05) and Chengdu (B = -0.065, 1.82, P <0.10) was also significant. In summary, the online presence of online second-hand housing, the distance to the metro and the length of time it takes to build a display exhibit a significant impact on the number of views taken offline by consumers.

Based on the analysis of the relevant literature, this article starts from the online display of online second-hand housing information, integrates online and offline information to study the influence of the number of second-hand houses taken. And focus on the existing online second-hand housing online attention to the distance and the construction of the subway time. The effect of length on the online second-hand housing marketing process. At the same time, this article combined with the property of the house, such as area and price, put forward the hypothetical model to explain the number of times looking at the second-hand housing line, found the online attention of the second-hand house and the distance to the subway would have an important effect on the online marketing of the second- influences. This also shows that buyers are more willing to choose those who focus on the larger and the principle of second-hand housing Metro, real estate intermediary in the network marketing time to seize the consumer's psychology, such as past consumer behavior information Can be placed in a prominent position, so that it can

well attract the attention of consumers online in order to further translate into offline transactions.

6. CONCLUSION

This article explores the impact of online second-hand housing information on the number of times consumers look offline and establishes a multiple linear regression model. Empirical studies verify the online attention of second-hand housing, and the distance to the metro will select the second-hand housing for consumers online. It has a significant impact, but also a reasonable exploration of new homes and rental online marketing. At the same time, this article also has some shortcomings. For example, the information of second-hand houses not only includes the text information but also the picture information. These pictures also affect consumers' choices to a great extent. And this time, all the data are sampled on the chain website, You can also go to other online second-hand housing sales site for comparison, so the result is more accurate.

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Dynamic study on the Impact of Non-financial Information Quality on Technological Innovation in Enterprises

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ABSTRACT

Non-financial information has gradually become an important basis for investors to understand the true value of the company. Technological innovation is a special kind of investment which can help companies to overcome the limitations of the law of marginal returns and break the stalemate in the production efficiency. By sorting out the economic consequences of non-financial information quality and the effect of technological innovation on research literature both at home and abroad, it has been found that few people have studied the relationship between the quality of non-financial information and the technological innovation of enterprises. The research on the relationship between the two helps to expand and deepen the research on the economic consequences of non-financial information which will help to enrich and develop the theory of economic growth.

CCS Concepts

• Applied computing → Law, social and behavioral sciences → Economics

Keywords

non-financial information quality, enterprise technology innovation, technical innovation value efficiency

1. THE RESEARCH ABOUT THE INFLUENCING FACTORS OF TECHNOLOGICAL INNOVATION

The influencing factors of technological innovation in enterprises can be divided into two aspects: The first aspect is the factors that influence the objective conditions for technological innovation in enterprises. The second aspect is the factors that influence the subjective motivation of the company for technological innovation.

1.1 In terms of research that affects the objective conditions for technological innovation

In terms of research that affects the objective conditions for technological innovation in companies, the study of the

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relationship between finance and economic growth originator Schumpeter (1942) proposed that technological innovation can successfully obtain the necessary funds is an important prerequisite for sustained economic growth; Nelson and Arrow[1] in the study have explained the importance of financial support for corporate technological innovation, and it also expresses the view that corporate technology innovation in real life is difficult to obtain sufficient financial support; Hall and Lerner (2010)[2] explain from the perspective of financing why there is always an underinvestment situation in the corporate technological innovation. Since then, most of the relevant studies have also come to the conclusion that financing constraints will inhibit technological innovation, such as Himmelberg and Petersen (1994), Giudici and Paleari (2000), Tang Qingquan and XuXin (2010)[3], Xiao Hailian et al (2014)[4], Lu Xin et al. (2013), Han Jian, and Yan Bing (2013)[5]. Based on the conclusion that most of the previous studies have found that financing constraints negatively affect technological innovation, some scholars have devoted themselves to exploring ways to mitigate the negative effects of financing constraints on technological innovation. Such as JieWeimin, Fang Hongxing (2011)[6], Mclean et al (2012) [7], Brown et al (2013)[8], Xiao (2013)[9], Kang Zhiyong (2013)[10], Wang Wenhua et al (2013)[11], Hyttinen et al (2002), respectively, from the promotion of financial market development, reduction Government intervention, improvement of the rule of law environment, implementation of preferential policies and other aspects proposed measures to mitigate the negative impact of financing constraints on technological innovation. Liu Yifang (2017) [12] found that government R&D subsidies have a significant incentive effect on technological innovation. Government R&D subsidies have a limited role to play in increasing the degree of transformation of economic benefits from technological innovation. The direct spatial effect of government R&D subsidies on technological innovation is significant, but the indirect spillover effect is not significant. The impact of government R&D subsidies on technological innovation has a significant threshold effect, and there is no inverted U-shaped impact form. JiYongyong (2017)[13] found that open innovation influences corporate performance through the intermediary role of network capabilities.

1.2 Research on the Influencing Factors of Subjective Motivation of Technological Innovation in Enterprises

Research on the influencing factors of subjective motivation of corporate technological innovation, John et al. (2008) analysis

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found that a perfect legal environment can effectively reduce the possibility of corporate management abandoning high-risk projects due to self-interest motives by effectively protecting investors, and increase the investment level of high-risk and high-yield projects. He and Tian's (2013) study shows that the higher the analyst coverage rate, the greater the managerial short-term operating performance of corporate managers, the higher the incentive for corporate managers to abandon technological innovation, and thus the analyst coverage will be reduced. The willingness of companies to invest in technological innovation; Fang et al. (2014)[14] explored two paths that influence the impact of stock liquidity on corporate technology innovation. First, higher stock liquidity will increase the risk of malicious acquisition by companies, which will force Corporate managers abandon technological innovation with a long payback period; another path is that stock liquidity is forced to reduce technological innovation by increasing the number of speculative institutional investors and increasing managers' short-term operating pressure. Level; Tian and Wang (2014) [15] found that investors' tolerance for failure can promote technological innovation; Yuan Jianguo et al. (2015)[16] found that once a company establishes political connections, at least in the next three years, political connections will impede corporate technological innovation. This study examines the curse effect of political resources from the perspective of technological innovation.

2. THE RESEARCH ABOUT THE VALUE EFFECT OF TECHNOLOGICAL INNOVATION

The essence of technological innovation is to create value. From the perspective of enterprises, the value effect of technological innovation is mainly reflected in the impact of technological innovation on the production value, financial value and market value of the enterprise.

2.1 On the Influence of Technological Innovation on Production Value

About the impact of technological innovation on production value, Classical economists believe that the accumulation of capital is the driving force for the growth of the value of production. However, due to the objective existence of the law of declining marginal returns to capital, enterprises only rely on capital accumulation, and their production efficiency growth will eventually stagnate. Based on the Douglas production function, Solow (1957)[17] incorporates technological innovation factors and proposes the theory of exogenous growth. This theory regards technological innovation as an exogenous variable, and believes that technological innovation can help to overcome the limitation of the law of diminishing marginal returns caused by capital accumulation, thereby helping to overcome the limit of unsustainable increase in the value of production and increase the value of production. Solow's (1957) research shows that technological innovation is an important driving force for economic growth and it has a profound impact on future related research and laid the foundation for research; Romer (1986) believes that technological innovation is a production factor with increasing marginal productivity, and he regards technological innovation as an intermediate product in the production process of the company, thus creating an endogenous growth theory. Griliches (1980) judged the impact of technological innovation on the production value of companies by calculating the output elasticity of technological innovation capital investment. Several

studies that Griliches and his collaborators later continued to adopt in a similar manner affirmed the positive influences of the value of technological innovation to the production of enterprises, such as Griliches and Mairesse (1984), Griliches (1986); King and Robson (1993) also supporting the endogenous growth theory, they believe that corporate technological innovation can improve the production efficiency of various production factors and overcome the limitation of the law of diminishing marginal about traditional economic model, thus raises the value of production. Aghion and Howit (1992) From the perspective of knowledge transfer and Young (1991) from the perspective of international trade explained how to achieve the growth of production value through technological innovation; Jones and Williams (1998) Inspected the impact of technological innovation investment on production value from a macro perspective, and proposed an estimation method for the rate of return on investment in technological innovation of enterprises; Hu et al (2003), Wu Yanbing (2008), Chen Xiude et al (2011) [18], Yang Yong and Yuan Zhuo (2014)[19] by using Chinese companies as research samples founded that technological innovation has improved production value for enterprises. Tang Jing et al. (2014)[20] found that technological innovation has a higher economic contribution to gross domestic product than capital investment. Chinese investment in technological innovation has not yet reached an optimal value. Therefore, it is necessary to strengthen the input intensity of technological innovation in enterprises to enhancing the positive impact of technological innovation on the regional GDP. Wang Fusheng and Han Meini (2016) [21] found that the company's technological innovation behavior can indeed attract QFII shares, but in the context of China's unique system, QFII adopts a more cautious investment attitude towards the government-controlled company's innovative behavior, which is large for the government. The innovation behaviors of the shareholders, but not the controllers, show significant investment preference; the technical innovations of companies with low net-book ratios can particularly attract QFII's attention.

2.2 About the Impact of Technological Innovation on Financial Value

About the impact of technological innovation on financial value, According to the competency theory, technological innovation can bring excess profits to the company, thereby increasing the company's profitability and its financial value. This is because technological innovation can enhance the competitiveness of enterprises, improve the company's cost leadership, and bring the advantages of product differentiation. Hsieh et al. (2003) found that technological innovation can bring higher returns to enterprises, and the impact of technological innovation on corporate earnings is higher than the impact of capital investment on corporate earnings; Jefferson 's research(2006) shows that the company's funds for technological innovation Investment can significantly increase the profitability of enterprises, and the marginal contribution of technological innovation investment to profits is much higher than the marginal contribution of fixed asset investment to profits. Specifically, the former is 3 to 4 times the latter; Xu Xin and Tang Qingquan (2010) found that there was a significant positive correlation between patents and profitability of enterprises, among which invention patents had the highest impact on corporate profitability, while designs and utility model patents had lower impact on corporate profitability.

2.3 On the Impact of Technological Innovation on Market Value

About the impact of technological innovation on market value, According to the theory of signal transmission, the company's behavior can communicate relevant information about the future earnings status of the company to the outside world. Therefore, investors will judge the market value of the company according to different investment behaviors of the company. For enterprises with high levels of technological innovation, investors can obtain signals that the company has good development prospects and room for growth, and therefore will pay higher prices for the company's stocks. In addition, as the company's technological innovation can improve the company's future profitability and increase the present value of the company's future cash flow, according to cash flow discount model, technical innovation can improve the intrinsic value of the company's stock. In addition, from the perspective of the capital pricing model, the higher the company's expected return, the higher the room for the growth of the company's stock price. Technological innovation can improve the company's expected rate of return, which can increase the company's stock price and market value. Previous empirical research by scholars has also supported this view, such as Griliches (1981), Sundaram et al. (1996), Bosworth and Rogers (2001)[22], Bloom and Reenen (2002) [23], Sonenshine (2010)[24], Xu Xin and Tang Qingquan (2010). The studies of Chen Xiude et al. (2011) all found that there is a significant positive relationship between the technological innovation of a company and its market value.

3. THE ECONOMIC CONSEQUENCES OF NON-FINANCIAL INFORMATION DISCLOSURE

3.1 Non-Financial Information Disclosure and Corporate Governance

Existing studies have found that non-financial information disclosure can improve corporate transparency and governance efficiency. Foreign scholars Glosten and Milgrom (1985) explained that improving the level of information disclosure can reduce the degree of information asymmetry and enhance the overall image of the company. Amir and Lev (1996) [25] founded that the disclosure of non-financial information plays a good role in supplementing financial information disclosure by using the US wireless communication industry as a research sample. Dan and Li (2010)[26]pointed out in the study that the higher the disclosure level of non-financial information related to social responsibility, the lower the company's cost of capital. Lang and Lundholm (1998)[27]have shown in their research that the amount of optimistic and pessimistic news will change significantly before and after the refinancing of corporate equity. The results of Fang Hongxing and Jin Yuna (2011) [28] show that high-quality internal controls can have a reverse effect in the company's earnings management activities. Cheng Xinsheng, Tan Youchao et al. (2012)[29]believe that the level of marketization plays a significant role in non-financial information influencing investment efficiency, and finds that institutional constraints have an impact on the economic consequences of information disclosure. Zhang Zhengyong and Dong Juan (2017)[30]found that the disclosure of corporate social responsibility reports will reduce information asymmetry; there is no significant negative correlation between the quality of social responsibility reports and information asymmetry; institutional investor's shareholding ratio

will weaken social responsibility information disclosure and information is not Negative correlation between symmetries.

3.2 Non-Financial Information Disclosure and Corporate Performance

Preston and O' Bannony[31]took social responsibility information as the research object, and the results showed that the better the corporate social responsibility implementation effect, the better its operating performance. Baker et al. (R "D "Banker2000) [32] found that the higher the customer satisfaction, the better corporate performance. Few scholars systematically research on non-financial information in China, but mostly on non-financial information such as corporate governance, social responsibility, and internal control. Zhang Chuan and Pan Fei (2008)[33]studied that the using of non-financial information from listed entities on the basis of agency and contingency theory has a significant effect on company performance. Zhang Xiaotong et al (2012)[34]found that the disclosure quality of listed companies' internal control information is closely related to their performance. Gao Ting and Wang Huaiming (2018) [35] think that we have found that the disclosure of corporate social responsibility information is significantly positively correlated with debt financing capacity, and it is significantly negatively related to the cost of debt financing.

3.3 Non-Financial Information Disclosure and Corporate Value

Peter Drucker (1995) pointed out that non-financial information should be included in the enterprise value evaluation system. Amir & Lev (1996) proved that non-financial information has an ability to interpret incrementally the value of the company. The research of Amal, Hassan, Benson (2003)[36]Jet al results show that the non-financial information disclosed by the company can help accurately assess the value of the company. Wu Shengzhu (2007)[37]used the listed entity's annual report as the research object, and the results showed that the higher the voluntary information provided by the listed entity, the better the liquidity of the stock. Zhao Ying and Li Mengfei (2009)[38]proved that the relationship between the disclosure of investor relations and the value of the company presented an inverted U-shaped relationship by using empirical approach. Chen Xia et al. (2015) [39]found that the better corporate governance of listed companies, the higher the company's value by using empirical approach. Han Peng, XuanXuanxuan, and Zhao Xiaoli (2017)[40]proposed several issues that need to be addressed to improve the usefulness of non-financial information, and provide theoretical guidance for realizing the sustainable value creation of non-financial information and advancing the construction of the value overview report system. Li Shuang (2016) [41]studies that development planning, equity changes and asset reorganization, and risk management are factors to consider when making investment decisions. The media's negative non-financial information reports on listed companies will cause investors to suspect the company and hinder companies. A new round of stock haircuts reduces the company's stock price.

4. COMMENTARY

This study combed the non-financial information quality impact on technological innovation of research literature at home and abroad, including the study of the influence factors of technology innovation, the value effect of technology innovation research and non-financial information disclosure the economic consequences

of three parts, and accordingly put forward the following conclusions.

(1) From the perspective of technical innovation, the research on the impact of non-financial information quality on enterprise technology innovation investment is less;

(2) The existing research on the non-financial information quality affects the internal mechanism and the conduction path of the enterprise technological innovation is basically in a blank state;

(3) The existing research is less to explore the impact of non-financial information quality on the value effect of corporate technological innovation.

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Digital Economy and Econometrics

Network Effects in Facebook

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ABSTRACT

Network effects are one of the defining properties of the digital economy. It has been shown, both in theory and practice, that network effects contribute to the growth and potential success of businesses in the digital economy. In this paper, we present a quantitative case study of network effects in Facebook for the period 2011 to 2017. We estimate the value of Facebook, and analyse how this value depends on the number of Facebook users. Our results show that there are strong network effects in Facebook, as the value per user increases more than estimations obtained from Metcalfe's law. We also outline a general theory of the strength of network effects, and quantitatively estimate the strength of network effects in Facebook.

CCS Concepts

• Applied computing → Electronic commerce → E-commerce infrastructure

Keywords

Network effects; Digital economics; Digital markets.

1. INTRODUCTION

Network effects are one of the defining properties in the digital economy [1]. Both in theory and practice, it has been shown that network effects contribute to company value growth and constitute a pre-requisite for market dominance in network industries [2]. For instance, the authors of [3] showed that there are significant network effects in many of the most popular social networking services, including Facebook and Twitter. In particular, it was shown that the value of a social networking service increased relatively more than the increase in service activity and number of users. Furthermore, as argued in [4], strong network effects tend to lead to natural monopolies, which is clearly evident in today's business landscape. As of September 2017, the top 4 companies in the world according to market capitalization were all providers of digital services: Apple, Alphabet, Microsoft and Amazon, all with a market cap of more than 400 billion USD [5]. The main reason for this is that network effects create value that favours companies with an already existing large user base, and thus often leads to a winner-takes-all situation [6]. Even though network effects are also found in the traditional industrial economy, network effects have relatively more impact on market evolution in the digital economy.

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Facebook is the world dominant social network service, with more than 2 billion active monthly users as per third quarter 2017 [7]. The main value proposition of Facebook is to enable communication between a homogenous group of Facebook users, as well as between Facebook users and advertisement providers. Hence, Facebook is a mediator of communication and thus a typical example of a value network. There are network effects between Facebook users, in the same way as there are network effects between subscribers in a telephone network. In addition to direct network effects between individual Facebook users, there are also indirect network effects in Facebook, primarily between providers of Facebook content and users, and ad providers and users.

An open issue is how to quantitatively measure the strength of network effects in Facebook, or in any digital service in general. This is a complex problem for several reasons. First, it is difficult to assess the value of a digital service, and in particular what contributes to the total value. We believe network effects are one such contribution, however, we also admit that there are several other contributions that are hard to identify and quantify. Second, it is difficult to assess the exact number of users of a digital service. Users also fall into different categories, depending on how often and how intensively they use a service. Third, the strength and impact of network effects may change over time.

In this paper we propose a model to quantitatively estimate the strength of network effects in digital services. We use our proposed model to assess the strength of network effects in Facebook. We believe that by providing a first step to assess the impact of network effects in digital services in general and in Facebook particular, we increase the understanding of digital markets and lay the basis for further development of such models. The rest of the paper is organized as follows. Section 2 presents network effects. Section 3 presents a case study of network effects in Facebook. A discussion of the results is presented in section 4. Finally, section 5 concludes the paper.

2. NETWORK EFFECTS

Network effects are defined as the value that a new user to a network adds to existing users in the same network. An owner of a network will not only get increased value from the new user, but also increased value from its existing users, since the new user adds value to those users. The strength of network effects is a quantitative measure of this impact. Network effects exist in all industries. However, network effects have become a defining property of the digital economy, since the business model of many digital services is based on matchmaking and mediation between users [8]. Examples of companies that are heavily influenced by network effects include Facebook, Uber and Airbnb.

Network effects can be quantified using various network laws. In this paper we will base our analysis on Metcalfe's law and Odlyzko-Tilly's law [9]. Both these laws provide a quantitative

relationship between the number of users in a network and the value of the same network. For the rest of this paper, we denote $v(n_t)$ as the value of a network with n_t users at time t . According to the Metcalfe's law, the value of such a network is given as

$$v(n_t) = kn_t^2$$

where k is a constant denoting the value of the network when $n_t = 1$, or when the network has reached its critical.

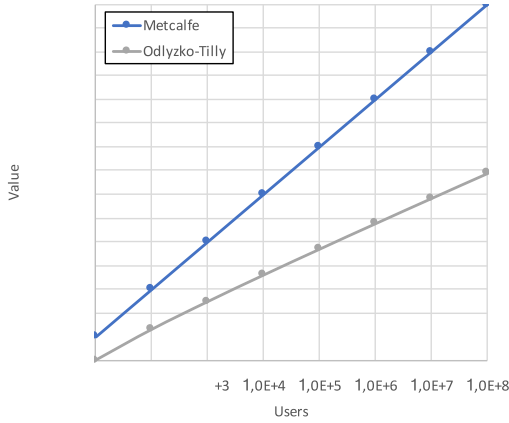


Figure 1. Value of a network estimated using Metcalfe's law and Odlyzko-Tilly's law.

Odlyzko-Tilly's law states that the value of a network is

$$v(n_t) = kn_t \log n_t$$

For both Metcalfe's law and Odlyzko-Tilly's law, value per user is given as $v(n_t)/n_t$. Figure 1 and 2 show the value, $v(n_t)$, and the value per user, $v(n_t)/n_t$, for both Metcalfe's law and Odlyzko-Tilly's law, respectively. A comprehensive discussion and comparison Metcalfe's law and Odlyzko-Tilly's law is found in [9].

In general, the strength of the network effect in a network can be estimated using the Network Strength Parameter (NSP), α , where

$$v(n_t) = kn_t^\alpha$$

Here, Metcalfe's law corresponds to $\alpha = 2$, while Odlyzko-Tilly's law corresponds to $\alpha \approx 1.2$.

It is very hard to find the value of k when estimating the value of a network. This is because k has no financial or other quantitative representation that can be extracted from relevant data. Hence, k , needs to be estimated from other parameters. Further in this analysis, we assume that both k and α are constant and independent on $v(n_t)$, n_t and t . Our objective is thus to estimate α based on measurable data on $v(n_t)$ and n_t . In order to estimate α , we compare the resulting value and the number of users in the network at times t and $t + \Delta$. In this case we obtain

$$k = \frac{v(n_t)}{n_t^\alpha} = \frac{v(n_{t+\Delta})}{n_{t+\Delta}^\alpha}$$

We re-arrange and obtain

$$\alpha(t, t + \Delta) = \frac{\log\left(\frac{v(n_{t+\Delta})}{v(n_t)}\right)}{\log\left(\frac{n_{t+\Delta}}{n_t}\right)}$$

The estimate $\alpha(t, t + \Delta)$ denotes the NSP from time t to $t + \Delta$. An example is the NSP for a network from 2011 to 2017, denoted as $\alpha(2011,2017)$.

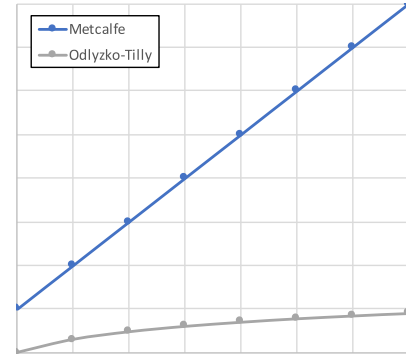


Figure 2. Value per user in a network estimated using Metcalfe's law and Odlyzko-Tilly's law.

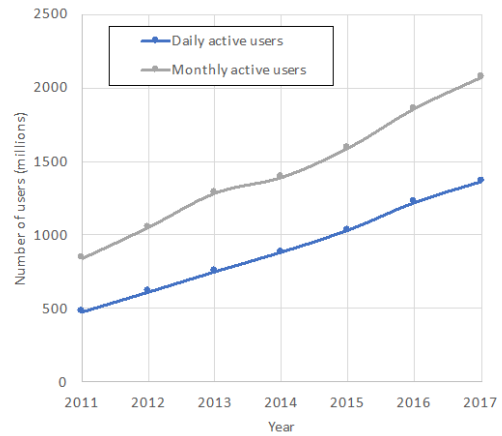


Figure 3. Facebook daily and monthly active users in the period 2011-2017.

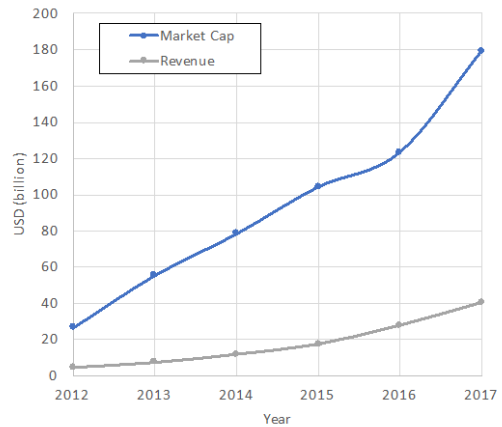


Figure 4. Facebook market cap and revenue in the period 2012-2013.

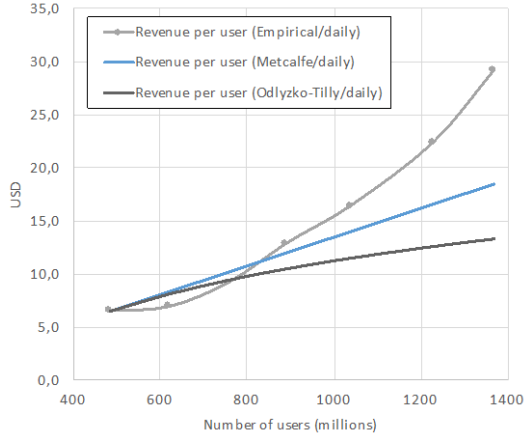


Figure 5. Facebook revenue per daily active user.

3. CASE STUDY: FACEBOOK

We have analysed the impact of network effects on the value of Facebook. The value of Facebook is estimated using market capitalization and yearly revenue. To estimate the number of users on Facebook, we use both daily active users and monthly active users. Our aim is to find the relationship between the value of Facebook and the number of users over a time series from 2011 to 2017, hence the $\alpha(2011,2017)$. No other parameters that may influence value is considered in this case study. We have obtained our statistics from [10].

Figure 3 shows the number of daily and monthly users on Facebook. Daily users are the number of distinct users that log in to Facebook over a 24 hour period. Monthly users are the number of users that log in to Facebook over 30 day period. We observe that both the number of daily and monthly users are increasing from 2011 to 2017. We also observe that the number of monthly users are always greater than the number of daily users for a given point in time. This is because not every user logs into Facebook every day.

Figure 4 shows the market cap and revenue of Facebook for the years 2012-2017. The market cap is estimated based on the number of stocks multiplied by the stock value on the end of December every given year. Revenue is the yearly revenue for the given year, taken from [10].

Figures 5 and 6 show Facebook revenue as a function of the number of daily active and monthly active users, respectively. For reference, we have compared the results with Metcalfe's law and Odlyzko-Tilly's law.

Figures 7 and 8 show Facebook market cap as a function of the number of daily active and monthly active users, respectively. In both figures we observe that the value increases as a function of number of users. Furthermore, the value increases more than what is estimated from both Metcalfe's law and Odlyzko-Tilly's law. This indicates that there are strong network effects in Facebook. We also observe that the difference between revenue and market cap, and between daily active users and monthly active users are noticeable, however, not significant.

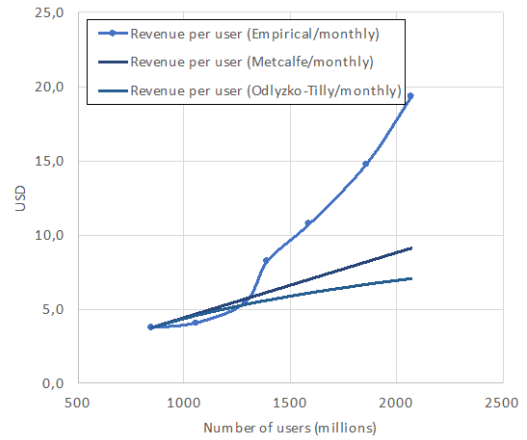


Figure 6. Facebook revenue per monthly active user.

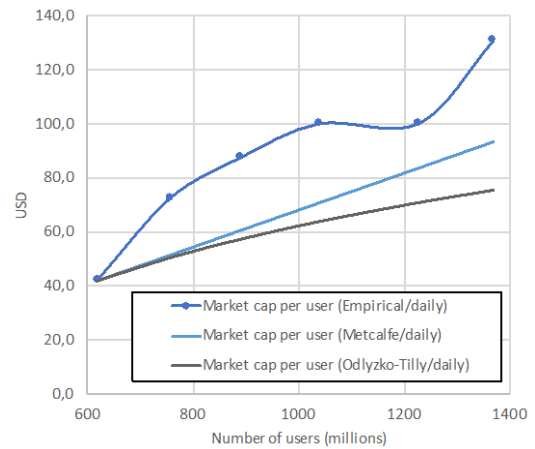


Figure 7. Facebook market cap per daily active user.

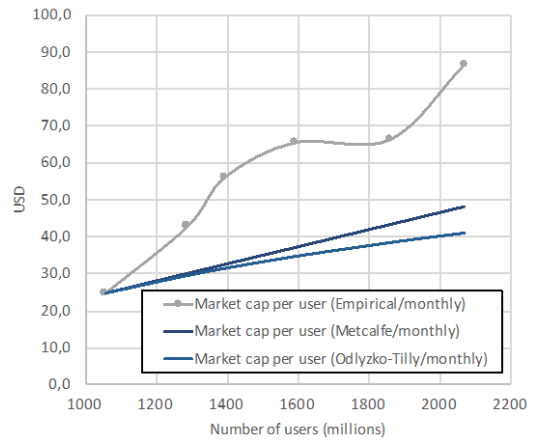


Figure 8. Facebook market cap per monthly active user.

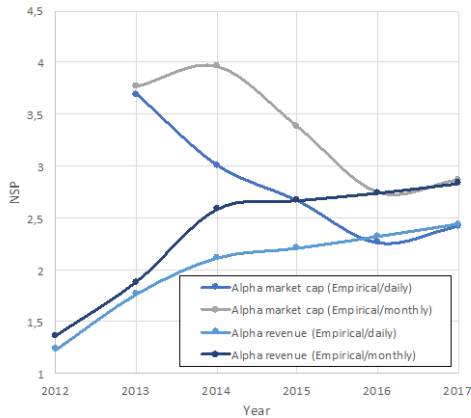


Figure 9. The NSP (α) estimated from 2011 (revenue) and 2012 (market cap).

Figure 9 shows the NSP, $\alpha(2011, i)$ and $\alpha(2012, j)$ when using the revenue and market cap, respectively, and for $i \in [2012, 2017]$ and $j \in [2013, 2017]$. We observe that the NSP converges to an interval $[2.4, 2.8]$ for $i, j \rightarrow 2017$. This indicates that the NSP is stronger than Metcalfe's law for the considered time period.

4. DISCUSSION

Our findings in section 3 indicate that the network effects in Facebook is $\alpha > 2$. This means that the network effects are stronger than estimated by Metcalfe's law. This is surprising result, since research in the field has indicated that Metcalfe's law is an overestimation of the network effects [11], and that the Odlyzko-Tilly's law is a more accurate estimate [9]. Hence, we should not take the results presented in this paper as definite, but more as new facts into the complex domain of the impact of network effects on digital businesses.

The value of a company may be influenced by more than network effects. Competition, launch of new products or services, changed user behaviour, new business models, new partners and stakeholders, stock market behaviour and adoption of new technology all influence how a company valuation and revenue. A comprehensive study of all these effects is being the scope of this paper.

The results in this paper is obtained using the current state of art in theoretical basis on network laws. Empirical findings on company valuation in the digital economy may encourage research on more advanced network laws.

5. CONCLUSIONS

In this paper we have analysed network effects in Facebook. We have estimated both the value and the number of users in Facebook, and calculated the strength of network effects for the period 2011-2017. Our results indicate that there are significant network effects in Facebook. However, as company valuation is complex and multi-faceted, the increase in value observed for Facebook in the period 2011-2017 may be due to other factors. Hence, future research should develop more advanced models, taking into account additional complexities and market behaviours.

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Corruption in the Customs Service

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ABSTRACT

Economic well-being of any country is one of the main foundations of any developing or developed nation. The openness to trade with other nations plays a very significant role in strengthening the economy of a country. This happens through two-way flow of resources to augment or complement each other's basic needs. It can also be an exchange of everyday use items in case of surplus production. In the majority of the countries, this exchange / entry and exit of goods are handled by the Customs departments of those countries. This work is intended to take a detailed look at a fundamental trade issue faced by the trade community: corruption in the customs departments at national and international levels. This study aims to describe the specifics of corruption in the customs service; helps justify the theoretical and practical importance of the issue under study. A study of prevailing anti-corruption measures being taken and their effectiveness assessment is carried out. The study also includes the main models of assessment of corruption in customs. In the end, conclusions are drawn based on the comparative literature study and recommendations are made.

CCS Concepts

• **Social and professional topics** → **Computing / technology policy** → **Government technology policy** → **Governmental regulations**

Keywords

Corruption; custom service; border

1. INTRODUCTION

In economic literature, it is widely believed that countries can significantly improve the potential for economic growth by

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integrating into the world economy. Nevertheless, corruption among developing countries is highlighted as a key barrier to free movement of capital and merchandises [1]. It is pertinent to mention that corruption in many state institutions affects the economic openness of countries, however corruption in the Customs service exerts the primary and the most significant negative effect on trade.

To delve deeper into the aforementioned matter, studies concerning issues related to corruption in the Customs service in the economic literature were conducted in a particular time periods. In the literature Bhagwati [2] firstly revealed empirical "signs" of corruption in the Customs service when he observed 'under-invoicing' in Turkey's trade balance. In the 1970s, series of studies [3, 4, 5, 6, 7 and 8] were conducted to investigate the consequences of inefficiencies in the customs service: in particular, the impact of illicit imports of goods on the economic welfare. And with the publication of the paper of Anderson and Markouler [1] "Insecurity and the Pattern of Trade: An Empirical Investigation" since the 2000s, empirical studies on the assessment of corruption in the Customs service are actively conducted [9, 10, 11, 4, 12, 6 and 7].

These two research trends seek to answer two mutually complementary questions. These are: "What is the impact of Corruption in trade on the economic welfare of a country?" And "What is the nature of corruption in International Trade?". But it is observed that they rarely intersect in literature. Nevertheless, we believe that the range of issues related to this institute is much broader and many details in the second issue have not yet been studied primarily cause of the lack of a structured broad analysis of this topic.

By this paper we intend to fill this gap in the literature and describe the specifics of corruption in the customs service, emphasize the practical importance of the issue and provide a comprehensive review of literature related to corruption in the customs service. The work is organized as follows: Section 2 describes the specifics of corruption in the Customs service, Sections 3 and 4 justify the theoretical and practical importance of the issue under the study, Section 5 describes the main anti-corruption measures being taken and assesses how effective they are. Section 6 analyzes the main approaches and models for assessing corruption in customs. Section 7 concludes the topic with suggestions. It is important to mention here that this study is

based on authors' personal study, observations and recommendations and does not carry any malice or bias against or towards any institution of any state.

2. CLASSIFICATION OF CORRUPTION AND FACTORS AFFECTING ITS SUPPLY AND DEMAND

It is widely believed that the main reason for corruption in the customs service is the monopoly power the Customs officials enjoy to provide formal services in trade on national and international level. As a rule, the crossing of goods across the border (import or export) is technically and bureaucratically routine. At each stage of the process there is a risk of corruption. The result of collusion between firms and employees in the Customs service can manifest itself in various fraudulent schemes, which, according to the classification of Hors [10], are manifested in a combination of the following types of corruption:

- *Routine corruption*: a customs officer receives a bribe to provide specific customs services to the bribing party or speed up the implementation;
- *Fraudulent corruption*: a customs officer receives a bribe for "closing eyes" on a wrong declaration of goods in order to reduce the customs expenses of the firms. As a rule, the result of "closing eyes" of a customs officer becomes an incorrect definition of the name and / or country of origin and / or the number of goods crossing the border, hence possibly permitting goods to pass the boundaries freely without passing fee of a legal boundary;
- *Criminal corruption*: a customs officer receives a bribe to pass unauthorized, prohibited and/or dangerous goods (for example, drugs, weapons, etc.).

In the literature, the following basic factors determine the private sector demand for corruption:

- *The quality of the supply of customs services*: depending on the individual desire of the customs officials or on their insufficient number (for example, due to unforeseen growth of trade), long queues may appear in customs agencies that cost the private sector undue time expenses;
- *High degree of regulation and entangled procedures*: the passage of import / export procedures, obtaining licenses and confirming the serviceability of documents may become an unusually / unduly costly and time taking process for the private firms;
- *The protectionist policy of the country*: the fiscal policy of imposing ad-valorem tariffs, quotas, import excises or the ban on imports to a group of goods encourages firms to rent-seeking. [13]

One can single out the following practical sources of corruption:

- *Low salaries of customs officials*: the low-wage factor is often applied to low-income developing countries, but for countries with a widespread corruption this argument is rather unconvincing mainly cause of the following factors:
 - *Corruption in country's political system*: In many import-oriented developing countries, political power groups "impose" corruption on the customs service to extract rents. Often, the rent is drawn up by creation of "parallel customs", which carry out the illegal imports;
 - *The presence of corrupt structures in customs*: Customs services in corrupt countries is carried out more as a

'dictation' from higher-ups and it is unlikely that one of the employees will be able to act contrary to the interests of colleagues in a corrupt environment. In the customs services of developing countries, nepotism is prevalent (the low rank officials have to share the illegal incomes with the superiors for patronage in the career).

3. THE IMPACT OF ILLEGAL IMPORT ON ECONOMIC WELFARE

In this section, we will review the relevant literature in order to understand the mechanisms of the relationship between customs service dysfunction and the economic well-being. The welfare theory for illegal imports is based on a simple microeconomic model of a small economy, where two interchangeable goods are consumed: imported and exported. Since the economy is small, international prices for import and export goods are fixed, but relative domestic prices for commodities are variable depending on the allocation of resources to the import (including illegal) or production sector. According to the fundamental theory, the illegal import of goods at tariffs can improve the welfare in comparison with the condition of free trade only if it compensates for the economic distortions in the distribution of resources generated as a result of the introduction of import tariffs in the domestic economy. Corresponding reductions in welfare losses can be manifested in the form of higher export figures at fixed relative prices in the domestic economy or in the form of lowering domestic prices for imported goods.

According to the pioneering work of Bhagwati [3], illegal imports can only occur bypassing the customs service and with additional resource costs. But since in the model smuggling and legally imported goods coexist in the same market, the authors assumed that the domestic price for imported goods would be equal to the world price with the application of tariff. As a result, the authors concluded that the presence of illegal imports contributed to the inefficient allocation of resources to imports and, consequently, it could not contribute to improving welfare in the economy. However, a year later Sheikh [6] showed that using domestic resources to organize the smuggling, with the tariff inclusive domestic prices on illegally imported goods, can improve welfare if it facilitates a sufficient redistribution of resources from the import sector to the export sector of the economy.

The hypothesis of the presence of two domestic prices for taxable imported goods, where the price of illegally imported goods is lower than the tariff inclusive one due to full competition in the illicit import sector, was primary investigated in Sheikh's study [7]. The author suggested that the price of illegally imported goods will be lower than the price of legally imported goods and it will be determined by two risks: the risk of the importer associated with the implementation of contraband imports and the risk of the consumer when buying an illegally imported commodity. However, in the model, the existence of a low-priced import did not allow consumers to extract the entire consumer surplus from low prices due to additional consumption risks. As a result, Sheikh [6] concluded that the presence of illegal imports in the presence of tariffs would lead to a level of welfare in the absence of tariffs, only if the risks associated with the first will not require resource costs.

Later, Pitt [5] proposed an alternative mechanism for modeling illicit imports. According to this approach, smuggled imports were made through the customs service through a partial declaration of the true import value. Pitt's model [5] showed that the domestic price of imported goods will be lower than the tariff inclusive

price and the consumer will be able to extract an additional consumer surplus from low prices, which will positively affect the welfare. Nevertheless, Pitt also noted that as a result of the price reduction, the general welfare effect is uncertain since part of the resources in the economy "evaporates" to ensure illegal imports. Later on, Martin and Panagariya [14] improved Pitt's model suggesting that the sum of the "volatilized" resources is endogenously determined (assuming that resource costs are concave with the increase in the share of illegal imports), nevertheless, the authors also failed to give a definite answer to the question of the effect of smuggling on welfare in general.

4. ESTIMATES OF THE CONSEQUENCES OF CORRUPTION IN THE CUSTOMS SERVICE

From the section above, you can see that corruption in the customs service is primarily detrimental to the state due to the loss of budget revenues. According to the World Customs Organization, the annual loss of customs revenues of 180-member countries due to corruption in the service is at least \$ 2 billion. According to Brian, Ferguson and Karimov [15], the most tangible losses are in large developing economies with high levels of corruption such as India (\$ 334 million), Russia (\$ 223 million) and China (\$ 170 million). But at the same time, among the countries with tangible budget losses from India and China, the ratio of budget losses and customs revenues is the least. The most efficient tax collectors in absolute terms are Australia and Canada. However, in the last study, the scale of real budget losses is noticeably underestimated due to a limited sample of countries (the study observed mainly countries with low corruption). Also, the study [15] does not take into account the budget losses from excise duties and value-added tax (VAT) on imports, where the latter, as a rule, is the key point of fiscal revenue for the developing countries. However, studies of individual low-income developing countries vary greatly with the estimates above. The more acute problem of inefficiencies in the customs service is for the countries of Africa, where tariff charges from imports are less than 70% of their real value, and in some cases cross the mark of 50%. Moreover, according to the study [10] in the late 90's, the Philippines and Afghanistan had an illegal import of 12-50% and 38% respectively. Bolivia had a staggering illegal import percentage 400% of the official figures, respectively.

In the literature, the issue of assessing the factors affecting illegal imports is also widely discussed. Misra et al. [16], having investigated the trade data of India from 1987 to 2003, found a strong negative relationship between the tariffs on imported goods and the efficiency of customs service. As a result of empirical analysis, the authors found that the elasticity of evasion from customs tariffs (i.e. the percentage reduction of declared imports due to a 1% tariff increase) in India is 0.1. Fisman and Wei [17] having investigated data on trade between China and Hong Kong in 1997-1998, evaluated the elasticity of customs tariff evasion in China, which is in the range of 2-3 which is much higher than the one aforementioned.

Nevertheless, in the literature, not all studies adhere to the presumption that the key reason for the "lost" imports are high tariffs. John Mitarito [18] having investigated the trade statistics of 75 countries, found that the elasticity of customs evasion mainly depends on the level of the country's income, in particular, in countries where GDP per capita exceeds \$ 16,000, the loss of customs revenues is mainly insignificant. But for countries below this threshold, it is assumed that an increase in customs duties by

1% lowers the true volume of imports by more than 1%. In turn, Buen and Farzanegan [19] developed an index of illegal imports, using data on imports of 54 countries in the period 1991-1997. According to the authors' estimates, the level of illegal imports in the countries is affected both by the rule of law and the level of corruption, and the presence of trade barriers and high tariffs, but the first two were statistically more significant. Teed and Gustafson [8] applied a more detailed approach in assessing the impact of corruption on imports by highlighting five features of corruption: level, prevalence, nature (routine or fraudulent), access to illegal services for the private sector and predictability. As a result of the empirical assessment, the authors found that corruption only negatively affects imports, but also noted that predictability underestimates the aggregate negative effect of corruption, and its prevalence weakens the fiscal barrier in trade.

In spite of the fact that corruption is harmful for nations in imports, its role in international trade from the viewpoint of exporting countries is ambiguous. Jansen and Nordas [20] note the exclusively negative effect of corruption and explain their result by the desire of importing countries to deal with less corrupt partners. Anderson and Markuler [1] argue that corruption is a hidden tax in trade for countries with opaque trade policies. As an example, if the level of transparency of institutions in Latin America is made equal to the average value of the same of the countries of the European Union, then trade in Latin American countries would grow by 30%. And according to the most cited paper on this issue [17], trade losses (19-34% of potential turnover) are caused by the cumbersome intermediary role of corruption in the trade between the institutionally inappropriate countries.

In literature, attempts have also been made to identify the measure of "effective corruption" [13] in trade. Shepherd [21] estimated the effect of corruption in the customs service on the potential (declared and undeclared) volume of imports of countries, measuring the impact of corruption on time costs in trade. As a result, the author found that, despite the fact that bribes in customs are usually paid to accelerate the import process (which implies an increase in trade), post factum, corruption slows down the trade. Nevertheless, Jong and Udo [18] find statistically significant negative impact of corruption on the import potential of economies only for countries with high levels of corruption where the results of corruption transactions are low. Dutt and Traca [9] also assess the role of corruption costs on the countries' import potential and establish a positive effect of corruption in customs in the importing countries in 6.8% of observations.

5. MEASURES TO COMBAT CORRUPTION IN THE CUSTOMS SERVICE

Surveys of firms from developed and developing countries made in the 1990s show that the customs service has often stood out as the most corrupt of all institutions of the state. Nevertheless, in two decades of reforms in developed, as well as in some developing countries, the effectiveness of customs services has significantly increased. According to the latest survey of the European Bank for Reconstruction and Development (EBRD), former socialist countries have achieved notable results in the fight against corruption in customs [15 and 22].

In accordance with the recommendations developed by the World Trade Organization (WTO), the International Monetary Fund (IMF) and the Organization for Economic Co-operation and Development (OECD), the main principles for improving the

efficiency of the customs service are to increase the transparency of the institution, simplify rules and procedures [10]. However, as shown in case studies [23, 10 and 24], the reform process is also associated with a multitude of technical, legislative, political and social transformations that have a key impact on the outcome and incomplete implementation of each item from the integrated recommendations can be disastrous for reforms.

Since the detailed consideration of individual reforms or packages of recommendations of international organizations already analyzed in the studies above is beyond the scope of this paper, we will briefly describe the main measures to counter corruption in customs that are fundamental to any viable reform program. These measures include the following:

- Trade facilitation consists of eleven OECD indicators, which are derived from more than 100 items from the WTO Trade Facilitation Agreement. According to the OECD estimates [25], the full implementation of all these precautions can reduce trade costs, by 15.1% for low-income countries, 14.1% for countries with below-average income and 12.9% for countries with an income level above the average. The important points in reducing costs from 11 indicators are the following 4 [14]:

- Transparency of customs procedures: ensuring the availability of information (including open access on the Internet) on the conditions and restrictions of the passage of goods across the border;
- Simplification of trade documentation in accordance with international standards;
- Streamlining and simplification of customs procedures: creating a single window for receiving all necessary documents;
- Automation of border procedures using the Automated System of Customs Data (ASYCUDA).

- Transfer of some of the functions of the customs service to the private sector is another point. More than 50 developing countries, hire private companies for pre-shipment inspection (PSI) of cargoes prior to their shipment in the fight with misdeclaration and customs corruption [8]. The task of the PSI involves checking the compliance of the documentation with the quantity, classification and value of the goods when sent to the country of export. Usually such measure is recommended for importing countries with a low-quality level of state institutions as a second-best solution for the issue. For example, Young [8], having studied the statistics of budget revenues from import tariffs in 19 countries, noted that PSI reduces the underestimation of imports and, as a result, raises customs revenues by 6-8% per year. However, Anson et al. [26] questioned the effectiveness of such a tool by examining the evidence of Argentina, the Philippines and Indonesia. The authors showed that the result of the application of the PSI had a negative, positive and insignificant effects in the fight against customs fraud in these countries, respectively.

- Liberalization of trade policy is the most important item in anti-corruption measures. The existence of a high tariff regime or the use of different tariff regimes for similar goods in the classification system of goods is a significant incentive for fraud and corruption in the customs service. According to the estimates [11], based on the data of 75 countries with an elasticity of evasion of 0.3, 0.6, 1 and 1.5, the actually applicable tariffs are 43%, 37%, 30% and 24%, respectively, at a set tariff of 50%, and 20%, 16%, 11% and 6% at a fixed rate of 100%. Similar positive results are confirmed by data at the firm level. For example, the lowering of tariffs in Mozambique on average by 30% reduced the

likelihood of paying bribes of 30% and the average amount of bribes by 20% [27]. As a result, the application of a lower tariff regime only positively affects the efficiency of the customs service.

5.1 Difficulties in Empirical Assessment of Corruption at Customs

Corruption in the customs, like any kind of illegal activity, does not have quantitative statistical data for a detailed study of the phenomenon. Among our known works only one study [8] used a firm level data of bribes in customs. The only quantitative data on corruption in customs can be obtained only by comparing trade data between countries that are initially partially unreliable because the export data shows only the value of exports (FOB - Free On Board), and the importing countries, in addition to the first, record the cost of transportation of goods (CIF - Cost, Insurance and Freight). Another problem is the task of applying the "correct" corruption index. Obviously, the level of corruption in customs is correlated to the average in the country, but, most likely, the first is higher.

5.2 Approaches to the Empirical Assessment of Corruption at Customs

For a long time, the Bhagwati [2] approach of linking the trade statistics of the exporting country and the importing country was dominant in the literature for assessing corruption in the customs service. However, after Anderson and Markouler (2002) [1] proposed a microeconomic rationale for applying the corruption factor to the gravity model of trade, the latter also became actively used to assess corruption in customs. The existing models are as follows.

5.3 The Trade Statistics Comparison Approach

A simple model. Bhagwati's work [2] prompted a strong hypothesis in the literature that corruption in customs is driven mainly by the desire of the private sector, who shirk away from import duties. To identify the link between the trade gap between the two countries, as a corruption proxy in customs, with import tariffs, Fisman and Wei [28] proposed the following simple empirical model:

$$(1) \quad \log(\text{export}_i) - \log(\text{import}_i) = \beta_0 + \beta_1 \text{tariff}_i + e_i$$

where the trade gap equations show, export_i - the volume of good i imported declared by the exporting country, import_i - the volume of imports declared by the importing country, tariff_i - the tariff applicable to the commodity i and e_i - error. Nevertheless, such a model does not explain the mechanisms of corruption in customs, but only establishes the relationship between the magnitudes of the scale of corruption in the customs service with tariffs. Mishra [16] also improved the simple hypothesis by proposing a micro-model with a honest customs officers with incomplete ability to detect the contraband, where the ability of a customs officer depends on the technical equipment of the service. Nevertheless, the authors could not determine such a factor for use in the simple formula above and confirmed their hypothesis by comparing the results of a simple model between technically bad and well-equipped agencies.

A model with collusion: It is obvious that illegal imports are often identified by customs officials, but as a result of collusion they are not officially disclosed. To describe the mechanism of a similar corruption deal, Jean and Mitarito [11] adapted the classic three-

stage game of Muharaji and Png [29] to the tariff evasion model, where the scale of undeclared imports depends on incentives of the customs officer for uncovering illegal imports, punishments for both parties when disclosing collusion and the number of bribes, the amount of which is set by the negotiation process between the importer and the customs officer. As a result, the model predicts that despite the fact that when importing goods with high tariffs for firms, the risk of being caught is high, since customs officials have higher incentives for detecting smuggling in a high tariff group, and with the corruption growth, the trade gap grows for all types of goods.

5.4 Approach with the Use of the Gravitational Trading Model

Compared with the models above, which aim to describe and explain the corruption in customs, the gravity model implies only the measurement of the impact of corruption in customs on the potential trade. The basis of the gravitational theory of trade is the hypothesis that the level of trade between countries is directly proportional to their GDP values and is negatively affected by trade barriers (distance between countries, import tariffs, price level difference, religion, language, etc.). And the key assumption that determines the microeconomic basis of the model is that each country produces unique goods, and the demand for them for consumers (i.e. countries) is described by a constant elasticity of substitution function (i.e., the existence of homogeneous goods is denied). Without delving into the mathematical foundations of the gravitational trading model, let's move on to expanded models with corruption at customs.

Anderson and Markouler Model: Anderson used a predator-prey model to describe the impact of corruption in customs on international trade, where exporters, each with a monopoly on trade with a certain country, are "prey"-s for the "predators" (corrupt workers at the borders of exporting and importing countries). The exporter's goal is not to "get caught" when crossing the borders of both the export and import countries by the "predators", who can take away all the goods. Since "predators" are rational and their resources are limited, the optimal solution for the search for "extraction" will be the distribution of their resources along the borders of countries proportional to the values of exports / imports. As a result, exporters' costs, in order to avoid "predators", are proportionate with export values, i.e. the risk associated with corruption in customs both in the country-importer and the country-exporter. Using the conclusion of the "predator-prey" model, Anderson and Vankup [1] derived the following empirical model:

$$(2) \log(exp_i) = \beta_0 + \beta_1 \log Y_i + \beta_2 \log Y_j + \beta_3 \log y_i + \beta_4 \log y_j + \beta_5 Corr_i + \beta_6 Corr_j + \beta_7 tariff_i + \sum_k^k \beta_k Z_{ij} + e_i$$

where i and j are the indexes for importer and exporter, exp_{ij} - value of the export from country i to j , Y - GDP, y - GDP per capita, $Corr$ - corruption index, $tariff$ - average level of tariff, Z - trade barrier, e_i - error.

5.5 Comparison of the Two Approaches

The review of the models above shows that both empirical approaches actively develop the microeconomic base, and application of both is theoretically justified. However, both the approaches cannot fully describe the consequences of corruption in the customs service because of the assumptions on which they are built. With the approach of comparing trade statistics, it is

assumed that corruption in the customs service in the exporting country does not have any effect on trade, and corruption in customs is caused by rent-seeking. At the heart of the gravity model of trade is the restriction on product heterogeneity, which contradicts the Ricardo Vernerian fundamental model used in the welfare theory. Other features of the two approaches are summarized in Table 1.

Table 1. Comparison of approaches of empirical assessment of corruption in the customs service

The approach	Theoretical justification	The main disadvantage of the approach	Description of the consequences of corruption	Difficulties in econometric estimation
Comparison of trade statistics	Relatively weak, but flexible for the application of new models	There is no microeconomic basis for using a wide range of factors affecting trade	Comparatively detailed	Hardly ever
Gravitational trading model	Strong and difficult to change	The model does not predict the scale of the trade gap with the importer	Weak underestimation of the impact of corruption for countries with low GDP	It is relatively difficult to obtain the correct estimates

6. CONCLUSION

This paper aims to build the taxonomy of Customs corruption by highlighting its specific structure and outlining the factors stimulating it. Also, a literature review was conducted that examines the causes and consequences of corruption in this institution, and accordingly, measures were taken to counteract with the assessments of their effectiveness conducted earlier. Nevertheless, as shown in Section 4, the practice of implementing anti-corruption policy has variable results, which means that there are still unaccounted factors that need to be studied.

In contrast to the conclusions in welfare theory that corruption in the customs service can be conditionally useful for improving economic efficiency, empirical studies that have been actively pursued in recent years generally do not support this hypothesis. If we summarize the results of the above-mentioned empirical studies in Section 3.2, corruption in general has significant negative consequences for the provision of budget revenues of developing countries (whose scale is highly underestimated) and also in international trade, due to additional resource costs and risks of uncertainty. However, in some circumstances, there is a positive impact, for example, with tough protectionist policies in importing countries.

If we may assume that the welfare theory in the presence of illegal imports is relatively fully studied, then the literature on the empirical investigation of customs corruption is in active development. Empirical studies on assignment and quantification of corruption are in active development and there is a long way to go in this regard. It has been observed that empirical models overestimate the impact of corruption in the customs service on international trade; however, models tend to be consistent with the fundamental theory. It is also obvious that the full potential of the models has not been used. In particular, in Section 3.2 it was shown that the VAT could be a stronger incentive for corruption in customs than import tariffs, but it was taken into account only in the "too simple" model of Fisman and Wei [28]. To solve this problem, it would be most useful to develop the gravity trade model.

Another important issue that needs to be answered is the assessment of the impact of corruption in customs on the level of prices in countries. Despite the fact that a strong link between corruption in the customs service and the level of prices in the country was revealed within the framework of welfare theory, this fact was omitted in the empirical literature. We assume that the answer to this question will radically affect the existing theory of trade and may help rethink the nature of corruption, in particular, within the framework of the theory of the gravity trade model.

7. ACKNOWLEDGMENTS

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The Security Vulnerabilities of On-Demand and Sharing Economy

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ABSTRACT

The cloud computing has been widely in on-demand-and-sharing service economy and has become a hotspot in recent years especially in the IT industry which really lead to some changes in human's daily life. However, many users and researchers believed that the information security is the most significant challenge in cloud computing. Therefore, this paper aims to discover the threats and vulnerabilities of the cloud storage which is the most common application originating from the cloud computing. This research utilized a quantitative approach and all qualified respondents were asked to complete an online questionnaire. The result shows that (1) Data loss and leakage is the biggest threat in using cloud storage application (2) Abuse use of cloud computational resources is the most severe impact in cloud storage application (3) Respondents with different backgrounds have the different perspectives towards the cloud service (4) The countermeasures to minimize the security vulnerability are flexibility in choosing the protective measures, strengthen the infrastructure, improve the password authentication and strengthen the authorization.

CCS Concepts

• Security and privacy → Human and societal aspects of security and privacy → Social aspects of security and privacy

Keywords

on-demand-and-sharing economy, cloud computing, cloud storage application, threats, vulnerabilities

1. INTRODUCTION

[1] Jadeja and Modi, the concept of cloud computing first came from John McCarthy "*Computation may someday be organized as a public utility*" in 1960s. After more than 50 years of development, it became a popular technology. More services such as storage (e.g. Dropbox, Google Drive), database (e.g. Microsoft

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Azure), and even operating system (e.g. Google Chrome OS) have been put in cloud and it generates a huge business value. [2] Bartels, Rymer and Staten points out that the revenue generated from the worldwide public IT cloud services was US\$58 billion in 2013 and it would possibly reach US\$191 billion in 2020. Even better, [3] Anderson and Rainie stated that people will live mostly in the cloud rather than the desktop in 2020. However, security concerns is the major challenge in cloud computing. In the review of [4] Kuyoro, Ibikunle and Awodele, over 70% of respondents stated that security is the significant challenges or issues ascribed to the cloud model. Therefore, identifying the potential threats and the vulnerabilities of cloud computing is important. Since the application of cloud computing is broad, this paper will focus on cloud storage services which is one of the biggest application of cloud computing.

As the cloud storage applications become more popular and the increased awareness on security of cloud services, identifying the threats and potential vulnerabilities associated to them is useful for users to minimize the possibility from suffering the leakage of their confidential information and even monetary losses.

2. LITERATURE REVIEW

Cloud computing is still an evolving technology, so there are no standard definition. [5] Wang, Laszewski, Younge, He, Kunze, Tao and Fu described cloud computing as "a set of network enabled services, providing scalable, quality of service guaranteed, normally personalized, inexpensive computing infrastructures on demand, which could be accessed in a simple and pervasive way". In other words, it involves services delivering from client to server or server to client over the Internet.

According to [6] Wei, cloud storage application is a new concept originating from the development of cloud computing, which can be described as a new network storage technology. When a specific cloud computing system mainly focuses on the storage and management of a large amount of data, it needs to be equipped with a large number of storage devices, which transforms the cloud computing system into a cloud storage system, so the cloud storage application can be defined as a cloud computing system of which the main purpose is to deal with data storage and management. Users can easily get access to the cloud storage application to upload, manage, share or just get the data they need whenever and wherever there is internet connection.

In the review of [7] Miller, the pros and cons of cloud computing are listed as follows. We have extracted the pros and cons which is applicable to cloud storage application. Cloud service is a web-based service, so it does not have high requirement about user's hardware and software. Instead of costing a lot of money for software and hardware, you can get most of the service for free. Meanwhile, cloud computing also offers limitless available storage for users which storage capacity is several times more than general U-disk. Furthermore, easier group collaboration is one of the most important advantages of cloud computing. Just as in this project, our team used Google Drive to edit and share our report together. Comparing with the traditional storage method, the disadvantage of cloud service is it cannot be used without Internet. And the security question such as anti-hacking is also a serious concern for cloud service provider.

It is important to understand the relationship between threat and vulnerability. In the review of [8] Maniscalchi, the NIST SP 800-30 – Risk Management Guide for Information Technology Systems – defined threat as ‘*The potential for a threat-source to exercise (accidentally trigger or intentionally exploit) a specific vulnerability*’ while vulnerability is ‘*A flaw or weakness in system security procedures, design, implementation, or internal controls that could be exercised (accidentally triggered or intentionally exploited) and result in a security breach or a violation of the system’s security policy*’. Since the threats are associated with different vulnerabilities, minimizing the potential vulnerabilities can prevent the occurrence of threats.

3. RESEARCH METHOD

3.1 Sampling Strategy

Convenience sampling has been used for data collection. The sample size was 130 respondents in this research. In order to achieve such a large sample size, an online survey has been created and distributed to the respondents through email and social networking application.

3.2 Explanation of Questionnaire Design

The questionnaire consists of three parts – Section A: Filter questions and warm up questions, Section B: Ranking questions and Section C: Demographic questions.

Section A: Filter questions and warm up questions

In this section, two filter questions were asked to determine whether respondents have the fundamental knowledge of cloud computing and cloud storage application because it is meaningless if they know nothing about cloud computing. Therefore, respondents who answer ‘1’ in the familiarity of cloud computing will be disqualified. Then, two questions will be asked to identify their learning medium of cloud services and their frequency in using different cloud storage services respectively.

Section B: Ranking questions

In this section, the qualified respondents were asked to rank the three questions from 1 to 7 including the importance factors for selecting a cloud storage service, biggest threats of cloud storage service and vulnerabilities with greatest negative impacts. Some other questions were designed to identify their preferred protection solution, their willingness to pay for the secure cloud storage service and their likelihood to use the cloud storage service.

Section C: Demographic questions

Five demographic questions were designed to identify the basic information of respondents such as gender, age group, education level, occupation and income level.

4 RESULTS ANALYSIS AND PRESENTATION

4.1 Descriptive Statistics

Section A: Filter questions and warm up questions

1. Most of the respondents are familiar with cloud computing and cloud storage service to some extent. In order to ensure the accuracy of results, 26 respondents indicated that they are not familiar at all with cloud computing and they were directed to the end of survey automatically.
2. Over 30% of respondents learn about cloud services from lessons. Besides, almost 30% of them learn about cloud services from friends and colleagues.
3. iCloud seems to be the most frequently used cloud storage service among the others since 20% of respondents indicated that they use it once a day and 10% of respondents indicated that they use it more than once a day.

Section B: Ranking questions

1. The mean value of ease to use is the lowest (2.21) which implies that it has a high possibility of being the most important factor. For question B1 to B3, we cannot determine the rank of these items by descriptive statistics. Some inferential statistics including Friedman Test and Wilcoxon Test will be used for determining the difference in mean rank among these factors.
2. The mean value of data loss and leakage is the lowest (2.35) which implies that it has a high possibility of being the biggest threat.
3. The mean value of abuse use of cloud is the lowest (2.4) which implies that it has a high possibility of being the biggest vulnerability.
4. The most preferred protection solution for respondents is to select the documents to be encrypted and the encryption level by themselves.
5. 67 % of respondents were willing to spend additional fees for a more secure storage service while the remaining 33% were not.
6. Over 80% of respondents are only willing to pay no more than \$50 for secure cloud storage service. The cloud storage service provider should take this into account and balance the development cost of the secure cloud storage service and the affordability of customers.
7. 90% of respondents hold the positive likelihood in using the cloud storage service.

Section C: Demographic questions

1. There are 54% female respondents and 42% of male respondents were asked to complete the questionnaire. The remaining 4% respondents did not indicate their gender.
2. Most of respondents (73%) were between 19 to 24 years old, 23% of them belongs to 25 to 30 years old. The remaining respondents were 31 to 40 years old (2%) and 2 % of them did not indicate their gender.

- Over 70 % of respondents were full-time students while 25% of respondents were employed in a full-time job. The remaining respondents were unemployed (2%) and 2% of them did not indicate their occupation.
- 65% of respondents belongs to postgraduate while 25% of them belongs to undergraduate.
- About 40% of respondents were in the range of HKD\$10,000 or below while the other 40% of respondents did not indicate their income level. 14 % of them were in the range of \$10,001 to \$20,000 and the rest of them belongs to \$20,001 to \$30,000 (2%) and \$30,001 to \$40,001 (4%) respectively.

4.2 Inferential Statistics

4.2.1. Correlation

In our research, we intend to use it to find out the correlation between the choices of different questions. In that way, we could dig out the deeper value of our questionnaire. The general method to do correlation analysis is Bivariate Analysis or Factor Analysis. But these two kinds of analysis method need continuous data. So they are not suitable for the analysis of our questionnaire since our data is not continuous. Therefore, we choose a descriptive method, crosstab, to do correlation analysis. By SPSS, we do correlation analysis for the two questions of our questionnaire. Figure 1 shows the correlation between familiarity of cloud storage service and willingness to pay for a secure cloud storage service.

- Respondents who have a basic understanding of cloud service are more willing to pay for a more secure cloud storage service.

	1. How familiar are you with cloud computing and cloud storage service? (1 is nothing, 7 is very...)	5. If there is a more secure cloud storage service provided with additional charges, will you con.		合计
		Yes	No	
2.00	10	8	18	
3.00	24	10	34	
4.00	18	6	24	
5.00	12	4	16	
6.00	2	4	6	
7.00	4	2	6	
合计	70	34	104	

Figure 1. Correlation between familiarity of cloud storage service and willingness to pay for a secure cloud storage service

From the crosstab of Question1 and Question 5, we could find respondents who choose 4 and 5 in Question1 have more possibility to choose “Yes” in Question5. (The percentages are both 75%). The analysis result indicated respondents who have a basic understanding (but do not have deep understanding) of cloud service are more willing to pay additional charge for a more secure cloud storage service.

It is easy to understand why respondents who are not familiar with the cloud service are not willing to pay for it. They are not familiar with it so they do not think it is important and are worth paying additional charge. But why respondents who are very familiar with it are relatively not willing to pay additional charge for a more secure cloud service? In order to find out the answer, we interviewed these respondents by phone. They told that they are so familiar with cloud service that they could find the most secure and suitable free cloud service. So they think they do not need to pay additional charge for it.

- Respondents who have higher degree are more likely to use cloud service.

4. What is your highest education level?	7. How likely will you use the cloud storage service? (Single answers)				合计
	Very likely	Likely	Somewhat Likely	Neutral	
Secondary 5 or below	2	0	0	2	4
Secondary /Ordinate	0	0	2	0	2
Undergraduate	4	14	6	2	26
Postgraduate	24	24	14	6	68
Prefer not to answer	4	0	0	0	4
合计	34	38	22	10	104

Figure 2. Correlation between education level and likelihood of using cloud storage service

Figure 2 shows the correlation between education level and likelihood of using cloud storage service. From the crosstab, it is obvious that along with the rise of education level, respondents are more likely to use cloud service. From the result we could see nowadays cloud service is still a relatively high-level field and has not been in widespread use.

Figure 3 shows the correlation between gender and familiarity of cloud computing. Male respondents relatively know more about cloud service than female ones.

1. How familiar are you with cloud computing and cloud storage service? (1 is nothing, 7 is very...)	1. How familiar are you with cloud computing and cloud storage service? (1 is nothing, 7 is very...)						合计
	2.00	3.00	4.00	5.00	6.00	7.00	
Male	6	12	10	10	2	4	44
Female	12	20	14	6	4	0	56
Prefer not to answer	0	2	0	0	0	2	4
合计	18	34	24	16	6	6	104

Figure 3. Correlation between gender and familiarity of cloud computing

From the crosstab of the question about gender and the degree of familiarity of cloud service, we could find male respondents are relatively more familiar with cloud service than female. To some extent, it is seemingly understandable that female might possess less comprehension on new techniques than male in the field of technology from the overall perspective. So the cloud service providers should enhance the usability of their cloud service products continuously in order to facilitate female users and gain more advantages in market competition.

- High-income respondents focus more on the responsibility ambiguity than others.

5. What is your monthly income level (HKD)?	2. What is the biggest threats of cloud storage service? (1 is the biggest threat) ? Responsibility ambiguity						合计
	1.00	2.00	3.00	4.00	5.00	7.00	
\$10,000 or below	0	4	0	0	14	6	24
\$10,001-\$20,000	0	6	2	2	0	4	14
\$20,001-\$30,000	0	2	0	0	0	0	2
\$30,001-\$40,000	2	0	0	2	0	0	4
Prefer not to answer	6	4	12	8	6	6	44
合计	8	16	22	10	20	16	82

Figure 4. Correlation between income level and responsibility ambiguity

Figure 4 shows the correlation between income level and responsibility ambiguity. The crosstab of the question about income level and the emphasis of responsibility ambiguity indicate that respondents who have higher income focus more on the responsibility ambiguity than others.

To dig out the reason of this phenomenon, we interviewed two respondents whose income level is in the range of HK\$30,001-HK\$40,000. From the interview, they indicated that the information they store in the cloud is always valuable and confidential. As a result, they really worry about the liability issues when the problem of data loss and information leakage actually occurs.

It is indeed that there is no specific law to define clear responsibility of cloud service until now, which results in the circumstance that people who want to store some valuable or confidential files will not choose cloud storage service. For a better market situation and better protection of user’s right, it is necessary for government to issue relevant laws about cloud service.

4.2.2. Friedman Test

As the data are not normally distributed, repeated-measures Anova seems not an appropriate statistic. Instead, non-parametric Friedman test will be used to find out whether there are differences in the mean values in a group of factors while the Kendall's W test will be used to compare the strength of relationship. According to [9] Laerd Statistics, the assumptions of Friedman and Kendall's W test as follows:

- Assumption #1: One group that is measured on three or more different occasions.
- Assumption #2: Group is a random sample from the population.
- Assumption #3: Your dependent variable should be measured at the ordinal or continuous level.
- Assumption #4: Samples do NOT need to be normally distributed.

Are there any differences between the mean values of the six important factors for selecting the cloud storage service?

Null Hypothesis (H₀): There is NO significant difference between the mean values of the six important factors.

Alternative Hypothesis (H₁): There is significant difference between the mean values of the six important factors.

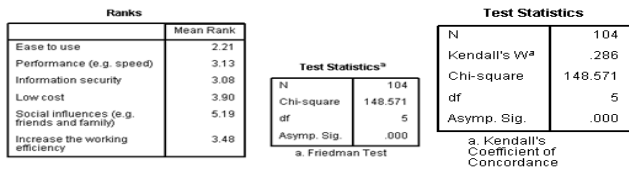


Figure 5. Friedman Test for comparing the difference in the group of important factors when selecting a cloud storage service

Figure 5 shows the Friedman Test for comparing the difference in the group of important factors when selecting a cloud storage service. From the results, the differences in mean among the six important factors is statically significant $\chi^2(5, N=104) = 148.571$, $p < .000$. Also, the value of Kendall's W is .286 which indicates there are fairly strong differences among these factors. Therefore, the null hypothesis is rejected and there is a significant difference between the mean values of the six important factors.

A. Are there any differences between the mean values of the seven threats?

Null Hypothesis (H₀): There is NO significant difference between the mean values of the seven threats.

Alternative Hypothesis (H₁): There is significant difference between the mean values of the seven threats.

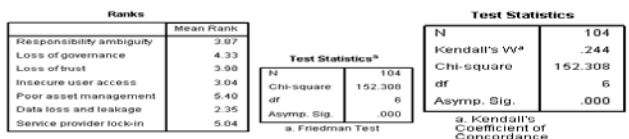


Figure 6. Friedman Test for comparing the difference of threats in cloud storage service

Figure 6 shows the Friedman Test for comparing the difference of threats in cloud storage service. From the results, the differences in mean among the seven threat is statically significant $\chi^2(6, N=104) = 152.308$, $p < .000$. Also, the value of Kendall's W

is .244 which indicates there are fairly strong differences among these threats. Therefore, the null hypothesis is rejected and there is a significant difference between the mean values of the seven threats.

B. Are there any differences between the mean values of the seven vulnerabilities?

Null Hypothesis (H₀): There is NO significant difference between the mean values of the seven vulnerabilities.

Alternative Hypothesis (H₁): There is significant difference between the mean values of the seven vulnerabilities.

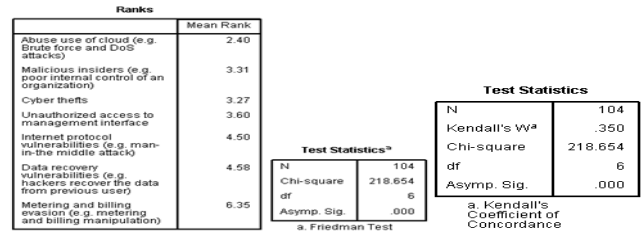


Figure 7. Friedman Test for comparing the difference of vulnerabilities in cloud storage service

Figure 7 shows the Friedman Test for comparing the difference of vulnerabilities in cloud storage service. From the results, the differences in mean among the seven vulnerabilities is statically significant $\chi^2(6, N=104) = 218.654$, $p < .000$. Besides, the value of Kendall's W is .350 which indicates there are strong differences among these vulnerabilities. Therefore, the null hypothesis is rejected and the Table 1 below shows the significant difference between the mean values of the seven vulnerabilities.

Table 1 Mean values in three separated groups of data

Factors for selecting cloud storage services	Mean	Biggest threats	Mean	Vulnerabilities with greatest impact	Mean
(1) Ease to use	2.21	(1) Data loss and leakage	2.35	(1) Abuse use of cloud	2.40
(2) Information security	3.08	(2) Insecure user access	3.04	(2) Cyber thefts	3.27
(3) Performance	3.13	(3) Responsibility ambiguity	3.87	(3) Malicious insiders	3.31
(4) Increase the working efficiency	3.48	(4) Loss of trust	3.98	(4) Unauthorized access to management interface	3.60
(5) Low cost	3.90	(5) Loss of governance	4.33	(5) Internet protocol vulnerabilities	4.50
(6) Social influences	5.19	(6) Service provider lock-in	5.04	(6) Data recovery vulnerabilities	4.58
		(7) Poor asset management	5.40	(7) Metering and billing evasion	6.35

From the results of Friedman Test, there are differences in the three captioned groups. However, the Friedman test cannot examine where the differences occur actually. Besides, we cannot determine the difference between two factors by comparing their mean values directly. Therefore, another test is required – the Wilcoxon Test.

4.2.3. Wilcoxon test

After differences were found in the three groups with the Friedman Test above, the difference between two related samples can be examined by Wilcoxon Test. According to [10] Laerd Statistics, the assumptions of Wilcoxon test as follows:

- Assumption #1: Your dependent variable should be measured at the ordinal or continuous level.
- Assumption #2: Your dependent variable should consist of two categorical, "related groups" or "matched pairs".

Assumption #3: The distribution of the differences between the two related groups.

Figure 8 shows the Wilcoxon Test for comparing the difference between each import factor when selecting cloud storage service. In order to perform the Wilcoxon test, the data has been transformed from conversely where 7 is the most important factors. The transformed factor will be labeled with 'Adj'. Figure 9 shows the test statistics of Wilcoxon Test for comparing the difference between each import factor when selecting cloud storage service.

Ranks			
		N	Mean Rank
InformationSecurityAdj - EasyToUseAdj	Negative Ranks	60*	62.30
	Positive Ranks	44*	39.14
	Ties	0 ^a	
	Total	104	
PerformanceAdj - InformationSecurityAdj	Negative Ranks	44*	62.95
	Positive Ranks	60*	44.83
	Ties	0 ^a	
	Total	104	
IncreaseEfficiencyAdj - PerformanceAdj	Negative Ranks	43 ^a	58.35
	Positive Ranks	52 ^b	46.65
	Ties	0 ^a	
	Total	104	
LowCostAdj - IncreaseEfficiencyAdj	Negative Ranks	56 ^b	57.52
	Positive Ranks	48 ^a	46.65
	Ties	0 ^a	
	Total	104	
SocialInfluenceAdj - LowCostAdj	Negative Ranks	87 ^b	52.29
	Positive Ranks	17 ^a	53.59
	Ties	0 ^a	
	Total	104	

a. InformationSecurityAdj = EasyToUseAdj
 b. InformationSecurityAdj = EasyToUseAdj
 c. InformationSecurityAdj = EasyToUseAdj
 d. PerformanceAdj = InformationSecurityAdj
 e. PerformanceAdj = InformationSecurityAdj
 f. PerformanceAdj = InformationSecurityAdj
 g. IncreaseEfficiencyAdj = PerformanceAdj
 h. IncreaseEfficiencyAdj = PerformanceAdj
 i. IncreaseEfficiencyAdj = PerformanceAdj
 j. LowCostAdj = IncreaseEfficiencyAdj
 k. LowCostAdj = IncreaseEfficiencyAdj
 l. LowCostAdj = IncreaseEfficiencyAdj
 m. SocialInfluenceAdj = LowCostAdj
 n. SocialInfluenceAdj = LowCostAdj
 o. SocialInfluenceAdj = LowCostAdj

Figure 8. Wilcoxon Test for comparing the difference between each import factor when select cloud storage service

Test Statistics ^a					
	Information SecurityAdj - EasyToUseAdj	Performance Adj - Information SecurityAdj	Increase EfficiencyAdj - Performance Adj	LowCostAdj - Increase EfficiencyAdj	Social InfluenceAdj - LowCostAdj
Z	-3.301*	-1.131*	-1.005*	-1.608*	-6.025*
Asymp. Sig. (2-tailed)	.001	.256	.315	.108	.000

a. Based on positive ranks.
 b. Wilcoxon Signed Ranks Test

Figure 9. The test statistics of Wilcoxon Test for comparing the difference between each import factor when select cloud storage service

Table 2. The rank of critical factors

Rank	Factors
1	Ease to use
2	Information security
	Performance (e.g. speed)
	Increase the working efficiency
	Low cost
3	Social influences (e.g. friends and family)

Table 2 shows the rank of critical factors. From figures 7 and 8, the rank between the six factors can be identified by using the Wilcoxon test. For those factors quoted in red, they have the significant value $p > 0.05$. The difference between them cannot be determined and they have the same rank.

Table 3. The rank of threats

Rank	Threats
1	Data loss and leakage
2	Insecure user access
3	Responsibility ambiguity
	Loss of trust
	Loss of governance

4	Service provider lock-in
	Poor asset management

Ranks				
		N	Mean Rank	Sum of Ranks
InsecureUserAccessAdj - DataLossAndLeakageAdj	Negative Ranks	60*	57.95	3477.00
	Positive Ranks	44*	45.07	1993.00
	Ties	0 ^a		
	Total	104		
ResponsibilityAmbiguityAdj - InsecureUserAccessAdj	Negative Ranks	59 ^a	60.80	3567.00
	Positive Ranks	45*	41.62	1873.00
	Ties	0 ^a		
	Total	104		
LossOfTrustAdj - ResponsibilityAmbiguityAdj	Negative Ranks	53 ^a	53.91	2857.00
	Positive Ranks	51 ^b	51.04	2603.00
	Ties	0 ^a		
	Total	104		
LossOfGovernanceAdj - LossOfTrustAdj	Negative Ranks	50 ^a	63.70	3199.00
	Positive Ranks	54 ^b	42.06	2271.00
	Ties	0 ^a		
	Total	104		
ServiceProviderLockInAdj - LossOfGovernanceAdj	Negative Ranks	59 ^a	59.19	3492.00
	Positive Ranks	45*	43.73	1960.00
	Ties	0 ^a		
	Total	104		
PoorAssetManagement - ServiceProviderLockInAdj	Negative Ranks	51 ^a	59.88	3054.00
	Positive Ranks	53 ^a	45.40	2406.00
	Ties	0 ^a		
	Total	104		

a. InsecureUserAccessAdj = DataLossAndLeakageAdj
 b. InsecureUserAccessAdj = DataLossAndLeakageAdj
 c. InsecureUserAccessAdj = DataLossAndLeakageAdj
 d. ResponsibilityAmbiguityAdj = InsecureUserAccessAdj
 e. ResponsibilityAmbiguityAdj = InsecureUserAccessAdj
 f. LossOfTrustAdj = ResponsibilityAmbiguityAdj
 g. LossOfTrustAdj = ResponsibilityAmbiguityAdj
 h. LossOfTrustAdj = ResponsibilityAmbiguityAdj
 i. LossOfGovernanceAdj = LossOfTrustAdj
 j. LossOfGovernanceAdj = LossOfTrustAdj
 k. LossOfGovernanceAdj = LossOfTrustAdj
 l. ServiceProviderLockInAdj = LossOfGovernanceAdj
 m. ServiceProviderLockInAdj = LossOfGovernanceAdj
 n. ServiceProviderLockInAdj = LossOfGovernanceAdj
 o. ServiceProviderLockInAdj = LossOfGovernanceAdj
 p. PoorAssetManagementAdj = ServiceProviderLockInAdj
 q. PoorAssetManagementAdj = ServiceProviderLockInAdj
 r. PoorAssetManagementAdj = ServiceProviderLockInAdj

Figure 10. Wilcoxon Test for comparing the difference between each threat

Test Statistics ^a						
	InsecureUser AccessAdj - DataLossAnd LeakageAdj	Responsibility Ambiguity - InsecureUser AccessAdj	LossOfTrust - Responsibility Ambiguity	LossOf Governance - LossOfTrust Adj	Service Provider LockIn - LossOf Governance Adj	PoorAsset Management - Service Provider LockIn
Z	2.476*	-2.793*	-4.16*	-1.512*	-2.400*	-1.050*
Asymp. Sig. (2-tailed)	.013	.005	.007	.130	.013	.290

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Figure 11. The test statistics of Wilcoxon Test for comparing the difference between each threat

Figure 10 shows the Wilcoxon Test for comparing the difference between each threat. Figure 11 shows the test statistics of Wilcoxon Test for comparing the difference between each threat. By using the Wilcoxon test, the rank between the seven threats can be identified. For those factors quoted in red, they have the significant value $p > 0.05$. The difference between them cannot be determined and they have the same rank. The Table 3 above shows the rank of threats and the biggest threat for cloud storage application is "Data loss and leakage". Table 4 below shows the rank of vulnerabilities. Figure 12 shows the Wilcoxon Test for comparing the difference between each vulnerability. Figure 13 shows the test statistics of Wilcoxon Test for comparing the difference between each vulnerability.

Ranks				
		N	Mean Rank	Sum of Ranks
CyberThreatsAdj - AbuseUseOfCloudAdj	Negative Ranks	64*	58.38	3738.00
	Positive Ranks	40*	43.10	1724.00
	Ties	0 ^a		
	Total	104		
MaliciousInsidersAdj - CyberThreatsAdj	Negative Ranks	40*	60.05	2759.00
	Positive Ranks	56*	45.00	2601.00
	Ties	0 ^a		
	Total	104		
UnauthorizedAccessTo MaliciousInsidersAdj	Negative Ranks	58*	53.03	3128.00
	Positive Ranks	46*	50.70	2332.00
	Ties	0 ^a		
	Total	104		
InformationProtocol VulnerabilitiesAdj - UnauthorizedAccessTo MaliciousInsidersAdj	Negative Ranks	72*	53.29	3837.00
	Positive Ranks	32*	50.72	1623.00
	Ties	0 ^a		
	Total	104		
DataRecovery VulnerabilitiesAdj - InformationProtocol VulnerabilitiesAdj	Negative Ranks	58*	45.81	2657.00
	Positive Ranks	46*	60.03	2803.00
	Ties	0 ^a		
	Total	104		
MeteringAndBilling VulnerabilitiesAdj - DataRecovery VulnerabilitiesAdj	Negative Ranks	89*	55.01	4945.00
	Positive Ranks	15*	34.07	511.00
	Ties	0 ^a		
	Total	104		

a. CyberThreatsAdj = AbuseUseOfCloudAdj
 b. CyberThreatsAdj = AbuseUseOfCloudAdj
 c. CyberThreatsAdj = AbuseUseOfCloudAdj
 d. MaliciousInsidersAdj = CyberThreatsAdj
 e. MaliciousInsidersAdj = CyberThreatsAdj
 f. MaliciousInsidersAdj = CyberThreatsAdj
 g. UnauthorizedAccessTo MaliciousInsidersAdj = MaliciousInsidersAdj
 h. UnauthorizedAccessTo MaliciousInsidersAdj = MaliciousInsidersAdj
 i. UnauthorizedAccessTo MaliciousInsidersAdj = MaliciousInsidersAdj
 j. InformationProtocol VulnerabilitiesAdj = UnauthorizedAccessTo MaliciousInsidersAdj
 k. InformationProtocol VulnerabilitiesAdj = UnauthorizedAccessTo MaliciousInsidersAdj
 l. InformationProtocol VulnerabilitiesAdj = UnauthorizedAccessTo MaliciousInsidersAdj
 m. DataRecovery VulnerabilitiesAdj = InformationProtocol VulnerabilitiesAdj
 n. DataRecovery VulnerabilitiesAdj = InformationProtocol VulnerabilitiesAdj
 o. DataRecovery VulnerabilitiesAdj = InformationProtocol VulnerabilitiesAdj
 p. MeteringAndBilling VulnerabilitiesAdj = DataRecovery VulnerabilitiesAdj
 q. MeteringAndBilling VulnerabilitiesAdj = DataRecovery VulnerabilitiesAdj
 r. MeteringAndBilling VulnerabilitiesAdj = DataRecovery VulnerabilitiesAdj

Figure 12. Wilcoxon Test for comparing the difference between each vulnerability

	CyberThefts Adj - AbuseUseOf CloudAdj	Malicious InsidersAdj - CyberThefts Adj	Unauthorized AccessTo Management InterfaceAdj - Malicious InsidersAdj	Internet Protocol Vulnerabilities Adj - Unauthorized AccessTo Management InterfaceAdj	DataRecovery Vulnerabilities Adj - Internet Protocol Vulnerabilities Adj	MeteringAnd BillingEvasion Adj - DataRecovery Vulnerabilities Adj
Z	-3.290 ^a	.227 ^c	-1.802 ^a	-3.638 ^a	-.239 ^b	-7.354 ^a
Asymp. Sig. (2-tailed)	.001	.820	.073	.000	.811	.000

a. Based on positive ranks.
b. Based on negative ranks.
c. Wilcoxon Signed Ranks Test

Figure 13. The test statistics of Wilcoxon Test for comparing the difference between each vulnerability

Table 4. The rank of vulnerabilities

Rank	Vulnerability
1	Abuse use of cloud
2	Cyber thefts
	Malicious insiders
	Unauthorized access to management interface
3	Internet protocol vulnerabilities
	Data recovery vulnerabilities
4	Metering and billing evasion

By using the Wilcoxon test, the rank between the seven vulnerabilities can be identified. For those factors quoted in red, they have the significant value $p > 0.05$. The difference between them cannot be determined and they have the same rank. The Table 4 shows the rank of vulnerability and the vulnerability with greatest impact is “abuse use of cloud”.

5 DISCUSSION

5.1 Limitations

Although a series of investigation and analysis have been conducted, there are several limitations about our research. Since time and cost constraints always exist in this research, convenience sampling was utilized to facilitate data collection. However, sampling error and data inaccuracy may occur easily since most of the data is collected from a specific portion of respondents. As a result, bias samples may be obtained from respondents and fairness cannot be guaranteed. The details are explained as follows:

- (1) Student nature: The student nature of most participants in our investigation results in the limitation of analysis. Since 71% of the respondents are full-time students who are mostly 19-24 years old, the result of “Where do you learn about cloud services” which shows “33.90% from Lessons” might affect the accuracy of our research. Besides, as far as “Factors for selecting a cloud storage service” is concerned, the lack of professional feedbacks from cloud service specialists exerts a biased impact on the perspective of what the prior concerns that people would take into consider because our information was collected mainly from postgraduate which takes a significant part of “Education level” (65%). Moreover, although nearly 90% of our respondents’ highest education level is above undergraduate, it is reasonably inaccessible for them to provide thoughtful opinions scientifically about the potential threats for cloud storage service.
- (2) Regional disparity: The regional disparity constrains caused the rationality of our data although we have tried our best to achieve diversity and breadth of survey field with the purpose of minimizing the result deviation brought by geographical factor. On the one hand, many respondents of our investigation who come from mainland China are aware

of “Google Drive” which is one of the most important usage types of cloud storage service around the globe, yet it is blocked in mainland China, which might cause the defective result of usage frequency of different cloud storage services and the inconsistency between what cloud storage services these people have access to use and what they actually have interest in use. On the other hand, since the differences of wage earnings and consumption level between Hong Kong and mainland China are so noticeable, respondents from different regions would have different degrees of willingness and acceptability on the payment for the secure cloud storage service, which might make the information that we obtained lack universality and overall importance.

- (3) Reliability of results: We also found that the reliability of some answers are uncertain. For instance, when we collected our questionnaires, some of the respondents explained their confusion about several questions to us, such as the terminology of vulnerabilities of cloud storage service. As a result, these participants even cannot make sure the answers that they submitted were aligned with their real experience in the usage of cloud storage service, which might weaken the validity and practicability of our analysis.

5.2 Findings

After analyzing the questionnaires gathered, we found that the “ease of use” and the “security level of information” are the most prior concerns for respondents in terms of the usage of cloud storage service since the above two factors represent the largest portions in the importance level 1 of the factors for selecting cloud storage service, 39% and 30% respectively.

Furthermore, no respondents hold the view that these two elements have the minimal level of importance according to the information we received. Therefore, compared with other considerations, users might put more emphases on the usage experience brought by the convenience feature which is the most fundamental reason makes cloud service marketable, and whether or not their personal information can be managed securely and trustworthily by cloud service provider.

In fact, this finding can also be proved by respondents’ feedback of “Preferred protection solution” and “Willingness to pay for a more secure cloud storage service with additional fees”, which show that 54% of participants are more likely to choose the documents to be encrypted and determine the encryption level by themselves, and 67% of participants tend to pay more as long as the cloud storage services they use reliably stay away from insecure issues.

Besides, we intend to dig deeper on the security issue of cloud storage service. After a series of data processing and discussion, we found that most of the respondents (total 70% approximately) whose answers are in the distribution of “Biggest potential threat” classify “Data loss and leakage” and “Insecure user access” into this section, and merely 8% of respondents consider these two threats are the least significant in the distribution of minimal level of threat. This result is consistent with respondents’ overall evaluation on “Vulnerabilities with different levels of impact”, which indicates “Abuse use of cloud” and “Cyber thefts” take the largest portions in the distribution of greatest impact, 35% and 20% respectively, and merely 4% of respondents categorize these two vulnerabilities into the minimal impact. All cloud service providers must focus on the issues of threat and vulnerability since people are more inclined to use cloud storage service (approximately 70% of respondents are “likely” and “very likely”

according to our research) in contemporary society in which both efficiency and privacy are exactly on the spotlight. Based on the findings above, some countermeasures are listed as below to minimize the occurrence of the captioned vulnerabilities:

- (1) Flexibility in choosing the protective measures: According to [10] Kaliski, Burton, and Wayne, the weaknesses of cloud storage service relinquish users' physical possession of their private information when they remotely store their data and enjoy the on-demand high quality cloud applications, which inevitably exerts obvious security risk on the correctness and integrity of data in cloud. Therefore, we suggest that the cloud service providers should grant users certain permissions to perform their preferred protective measures based on some basic cloud service protocols and security standards for the sake of reserving the innate convenience and building up a service platform with security mechanism at the same time.
- (2) Strengthen the infrastructure: The cloud service providers should strengthen their infrastructure regularly. [11] Chou pointed out that the infrastructure can be enhanced by building up strict user registration process and monitoring users' network traffic information, in case that hackers would take advantage of their weak links to launch various malicious attacks through the abuse use of cloud computational resources, which can result in severe disorder of cloud service and worst data loss and leakage.
- (3) Improve the password authentication: [12] Chang and Choi stated that user authentication requires a high-guaranteed security among many security issues of cloud computing, such as service availability, access control, massive traffic handling, application security and etc. The cloud service providers should improve the password authentication and enhance their internal audit control since the threat of insecure user access can significantly put users' personal or business information in jeopardy.
- (4) Strengthen the authorization: [13] Ramgovind, Eloff and Smith suggested that the referential integrity can be maintained through the control by system administrators towards the different privileges on the process flows. The cloud service provider should strengthen the authorization process by granting different privileges strictly to limit their access and forbidding all unauthorized access in any circumstances.

6 CONCLUSION

After finishing all the procedures above, we conclude some significant results about our topic from the data collected: (1) The results distribution of all the related questions. (2) Some relations between several results distributions by conducting the correlation analysis and corresponding explanations of them. (3) The differences among the mean rank values of the listed threats (4) The differences among the mean rank values of the listed vulnerabilities (5) A rank list for them through Friedman Test and Wilcoxon Test. Although there are still some limitations in the results, we still extracted some useful findings about cloud service

vulnerabilities and also made some discussions about the reasons and influences of the limitations we had.

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Chinese Foreign Direct Investment and Economic Growth in West Africa: Evidence from Pooled Mean Group Model

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ABSTRACT

Over the last decade, diverse efforts have been deployed in place by various governments of the developing economies to attract more inward China FDI and accelerate its economic growth remains one of the most important issues in the economic debates. Many empirical works support the impact of Chinese FDI flows on economic growth, but some do not. West Africa, high poverty, non-existing markets, low savings and terrorism-torn economy and political crisis, countries may find in FDI an important and potential source of finances. Therefore, this paper attempts to evaluate the long-run and short-run relationships between China FDI and economic growth of West Africa by using Pooled Mean Group (PMG) models over the period of 2003–2015. The Pooled Mean Group results provide strong evidence on the significantly positive effects of China FDI on West Africa's economic growth (real GDP per capita). However, the causality results suggest that China FDI hasn't causal effects on West Africa's economic growth. This can be concluded that an additional investment for Chinese investor and technology transfer is sufficiently supported in West Africa.

CCS Concepts

• Applied computing → Law, social and behavioral sciences → Economics

Keywords

Chinese FDI, economic growth, PMG model, Causality, West Africa

1. INTRODUCTION

Highlight China, one of a major recipient of foreign direct investment, has recently become one of the main 'emerging' investors, especially in developing countries. With China's rapid economic rise, China FDI has great potential to enhance economic growth; however China's investment in Africa in infrastructure and agricultural technology and training could facilitate agricultural growth in Africa [1]. In general, a huge amount of the impact of China FDI by multinational enterprises (MNEs) on growth is complex. For many decades, FDI has been considered as a major source stimulate domestic investment and facilitates

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improvements in human capital can be done through the production chain when foreign investors purchase locally made inputs or vend intermediate inputs to local firms. Therefore, these countries produce all possible policies to attract more inward FDI via removing restrictions of foreign investment, enhancing domestic economic policies and regulations, provoking the financial sector development, and causing the developing country to augment its foreign exchange earnings.

The empirical literature review implies that Chinese FDI is one of potential to enhance of economic growth. However, the empirical literature studying the relationship between China FDI and economic growth is very large. For example, a majority of studies support Chinese FDI to be an important catalyst for growth[2],[3],some confirm the effect of China FDI Inflows on the employment sector[4],[5],some study confirm the variable to have growth impact in a host economy only with an economic openness, natural resources and market size, while not significantly affected by the political turmoil[6] and a high level of unqualified workforce [3],[7].Others indicate that the Contribution of China FDI on the developing countries growth is still at an early stage and there are still a number of key areas where current cognizance is limited[8].In addition, some empirical findings do not support the view that Chinese FDI has positive impact on African labor force[9].Although the growth benefits of Chinese FDI is arguable, it is still have evidence and strong believed that China FDI inflows has an important role in spurring growth due to its advantages are seen in many developed and developing countries.

Regarding to West Africa, given the high poverty levels, corruption, low of domestic savings and income, especially terrorist wars and crisis political, which decelerate its development economic, therefore, it is quite challenging for the country to stand up and strive to develop this war-torn economy with empty hands. In the sense, given the benefits to China FDI, to attract greater volumes of this important potential resource. Although an enormous amount of inward China FDI is seen in Africa, China FDI inflows into West Africa were likely to be small before the 2000s. However, it starts to increase gradually thereafter although the size is still small compared to other Africa. In the continent, there has been a large analysis of empirical on the growth impact of FDI in low and medium-income countries, our findings on the causal effect of FDI on West Africa's economic growth are entirely known. Therefore, the significance of this research is to analyze the causality between Chinese FDI and growth in West Africa, with the participation of FDI as a catalyst of change, using the Pooled Mean Group cointegration technique (PMG) and Granger causality test.

The remainder of the article is structured as follows: In Section 2 we set empirical review of literature and theoretical literature

review. Section 3 describes the used data, while Section 4 deals with the estimation technique and the empirical analysis of the results. Section 5 exposes the conclusion and policy implications.

2. LITERATURE REVIEW

All In developing countries, it is believed that Chinese FDI has great potential to enhance economic growth. At the building and construction sector, several studies provide evidence of high technology spillovers and enhanced firm productivity [7]. At the infrastructure and agricultural technology level, China FDI will certainly help build up the capacity and ensure sustainable development, industrial productivity[10] and higher productivity[11]. Furthermore, based on the endogenous growth theory, FDI promotes growth via increasing the volume of money supply as well as efficiency of the quantity of total investment, FDI furnish growth by extending new technologies and knowledge spillovers from the developed world to the host economies, significance that through FDI, a host economy gains new employment, managerial skills, diffusing technologies, inputs, organizational and managerial practices, fostering innovations and access to markets[12],[13]. In addition, Chinese FDI is also a main source of employment in a host economy[14]. Some researchers confirm China FDI to have causal impact on exports as well [15]. Other benefits of China FDI are also seen in many recipient countries. For example, some literature claims that China FDI plays a crucial role in the complementary domestic investment[16], Chinese FDI inflow are a model for Africa and the way of industrialization and modernization of the continent[17] and Chinese capital and its job creation are the only forces that can reduce poverty in Africa [18].

Aside from positive effects, China FDI has some negative impacts in a host economy. For instance, it might place more pressure on limited employment quota for local citizens, poor labour standard, limited technology transfer, and the quality of Chinese construction. Moreover, FDI be able to also provoke limited of employment and pollution[19] if a host economies does not have sufficient capacities to sparing their resources efficiently. Outside of these, many papers on the effect of China trade and investment reveals the crowding-out effect son textile industry[20]. This might be resulting from their superior technology, make it internationally competitive.

For example,[16] investigates the causal link of China FDI on growth in African economies and finds that Chinese FDI could positively contribute to economic growth in Africa. The agricultural land, large market size and oil are an important determinant in attracting Chinese FDI. They reveal that Chinese FDI inflows has bi-directional impacts on economic growth(GDP).[21] showed bidirectional causality between China FDI and Gross Domestic Product (GDP) growth for a sample of Nigeria economic. Most recently, [22] investigated the effect of inward FDI on new job creation in Thailand, using vector auto regression model from 2001 to 2014. They showed that a positive effect of China FDI on industrial sector and exports in Thailand economics. Their findings provide exports are more critical than China's FDI in industrial sectors in reduction potentials of employment in Thailand's industrial in the short term. Turning to countries-Asian, [23] used An index, RRCA and AR(p) modeling to examine the economic linkages between China and Japan. The results suggest that Japanese direct investment in China has contributed not only to the increase of Chinese exports to Japan, but also to the augment of Chinese imports from Japan.

On the basis of the above, it is evident that debate on the growth impact of China FDI is inconclusive as results vary from countries to countries and methodologies and theoretical framework used, among other things. This means that findings on the impact of Chinese FDI on economic growth are still arguable.

3. SPECIFICATION OF MODELS

3.1 Data Sources and Model Construction

The main objective of the present paper is to investigate the panel data model on economic growth, China FDI covering the 2003 – 2015 period have been used in this study. All variables were collected from the World Development Indicators (WDI) database of the World Bank Special (<http://www.worldbank.org/exceptChinaforeigndirectinvestment>) West Africa (CFDI) variable was accumulated from ASE (www.pairault.fr/sinaf/index). Economic growth (Y) is measured by real GDP per capita in each successive time period [24]. Chinese FDI is the value of net inflows CFDI in West Africa.[21]. The labor force (L) is proxied as the volume of the sum labor force; Domestic investment (K) is proxied by gross fixed capital formation (constant 2000 US). Agricultural sector is included in the study because the variable is also considered as an engine of growth. Agricultural sector here denotes the share of manufacturing output to GDP [25]. To test the linkage between China FDI and economic growth in West Africa.

$$CFDI_t = \beta_0 + \beta_1 Y_t + \beta_2 K_t + \beta_3 L_t + \beta_4 AGRI_t + \beta_5 EXR_t + \mu_t \quad (1)$$

3.2 Methodology Specification

The we several stride of the procedure were used, to analysis the link between China FDI and economic growth in West Africa. Thus, the Pooled Mean Group (PMG) cointegration technique is the appropriate technique to investigate the long run relationship between Chinese FDI inflows and West Africa economic growth. Following next step, we have first investigated the stationarity properties of the variables. We adopt the recently developed panel unit root tests suggested by Fisher Augmented [26],[27] (Dickey and Fuller,) and (Phillips and Perron,) to test for the presence of a unit root in the panel data series. The second step is to test for the existence of a long run relationship between Chinese FDI inflows and West Africa economics growth by using the [28] and [29] cointegration test, which takes into account heterogeneity and specific parameters. Finally, on finding cointegration in the second step, we estimate the coefficients on China FDI by using the Pooled Mean Group (PMG). For so doing, the PMG approach was used for first by [30] and extended by [30]. However, PMG model has advantages over the traditional econometric procedures. The PMG procedure can determine the cointegration relation in small samples, whereas Johansen's cointegration procedure requires larger sample sizes [31]. However, the long-run and short-run relationship among Chinese FDI inflows and economic growth in West Africa could be formulated as the system follows (See Eq. (2)).

$$\begin{aligned} \ln Y_t = & \beta_1 + \vartheta_2 \ln Y_{t-1} + \gamma_3 FDI_{t-1} + \pi_4 \ln K_{t-1} + \omega_5 \ln lab_{t-1} + \\ & \varphi_6 \ln EXP_{t-1} + \sigma_7 EXR_{t-1} + \sum_{i=1}^p \alpha_1 \ln Y_{t-1} + \sum_{i=1}^p \alpha_2 \ln FDI_{t-1} + \\ & \sum_{i=1}^p \alpha_3 \ln Lab_{t-1} + \sum_{i=1}^p \alpha_4 \ln EXP_{t-1} + \sum_{i=1}^p \alpha_5 \ln EXR_{t-1} + \varepsilon_t \quad (2) \end{aligned}$$

4. EMPIRICAL RESULTS AND DISCUSSION

Table 1 gives the descriptive statistics results of the variables used in this article. According to the Jarque– Bera test, these statistics reveal that all the series such as (Agricultural sector, Chinese FDI, labor force, capital investment, exchange rate and economic growth) have normal distributions.

Table1. Descriptive statistics and correlation matrix results

Variable	Y_t	K_t	Lab_t	$CFDI_t$	EXR_t	$AGRI_t$
Mean	1.4367	1.6523	6.4745	21.5824	1.2834	1.2925
Median	1.4464	1.6888	6.5824	2.2477	1.3000	1.4424
Maximum	1.7626	1.9000	7.7423	390.35	1.9999	2.0110
Minimum	0.8849	1.2545	5.2333	-195.94	0.0000	-1.6923
Std. dev.	0.1926	1.1656	0.5435	58.83	0.3145	0.5723
Y_t	1000					
K_t	0.4632	1000				
Lab_t	0.3026	0.5545	1000			
$CFDI_t$	-0.0000	0.3004	0.4723	1000		
$AGRI_t$	-0.3420	-0.1387	-0.1625	0.000	1000	
EXR_t	-0.1823	-0.1454	-0.3334	0.2523	0.520	1000

4.1 Stationary and Co-integration Tests

Table 2 shows the results of Fisher ADF and P.P unit root tests indicate that all the variables set are integrated of I(0) or I(1) (see Table 2).The results pointed out that the H0 of unit root tests are rejected at 1%, 5% and 10% significance levels. Therefore, if all the variables are stationary at I (0), I (1) or both, the bounds testing approach would be used and are the major advantages of using the PMG estimators. Generally, none of the data series are I (2) or above. In our estimation, Table 3, after confirming the order of integration of the series, the next stage of reveals the results of the co-integration among the variables in our estimation. These findings are determined by the panel cointegration tests. Table 3 shows that two panel cointegration tests, Namely Pedroni and Kao, cointegration tests revealed are co-integrated. The result shows that the H0 of no co-integration among the variables in the (agricultural sector, Chinese FDI, Labour force, Capital investment, Exchange rate and economic growth)models are rejected at 5 % significance level. Under the alternative hypothesis, for the panel statistics, a long run relationship exists between economic growth and Chinese FDI inflows, for all countries and across countries.

Table 2. Result of panel unit roots tests

Variable	ADF-Fisher chi-square		PP-Fisher chi-square		Order of integration
	Level	1st Diff.	Level	1st Diff.	
EXP_t	-9.9954	64.1034	140.2224	76.3563	I(0)
$LAGRI_t$	-7.2734	54.6054	107.8526	70.4888	I(0)
Lab_t	48.4554	96.9967	50.3244	97.9524	I(1)
$CFDI_t$	-8.8234	64.3767	123.6111	56.5221	I(1)
DI_t	47.6888	134.8556	53.6723	183.7534	I(1)
Y_t	-9.6956	54.2678	134.8711	65.0726	I(1)

Note: *, **, *** indicate 10%, 5% and 1% level of significance.

Table 3. Pedroni and Kao panel cointegration tests

Test	Intercept	Intercept and trend	None	Kao
	$Y_t, K_t, Lab_t, FDI_t, EXP_t, EXR_t,$			
Panel-v	-3.2645	-4.3734	-3.7220	0002
Panel-rho	4.2432	5.9467	3.6689	
Panel-PP	-3.5023	-5.4898	-5.6024	
Panel-ADF	-2.6034	-2.1332	7.0110	
Group-rho	5.1723	6.3432	4.5445	
Group-PP	-14.5243	-17.64 43	13.2723	
Group-ADF	8.5034	-8.0222	-8.9220	

Note: *, **, *** indicate 10%, 5% and 1% level of significant

4.2 Long-run Pooled Mean Group Results

Long-run Pooled Mean Group results of the relationships between the variables based on Schwarz Bayesian criterion (SBC) are presented in Table 4. From the results, it can be deduced that when China FDI is the dependent variable, significant relationship exists between Chinese FDI and economic growth in the long in West Africa economics. The coefficient of economic growth, which is 8.2971, implies that 1% increase in Chinese FDI inflows receipts leads to 8.29% increase in real per capita GDP in the long run. The finding confirms that China FDI inflows have impact on economy growth. This is in consistent with the analysis of [16] who noted that a significant relationship existed between China FDI and economic growth for Africa. However, the findings contradict the results of [32] who documented that no clear evidence exists to support the existence of any linkage between China FDI inflows proxy by CFDI and economic growth for MENA economies. The results also revealed that a positive and significant of China FDI on domestic investment. The coefficient of domestic investment, which is 0.0855, implies that 1% increase in Chinese FDI inflows receipts leads to 0.08% raise in capital investment in the long run. The findings of the present study [33] are in line with, who estimate that the improvement in FDI inflows will lead to higher level of output. On the contrary, the relationship between China FDI and agricultural sector is negative and significant in the long run. This is a departure from the reviewed literature as it contradicts the findings of [25] who argued that a positive relationship exists between FDI inflows and agricultural sector productivity. Specifically, we find a significant negative relationship in the long run between China FDI and labour force. This result is identical with the findings by [32] for Ghana. In the long run, the link between China FDI and exchange rate is negative and significant. Similarly, when economic growth is the dependent variable, it can be deduced that in the long, a significant and positive relationship exists between the dependent variable and each of the China FDI inflows, domestic investment, labour force, exchange rate and agricultural sector in West Africa.

Table 4. Result of long-run ARLD tests

Variable	Coefficient	SE	T-ratio	Prob
Constant	29.8324	6.2619	4.7641	0.000
$AFDI_t$	0.0356	0.0024	14.7526	0.0000
lab_t	0.2076	0.0113	18.3150	0.0000
K_t	0.0126	0.0254	4.5480	0.6122
EXP_t	0.3607	0.0356	10.1126	0.0000
EXR_t	0.1785	0.0174	10.2598	0.0000
Diagnostic test statistics (p-values)				
χ^2 (normality)			0.2234	
χ^2 (heteroscedasticity)			0.8134	
χ^2 (functional form)			0.1902	
χ^2 (serial correlation)			0.6345	

4.3 Short-run and ECMt – 1 Results

After the long run results, the short-run analyze is estimated and the results are presented in Table 5. These results indicated that at 1% significance levels, the error-correction terms from FDI to economic growth are positively. In addition, the coefficients of ECMt –1 are significant with appropriate signs for all models (China FDI, real GDP per capita, exchange rate, capital and labor). ECMt-1 high coefficient of significance means a relative speed of achieving the long-run equilibrium. Specifically, China FDI and Economic growth models reported the highest ECMt –1 coefficient in absolute value among other models with –113% and 110%. This implies that these models FDI are corrected from the short-run towards the long-run equilibrium by 113%. Also, this means that the long-run would be shortly corrected back by 1.4 years for the FDI models. Therefore, the results of short-run and ECMt–1 show that there is a significant relationship among FDI inflows, economic growth in West Africa. The long-run results conclude that FDI inflows increase with higher real GDP per capita, exchange rate and domestic investment indicators, which are supported by the ECMt – 1 coefficient of the FDI model, giving an adjustment speed from the short-run towards the long-run equilibrium.

Table 5. Short-run and ECMt – 1 ARLD result

Variable	Coefficient	SE	T-ratio	Prob
ΔY_t	-2.2126	0.1615	-1.3160	0.1899
ΔFDI_t	0.0001	0.0051	0.0236	0.9812
$\Delta AGRI_t$	0.0133	0.1193	0.1116	0.8112
ΔK_t	-0.0176	0.0314	-0.5617	0.5750
ΔLab_t	-15.8270	38.3333	-0.4128	0.6802
ΔEXR_t	-0.014	0.0395	-0.3701	0.7118
ECM_{t-1}	-0.1913	0.0827	-2.3119	0.0220

4.4 Granger Causality Analyses

In the Pooled Mean Group cointegration test, the direction of causality is not clear between form China FDI, capital investment, agricultural sector, labor force, economic growth and exchange rate. In this paper, there is significant Granger unidirectional and neutral causality among the variables. The causality results also reported evidence of unidirectional causal relationships from domestic investment to Chinese FDI variables. The causality from labour force to Chinese FDI inflows variables confirms previous findings which stated that Chinese investors tend to develop domestic firms. The findings found that China FDI has unidirectional effects on exchange rate in West Africa. However, these results are confirmation with the findings of [34] for some

south Mediterranean countries; [33] for Tunisia. Therefore, this finding is important for foreign investors to encourage them for investing in West Africa.

5. CONCLUSION AND RECOMMENDATION

The present study investigated the dynamic causal relationship among the series of Chinese FDI, economic growth, agricultural sector, labor, and capital investment in West Africa for the period of 2003– 2015. Although high importance is placed on Chinese FDI in West Africa, the issue of FDI contribution to economic growth has often been raised by policymakers but rarely examined empirically. The present study used the ADF and PP unit root in order to determine the order of integration, the direction of causality between all variable and Pooled Mean Group technique. The subject merits special attention due to the impact positive of China FDI on West Africa 'economic growth coefficient of 8.2971 makes the study conclude that China FDI accelerate Economic Growth in West Africa. The Pooled Mean Group results reveal that a long-run and short-run causality relationship among the variables. The short-run results and ECMt –1 was also significant confirming the existence of long-run relationships. Also, the equilibrium correction would be shortly corrected back by 1.4 years for the FDI models. Even though there is a voluminous literature on the impact of FDI on growth across countries, our empirical results to confirm.

In addition, the article also confirms Chinese Foreign direct investment and domestic investment to be important determinants of West Africa's long-run growth. Agricultural sector, one of the important variables used in the growth analysis, is also included into the study. In addition, the article also confirms agricultural sector and domestic investment to be important determinants of West Africa's long-run growth.

Hence, the results can generate important implications and recommendations for policymakers in West Africa. The present paper suggests that for Chinese FDI to have the anticipated positive impact on economic growth, West Africa will have to undertake serious reforms with clear objectives and strong commitments. Based on findings, ECOWAS policymakers have to concentrate more on the policies that are friendly and attractive to inward Chinese FDI. Most importantly, to attract more inward FDI, the government should produce sound macroeconomic policies, develop infrastructure, remove restrictions against inward FDI, enhance the financial sector, and promote encouraging environments for trade and investment. Also, they should not forget the development of regional integration such as activating the West African Economic and Monetary Union (WAEMU), reforming its educational and financial system, and financial development). They have to pay more attention to the current regulation to take full advantages of FDI. The FDI-growth was due to the higher economic growth and domestic investment and another important determinant of FDI and growth is political stability. Political stability must be supported because it might be the most crucial contributor of FDI and growth in West Africa.

6. ACKNOWLEDGMENTS

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E-Government and Data Privacy Protection

Data Privacy Act of 2012 Compliance Performance of Philippine Government Agencies: A Case Study Approach

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ABSTRACT

After three months of the initial deadline of the National Privacy Commission (NPC), it is vital to know the status of compliance of the Commission on Higher Education (CHED) and Commission on Elections (COMELEC), especially with the data breached that occurred last March 2016. This research study aims to uncover this and how CHED and COMELEC are applying R.A. 10173 to its business processes and strategies. It has been found out that both government agencies are Partially Compliant having its own challenges. It is prevalent in their latest Information Systems Strategic Plan (ISSP) how they incorporated data protection, data privacy, and information security in their Information Systems initiatives. Although, this will not stop here because they need to implement it and comply with the rest of the R.A. 10173 requirements in time for the next deadline, which is on March 8, 2018.

CCS Concepts

• Social and professional topics → Computing / Technology policy → Privacy policies

Keywords

e-Governance; Security; Data Privacy; Personal Information; Data Privacy Compliance.

1. INTRODUCTION

1.1 Background of the Study

This research study is a continuation of the “Data Privacy Act of 2012: A Case Study Approach on Philippine Government Agencies Compliance” by Ching, Fabito, and Celis (2017), which was presented in the Social Sciences and Humanities (SOSHUM) 2017 held at Jakarta, Indonesia. Ching et al (2017) study focused on the reasons why government agencies comply with R.A. 10173 or the “Data Privacy Act of 2012”, the challenges they are experiencing, and if R.A. 8792 compliance contributes to the difficulties of government agencies in complying with R.A. 10173 [1], while this research study focuses on the requirements complied after the September 11, 2017 (formerly, September 8, 2017) deadline set by the “National Privacy Commission” (NPC). Additionally, it adopted the research methodology conducted by

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Ching et al (2017) and performed data triangulation of the data and information collected that will be used for the pattern matching technique of Trochim (1989). Furthermore, this aims to uncover the status of the compliance of the “Commission on Education” (CHED) and “Commission on Elections” (COMELEC) with R.A. 10173 after its initial deadline through interviews and examination of its previous and current Information Systems Strategic Plans (ISSPs).

1.2 Overview of Related Literatures

1.2.1 EU Data Protection Directive

The “EU Data Protection Directive” was adopted by the “European Union” to protect the privacy of its citizens’ personal information. This is also based on the recommendations proposed by the “Organization for the Economic Co-operation and Development’s” (OECD) seven principles, which are: (1) *subjects whose data is being collected should be given notice of such collection*; (2) *subjects whose personal data is being collected should be informed as to the party or parties collecting such data*; (3) *once collected, personal data should be kept safe and secure from potential abuse, theft, or loss*; (4) *personal data should not be disclosed or shared with third parties without consent from its subject(s)*; (5) *subjects should granted access to their personal data and allowed to correct any inaccuracies*; (6) *data collected should be used only for stated purpose(s) and for no other purposes*; and (7) *subjects should be able to hold personal data collectors accountable for adhering to all seven of these principles* [2]. Additionally, it has been expanded in April 2016 and will be enforced on May 2018 to make it fit for the digital age [2], [3]. According to Dr. Rolando Lansigan of NPC, R.A. 10173 was patterned from the “EU Data Protection Directive”.

1.2.2 Republic Act No. 10173 of the Philippines

01 to 06	07 to 10	11 to 21	22 to 24	25 to 37
• Definitions and General Provisions	• The National Privacy Commission	• Rights of Data Subjects ad Obligations of Personal Information Controllers and Processors	• Provisions Specific to Government	• Penalties

Figure 1. Parts of the R.A. 10173

The R.A. 10173 was created last August 15, 2012 that aims to protect the individual’s personal information collected, processed, and stored by both private and public organizations [4] and its implementing rules and regulations was promulgated last August 24, 2016 [5]. It is composed of five parts as shown in Figure 1. According to this law, both private and public organizations that either employ at least 250 employees or fewer than 250 employees but poses risk to rights and freedom of data subjects, is

not occasional, and involves sensitive personnel information of at least 1,000 individuals are required to register [4].

In summary, the law aims to (1) “protect the privacy of individuals while ensuring free flow of information to promote innovation and growth”; (2) “regulate the collection, recording, organization, storage, updating or modification, retrieval, consultation, use, consolidation, blocking, erasure or destruction of personal data”; and (3) “ensures that the Philippines complies with [the] international standards set for data protection through [the] NPC” [4].

1.2.3 The National Privacy Commission

Because of the enactment of R.A. 10173, NPC was established under the “Department of Information and Communications Technology” (DICT) headed by a privacy commissioner, two deputy privacy commissioners, and a secretariat (refer to **Figure 2**) to administer and implement the provisions to those organizations affected by it [4]. Currently, the privacy commissioner is Mr. Raymund Enriquez Liboro and the deputy privacy commissioner is Atty. Ivy D. Patdu. Before, Mr. Damian Domingo O. Mapa was also the deputy privacy commissioner but he had resigned [6], leaving Atty. Patdu the sole deputy privacy commissioner. Consequently, they are appointed by the incumbent president, while the secretariat is appointed by the “Commission” [4].

Furthermore, its goal is to protect the individual’s personal information and uphold their right to privacy through the regulation of the personal information processes [6]. Consequently, the “Commission” acts as the collegial body, wherein they are the ones to conduct investigation, and settle personal information breach complaints; prepare and release the complaints reports and corresponding resolutions; monitor the compliance of the affected organizations and recommend prosecution and impositions of the penalties to the “Department of Justice”; and modify, propose, and amend the privacy and data protection law [4].

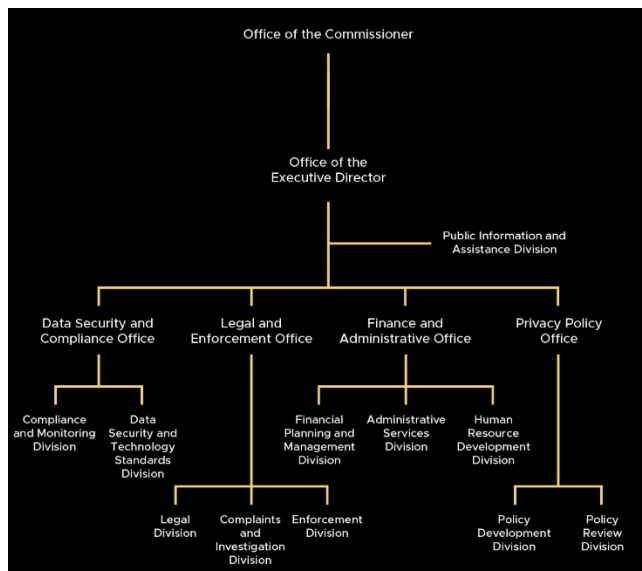


Figure 2. NPC Organizational Chart

1.2.4 The Data Privacy Accountability and Compliance Framework

The “Data Privacy Accountability and Compliance Framework” is composed of five pillars. These pillars are (1) appoint a “Data

Protection Officer” (DPO); (2) conduct a privacy impact assessment; (3) develop a privacy management program and privacy manual; (4) implement privacy and data protection measures; and (5) develop breach reporting procedures [7].

As stated from the NPC toolkit (2017), the appointed DPO will be accountable in ensuring the compliance of the “Personal Information Controller” (PIC) and the “Personal Information Processor” (PIP). PIC refers to “a person or an organization who controls the collection, holding, processing or use of personal information and as well as instructs another person or an organization to collect, hold, process, use, transfer, or disclose personal information on his or her behalf”, while PIP refers to “any natural or juridical person or body to whom a PIC may outsource or instruct the processing of the personal data” [7]. Moreover, the DPO should have specialized knowledge and expertise on relevant privacy or data protection policies and practices [7] and should not be part of the information technology services department or similar to it. Moreover, the “Privacy Impact Assessment” (PIA) is a systematic description of the personal data flow and processing activities of the PIC and PIP [7]. Furthermore, the privacy management program according to NPC is “a holistic approach to privacy and data protection, important for all agencies, companies or other organization involved in the processing of personal data” and the privacy manual “serves as a guide or handbook for ensuring the compliance of an organization or entity with the DPA” [7]. The fourth pillar is implemented through the “Data Privacy Accountability and Compliance Framework” as shown in Figure 3. And lastly the breach management includes the personal data breach notification and annual report on breaches and security incidents [7].

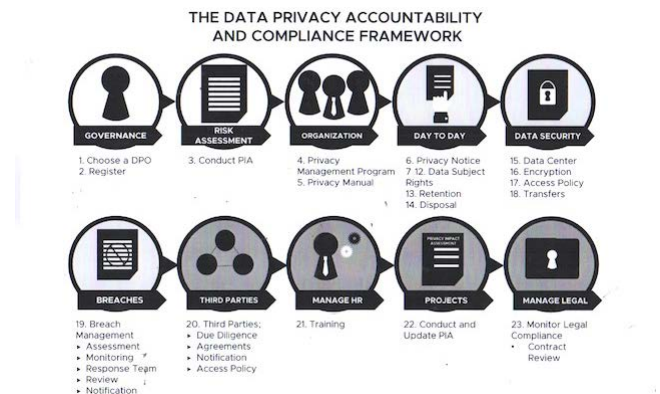


Figure 3. Data Privacy Accountability and Compliance Framework [7]

1.3 Research Questions and Objectives of the Study

The objective of this research study is:

To uncover the status of compliance with R.A. 10173 of the two government agencies.

Thus, the main research question is:

How are the government agencies applying and integrating R.A. 10173 with their Information Systems and Business Processes?

To be able to answer this, the following are the specific research questions:

1. What are the requirements complied on the September 11, 2017 deadline?

2. What are the information security controls and/or strategies being applied in compliance with the R.A. 10173?
3. What are the changes made from the previous "Information System Strategic Plan" (ISSP) to the current?

1.4 Scope of the Study

As mentioned from the introduction, this research study is the continuation of the research study conducted by Ching et al (2017) on the compliance of CHED and COMELEC with R.A. 10173. In addition to this, the resource persons for CHED were Dr. Sherwin E. Ona, who is in charge of the information systems integration, and Dr. Terisita Semana, the chief information officer" for the approval of the release of the documents; for COMELEC, Atty. Pamela Joy T. Herrera, who is the attorney under the information technology department, and Mr. Jose M. Tolentino, Jr., who is the executive director and the DPO; and Mr. Cleo Martinez of the NPC.

2. METHODOLOGY

This research study was conducted through the qualitative method that employs the case study technique. According to Runfola (2017), qualitative case study is a means for researcher to explain the connection between the context in which a phenomenon exists.

Because the main research question of this study starts with a *how*, this makes it an *exploratory* approach and the specific research questions are *what*, this also makes it an *explanatory* approach. Moreover, since there are two government agencies being studied, it becomes a *multiple holistic case study* (refer to **Figure 4**).

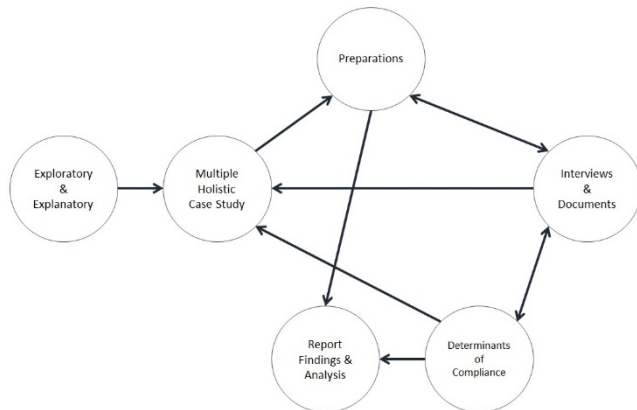


Figure 4. Operational Case Study Model

Furthermore, pattern matching technique of Trochim (1989) is applied in this research study to analyze the gathered data, information, and documents, which follows the process pattern matching diagram as shown in **Figure 5**.



Figure 5. Process Pattern Matching

As defined by Trochim and Yin, it is a technique where in the predicted patterns are compared with the empirical patterns [8], [9]. With this, there will be three patterns to determine the status of the compliance of the government agencies with R.A. 10173 as shown in **Table 1**.

Table 1. Compliance Pattern

	ISSP	5 Pillars	Match
Pattern A	High	High	Fully Compliant
Pattern B	High	Medium to High	Partial Compliant
Pattern C	Low	Low	Not Compliant

3. FINDINGS

Based on the findings of Ching et al (2017), CHED is currently centralizing its information systems and syncing its business processes with it [1]. Aside from that, the challenges that they are facing in compliance with R.A. 10173 are (1) no technical expertise; (2) there is only one executive position that can take the DPO position; (3) currently complying with R.A. 8792; and (4) lack of budget for R.A. 10173 compliance. Identifying the data processing systems are vital because these are the ones affected by R.A. 10173.

Table 2. CHED's Previous ISSP

COMMISSION ON HIGHER EDUCATION (CHED)		
	Information Systems ISSP 2015-2017	Yes/ No
1	Electronic Verification and Certification System & Special Order Application and Issuance System (EVCS & SOAIS)	Y
2	Scholarship Administration System (SAS)	Y
3	Faculty Development Information System (FDIS)	Y
4	Integrated Higher Education Institutions Administration System (IHEIAS) - Student Registration and Accounting System (SRAS) - Curriculum Information System (CIS) - Faculty Personnel Information System (FPIS)	Y
5	E-Learning or Learning Commons	N
6	Research and Extension Management Information System (RAEMIS)	N
7	Graduate Tracer Study Information System (GTSIS) - Graduate Module - Curriculum Module - Employment Module	Y
8	Higher Education Institution-Content Management System (HEI-CMS)	N
9	HEI Document Tracking Management System (HEI-DTMS)	Y
10	CHED Document Management System (CHCED-DMS)	Y
11	CHED Electronic Collection and Knowledge System (CHECKS) - Phase 1: Data Collection Module - Phase 2: Reporting Module - Phase 3: Analytics Module	Y
12	Knowledge Portal - Phase 1: Migration of old CHED website to government standard template - Phase 2: Integration of CHED Regional Offices - Phase 3: Integration of SUCs, Private and other HEIs Stakeholders	N
13	Knowledge Management System (KMS)	N
14	CHED Legal Information System (CLIS)	N
15	Foreign Student Monitoring System (FSMS)	Y
16	Electronic New Government Accounting System (eNGAS) & Electronic Budget System (eBudget)	N
17	Integrated Library Management System (ILMS)	N
18	Project Management System (PMS)	N
19	Attendance Monitoring and Payroll System (AMPS)/Personnel Management Information System (PMIS)	Y
20	Equipment and Supplies Inventory System (ESIS)	N

As shown in **Table 2**, these are the information systems of CHED that process personal information based on their previous ISSP. However, upon examining the document, it did not mention any information security controls and policies to be able to protect the personal information even though R.A. 10173 was passed last 2012 and the ISSP covers 2015-2017. After the incident of the COMELEC, NPC made sure that all organizations covered by the law should comply. Hence, in the latest ISSP of CHED, it incorporated information security policies and controls of subscription to anti-virus software and data redundancy through mirror site. Additionally, CHED trimmed the information systems included in the strategic plan, as shown in **Table 3**.

Furthermore, it is the same case with COMELEC. As depicted from **Table 4**, these are the information systems that processes personal information but there are no information security policies and controls in place. It was also trimmed down, as depicted from **Table 5** and incorporated information security policies and controls. Aside from this, they have drafted their Information Security Management System and looking for experts to help them in getting an international certification that is ISO.

Table 3. CHED's New ISSP

COMMISSION ON HIGHER EDUCATION (CHED)		
Information Systems ISSP 2018-2020		Yes/ No
1	Electronic Verification and Certification System & Special Order Application and Issuance System (EVCS & SOAIS)	Y
2	Student Financial Assistance Programs (StuFAPs) Administration Systems (SAS)	Y
3	Knowledge Management System (KMS)	Y
4	Integrated Higher Education Institutions Administration System (IHEIAS) - Student Registration and Accounting System (SRAS) - Curriculum Information System (CIS) - Faculty Personnel Information System (FPIS)	Y
5	Faculty Development Information System (FDIS)	Y
6	Virtual Learning Management System	N
7	Research and Extension Management Information System (RAEMIS)	N
8	Graduate Tracer Study Information System (GTSIS)	Y
9	Higher Education Institution-Content Management System (HEI-CMS)	Y
10	HEI Document Tracking Management System (HEI DTMS)	N
11	CHED Document Management System (CHED-DMS)	Y
12	Legal Information System (LIS)	N
13	Attendance Monitoring and Payroll System (AMPS)/Personnel Management Information System (PMIS)	Y
14	Equipment and Supplies Inventory System (ESIS)	N

Table 4. COMELEC's Previous ISSP

COMMISSION ON ELECTIONS (COMELEC)		
Information Systems ISSP 2011-2016		Yes/ No
1	Voter Registration System & Data Capture System (Biometrics)	Y
2	Automated Fingerprint Identification System (AFIS)	Y
3	Case Management Information System (CMIS)	N
4	Consolidated / Canvassing System (CCS)	N
5	Automated Operational System	N
6	Web-Based Voter & Awareness System	Y
7	Human Resources Training System	Y
8	Performance Evaluation System	Y
9	Competency-Based Recruitment System	Y

Table 5. COMELEC's New ISSP

COMMISSION ON ELECTIONS (COMELEC)		
Information Systems ISSP 2018-2020		Yes/ No
1	Voter's Registration System	Y
2	AFIS Security and Monitoring System	Y
3	Geographic Information System	N
4	Executive Management System	N
5	Technical Support System	N

Furthermore, applying the pattern matching technique of Trochim (1989) [9] to uncover the status of compliance of CHED and COMELEC, with the information gathered from the interviews and documents acquired, **Table 6** depicts the results. In the development of the pattern matching, there were two sources considered, *documents archival records* and *interviews*. For the documents archival records, there were three events, which are *after enactment of R.A. 10173*, *before NPC took action*, and *during enactment of R.A. 10173I*, and *after NPC took action*. While for the interviews, there was only one event included, which is *during enactment of R.A. 10173* and *after NPC took action*. These are the events considered because it is necessary to know if the personal information collected, stored, and processed by these organizations are being secured even before there is a data protection law, when a law was established, and after NPC acted in checking the compliance of the affected organizations.

Table 6. Pattern Matching Result

Case	Source	Event	Expected Patterns		Pattern A Pattern B Pattern C		ISSP			5 Pillars		Match			
			Evidence	Rating	Evidence	Rating	Evidence	Rating	Evidence	Rating	Evidence	Rating	Evidence	Rating	Match
CHED	Documents Archival Records	After Enactment of R.A. 10173	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
		Before NPC Took Action	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
		During Enactment of R.A. 10173 and After NPC Took Action	ISSP	High	DPO	High	PIA	High	PMP and PM	Medium	PDPM	Medium	BRP	n/a	Pattern B
COMELEC	Documents Archival Records	After Enactment of R.A. 10173	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
		Before NPC Took Action	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
		During Enactment of R.A. 10173 and After NPC Took Action	ISSP	High	DPO	High	PIA	High	PMP and PM	Low	PDPM	Medium	BRP	n/a	Pattern B
COMELEC	Interviews	During Enactment of R.A. 10173 and After NPC Took Action	ISSP	High	DPO	High	PIA	High	PMP and PM	Medium	PDPM	Medium	BRP	n/a	Pattern B

Legend:	
DPO	Data Privacy Officer
PIA	Privacy Impact Assessment
PMP and PM	Privacy Management Program and Privacy Manual
PDPM	Privacy and Data Protection Measures
BRP	Breach Reporting Procedures

4. CONCLUSIONS

As depicted in **Table 6**, for CHED, the *after Enactment of R.A. 10173* and *before NPC took action*, they are not compliant. However, the *during enactment of R.A. 10173* and *after NPC took action*, both reflected under documents, archival records, and interviews, they are partially compliant. This is so because what they have complied with on the initial deadline of September 8,

2017, which later moved to September 11, 2017, was to appoint a DPO, who is executive director Napoleon B. Imperial, privacy management program, and privacy manual. This means, they have already defined who oversees their compliance with R.A. 10173 and registered in NPC their data processing systems.

On the other hand, COMELEC is also not compliant in the *after enactment of R.A. 10173* and *before NPC took action* and partially

compliant for *during enactment of R.A. 10173 and after NPC took action*. However, upon interview and based with Ching et al (2017) research, COMELEC's bidding for their "Information Security Management System" (ISMS) had failed twice already due to undisclosed reason [1]. In the document and archival records, they are *low* for privacy management program and privacy manual and *medium* for interview because they have written ISMS developed by their information technology department but not standardized under ISO 27001. Additionally, their DPO is Mr. Jose M. Tolentino, Jr.

Consequently, the pillar 4 is *medium* for both CHED and COMELEC because they will not be able to create pillar 2 and pillar 3 without knowing the privacy and data protection measures. However, pillar 5 is *n/a* because they are not yet fully compliant to be able to submit breach reports annually to NPC since not all of their plans had been implemented yet.

The next deadline is on March 8, 2018. This implies that all of the necessary requirements for compliance should be submitted already to NPC. And if tagged as fully compliant, the punishment when a breach occurred will be lighter compared to those who are not, provided that the organization followed the breach report procedures of NPC and their organization.

5. FUTURE WORK

This research study was conducted after the initial deadline last September 11, 2017. With this, it is recommended to conduct a follow-up research study after the March 8, 2018 deadline, where all the requirements needed for compliance with R.A. 10173 will be submitted to find out which among the government agencies are fully compliant with it and which are not. Furthermore, similar with the previous study conducted on this topic, it is beneficial to the government agencies who are having difficulties in complying with the R.A. 10173 to discover and uncover the best practices of those who were able to comply on time with the NPC's deadline. Additionally, replication of this study on private organizations is necessary to see what is the challenges that they are encountering in order for the NPC to help in the smooth and efficient compliance of all that is required.

6. ACKNOWLEDGMENTS

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Understanding Philippine National Agency's Commitment on Data Privacy Act of 2012: A Case Study Perspective

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ABSTRACT

The Republic Act No. 10173 of the Philippines, also known as "Data Privacy Act of 2012" was established to protect and safeguard the personal data of its citizenry whether in public agencies or private entities, thereby creating the National Privacy Commission (NPC) in 2015, as an independent body mandated to administer the DPA of 2012, to monitor and ensure compliance to right to privacy and data protection. This qualitative research using case study technique aims to explore and explain why and how the National Commission on Indigenous Peoples will comply with R.A. 10173 as the subject of the study, and to determine the challenges and best practices encountered by NCIP relative to compliance. Using single case holistic design with common rationale, and pattern matching as an analytic technique as adapted in Robert Yin's methods and design this study resulted to: e-commerce act is a moderating factor in compliance with DPA 2012, and the determinants of compliance, such as general deterrence and legitimacy of regulations has a compelling casual effect on complying with the law. Further, challenges that encountered by the agency was also a factor in compliance with R.A. 10173 such as, (1) lack of awareness, (2) resource constraints, (3) organizational structure and (4) low priority agenda. It is further recommended to conduct a follow-up study once the recent ISSP is available, vis-à-vis to March 8, 2018 extended deadline.

CCS Concepts

• **Social and professional topics** → **Computing / technology policy** → **Privacy policies**

Keywords

Data privacy; Data Privacy Compliance; e-Governance; Personal Data.

1. INTRODUCTION

The idea of data privacy or information privacy has been in long decades prior to information and communications technology rapidly changed its occurrence, its effect and even the way it will be managed; and the protection of privacy is the foundation of

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citizen's self-worth and free will in a democratic society[1].

In fact, it was suggested that in this recent digital age, privacy, protection and accessibility will have an increasing concern over the years [2]. In European Union, Data Protection Authorities (DPAs) are independent authorities, with a supreme role in relation to data privacy and protection [3], and the General Data Protection Regulation (GDPR), a regulating body, which monitors and enforces action with matters to data protection among organization and private institutions[4]. In the Philippine setting, the National Privacy Commission (NPC) was created in 2015 to promote, regulate, and monitor data privacy compliance of both government agencies and private institutions [5] with international standards set for data protection [6], and by enacting the Republic Act No. 10173, or commonly known as the Data Privacy Act of 2012, which merely focusing on the measures and mechanism that would protect the interest of its citizenry with regards to their personal information.

With the existence of the said law, most of government agencies and other private entities have not given utmost importance on the necessities, while others still on process of crafting the essential measures as mandated in the act, but only a handful of government agencies already complied, such as the Commission on Higher Education (CHED), the Bureau of Internal Revenue (BIR), and partly, the infamous Commission on Elections (COMELEC) [5], [7], viewed as an example of data breached that made the NPC to be more prudent in enforcing the regulation.

The National Commission on Indigenous Peoples (NCIP), one of government agencies under the Office of the President is mandated to protect and promote the interest and well-being of the Indigenous Cultural Communities / Indigenous Peoples (IP) with due regard to their beliefs, customs, traditions and institutions by virtue of Republic Act No. 8371 or "The Indigenous Peoples Right Act IPRA of 1997", and this study further aims to discover the challenges and best practices that the National Commission on Indigenous Peoples (NCIP) encountered relative to the compliance of the DPA of 2012. And, using a qualitative research in a case study technique, this paper will provide an empirical results on how NCIP is committed pertaining to the said law.

2. REVIEW OF EXISTING STUDIES

2.1 Information Privacy, Security, Governance and Compliance

As Internet, one of technological breakthroughs changes the way businesses are conducted [8], [9], it has also influence human life significantly [10]; hence, information also must be safeguarded to ensure privacy among individual and the organization. Regulatory

authorities should be established to monitor and protect such, like in EU, they amended the General Data Protection Regulation (GDPR), intends to address the pitfalls of previous body and provide a way for companies to use certifications as part of their compliance framework [4] and to harmonize the data protection across European Union. Information security issues are also a prevalent concerns for any organizations [11] and increasingly threatened by data-and function-related IS risk [12] leading to growing level of IS breaches worldwide [13]–[15], in which the Philippines is not exempted in this growing phenomenal concern.

2.2 Republic Act No. 8792 of the Philippines

R.A. No. 8792 also known as “e-Commerce Act of 2002” aims to facilitate domestic and international dealings, business transactions, arrangements, agreements, contracts, and exchanges and storage of information through the utilization of electronic, optical, and technology medium [16] to recognize the authenticity and reliability of the electronic documents, thus promoting the universal use of electronic transaction in the government and general public [7]. This law plays a very vital role in compliance with the DPA of 2012, hence, data processing has been in the forefront of every government institutions, and thus, protection of information is a must.

2.3 Republic Act No. 10173 of the Philippines

The R.A. No. 10173 of the Philippines or the “Data Privacy Act of 2012” or DPA of 2012 is a law that aims to protect individual’s personal information in information and communications systems in both the government and private sectors that was enacted on August 15, 2012 [17]. More so, its Implementing Rules and Regulations (IRR) was promulgated on August 24, 2016 [6].

2.4 The National Privacy Commission

The National Privacy Commission is the Philippine’s privacy watchdog; an independent body mandated to administer the Data Privacy Act of 2012, and to monitor and ensure compliance of the country with international standards set for data protection; a regulatory and enforcement agency upholding the right to privacy and data protection while ensuring the free flow of information, committed to excellence, driven by a workforce that is highly competent, future-oriented, and ethical, towards a competitive, knowledge-based, and innovative nation [18].

2.5 Republic Act No. 10175 of the Philippines

The R.A. No. 10175 is also known as “Cybercrime Prevention Act of 2012”, as the state recognize the vital role of information and communications industries, such as content production, telecommunications, broadcasting, electronic commerce, and data processing, in the nation’s overall social and economic development. It is critical and need of the state to use such information and communications technologies (ICT) in the conduct of businesses and processing, however, data privacy and safeguards are at its paramount, thus providing provision for penalties to whoever breaches such act[19].

3. RESEARCH QUESTIONS AND OBJECTIVES OF THE STUDY

The main objective of this research study is to determine the challenges and the best practices encountered by the National Commission on Indigenous Peoples (NCIP) relative to the Data Privacy Act of 2012 compliance. In consequence, the main research question is *how and why will the National Commission on Indigenous Peoples (NCIP) comply with Republic Act No.*

10173 of the Philippines? To be able to answer this, a specific research questions are formulated:

1. What are the data processes that deal with personal data?
2. What information systems are in place that deal with personal data?
3. How do the determinants of compliance by Kagan [20] affect NCIP to comply with R.A. No. 10173?
4. How does R.A. No. 8792 or “e-Commerce Act of 2002” moderates the compliance of NCIP to Data Privacy Act of 2012?

4. SCOPE OF THE STUDY

This research study focus on the Philippines’ National Commission on Indigenous Peoples (NCIP) as the prime agency concerning the R.A. No. 10173 compliance and the National Privacy Commission (NPC), which in under the Department of Information and Communications Technology (DICT) as the regulating body in matters with Data Privacy Act of 2012.

5. METHODOLOGY

The methods used in this study is qualitative research imploring case study method; case research allows the researcher to empirically investigate the connections or boundaries between a contemporary phenomenon and its real-world context [5], [21] or intensively studying phenomenon over time within its natural setting in one or a few sites [22]. Figure 1 depicts the entirety of case study, adapted in the book of Yin [23].



Figure 1. Case Study model

5.1 Planning

This empirical study started at the planning phase, in which crafting of research questions are carefully planned and designed; thus, reflected in the main research question, possesses the “*how*” and “*why*” questions, and focuses on contemporary events, makes it an *Explanatory* approach, while specific research inquiries with “*what*” questions are *Exploratory*, that is a justifiable rationale for exploratory study, hence, it is to describe the prevalence of a phenomenon [23].

5.2 Design

One of the very important part of a research design is to define the unit of analysis, in which in this case, the organization of the National Commission on Indigenous Peoples. And, since there is only one (1) agency that is subject for the study (case), the researcher employed the single-case holistic design with common rationale, which is fitting to the context of this paper.

5.3 Preparation

In this phase, a proper authorization from the subject of the study is formally gained; case study protocols are defined, such as communication letters, documents to be reviewed and screened candidates for the interview.

5.4 Evidence Collection

In relative to preparation, in this phase, the evidences collected were Documentation and Interview. The Information Systems Strategic Plan (ISSP) of the agency is the primary document for assessment in connection to the set standards of the Data Privacy Act of 2012 compliance. Interviewed some personnel of the agency that has direct or has a possible impact of the case study analysis; and analogous to their documents for data triangulation that helped strengthen the construct validity of the case [21].

5.5 Analysis

For the analysis of the study, the researcher used the work of Kagan [20] to validate the determinants of compliance shown in Figure 2.

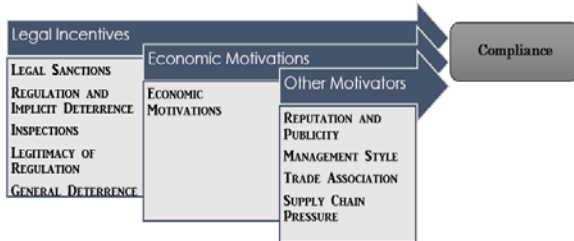


Figure 2. Determinants of Compliance

Based on the evidence collected, only a handful constructs from the determinants of compliance model has compelling casual factors affecting the behavior of compliance of said agency, to list: (a) General Deterrence, and (b) Legitimacy of Regulation. The other determinants are ignored since they did not serve as casual factors for the agency to comply with the Data Privacy Act of 2012.

Deterrence construct is defined as a strategy that enforces punishment surpassing any economic gain from failing to comply with the required rules to promote industry compliance [10], [24], while Legitimacy is defined as the recognition and acceptance to a governing body, and are expected to comply regardless of its own dictates [5]. The overall operational framework is presented in Figure 3.

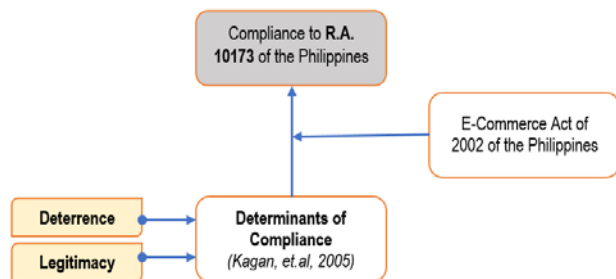


Figure 3. Operational Framework

For the analytic technique, the researcher used the pattern matching [25] to analyze the gathered information and documents that follows the process of pattern matching as presented in Figure 4.

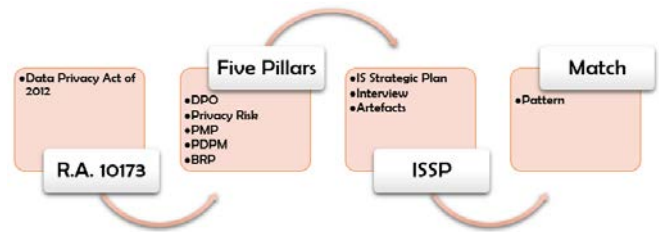


Figure 4. Pattern matching model

As defined by Trochim and Yin, it is a technique where in the predicted patterns are compared with the empirical patterns [23], [25]. Also, it is a set of patterns in determining the status of compliance of the National Commission on Indigenous Peoples with Data Privacy Act of 2012 [5] presented in Table 1.

Table 1. Compliance Pattern

Pattern	ISSP	Five (5) Pillars	Match
Pattern A	High	High	Fully Compliant
Pattern B	High	Medium to High	Partial Compliant
Pattern C	Low	Low	Not Compliant

In order for the agency to be Fully Compliant, based on the Pattern A, the ISSP Document cross-matched with the DPA of 2012's Five (5) Pillars, results must be all in *High*. Otherwise, if the level of ISSP compliance is *High* and in the Five (5) Pillars is only between *Medium to High* that falls to Pattern B and the agency is only Partial Compliant. And, if the agency's ISSP is *Low* cross-matched with the five (5) Pillars which is also *Low*, said agency has not complied at all and belongs to Pattern C.

5.6 Report & Findings

For this phase, a detailed information as the outcome of the case study conducted will be presented in a way understandable to a variety of audiences. Evidences and results of this empirical and compelling work will also be provided.

6. FINDINGS

The agency has a list of information systems that may aid in their business transactions every day. To present the list, Table 2 below is provided.

Table 2. List of Information Systems

NATIONAL COMMISSION ON INDIGENOUS PEOPLES (NCIP)					
Information Systems ISSP 2013-2015	Presence of Personal Data				
	Yes/No	Responsible Office	Internal Processor	External Processor	
1 Ancestral Domains Database Information System (ADDIS)	Y	Ancestral Domains Office	CO, RO, PO, CSC	ICCs/IPs, Executive NGOs	
2 Plan and Policy Information System (PPIS)	N	Office on Policy, Planning and Research	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign	
3 Project Development Information System (PDIS)	N	Office on Policy, Planning and Research Office on Socio-Economic Services and Special Concerns Office on Empowerment and	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign Partners	
4 Foreign Assisted Programs/Projects	Y	Office on Socio-Economic Services and Special	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign	
5 ICCs/IPs Profile Information System (IIPIS)	Y	Office on Policy, Planning and Research Office on Socio-Economic Services and Special Concerns	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign Partners	
6 Educational Assistance Program Information System	Y	Office on Education, Culture and Health	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign	
7 Library and Museum Information System (LMIS)	N	Office on Education, Culture and Health	CO, RO, PO, CSC	ICCs/IPs	
8 IP, IPO, NGO Monitoring Information System (IINMIS)	Y	Office on Education, Culture and Health	CO, RO, PO, CSC	ICCs/IPs, Executive, Foreign	
9 Legal and Adjudicatory Services Information System	N	Legal Affairs Office	CO, RO, PO, CSC	ICCs/IPs, Executive	
10 Executive Information System (EIS)	Y	Commission En Banc Office of the Commissioner Office of the Executive	CEB, OC, OED, BDs, RDs	Executive, Legislative, Judiciary	
11 Financial and Administrative Information System (FAIS)	Y	Finance and Administrative Office	CO, RO, PO, CSC	Executive, Legislative	
12 Human Rights Information System (HRIS)	Y	Office on Empowerment and Human Rights	CO, RO, PO, CSC	Civil Society, IPOs, CHR, LGU	

There are twelve (12) major systems, of which some of these have sub-systems. Eight (8) systems basically deal with personal data as depicted in the second column with label ‘Y’ means YES, there is a presence of personal data. With the given lists of information systems, two (2) of them with personal data dealings is frequently used, to name: (a) #1- *Ancestral Domains Database Information System (ADDIS)* and (b) #5- *ICCs/IPs Profile Information System (IIPIS)*, and looking towards compliance with R.A. No. 8792 or “e-Commerce Act of 2002”, these systems are needed to be overhauled and re-engineering in order to conform with said law. A pattern matching was conducted to analyze the empirical study compared to the predicted pattern. Table 3 presents the results of pattern match.

Table 3. Pattern Matching Result

	ISSP	5 Pillars	Match
Expected Patterns	Pattern A	High	High (5/5)
	Pattern B	High	Medium (<5)
	Pattern C	Low	Low
			Fully Compliant
			Partial Compliant
			Not Compliant

SOURCES					
Evidences	ISSP	Document Archival Records		Interview	
		Before Enactment of R.A. 10173	Before NPC Took Action	During Enactment of R.A. 10173 and After NPC Took Action	During Enactment of R.A. 10173 and After NPC Took Action
	ISSP	Low	Low	High	High
5 Pillars	DPO	n/a	n/a	Medium	Medium
	PIA	n/a	n/a	Medium	High
	PMP and PM	n/a	n/a	Medium	Medium
	PDPM	n/a	n/a	Medium	Medium
	BRP	n/a	n/a	n/a	n/a
Pattern Match	Pattern C	Pattern C	Pattern B	Pattern B	Pattern B

Results showed that Before Enactment of R.A. No. 10173 and Before NPC Took Action, the agency’s ISSP rating is Low, represented as unavailable data or still on crafting; for the five pillars of NPC, it is evidently seen that the agency has “n/a”,

meaning, NCIP has not yet conducted any measures relative to Data Privacy Act of 2012, and the result is Pattern C with is *Not Compliant* at all.

Then, During the Enactment of R.A. No. 10173 and After NPC Took Action, they already have the Information Systems Strategic Plan (ISSP) for 2013- 2015 and has a rating of High. Amongst the five pillars, (1) *Appointment of a Data Privacy Officer (DPO)*, the rating is Medium, hence, the agency already appointed, but temporary DPO; for (2-4) *Privacy Impact Assessment, Privacy Management Program / Privacy Manual, and Privacy and Data Protection Measures* respectively, the ratings are Medium, hence the agency has provided these measures, only that they are not religiously done these into practice; for (5) *Breach Reporting Procedures*, the rating is n/a, since NCIP did not have the annual report on breaches submitted to the NPC, which further resulted to Pattern B, that is *Partial Compliant*.

The researcher also conducted interview to triangulate the evidences from the documents provided, and results showed that only in second pillar (2) *Privacy Impact Assessment*, that has a rating of High, it is because the agency has conducted such assessment, only that, it was documented on a separate file, nevertheless, all other evidences has same ratings and resulted to Pattern B, which is *Partial Compliant*.

7. CONCLUSIONS

Based on the findings and pattern matching results, before enactment of DPA 2012 and before NPC took action, NCIP is not compliant at all, this is because of following concerns posed by said agency, first, the lack of awareness of said act, hampers them in complying, second, they don’t have the right people to focus on the matter, and resources also forbids, and lastly, projects and programs relative to this is mostly on low priority agenda. And during the enactment of R.A. 10173 and NPC Took Action on the matter, the agency has tried to comply, but not fully complied, this is also due to the challenges that they have: (a), they are still looking for the right person to be a DPO, considering the very vital role and duties of a DPO set forth in the law and restructuring of their IT department is a must also; (b) lack of budgetary requirements; and (c) time constraints in fast-tracking these issues and even (d) prioritization of plans and projects relative to the matter. The determinants of compliance, such as general deterrence and legitimacy of regulations also has a compelling casual factor in compliance with DPA of 2012.

8. FUTURE WORK

It is highly recommended that a further study will be conducted once the recent ISSP of said agency will be available, and how far compliance to the said law does affects the organization since due date of submission is extended until March 08, 2018. Also, a comparative method and multiple case synthesis is suggested to empirically test the behavior of compliance amongst other government agencies.

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RA 10173 and its Challenges to Philippine State Universities and Colleges' Compliance Performance: The Case of Mindanao State University- General Santos City

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ABSTRACT

Data privacy has become a major concern in the Philippines owing to the promulgation of Republic Act No. 10173, otherwise known as the Data Privacy Act of 2012, duly enforced by the National Privacy Commission (NPC). This study seeks to determine the level of compliance of Mindanao State University- General Santos City (MSU-GSC) as well as understand the challenges it encounters in accordance with the Data Privacy Act. Using a qualitative single holistic case study design and pattern matching technique, this paper was able to uncover how and why SUCs can comply with the RA 10173 and can apply such law in their information systems and academic processes. It was found out that MSU-GSC is qualitatively described as partially compliant and it further supports deterrence and legitimacy as its determinants. The moderating effect of compliance with RA 8792 or E-Commerce Act of 2000 also significantly affects its abidance with Data Privacy Act as efforts are continuously directed towards automating university processes and transactions. Moreover, three factors were identified that contributes primarily on the challenges of its compliance namely lack of better understanding, budgetary issues and time constraints. The study contributes to the literature by providing inputs about SUCs' continuing efforts toward compliance with RA 10173. It is suggested NPC to diffuse responsibility to SUCs, so as compliance with data privacy act will weigh down less. Further, it is expected a greater appreciation of the law will fuel enthusiasm to overcome challenges of compliance.

CCS Concepts

• **Social and professional topics** → **Computing/Technology policy** → **Privacy policies**

Keywords

Data Privacy; Personal Information; Data Privacy Compliance; e-Governance

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1. INTRODUCTION

1.1 Background of the Study

Data privacy has been defined in many ways by literatures. It has been thought of as a moral or legal right, having control over information about oneself [1] or having control as to how it is acquired and used [2]. In spite simple definitions, its varied nature has earned data privacy its place as one of major concerns in different domains such as information systems, marketing, psychology and management among others [2]. In the Philippine setting, a culture of protecting the data privacy of citizens while keeping a free-flow of information forms part of the government's commitment to serve and defend its people well [3]. Pursuant to the National Privacy Commission's (NPC) Circular Number 16-01, all heads of government branches, bodies or entities including those of state universities and colleges were reminded of the provision of the law that applies to all government agencies that are engaged in the processing of personal data in light of RA 10173 or otherwise known as Data Privacy Act of 2012. The circular affords to assist these government agencies engaged in processing of personal data as the rules stipulated therein can be used to craft detailed policies and procedures along the line of their operating requirements.

As information technology continues to change the way we do transactions on a daily basis, concerns about data protection and usage are put in the limelight [4]. As SUCs continue to invest on data systems to improve quality and increase proficiency in managing data, a clear understanding of and commitment to data privacy and a rational implementation and supervision of strong policies and practices are encouraged to protect student data from misuse [5]. As such, effective use of data is highly recommended. Consequently, a balance between the data's use and protection can be achieved so as to mitigate risks related to its intentional or unintentional manipulation. While the law is strongly enacted, SUCs however are faced with numerous impediments to its compliance owing to the changes it may bring to its operations [6]. In spite these challenges, SUCs continuously pursue abidance along the line of its implementation to meet legal responsibilities and to respect confidentiality of personally identifiable information.

To contribute to the understanding of this phenomenon, this case study research was conducted following a single holistic approach [7], taking into account the context within which abidance with the law is implemented by Mindanao State University- General Santos City (MSU-GSC). Moreover, this paper aims to uncover efforts

and challenges made by MSU-GSC with respect to RA 10173 thereby assessing its level of compliance.

1.2 Overview of Related Literature

1.2.1 Data Privacy in Education Sector

The fast-paced technological adoption of systems that cater to store and analyze academic outcomes at a granular level has become an opportunity as well as threat to the education sector [8]. While various data sets that represent students are in danger of being misused, its potential to initiate personalized education for every student is still in effect. In spite threats, positive outcomes can be achieved if compliance to legal procedures of data sharing and clear-cut policies are in place.

In the US context, the Family Educational Rights and Privacy Act or FERPA protects students and its family members by “prohibiting educational institutions from denying parents and eligible students certain rights with respect to student records”. It also provides for inspection of students education records and for amendment whenever the data is deemed inaccurate or misleading. Moreover, FERPA prohibits the access of third party entities to personally identifiable information of students, such as names, address, social security numbers date of birth and other information linked to a student that identifies them “with reasonable certainty”, without parents’ consent. To date, FERPA and its implementing rules by the US Department of Education remains to be a regulatory scheme for protection of data held by public schools [9].

In the European context, on the other hand, the General Data Protection Regulation or GDPR addresses concerns that shall bring cultural shift in the way European businesses and institution handle personal data [10]. This major legislative move is seen as a crucial step in promoting fundamental rights of its citizens by enabling them to object to certain data processing and have control over the use of their personal data. Major changes is also seen in Europe’s education system as more accountability is passed on to schools in the way records are handled. As such, GDPR may require schools of having documented understanding of why and how the information is held and collected, when will data be deleted and who can access it. The General Data Protection Regulation replaces Data Protection Act and will take effect starting May 2018.

1.2.2 Republic Act No. 10173

In the Philippine setting, initiatives on data privacy was formalized when the Republic Act 10173 or Data Privacy Act of 2012 was approved on August 15, 2012 while its implementing rules and regulations was put into effect on August 24, 2016 . The law aims for the protection of Filipino’s personal information that resides from information and communications systems on both public and private sectors. It is divided into five parts; definitions and general provisions, the National Privacy Commission, rights of data subjects and obligations of personal information controllers and processors, provisions specific to the government and finally, penalties. In addition, the law provides for the protection of individual’s privacy while maintaining free flow of information thereby promoting innovation and growth, regulation of data collection, recording, organization, storage, modification, retrieval, consultation, use, consolidation, obstruction and destruction of personal data and the compliance of the country with international standards for data protection through the National Privacy Commission. Moreover the creation of this law

was patterned to the General Data Protection Regulation (GDPR) of Europe [11].

1.2.3 Republic Act No. 8792

The Republic Act No. 8792 , otherwise known as the E-Commerce Act of 2000 in the Philippines shall “facilitate domestic and international dealings, transactions, arrangements, agreements, contracts and exchanges and storage of information through the utilization of electronic, optical and similar medium, mode, instrumentality and technology to recognize the authenticity and reliability of electronic documents related to such activities and to promote the universal use of electronic transaction in the government and general public. Moreover, the act applies to any kind of data message and electronic document used in the context of commercial and non-commercial activities to include domestic and international dealings, transactions, arrangements, agreements, contracts and exchanges and storage of information” [11], [12].

This act plays an important role in terms of compliance with RA 10173 as it outlines data processing initiatives of both public and private sectors in order to create an information-friendly environment which supports and ensures the availability, diversity and affordability of ICT products and services. As such, protection of data becomes imperative.

1.2.4 NPC and the Data Privacy Accountability and Compliance Framework

The promulgation of RA 10173 paved the way for the establishment of the National Privacy Commission under the Department of Information and Communications Technology. The said commission shall oversee and enforce the provisions of the act thereby ensuring compliance of personal information controllers in both public and private sectors and upholding their right to privacy. The NPC also provides for the Data Privacy Accountability and Compliance Framework as stipulated in the commission’s toolkit. The framework is composed of 5 pillars; appointment of Data Protection Officer (DPO), conduct of a Privacy Impact Assessment (PIA), Development of Privacy Management Program and Privacy Manual (PMP&PM), Implementation of Privacy and Data Protection Measures (PDPM) and finally, development of Breach Reporting Procedures (BRP) [3]. The framework is shown in Figure 1.

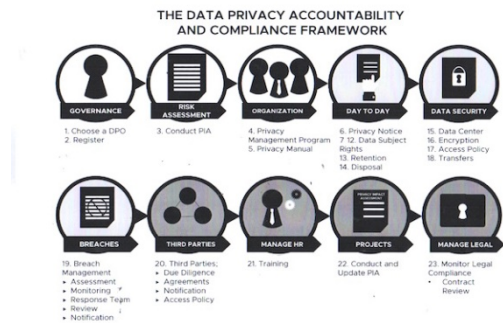


Figure 1. Data Privacy Accountability and Compliance Framework

1.3 Research Questions and Objectives of the Study

This study aims to assess the level of compliance of SUCs with RA 10173 thereby determining the challenges and issues they faced in abidance with the law. The main research question revolves around how and why will SUCs comply with the RA 10173 and how are they integrating and applying the said law in their information systems and academic processes. In light of the objectives and main research question, the following specific research questions are considered:

1. What are the data processes and information systems that deal with personal data?
2. How does SUCs compliance with RA8792 affect its compliance with RA 10173?
3. What are the documents submitted for the initial deadline of NPC regarding compliance with RA 10173?
4. How do determinants of compliance by Sutinen and Kuperan's [13] affect SUCs compliance with RA 10173?
5. What information security controls and strategies do SUCs apply in compliance with RA 10173?
6. What changes were made from the previous Information Systems Strategic Plan (ISSP) compared to the current?

1.4 Scope of the Study

The SUC under analysis in this study is Mindanao State University- General Santos City (MSU-GSC) through their computer center director, Professor Rodulfo L. Dorado. MSU-GSC is a premiere regional university in Region 12, Mindanao that has a special mandate on integration of different cultural communities into the mainstream socio-cultural and political life by providing them opportunities in terms of quality and timely education essential for their development thereby producing skilled manpower contributing to the economic development of its area.

2. METHODOLOGY

The study employs a qualitative single holistic case study in order to explain the link between the identified phenomenon and the context where it exists. Yin [7] posits that a qualitative case study is a form of empirical inquiry that investigates a given phenomenon through multiple sources of evidence. The case study framework used is shown in Figure 2.

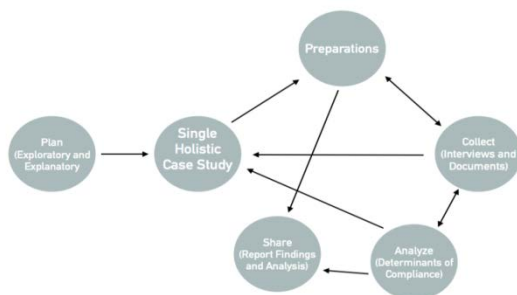


Figure 2. The Case Study Model

The process starts with a planning phase where research questions were formulated. The questions were exploratory and explanatory nature as they are in the context of how and why respectively as explained by Yin [6], [7]. The design phase is represented by the single holistic case study as this paper focused on a single and significant unit of analysis, which is Mindanao State University-

General Santos City and its compliance initiatives. Preparations come by defining case study protocols in the form of consent letters to the institution, through the focal person, and for documents needed to be reviewed. Series of interviews were done after the approval of the request to conduct the case study. Data from series of interviews, email correspondence and document reviews were then collected. Examination of the institution's Information Systems Strategic Plan (ISSP), which is considered as the primary document to be assessed for RA 10173 compliance, were also made. Analysis of data is done by applying the determinants of compliance by Sutinen and Kuperan [13]. As case studies in general can validate existing theories, this study was able to narrow down the list of determinants from the original proposition by analyzing interview narratives as shown in Figure 3.

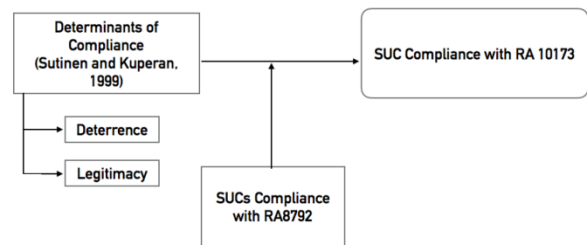


Figure 3. Operational Framework

In addition, the moderating effect of compliance with RA 8792 was included in order to determine its impact on SUCs compliance with RA 10173 as the former lays down all data processing initiatives [12] thereby determining what information systems are to be included in the assessment of compliance by the university. Pattern matching technique of Trochim [14], as seen in Figure 4, was also applied where predicted patterns are compared with empirical patterns [11], [14]. Consequently, this study has identified three patterns in determining compliance status of MSU-GSC with RA 10173 as presented in Table 1.



Figure 4. Pattern Matching Process

It can be gleaned from Table 1 that in order for SUCs to be fully compliant, the match between the ISSP document and the 5 pillars of data privacy accountability and compliance framework must both be High as reflected in Pattern A. Pattern B shows a High remark for ISSP while Medium to High remark for the 5 pillars resulting to Partially Compliant result. Finally, a Low remark for both ISSP and 5 pillars as reflected in Pattern C results to being not compliant.

Table 1. Compliance Patterns

Pattern	ISSP	Five Pillars	Match
Pattern A	High	High (5/5)	Fully Compliant
Pattern B	High	Medium to High (<5)	Partially Compliant
Pattern C	Low	Low	Not Compliant

Finally, the share phase is expected to be done once the study is completed and the results will take a significant role in answering the questions of this study in light of academic inquiry.

3. RESULTS AND DISCUSSIONS

Based on the series of interviews conducted with Professor Rodolfo Dorado of the MSU-GSC computer center, the university is found to have continuously exerted efforts in maintaining information systems necessary for operations. The primary focus of the computer center, as of this writing, is on the school's management system and internet use. These two were prioritized so as not to hamper enrolment procedures and academic activities needing internet connection such as library services, computer laboratory classes and grade query transactions done online through its website in addition to activation of LDAP servers for its directory services.

Table 2. List of Information Systems from ISSP 2015-2017

MINDANAO STATE UNIVERSITY- GENERAL SANTOS CITY (MSU-GSC)				Presence of Personal Data		
Information Systems	Owner	Status	Description	Y/N	Internal Processor	External Processor
1 Schools Management System	Registrar	Being Developed	Integrates key activities from admission, course scheduling, registration/enrollment, assessment, billing, cashing, and students records management.	Y	All personnel handling student data	CHED, COA
2 MSU-General Santos Web Portal	OC	Being Developed	A content Management System that will adhere to the CHED template for HEIs will be adapted. CHED's content management module will be largely followed and enhanced by features unique to MSU-Gen. Santos.	N	MSU-GSC Stakeholders	CHED, Public
3 Admission Management System	Admission Office	For Development	A subsystem of the School Management System. A web-based portal that will be used to disseminate information for the annual admission and scholarship examination and electronically publish and communicate results to students.	Y	Admission Office	Incoming students, parents, guardian
4 Virtual Learning Management System	MSU-GSC	For Adoption	To develop this fully developed system through Virtual Learning Management System (VLM) that enables an academic institution to provide e-learning for students anytime and anywhere that addresses the issues of distance, digital divide and disaster mitigation, initiative of the government.	N	Academic Sector	All Learners
5 Property Management and Inventory Information System	SMD	For Development	The system will maintain an inventory of all property, materials and equipment and monitor the issuance of MEIs.	N	SMD	COA, CHED
6 Executive Information System	OC	For Development	The system is designed to serve the information needs of management, hence will contain summaries of overall operations.	Y	OC, VCAA, VCAF	CHED
7 Document Management System	OC	For Development	A web-based system for electronic creation, receiving and filing documents. It shall store and catalog digitized documents or soft-copy files for electronic access, retrieval and printing.	N	All employees	CHED
8 Teacher's Evaluation Report System	VCAA	Being Developed	The system archives and computes teacher's performance as rated by students, peers and supervisors.	Y	VCAA	VCAA, VCAA Staff
9 Research and Extension Projects Tracking Information System	RDO	For Development	This is an integrated system that will maintain a database of research proposals, on-going research and extension projects, completed projects and researchers, with Web interface.	N	RDO, Academic Sector	General Public
10 Student Portal	OEA	For Development	The system will serve as a single stop shop for the students to verify their academic status and academic related concerns.	Y	Students, Faculty Guidance Office, OEA	Parents and Guardians
11 Financial Information System	MSU-GSC	For Development	This system will integrate all finance-related functions such as budgeting, accounting, cashing and purchasing and generate both soft and hard copies of reports.	N	Budget, Accounting, Cashier	COA, DBM
12 Human Resource Information System	HRMO	For Enhancement	The system will store and retrieve records of all personnel including personal information, trainings, experience, leaves and absences, performance ratings, etc.	Y	HRMO, All Employees	

Information systems present in the university are still used and are still in place as security and privacy measures are always part of its planning, development or adoption although limited to firewalls and built-in server security measures. Looking at the ISSP document, it can be learned that there is not much significant difference with the twelve information systems for the year 2015 to 2017 as compared to only ten for the year 2018-2020. The interview results explained that while there are systems that are yet to be developed, most of the existing systems are with the status for enhancement, adoption or being developed and were carried over from the previous to the new ISSP. Tables 2 and 3 show data processes and information systems where personal data resides as well as the comparison as to the changes made from the previous up to the current ISSP.

It was also found out, through observations, that not all organizational processes are automated leading to partial compliance with RA 8792. However, continuous efforts are made by computer center unit as it has its own means of integrating newly developed systems thereby eliminating the need to re-engineer the whole existing processes. Consequently, compliance with RA 10173 is not hampered in any way but is more encouraged so as data protection measures will still be pursued in future developments.

To explore the level of compliance of MSU-GSC with RA 10173, the pattern matching technique was applied using the information gathered and documents collected. It can be drawn from Table 4 that before the enactment of RA 10173 and before NPC took action, no compliance is observed thereby resulting to Pattern C.

However, during the enactment of RA 10173 and after NPC took action, it can be observed that both Documents, Archival Records and Interviews got the remark of Pattern B or partially compliant. This can be attributed to their initial compliance of appointing a temporary data privacy officer while registering the university's data processing systems to NPC are also being processed.

Interestingly, the evidence Privacy Impact Assessment (PIA) earned different remarks. Results of the interview revealed that while the computer center is aware of privacy concerns, there is a need to document their plans and measures to formalize it. As such, although it is not reflected on the documents, the interview revealed otherwise causing both pillar to have different remarks. Moreover, Professor Dorado discussed that the Philippine Association of State Universities and Colleges (PASUC) has already worked on a privacy manual that shall cover pillars 2 to 4 and is up for final revision. As such, MSU-GSC is also anticipating the distribution of the said manual for them to develop privacy measures along the line of PASUC standards. Overall, after employing pattern matching, MSU-GSC was deemed Partially Compliant.

Table 3. List of Information Systems from ISSP 2018-2020

MINDANAO STATE UNIVERSITY- GENERAL SANTOS CITY (MSU-GSC)				Presence of Personal Data		
Information Systems	Owner	Status	Description	Y/N	Internal Processor	External Processor
1 Schools Management System	Registrar	Being Developed	Integrates key activities from admission, course scheduling, registration/enrollment, assessment, billing, cashing, and students records management.	Y	All personnel handling student data	CHED, COA
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3 Admission Management System	Admission Office	For Development	A subsystem of the School Management System. A web-based portal that will be used to disseminate information for the annual admission and scholarship examination and electronically.	Y	Admission Office	Incoming students, parents, guardian
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5 Executive Information System	OC	For Development	The system is designed to serve the information needs of management, hence will contain summaries of overall operations.	Y	OC, VCAA, VCAF	CHED
6 Document Management System	OC	For Development	A web-based system for electronic creation, receiving and filing documents. It shall store and catalog digitized documents or soft-copy files for electronic access, retrieval and printing.	N	All employees	CHED
7 Teacher's Evaluation Report System	VCAA	Being Developed	The system archives and computes teacher's performance as rated by students, peers and supervisors.	Y	VCAA	VCAA, VCAA Staff
8 Research and Extension Projects	RDO	For Development	This is an integrated system that will maintain a database of research proposals, on-going research and extension projects, completed projects and researchers, with Web interface.	N	RDO, Academic Sector	General Public
9 Student Portal	OEA	For Development	The system will serve as a single stop shop for the students to verify their academic status and academic related concerns.	Y	Students, Faculty Guidance	Parents and Guardians
10 Equipment Procurement and Management Information System	SMD	Being Developed	The system will maintain an inventory of all property, materials and equipment and monitor the issuance of MEIs.	N	SMD	COA, CHED

When asked about determinants of compliance of the university to RA 10173, Professor Dorado discussed about deterrents and legitimacy as primary reasons. Accordingly, MSU-GSC will have to comply because it is the law. While the motive behind the formulation of the law is the sense of rightness and justice in protecting private data, which is morally upright in nature, whether it be morally right or wrong becomes immaterial since the determining factor for compliance is the law and not one's conscience.

Table 4. Pattern Matching Results

Case	Source	Event	ISSP		5 Pillars		Match								
			Evidence	Rating	Evidence	Rating	Evidence	Rating							
MSU-GSC	Documents Audited	Before Enactment of R.A. 10173	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PCPM	n/a	BRP	n/a	Pattern C
		NPC	ISSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PCPM	n/a	BRP	n/a	Pattern C
		During Enactment of R.A. 10173 and After NPC Took Action	ISSP	High	DPO	High	PIA	Low	PMP and PM	Low	PCPM	Low	BRP	n/a	Pattern B
Interviews	ISSP	High	DPO	High	PIA	Medium	PMP and PM	Low	PCPM	Low	BRP	n/a	Pattern B		

Legend:	
DPO	Data Privacy Officer
PIA	Privacy Impact Assessment
PMP and PM	Privacy Management Program and Privacy Manual
PCPM	Privacy and Data Protection Measures
BRP	Breach Reporting Procedures

As a result, deterrence, being the most common factor, and legitimacy were identified as constructs that has a significant causal effect on the compliance behavior. Deterrence is defined as a strategy where punishment is enforced, surpassing any economic gain from failing to cope with requirements, to promote industry compliance while legitimacy is defined as one's recognition or acceptance of a governing body [6]. Other constructs were neglected, based on the results, as they did not show any causal relationship needed in understanding the phenomenon being analyzed in the study.

Interview narratives also revealed three factors that contribute primarily on the challenges on compliance by the university; lack of better understanding, budgetary issues and time constraints. Lack of better understanding emanates from not getting everyone involved in the organization on the initiative of protecting university data from the highest authority going across all units. In addition, the role of the DPO might also be too wide to absorb as greater understanding of its roles and accountabilities is needed for everyone to maintain compliance initiatives. Budgetary constraints, on the other hand, is always considered an issue in any government agency as IT investments may be overshadowed by other priorities or projects as these investments can be very expensive. However, with the existence of the law, the university will be more encouraged to include it for the coming allocation. Finally, in spite being promulgated on the year 2012, the NPC's awareness campaign came only in 2016. As such, the impact of the law and the severity of its punishment was made known late for universities to take action immediately as the compliance window was given for only a year, making time limited.

4. CONCLUSION

This paper contributes to the determination of the level of compliance of government agencies, from a State University perspective, and understanding of the challenges they face in order to abide by the law in RA 10173. MSU-GSC was found out to be partially compliant and their reason for compliance is due to deterrence and legitimacy. In spite challenges, the university continues to exert effort with their compliance initiatives thereby pursuing what is right and ethical in the field of security and privacy. Moreover, the study may serve as a call for the National Privacy Commission to intensify its efforts in extending support to SUCs by providing dialogues in every region concerning RA 10173 for greater appreciation of the law leading to more enthusiastic compliance performance.

5. FUTURE WORK

As this study uncovers compliance challenges faced by SUCs, a large area is left for discovery in future researches like the issue of RA 10173 compliance in government sectors, specifically SUCs, by studying compliance of inter-governmental organizations and identifying critical success factors and best practices in implementing an effective data protection policies along the line of data privacy act.

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Philippine SUCs Compliance Performance on RA 10173: A Case Study on Bukidnon State University

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ABSTRACT

The advancements in technologies have accelerated educational institutions by improving service delivery while reducing costs. As a result, it provided avenues of learning, the use of online discussions, Virtual Learning Environments (VLEs) and mobile technologies, thus making data security vulnerable. With these, it is imperative that through the lens of R.A. 10173 and NPC's five pillars that data be protected by a policy that is sustained and executed effectively. This qualitative research using case study technique aimed to evaluate, explore and explain the level of compliance of Bukidnon State University (BukSU) with RA 10173. Likewise answering the research question how does PSUCs apply and integrate R.A. 10173 with its Information Systems and Business Processes? Using single case holistic design with common rationale, and pattern matching technique in interpreting the tabulated results. It was found out that BukSU, just like most government agencies in the Philippines, is qualitatively described as Partial Compliant. Furthermore, their compliance was due to moral suasion, where BukSU, considers it as its moral obligation to protect the students and its employees' data. An initiative from PASUC, to come up with a Data Privacy Manual that will serve as a model for all PSUC's in drafting their own manual, where BukSU practices can be aligned with that of PASUC. After the September 11, 2017, deadline, BukSU invested in a UTM Unified Threat Management with a three-year license to safeguard university data resources.

CCS Concepts

• **Social and professional topics** → **Computing / Technology policy** → **Privacy policies**

Keywords

e-Governance; Security; Data Privacy; Personal Information; Data Privacy Compliance.

1. INTRODUCTION

1.1 Background of the Study

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Data privacy is described as the desire of an individual to control or influence information about one's self, the right of an individual not to disclose his or her information and to live free from surveillance. In the Philippine setting, data privacy is being protected thru Republic Act No. 10173, or Data Privacy Act (DPA) of 2012, it is to protect the fundamental human right of privacy, and of communication while ensuring free flow of information to promote innovation and growth, this law also established the National Privacy Commission who outlined the guidelines and serves as the enforcer and overseer of the law.

The question however, is how do the Philippine agencies be it government of private, are conforming with the law. What are the measures they employed to protect data that were gathered from their clientele, stakeholders and the community in general? The same question applies in the different academic institutions [1], especially the State Universities and Colleges (SUC), government owned institutions, where majority of the Filipinos enroll in due to its lower school fees. With R.A. 10931, tuition fees for most SUC's are even made free, the more chances that enrollment in the tertiary level will increase.

A study on "Data Privacy Act of 2012 Compliance Performance of Philippine Government Agencies: A Case Study Approach" was conducted [2], it assessed the, compliance level of government agencies. The study uncovered how CHED and COMELEC applied R.A. 10173 to their business processes and strategies. Also, on their reasons for complying with R.A. 10173 or the Data Privacy Act of 2012 and the challenges encountered

This scholarly paper is anchored from the above-mentioned study and applied in other government agencies. While this study also assesses another government agency, it focuses on Philippine State Universities and Colleges. The researcher is interested to uncover what requirements they have submitted to comply with the September 11, 2017, deadline set by the National Privacy Commission (NPC) and what have they done five months after the deadline. More importantly what are the measures done to protect the data that are collected which is of the students and other internal and external stakeholders of Bukidnon State University (BukSU).

1.2 Overview of Related Literatures

1.2.1 Information and Data Privacy Protection in Higher Education

The technological advancements have made quite an impact everywhere. Regardless of the innovation it provides, data gathered using these technologies must be protected at all times.

Academic institutions are of no exemptions to these phenomena. The advancements in technologies have accelerated educational institutions by improving service delivery while reducing costs [3]. Protecting data especially in an educational institution is often burdened with challenges.

Higher Education landscape has progressed extensively in recent years with cutting-edge technology. Presence of speedy broadband connections and more useful networking methods have afforded both educators and students with more options for teaching and learning [4]. As a result of it provided avenues of learning, the use of online discussions, Virtual Learning Environments (VLEs) and mobile technologies. With these, it is imperative that data be protected through a policy that is maintained and implemented successfully. Thus, in the Philippine scenario, all agencies be it government or private are mandated to draft their guidelines with the five pillars of data privacy and protection. An initiative was spearheaded by the Philippine Association of State Universities and Colleges (PASUC), to come up with a unified format that will later be customized specifically for every SUC's. As students and employees' personal information is among the most significant asset in any organization today, a clear transaction or process rules and guidelines are becoming gradually imperative. Organizations, specially higher education, are given more responsibility to protect the personal information used during the course of any business transactions, specifically internal and external stakeholders data [5].

1.2.2 EU Data Protection Directive

In order to protect the privacy of citizens' personal information the EU Data Protection Directive was crafted, it is adopted by the European Union. It is also built in reference to the Organization for the Economic Co-operation and Development's (OECD) seven principles, namely: (1) "subjects whose data is being collected should be given notice of such collection"; (2) "subjects whose personal data is being collected should be informed as to the party or parties collecting such data"; (3) "once collected, personal data should be kept safe and secure from potential abuse, theft, or loss"; (4) "personal data should not be disclosed or shared with third parties without consent from its subject(s)"; (5) "subjects should be granted access to their personal data and allowed to correct any inaccuracies"; (6) "data collected should be used only for stated purpose(s) and for no other purposes"; and (7) "subjects should be able to hold personal data collectors accountable for adhering to all seven of these principles". Additionally, it has been expanded in April 2016 and will be enforced on May 2018 to make it fit for the digital age [2], [6], [7].

1.2.3 Republic Act No. 10173 of the Philippines

In 2012 the Data Privacy Act 2012 was passed, it is a comprehensive and strict privacy legislation "to protect the fundamental human right of privacy, of communication while ensuring free flow of information to promote innovation and growth." [8] This comprehensive privacy law also established a National Privacy Commission that enforces and oversees it and is endowed with rulemaking power. On September 9, 2016, the final implementing rules and regulations came into force, adding specificity to the Privacy Act.

RA10173 aims to (1) "protect the privacy of individuals while ensuring free flow of information to promote innovation and growth"; (2) "regulate the collection, recording, organization, storage, updating or modification, retrieval, consultation, use, consolidation, blocking, erasure or destruction of personal data";

and (3) "ensures that the Philippines complies with the international standards set for data protection through the National Privacy Commission (NPC)" [2], [6].

1.2.4 The National Privacy Commission

As a result, to the R.A. 10173 enactment, the National Privacy Commission was established under the Department of Information and Communications Technology (DICT). The current officials are appointed by the incumbent President, while the Secretariat is appointed by the Commission [2], [6].

The goal of establishing the Commission is to enforce Data Privacy Act of 2012. They act as the collegial body in conducting investigation, and address personal information breach complaints; prepare and release the complaints report and corresponding resolutions; monitor the compliance of the affected organizations and recommend prosecution and impositions of the penalties to the Department of Justice; and modify, propose, and amend the privacy and data protection law [2], [6].

1.2.5 The Data Privacy Accountability and Compliance Framework

There are five pillars composing the Data Privacy Accountability and Compliance Framework. These Pillars are (1) Appoint a Data Protection Officer (DPO); (2) Conduct a Privacy Impact Assessment; (3) Develop a Privacy Management Program and Privacy Manual; (4) Implement Privacy and Data Protection Measures; and (5) Develop Breach Reporting Procedures [2], [9].

The NPC Toolkit (2017) states that, the appointed DPO will be accountable in warranting the compliance of the Personal Information Controller (PIC) - "a person or an organization who controls the collection, holding, processing or use of personal information and as well as instructs another person or an organization to collect, hold, process, use, transfer, or disclose personal information on his or her behalf" and the Personal Information Processor (PIP) - "any natural or juridical person or body to whom a PIC may outsource or instruct the processing of the personal data". Moreover, the DPO is recommended to be equipped with a specialized knowledge and expertise on relevant privacy or data protection policies and practices. Furthermore, the Privacy Impact Assessment (PIA) is a systematic description of the personal data flow and processing activities of the PIC and PIP. Similarly, the Privacy Management Program according to NPC is "a holistic approach to privacy and data protection, important for all agencies, companies or other organization involved in the processing of personal data" and the Privacy Manual "serves as a guide or handbook for ensuring the compliance of an organization or entity with the DPA". The fourth pillar is implemented through the Data Privacy Accountability and Compliance Framework as shown in Figure 1. Finally, the Breach Management which includes the personal data breach notification and annual report on breaches and security incidents [2], [9].



Figure 1 Data Privacy Accountability and Compliance Framework[10]

1.3 Research Questions and Objectives of the Study

The main objective of this study is to evaluate the level of compliance of Bukidnon State University (BukSU) with RA 10173. Further leads to the main research question, how do State Universities and Colleges (SUCs) apply and integrate R.A. 10173 with its Information Systems and Business Processes? To be able to answer this, the following are the specific research questions:

1. What are the requirements submitted by BukSU during the September 11, 2017, deadline?
2. What are the information security controls and/or strategies being applied by BukSU to comply with the R.A. 10173?
3. What are the changes made from the previous Information System Strategic Plan (ISSP) to the current?

1.4 Scope of the Study

As mentioned, this study is anchored from the study “Data Privacy Act of 2012 Compliance Performance of Philippine Government Agencies: A Case Study Approach”, in this research, it will be applied in the Educational sector of the government, Philippine State University and Colleges, specifically it will be applied/conducted at one of the SUC in Region 10, Province of Bukidnon, Bukidnon State University [2].

2. METHODOLOGY

In order to evaluate the level of compliance of BukSU with RA 10173, a qualitative case study method presented in figure 2, combined with pattern matching as presented in figure 4, was employed to determine its level of compliance.

To further establish the level of compliance with BukSU, dimensions, and determinants, as illustrated in figure 3, was considered. For the study to be considered in the context of a case study, the question provided in the main problem started with how or why. In analyzing the collected data, the determinants of compliance in figure 3 was used[10].

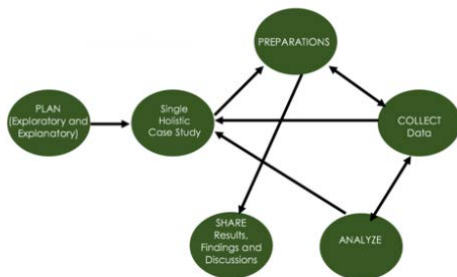


Figure 2. Operational Case Study Model

2.1 Plan

In the planning phase, the researcher designed and constructed research questions used in this study. As reflected in the main research question, possessing the ‘how’ and ‘why’ questions, focusing on existing events, as the Explanatory approach, while specific research questions with “what” questions are the Exploratory, as described by Yin [11], [12].

2.2 Design

This stage allowed the researcher to define the unit of analysis, where, in this study, it is Bukidnon State University being one of PSUCs. Since the subject of the study (case) is only one (1) SUC, the researcher adopted the single-case holistic design.

2.3 Preparation

In order to gather data and conduct the interview, the researcher, seek for the subject universities’ consent to conduct the case study. When the letter of request was approved, the researcher then, submitted a list of documents needed and made an appointment with the authorities to interview.

2.4 Collect Data

After the necessary preparations, data are finally collected and interviews conducted for triangulation purposes. The Information Systems Strategic Plan (ISSP) of the agency served as the primary document for assessment in relation to the set standards of the R.A. 10173 and the interview served as supplementary data.

2.5 Analyze

In the phase, the researcher used determinants of compliance found in figure 3, to determine whether they affect the SUC’s compliance with DPA 2012 [10]. Aside from deterrence, which is perceived as the most common type of factor for regulatory compliance, the researcher also included other causal factors affecting the compliance behavior.

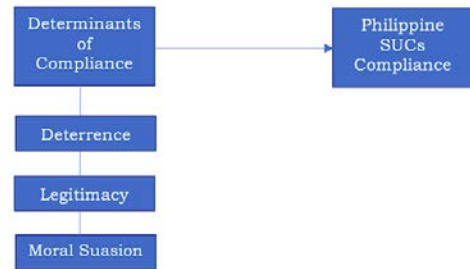


Figure 3 Operational Framework

Additionally, pattern matching is applied in this research study to analyze the gathered data, information, and documents, which follows the process pattern matching diagram as shown in figure 4 [13].



Figure 4. Pattern Matching Process

In determining the status of the compliance of the PSUC - Bukidnon State University with R.A. 10173, three types of patterns was adapted from the study of Ching, as shown in table 1 [2]. It is a technique where the predicted patterns are compared with the empirical patterns [12], [13].

Table 1. Compliance Pattern

	ISSP	5 Pillars	Match
Pattern A	High	High (5/5)	Fully Compliant
Pattern B	High	Medium to High (<5)	Partially Compliant
Pattern C	Low	Low	Not Compliant

2.6 Share Results, Findings and Discussions

The last phase, discusses in detail, the results and findings of the study. Tabulated results along with its interpretation of this research were also provided.

3. RESULTS AND DISCUSSIONS

Based on the ISSP of Bukidnon State University a summary of Information Systems (IS) available and to be developed are presented in tables 2 and 3. These information systems, assist the daily transactions of BukSU.

Table 2. List of Information Systems for 2011-2016

BUKIDNON STATE UNIVERSITY (BUKSU)				Presence of Personal Data		
Information Systems Strategic Planning / Roadmap 2011-2016	Owner	Status	Description	Yes/No	Personal Data	
				Y/N	Internal Personnel	External Personnel
1 Document Tracking System	Office of the President	Developed / Operational	A document Tracking System (DTS) is a system used to track, manage and store documents. Most are capable of keeping a record of the various versions created and modified by different users (history tracking).	Y	BuksU personnel, Faculty and Students	CGA/CHED/ PASUC/AACUPP etc.
2 Student Information System	Registrar's Office/Data Center	Developed / Operational	The SIS (Student Information System) supports the management of all student-related information including admissions, timetable schedules, course enrollment, grades, records, transcripts and student self-service, etc.	Y	BuksU personnel, Faculty and Students	External Studies Center
3 eFOAS	Finance Department	Developed / Operational	A software provided by CGA to be used in the Finance and Accounting Departments	Y	BuksU personnel	CGA
4 Library Information System	Library	Developed / Operational	Library Information System, is software that has been developed to handle basic housekeeping functions of a library. It's a well organized software solution for a library. It help to provide information on books, authors and its location.	N	BuksU personnel, Faculty and Students	BuksU Alumni, Researchers, and other SU/Cs and the General Public
5 Human Resource Management Information System (HRMIS)	HRDU	Developed / Operational	Human Resource Management Information System (HRMIS). HRMIS is a relational system that provide direct access to Human Resource (HR) information in support of operational activities, via client-server technology and intranet/Internet technology.	Y	BuksU personnel	-
6 Portable Attendance Monitoring System	Personnel Department	Developed / Operational	An automated attendance system using biometric finger print recognition for easier monitoring of employees' attendance to activities and events in the university.	Y	BuksU personnel, Faculty	CGA/DHDM
7 Student Information Management System	Office of the Student Services	Developed / Operational	The Student Information Management System (SIMS) is automating the collection of student-related fees, governance tool for all University Students Organization and the Office of Student Services (OSS).	Y	BuksU personnel and Students	BuksU Community, Parents, and other stakeholders.
8 BukSU Scholar Information System	Office of the Student Services	Developed / Operational	The BukSU Scholar Information System automates the collection of student-related information of the identified University scholars, thus providing user defined reports.	Y	BuksU personnel and Students	CHED and other Scholarship Providers.

Table 2 depicts the lists of information systems that are already developed and deployed in the university. There are 8 identified IS, only one of them does not contain personal data of students or employees of BukSU. Among the lists of IS, most of them are frequently used, except for Portable Attendance Monitoring System, that is used during the flag raising and retreat, and special activities and events where attendance is mandatory. Likewise, the majority of the IS listed are in compliance with the e-commerce law RA 8792. Communications with external study centers using the Student Information System (SIS), where enrollment of students are done online, according to the IT Officer when the interview was conducted, the system is embedded with security measures. Moreover, the student information system is also bound for an update, which is due to start the earliest possible in 2018. In terms of the factors in complying with the law, the university is very much apprehensive about the legal sanctions and possible enforcement of the law enacted.

Table 3. List of Information Systems for ISSP 2017-2020

BUKIDNON STATE UNIVERSITY (BUKSU)				Presence of Personal Data		
Information Systems ISSP 2017-2020	Owner	Status	Description	Yes/No	Personal Data	
				Y/N	Responsible Office	Processor
1 PROCUREMENT MANAGEMENT INFORMATION SYSTEM	Supply and Procurement Office (VPAD)/ICTSU	To Be Developed	This is a system that will automate the procurement of supplies and equipment of the university from the creation of PMP to the management of the issuance and equipment.	N	BuksU personnel	Supplier
2 ONLINE ELECTRONIC DOCUMENTS AND ARCHIVING SYSTEM	Office of the President (ICTSU)	To Be Developed	This is a system that will provide secure and centralized location for all of extension's information; an instant access to all extension documents from anywhere with an internet connection; and enhance the promotion and transfer of technologies to the rural communities.	Y	BuksU personnel, Faculty	External Studies Center
3 IMADD FACILITY: KNOWLEDGE PORTAL	Office of the President (ICTSU)	To Be Developed	This is a system that will provide digitization of existing instructional materials in the University, and to put them in a digital repository ready for access via the internet, mobile or intranet; continuity of the development of online version of other instructional materials; access to these materials via a 300 seater digital access facility and online availability of the materials.	Y	BuksU personnel and Students	BuksU Alumni, Researchers, and other SU/Cs

Table 3 provides the lists of systems that are yet to be developed. While a document tracking system was already developed, still usable and functional to date, due to its age, it requires a new development since the system can no longer be updated due to its obsolescence. Among the three IS to be developed only the Procurement Management System will not require personal data from students and employees of the University.

A pattern matching was conducted to analyze the study compared to the predicted pattern in reference to table 1, presented in table 4.

Table 4. Pattern Matching Result

Case	Issues	Event	Evidence	Rating	ISSP					Rating	Evidence	Rating	Evidence	Rating	Match																																													
					Principle 1	Principle 2	Principle 3	Principle 4	Principle 5																																																			
BukSU	Before Enactment of R.A. 10173	Before NPC Took Action	ISSP	Medium	DPO	N/A	NA	N/A	PIF and PM	N/A	PIPM	N/A	ISSP	N/A	Pattern C																																													
																BukSU	After NPC Took Action	ISSP	Medium	DPO	N/A	NA	N/A	PIF and PM	N/A	PIPM	N/A	ISSP	N/A	Pattern C																														
																															BukSU	During Enactment of R.A. 10173	ISSP	High	DPO	Medium	NA	Medium	PIF and PM	Medium	PIPM	Medium	ISSP	N/A	Pattern B															
																																														BukSU	After NPC Took Action	ISSP	High	DPO	High	NA	Medium	PIF and PM	High	PIPM	Medium	ISSP	Medium	Pattern B

Table 4 presents the pattern matching result *Before Enactment of R.A. 10173* and *Before NPC Took Action*. At this period, the universities rating aside from the ISSP is rated *Low*. The ISSP which is rated *Medium*, this is due to the initiatives that were evident and although the presence of the ISSP itself is unavailable, a similar document was found in the form of Roadmap, the remaining parts were either the data is unavailable or still being crafted; for the five pillars of NPC, the agency has "N/A" mark, connoting, that the university has no evident measures relative to Data Privacy Act of 2012, and the result is *Pattern C*, denoting, *Not Compliant*.

During the Enactment of R.A. 10173 and *After NPC Took Action*, the university, even before NPC took action already have an ISSP for 2017- 2020 and was therefore rated *High*. Amongst the five pillars, (1) Appointment of a Data Privacy Officer (DPO), is rated *Medium*, this is because the universities has already appointed a DPO; for the next four namely, Privacy Impact Assessment, Privacy Management Program / Privacy Manual, and Privacy and Data Protection Measures respectively, it is also rated *Medium*, currently, the university is working religiously on crafting manuals and adhering with the law to protect data that are

collected by the university, these manuals contain policies and guidelines. However, the crafting of manuals is put on hold due to the directive of PASUC where, a unified format will be produced and customized appropriate for each SUC's; for (5) Breach Reporting Procedures, is rated *N/A*, this is due to the absence of any report on breaches submitted to the NPC, overall resulting to *Pattern B*, denoting, *Partial Compliant*.

In order to triangulate the evidence from the documents provided, an interview with the proper authorities of the university was conducted. Results revealed that the ISSP and three (3) pillars namely DPO and PMP and PM, are rated *High*, this is due to the universities initiative to come up and comply with the necessary requirements even before the directive from PASUC, to avoid sanctions and penalty. Regardless of the 3 pillars rated as *High*, the overall result is still *Pattern B*, which connotes *Partial Compliant*.

Overall after the pattern matching, it was found out that before enactment of DPA 2012 and before NPC took action, BukSU is *Not Compliant*. Although, information systems are already part of the strategic planning and roadmap for five years that is done by the university annually, the terms used for the IS planning and the likes, is not called ISSP but rather, simply integrated to the overall strategic plan and roadmap of the university. This is also because, before the enactment, the law has been toothless, and the information dissemination and making agencies understand the importance of the DPA 2012 was not given much importance. During the enactment of R.A. 10173 and NPC Took Action on the matter, due to its moral obligation to the community, the agency complied, BukSU now is *Partial Compliant*, the university appointed a DPO, drafted manual and applied measures to safeguard the data collected by the university. In the event where, regulating bodies will visit the university to assess the administration, should there be a need to look into a certain employee or student record, consent from the person concerned is already obtained before all data needed is disclosed.

4. CONCLUSIONS

The main objective of this study was to evaluate the level of compliance of Bukidnon State University (BukSU) with RA 10173 after the results were tabulated and interpreted, it was found out that BukSU, just like most government agencies in the Philippines is qualitatively described as *Partial Compliant*. Furthermore, their compliance was due to moral suasion, where BukSU, considers it as its moral obligation to protect the students and its employees' data [14], [15]. An initiative from PASUC, to come up with a Data Privacy Manual that will serve as a model for all PSUCs in drafting their own manual. Although an initial draft was crafted, it was tabled, to align BukSU practices with that of PASUC.

After the September 11, 2017, deadline, BukSU invested in a UTM Unified Threat Management with a three-year license. A hardware with a layer 8 security policy specializes in Network security: firewall, intrusion detection, wireless security; content security: anti-virus, anti-spam, https/SSL content security. UTM also served as bandwidth manager for the Internet, which according to the IT officer interviewed, Sophos UTM is widely used by large industries all over the world and he is confident by the performance of the UTM since there are no records of breaches for this technology yet. Based on the interview a number

of projects that were not stated in the ISSP are added and for implementation once winning bidder will be awarded.

5. FUTURE WORK

Further study on interagency compliance using a comparative method and multiple case synthesis is recommended to empirically test the behavior of compliance amongst other PSUC's and other government agencies.

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Performance Compliance of Philippine National Government Agency on the Data Privacy Act of 2012: A Qualitative Case Study

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ABSTRACT

The “Data Privacy Act of 2012” also known as the Republic Act No. 10173 of the Philippines aims to safeguard the personal data of its citizens, this gave rise to the creation of the National Privacy Commission (NPC) in 2015 and this agency is tasked to oversee and enforce the DPA of 2012. This case study aims to explore and understand the underpinning reasons on how the Department of Health (DOH) will comply with RA 10173 and to identify the challenges and determinants to success of the DOH relative to compliance. The research will implore (Yin, 2014) case study method that uses single case holistic design with common rationale and pattern matching for its analytics. This study uses the e-Commerce Act as the moderating variable with DPA 2012 and the determinants of compliance are deterrence, legitimacy and moral obligation. Also, the challenges that were identified in the research were the lack of awareness, budget priorities, and human capital capacity.

CSS Concepts

• **Social and professional topics** → **Computing / technology policy** → **Privacy policies**

Keywords

Information Security, Data Privacy, Compliance

1. INTRODUCTION

Data privacy is an attribute that corresponds to the relationship between the following; collection, dissemination of data, technology, the classification of privacy relative to public expectation, the political, legal, and other issues that surround them [1]. Whenever, personally identifiable or other sensitive information is collected, stored, used, and finally destroyed or deleted – in digital form or otherwise there will be privacy concerns, because in today’s world of interconnectivity every fragment of a persons’ life is collected whenever they connect to the internet. Therefore, improper or absence of disclosure control can be the root cause for privacy issues and they may give rise in

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response to information acquisition from countless of sources.

The National Privacy Commission (NPC) of the Philippines is an independent body created in response to Republic Act No. 10173 or the Data Privacy Act of 2012. Its obligation; to oversee and apply the provisions of the Act, to monitor and ensure compliance of the Philippines with international standards set for data protection and to protect the basic human right of every individual to privacy, above all information privacy while guarantee the free flow of information for innovation, growth, and national development [2]. The Department of Health (DOH) on the other hand is the technical authority on health. Its core responsibilities are to ensure access to basic health services to the public, provision of quality health care and the oversight of regulations on all health services and products for the Filipinos. Relative to data privacy, “The DOH is committed to ensure the free flow of information as required under Executive Order on the Freedom of Information Act (Executive Order No. 2, s. 2016) and to protect and respect the confidentiality and privacy of data and information as required under the Data Privacy Act of 2012 (Republic Act No. 10173) [3]” For now, the analysis will be to understand the agency’s degree of compliance to RA 10173.

2. REVIEW OF EXISTING STUDIES

2.1 Information Security and Compliance

In a study by (Bulcuru et al, 2010) [4], they believe that evidence regarding the impact of motivational factors apart from rewards and sanctions reinforce an employee’s behavior towards compliance and that outcomes play an important role in the employee’s consequential belief. It is suggested that information security awareness should be designed around these outcome beliefs, and some of these areas are intrinsic cost and benefit, safety, and vulnerability. It is also believed that practitioners can use external instruments to complement their security training and awareness programs because rewards influence the perceptions of benefit of compliance which therefore, affects the employees’ attitude towards it. It is equally important to note that work barriers are costly and that organizations should allocate time for employees to accomplish compliance requirements and that they do not interfere with their day-to-day job activities [5]. (Hong, Chi, Chao, & Tang, 2003) [6] in their study of integrated system theory of information security management, they said that firms today are dependent on information technology and information security and it has been the subject of a great deal of attention recently. Unfortunately, only a few information security strategies and guidelines are available for knowledge consumption at any given time. Therefore, this has led to a deficiency in rational and comprehensive information security management theory. Their paper integrates perspectives from security policy, risk

management, such as control and auditing, MIS and contingency theories. It contributes the following;

- It explains organizational behavior regarding information security management strategies.
- The theory proposed in this paper could be applied to predict organizational attitudes and behavior
- The theory could be a building block for further information security management research.

2.2 Republic Act No. 8792 of the Philippines

R.A. 8792 also known as “e-Commerce Act of 2000” aims to facilitate domestic and international dealings, business transactions, arrangements, agreements, contracts, and exchanges and storage of information through the utilization of electronic, optical, and technology medium [7] to recognize the authenticity and reliability of the electronic documents, thus promoting the universal use of electronic transaction in the government and general public [8]”. This regulation is one of the key concepts that allows for the success of the Republic Act No. 10173.

2.3 Republic Act No. 10173 of the Philippines

The Data Privacy Act, aims to protect individuals from the unauthorized processing of personal information that is identified as private, not for public consumption; and identifiable, where the identity of the individual is evident either through direct attribution or when put together with other available information [2].

2.4 Republic Act No. 10175 of the Philippines

The Cybercrime Prevention Act of 2012, or Republic Act No. 10175, is a law enacted on September 12, 2012. Its objective is to address the legal issues relating to online behavior and the Internet in the Philippines. Among the offenses listed are cybersquatting, cybersex, child pornography, identity theft, illegal access to data and libel [9]. The law was developed in response to the case of Onel De Guzman, a dropout from AMA Computer College who claims to have authored the ILOVEYOU worm. De Guzman was not prosecuted by the authorities as there was no legal basis for him to be charged with cybercrime at the time of his arrest. The government aims to take a step forward in preventive countermeasures with the Cybercrime Prevention Act and Data Protection Act [10].

3. RESEARCH QUESTIONS AND OBJECTIVES OF THE STUDY

The main objective of this research study is to determine the degree of compliance by the Department of Health relative to the Data Privacy Act of 2012. Consequently, the main research question is how has the Department of Health (DOH) complied with Republic Act 10173 of the Philippines? To answer this, specific research questions were formulated:

1. What are the data processes that deal with personal data?
2. How do the determinants of compliance [5] affect Department of Health to comply with DPA 2012?
3. How does the compliance of government agencies with the e-Commerce Act of 2000 impact its compliance with the DPA 2012?

4. SCOPE OF THE STUDY

This research study focuses on the Department of Health, as the prime agency with regards to its compliance to R.A. 10173 and the National Privacy Commission (NPC) which is under the

Department of Information and Communications Technology (DICT) as the regulating body in matters of data privacy.

5. METHODOLOGY

This research will use the (Yin, 2011) [11] case study model. It is a qualitative case study method that investigates the empirical connections between a contemporary phenomenon vis-à-vis real-world context, see figure 1.

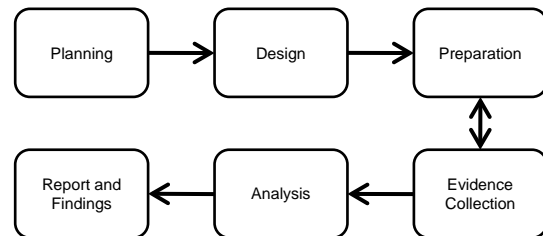


Figure 1. Case Study model

Due to the importance of the behavioral aspects of information security, there has been an increase in research focusing on organizational information security practices as well as individual security behaviors [12]. As a result, many security breaches may be from negligence or ignorance of security policies and perhaps of employees who choose not to comply with security policies for reasons of convenience in their day-to-day routine.

5.1 Planning

This phase involves the crafting and designing of the research questions where the questions “how” and “why” are focused on contemporary events thus validating an Explanatory approach and that the case study is an empirical inquiry that 1). Investigates a contemporary phenomenon we can refer to as “the case” in depth and within its real-world context, especially when 2). The boundaries between phenomenon and context may not be clearly evident [11]. Therefore, defining the research questions may likely be the most important step to be undertaken in this research. Now, the key is to understand that research questions are two folds. First is substance, which asks “what is the study about?” The second is form, these are who, what, where, why and how questions [13]. Moreover, (Yin & Davis, 2007) [14] describes that the case study research is undertaken because of the desire to understand a real-world case context.

5.2 Design

We can think of design as the blueprint of the research, because it deals with four problems: what questions to study, what data are relevant, what data to collect and how to analyze the results [15]. Simply put a research design includes five components, defining the research questions, proposition, and the unit of analysis that will steer the researcher towards the relevant data to be gathered. The core of design is to make sure that the evidence is relevant to the research question. Hence, the research will be on the DOH because compliance is vital of each agency and of the individuals within the agency. In addition, the focus of this empirical work is on a single government entity and therefore, a Single Case Holistic design of a case study approach will be used.

5.3 Preparation

The objective of the study is not to criticize the Department of Health but rather to create value from the development of a theoretical proposition which is the goal of the researcher. Regardless of whether the research is exploratory, descriptive, or explanatory. The theoretical propositions will provide immense

support in allowing the design and data collection to be congruent and that this same concept allows for the formation of the general findings relative to the case. Since, this study implores explanatory and exploratory, the researcher is able to formalize and gain approval and consent from the department by providing an authorization letter and was allowed to conduct interviews to some of the key personnel of the agency that had information critical to data privacy. Documentation on the other hand were also provided to the researcher for further triangulation of data.

5.4 Evidence Collection

The primary sources of data were collected in the form of documentation and specific interviews facilitated by the researcher. The agency Information Systems Strategic Plan (ISSP) provided the guidelines with which the data gathering was conducted. Furthermore, the ISSP's were congruent to R.A. 10173 or DPA of 2012 compliance. The interviews were towards a specific group of individuals who were identified to be of critical importance to the case study. Similarly, data triangulation between the documentation and interviews assisted in reinforcing the validity of the construct relative to the case.

5.5 Analysis

The researcher used the model for determinants of compliance by (Sutinen & Kuperan, 1999) [5] shown in Figure 2.

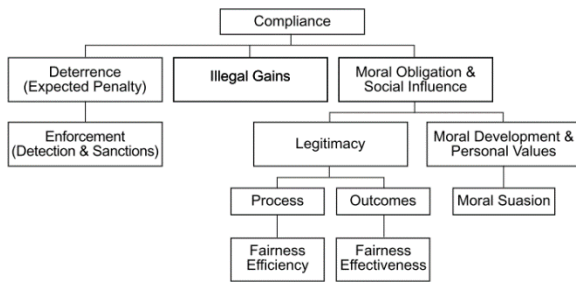


Figure 2. Determinants of Compliance

The evidence presents only three constructs that were applicable to compliance with DPA of 2012. These are (a) Deterrence, (b) Legitimacy, and (c) Moral Obligation. Deterrence is the strategy with which entities thwart actions that are classified as violations. Violations occur when the benefits less the expected costs of violating exceed or equal the benefits of compliance [5]. Legitimacy involves four sets of an authority's characteristics. First is effectiveness of outcome which involves the extent to which conservation is realized and an individual is better off. Second is the distributive justice of the outcome, this involves the perceived fairness of how the benefits or sacrifices are shared among parties. Third is the effectivity of the process, this involves the speed and efficiency at which people perceive the authority responding to problems is within the scope of the authority's jurisdiction. And finally, procedural justice which involves how fairly the authority treats people and the concerns of those affected by the process. Moral obligation and social influence are based on the perceived legitimacy of the authorities charged with implementing the regulations. Hence, political and legal institutions in society, and regulatory bodies should devote great effort in developing legitimacy [5]. Therefore, deterrence describes the repercussions of non-compliance with DPA 2012 have expedited the compliance of DOH with e-Commerce Act of 2000 which therefore allowed it to be partially compliant with DPA 2012 this is evident through the assignment of a DPO after

the enactment and even before the NPC took action. Legitimacy and moral obligation are non-issues as the DPA 2012 is a law enacted towards the protection of all citizens. The overall operational framework is presented Figure 3. Operational framework adapted from the output of (Celis, 2017) [16].

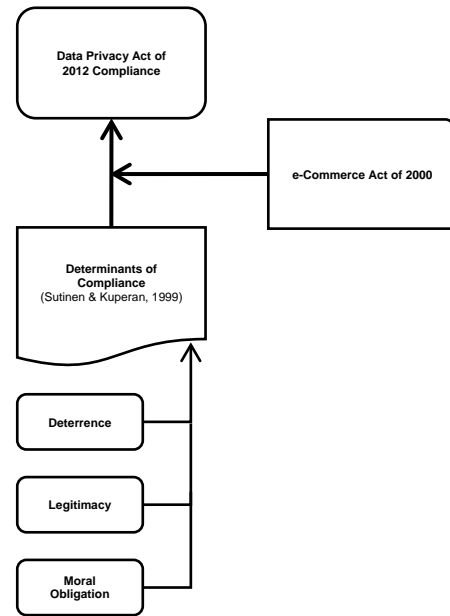


Figure 3. Operational Framework

In reference to analytics, the researcher used pattern matching (Trochim, 1989) [17] on the information gathered for analysis as presented in Figure 4.

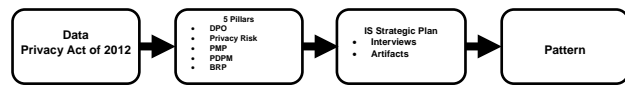


Figure 4. Pattern matching model

Trochim and Yin defined pattern matching as a method where the patterns are compared with empirical patterns [11], [17]. The table was adapted from an earlier work of (Ching, 2017) [18] relative to the compliance status the Department of Health with R.A. 10173 [18] as presented in Table 1.

Table 1. Compliance Pattern

Pattern	ISSP	Five (5) Pillars	Match
Pattern A	High	High	Fully Compliant
Pattern B	High	Medium to High	Partial Compliant
Pattern C	Low	Low	Not Compliant

By using the ISSP document the researcher can identify an agency's compliance status through cross referencing against the DPA 2012 five (5) pillars, a score of High would mean that the agency is fully compliant whereas a score of Medium to High would mean a score of partially compliant and an N/A would be Low compliant. How the score is rated would be based on the process with which agency went on to address the issue.

5.6 Report & Findings

In this phase, the outcome of the case study will be presented in a manner understandable to a multitude of audiences. The empirical evidence and results of this study will also be provided.

6. FINDINGS

This presents the list of information systems and includes the offices responsible, the internal processors and also the external processors for the Department of Health. See table 2

Table 2. IS With Personal Data

DEPARTMENT OF HEALTH				
DETAILED DESCRIPTION OF INFORMATICS				
Presence of Personal Data				
NAME OF INFORMATION SYSTEM/SUB-SYSTEM				
EXISTING	Yes/No	Responsible office	Internal Processor	External Processor
1. HEALTH REGULATION				
1.1 Integrated DOH Licensing Information System (IDLIS)	N	BHFS FDA- CDRRHR & CDRR	BHFS CDRRHR & CDRR NCPAMNCHFD	Hospitals OFW Clinics POEA Dialysis Clinics OFWs General Public
1.2 Integrated Drug Test Operations and Management Information System (IDTOMIS)	Y	DDAPTP BHFS		Drug Testing Laboratories, LTO, DEPED, DDB, Schools, Employers other data beneficiaries
1.3 Integrated Food and Drug Administration Information System (FDAIS)	N	FDA	FDA NCPAM CHDs Hospitals	All health products establishment and health products, Public
1.4 Adverse Drug Online Reporting System (ADORS)	N	FDA	NEC, NCPDC CHD Hospitals	All health facilities, Phil. Research Ethics Board, Institution Ethics Review Committees, Pharmaceutical Companies
2. HEALTH FINANCING				
2.1 PhilHEALTH Financial Management Information System (PFMS)	N			
2.2 Health Care Investment and Performance Monitoring System (HCIPMS)	N	HPDPB BIHC	OSEC Technical & Operations Cluster	All health investors/donors/ development partners
3. HEALTH SERVICE DELIVERY				
3.1.1 Electronic Field Health Services Information System (EFHSIS)	Y	NEC	NEC, NCDPC HPDPB CHDs HSD	All rural health units/provinces/ regions
3.1.2 Clinic Information System (CIS)	Y	NCHFD NEC	NCHFD NCDPC Hospitals	Other Government agencies especially statistics bodies, RHU/HC,
3.1.3 Filariasis Information System (FIS)	Y	NCDPC	NCHFD NEC CHD	All health facilities UP- NIH
3.1.4 Schistosomiasis Information System (SIS)	Y	NCDPC	NCHFD NEC CHD	All health facilities
3.1.5 Watching Over Mothers and Baby (WOMB)- Maternal and Neonatal Health Tracking System	Y	NCDPC	NCHFD NCDPC Hospitals	General Public, RHU/HC Hospitals

There are four (4) major systems and sixty (60) sub-systems. Twenty-two (22) of which deals with personal data as identified by “Y” in column 2, this indicates the presence of personal data. The data also includes additional information such as the responsible office, internal and external processors. However, it is important to note that some of these systems are under development or maybe nearing completion, also some are outsourced as indicated in the interview. Within the list we can see that National Center for Disease Prevention & Control (NCPDC) and Information Management Service (IMS) are the offices with the most involvement in data privacy and towards compliance with R.A. 8792 or the e-Commerce Act of 2000 [7], once accomplished the agency is well on its way towards full compliance to the DPA of 2012. The IMS specifically needs to adopt and upgrade as soon as possible because of its role as the backbone of the information system architecture of the agency. In reference to regulatory compliance the DOH is very much concerned with sanctions and enforcement since the law has been passed. Also, it is fundamental for the agency to safeguard its information, but the agency has to overcome a variety of challenges as well namely; budget prioritization, internal bureaucracy, management commitment, human capital expertise, project management execution. At the moment they are developing measures that will conform to the e-Commerce law such as encryption, e-signatures and other security measures among others. Pattern matching was done to analyze the empirical study against the predicted pattern. See Table 3.

Table 3. Pattern Matching Result

Case	Source	Event	Expected Rating		ISPP					5 Pillars		Match			
			Evidence	Rating	Evidence	Rating	Evidence	Rating	Evidence	Rating	Evidence	Rating	Match		
DOH	Documents/Archival Records	After Enactment of RA 10173	SSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
		Before NPC Took Action	SSP	Low	DPO	n/a	PIA	n/a	PMP and PM	n/a	PDPM	n/a	BRP	n/a	Pattern C
	During Enactment of RA 10173 and After NPC Took Action	SSP	High	DPO	High	PIA	High	PMP and PM	High	PDPM	Medium	BRP	High	Pattern B	
	Interviews	During Enactment of RA 10173 and After NPC Took Action	SSP	High	DPO	High	PIA	High	PMP and PM	High	PDPM	Medium	BRP	High	Pattern B

Legend: SSP Data Privacy Officer
PIA Privacy Impact Assessment
PMP and PM Privacy Management Program and Privacy Manual
PDPM Privacy and Data Protection Measures
BRP Breach Reporting Procedures

The results presented show that after the enactment of RA 10173 and before the NPC took action the agency had a rating to “N/A” on four (4) of the five (5) pillars of the NPC. This granted the agency ISSP a LOW rating, and thus matched with Pattern C. However, during the enactment of RA 10173 and after the NPC took action, the agency significantly improved its position on regulatory compliance. The agency ISSP went from a predominantly “N/A” and LOW rating to HIGH on four (4) out of five (5) areas and a MEDIUM rating on Privacy and Data Protection Measure (PDPM) netting it a pattern B partially compliant rating. Suffice to say that the agency has put together a really compelling action plan and implemented on its commitment. It is only a step away from being fully compliant and matched with pattern A.

The researcher conducted interviews in order to triangulate the cause and effect of on how the agency PDPM was not rated fully compliant with pillar four (4). The cause behind it is that it is still under development, at the time of the interview the level of sophistication of the controls were rather under developed, but they were in place. This resulted in a pattern that matched pattern B, hence partially compliant.

7. CONCLUSIONS

Upon initial review, the results of the pattern matching reveal that the DOH was not compliant with the DPA 2012. Perhaps the details of data privacy were not defined before. In the Philippines, very few really understood the gravity of compromised personal data. While the country has a rather passive attitude towards change and innovation, it has struggled to keep up with its other Asian counterparts. The DOH as a government agency is also subject to the same disadvantages that other agencies suffer from and the concerns raised relative to the challenges in implementing compliance were; the lack or even the absence of awareness of the subject and having the right people with the right skill set at the right time was also a great challenge. Bureaucracy and budget prioritization were the byproducts of the lack of awareness and were cited to be the causes of compliance failure. On the other hand, upon the time of this research the agency has been partially compliant to the DPA 2012 and the elements of compliance such as deterrence, legitimacy and moral obligation have played well in this case, they served as catalysts to conformity with DPA 2012 soon enough the agency will be fully compliant as this was observed in the continuous development and improvement of the agency. Furthermore, its commitment is unquestionable as its management is unwavering in making it compliant before the deadline in March 8, 2018.

8. FUTURE WORK

It is recommended that further study of the agency be conducted after the deadline extension. In addition, a comparative method

and multiple case syntheses could be conducted to cross reference other agencies against the DOH.

9. ACKNOWLEDGMENTS

The researcher would like to acknowledge the critical contributions of individuals who were the catalyst for its success. Dr. Nelson Celis for his work on compliance and information security on government agencies and his network of experts in the field of data privacy and information security and Asst. professor Vicente Pitogo for his support and contribution to this study and the De La Salle University Office of the Vice Chancellor for Research and Innovation. Finally, to the Department of Health for allowing the author to conduct this case study.

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Compliance Performance of a Large Local Company to Electronic Commerce Act of 2000 and Data Privacy Act of 2012: A Case Study Approach

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ABSTRACT

Electronic commerce and data privacy have become a very important aspect of performing business in the Philippines. This research study aims to ascertain the compliance performance of a large local company to the Electronic Commerce Act of 2000 (R.A. 8792) and Data Privacy Act of 2012 (R.A. 10173). Through Outcome Pattern Matching, it has been determined that, though the company is fully compliant with the applicable sections of R.A. 8792, it is Partially Compliant (High) to R.A. 10173 with few challenge areas. Using Benchmarking Process, this research study also recommends factors that could improve the compliance performance of the company. The following dimensions should be considered: (1) spontaneous compliance, (2) control and (3) sanctions. Further, the company should take into account not just the legal aspects of the Republic Acts but also the value-based ethics and business case of compliance.

CCS Concepts

• **Social and professional topics** → **Computing / Technology policy** → **Privacy policies.**

Keywords

Electronic Commerce Act of 2000; RA8792; Data Privacy Act of 2012; RA10173; Pattern Matching; Benchmarking.

1. INTRODUCTION

1.1 Background of the Study

In a currently connected world, electronic commerce and data privacy have become a very important aspect of doing business throughout world. The same is true in the Philippines. Government and private companies invest resources in enabling e-commerce and in ensuring data privacy. Policies and systems are defined to regulate electronic transactions and data. This study focuses on a large Filipino company (the Company) and its compliance to Philippine regulations on e-commerce and on data privacy.

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1.2 Research Questions and Objectives

The objectives of the research study are:

- To determine the compliance performance of the Company to: Electronic Commerce Act of 2000 (R.A. 8792) and Data Privacy Act of 2012 (R.A. 10173).
- To give recommendations to the Company to increase or maintain its compliance performance.

Specifically, this case study aims to answer the following questions:

Research Question A (RQ A). What is the compliance performance of the Company to the specified Republic Acts?

Research Question B (RQ B). What actions should the Company perform to increase or maintain its compliance performance?

2. METHODOLOGY

The research study model used in this report is shown in Figure 1.

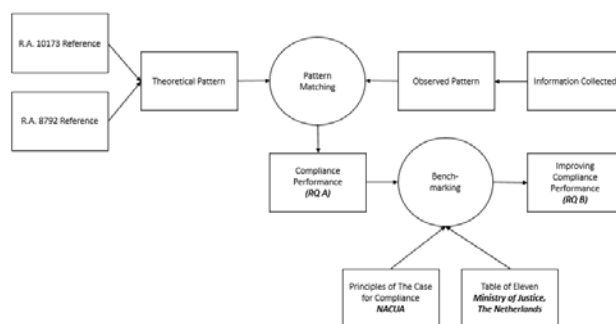


Figure 1. Research Study Model

To answer RQ A, Outcome Pattern Matching of Trochim (1989) has been applied to analyze the information and documents collected from the Company. According to Trochim, this method involves the design of a theoretical pattern, the collection of an observed pattern and an attempt to match these two [1]. Table 1 shows the theoretical compliance performance patterns used for the Company. The bases of the theoretical pattern are the provisions and references of R.A. 8792 and R.A. 10173.

Table 1. Compliance Pattern

Pattern	%	Match
Pattern A	100%	Fully Compliant
Pattern B	50-99%	Partially Compliant (High)
Pattern C	1-49%	Partially Compliant (Low)

Pattern	%	Match
Pattern D	0%	Non-Compliant

To answer RQ B, Benchmarking Process of Elmuti and Kathawala (1994) has been used. This technique identifies high standards of excellence, matching it with the existing performance and specifying programs and actions to meet or surpass the performance of excellence [2]. The following are used as standards for benchmarking: (1) “Table of Eleven” of The Ministry of Justice of Netherlands and (2) “Principles of the Case for Compliance” of the National Association of College and University Attorneys (NACUA).

3. OVERVIEW

3.1 Review of the IS of the Company

The Company is a large local business organization specializing in telecommunications and mass media services. Its Information Technology Division is responsible for managing and maintaining 184 Information Systems (IS), excluding those of subsidiaries and affiliates. These application systems, as shown in Table 2, are classified into (1) Critical, (2) Medium-Critical and (3) Low-Critical.

Table 2. Information Systems Classification of the Company

Classification	Description	No. of Applications	%
Critical	Regulatory, Mission Critical, Has Financial Impact	32	17
Medium-Critical	Internal Business Processes	66	36
Low-Critical	Limited Internal or Departmental Processes	86	47
TOTAL		184	100

Table 3. In-Scope Information Systems of the Company

Item	Application Name	Description	Owner	Status	Personal Data
1	Content Distribution System	Application used to distribute content from one medium to another.	Content Owner	Active	Yes
2	Content Management System A	Application used to manage contents for a specific medium A.	Content Owner	Active	Yes
3	Content Management System B	Application used to manage contents for a specific medium B.	Content Owner	Active	Yes
4	Cost Monitoring System	Application that monitors the costs of the Company.	Finance Department	Active	Yes
5	Customer Database System	Application that collects customer information.	Customer Management Department	Active	Yes
6	Financial System	Application that manages the financial aspects of the Company.	Finance Department	Active	Yes
7	Inventory Management System	Application that manages the inventory of resources from reservation, issuance and return.	Engineering Department	Active	Yes
8	Invoice System	Application that processes accounts payable.	Finance Department	Active	Yes
9	Meta Data System	Application that handles the recording of logged conversations, activities and observations, corresponding content. This is used for Content development	Content Owner	Active	Yes
10	Payroll System A	Application that computes, records, monitors a classification of employees / personnel, including tax withheld and other deductions.	Human Resource Department	Active	Yes
11	Payroll System B	Application that computes, records, monitors the remaining classification of employees / personnel, including tax withheld and other deductions.	Human Resource Department	Active	Yes
12	Payroll System C	Application that records budgets and personnel attendance. Data are interfaced to Payroll System B.	Human Resource Department	Active	Yes
13	Payroll System D	Application that consolidates services rendered by the personnel. Corresponding rates are applied and system computes for the gross pay. Data are interfaced to Payroll System B.	Human Resource Department	Active	Yes
14	Revenue System A	Application that captures order placements to content distribution, with billing and interface with financial systems for payment and collection.	Revenue Department	Active	Yes
15	Revenue System B	Application that captures order placements to content distribution, with billing and interface with financial systems for payment and collection. This is used for groups located outside the country.	Revenue Department	Active	Yes
16	Single Sign On System	Application that enables Single Sign On for the Company for client facing digital assets.	Customer Management Department	Active	Yes
17	SMS Platform	Application that handles Value-Added-Services, supporting all service business models from different business units.	Business Unit	Active	Yes
18	Website A	Application that handles the tabulation of specific government event data and is the source of content.	Content Owner	Active	Yes
19	Website B	Application that handles specific government event data and is the source of content.	Content Owner	Active	Yes

Out of the 32 Critical applications, 19 contain personal data. Thus, the scope of this study is to focus on these 19 applications, as shown in Table 3.

3.2 Philippine Government Laws

3.2.1 Electronic Commerce Act of 2000 (R.A. 8792)

The Act has been passed by the Senate and House of Representatives last June 2000. The purpose of this Act is to “facilitate domestic and international dealings, transactions, arrangements, agreements, contracts and exchanges and storage of information through the utilization of electronic, optical and similar medium, mode, instrumentality and technology to recognize the authenticity and reliability of electronic documents related to such activities and to promote the universal use of electronic transaction in the government and general public” [3]. Its Implementing Rules and Regulations has been promulgated a month after [4]. Further, The Philippine Department of Trade and Industry released the Philippine E-Commerce Roadmap for 2016-2020 [5].

The Act contains 5 parts with 42 sections, of which 24 are applicable for Pattern Matching against the Company and its IS. These are summarized in Table 4.

Table 4. Applicability of R.A. 8792 with the Company and Its Information Systems

R.A. 8792	Applicability for Pattern Matching
PART I. SHORT TITLE AND DECLARATION OF POLICY	
1 Short Title	N/A
2 Declaration of Policy	N/A
PART II. ELECTRONIC COMMERCE IN GENERAL	
3 Objective	N/A
4 Sphere of Application	N/A
5 Definition of Terms	N/A
CHAPTER II. LEGAL RECOGNITION OF ELECTRONIC WRITING OR DOCUMENT AND DATA MESSAGES	
6 Legal Recognition of Electronic Data Messages	Yes
7 Legal Recognition of Electronic Documents	Yes
8 Legal Recognition of Electronic Signatures	Yes
9 Presumption Relating to Electronic Signatures	Yes
10 Original Documents	Yes
11 Authentication of Electronic Data Messages and Electronic Documents	Yes
12 Admissibility and Evidential Weight of Electronic Data Message and Electronic Documents	Yes
13 Retention of Electronic Data Message and Electronic Document	Yes
14 Proof By Affidavit	Yes
15 Cross-Examination	Yes
CHAPTER III. COMMUNICATION OF ELECTRONIC DATA MESSAGES AND ELECTRONIC DOCUMENTS	
16 Formation and Validity of Electronic Contracts	Yes
17 Recognition by Parties of Electronic Data Message or Electronic Document	Yes
18 Attribution of Electronic Data Message	Yes
19 Error on Electronic Data Message or Electronic Document	Yes
20 Agreement on Acknowledgment of Receipt of Electronic Data Messages or Electronic Documents	Yes
21 Time of Dispatch of Electronic Data Messages or Electronic Documents	Yes
22 Time of Receipt of Electronic Data Messages or Electronic Documents	Yes
23 Place of Dispatch and Receipt of Electronic Data Messages or Electronic Documents	Yes
24 Choice of Security Methods	Yes
PART III. ELECTRONIC COMMERCE IN SPECIFIC AREAS	
CHAPTER I. CARRIAGE OF GOODS	
25 Actions Related to Contracts of Carriage of Goods	Yes
26 Transport Documents	Yes
PART IV. ELECTRONIC TRANSACTIONS IN GOVERNMENT	
27 Government Use of Electronic Data Messages, Electronic Documents and Electronic Signatures	N/A
28 RPWEB To Promote the Use Of Electronic Documents and Electronic Data Messages In Government and to the General Public	N/A
29 Authority of the Department of Trade and Industry and Participating Entities	N/A
PART V. FINAL PROVISIONS	
30 Extent of Liability of a Service Provider	Yes
31 Lawful Access	Yes
32 Obligation of Confidentiality	Yes
33 Penalties	N/A
34 Implementing Rules and Regulations	N/A
35 Oversight Committee	N/A
36 Appropriations	N/A
37 Statutory Interpretation	N/A
38 Variation by Agreement	N/A
39 Reciprocity	N/A
40 Separability Clause	N/A
41 Repealing Clause	N/A
42 Effectivity	N/A
TOTAL APPLICABILITY	
% APPLICABILITY	
24	
57%	

3.2.2 Data Privacy Act of 2012 (R.A. 10173)

The Philippine Government through the National Privacy Commission (NPC) released the Implementing Rules and Regulations of R.A. No. 10173 last August 2016 [6]. The Policy aims to “protect the fundamental human right of privacy of

communication while ensuring free flow of information to promote innovation and growth” [7].

A toolkit released by the NPC has 5 Pillars of Data Privacy Accountability and Compliance: (1) Commit to Comply: Appoint a Data Privacy Officer, (2) Know Your Risks: Conduct a Privacy Impact Assessment, (3) Write Your Plan: Create Your Privacy Management Program, (4) Be Accountable: Implement your Privacy and Data Protection (PDP) Measures, and (5) Be Prepared: Regularly exercise your Breach Reporting Procedures [8]. All the 5 Pillars are applicable for Pattern Matching with the Company and its Information Systems.

3.3 Select International High Standards for Excellence

3.3.1 Table of Eleven

According to Organisation for Economic Co-operation and Development (OECD), “The Netherlands has engaged in pioneer work to ensure that compliance and enforcement are considered at the start of the rule-making process.” [9]. In 1993, the Netherlands Inspectorate of Law Enforcement, under the Ministry of Justice, together with the Rotterdam Erasmus University and Dick Ruimschotel, established the Table of Eleven (T11) Key Determinants of Compliance. According to T11, there are 11 factors that determine compliance with laws and regulations. These factors are further categorized into 3: (1) Spontaneous compliance dimensions, (2) Control dimensions, and (3) Sanctions dimensions [10]. Figure 2 illustrates these dimensions and factors.

The Netherlands Table of Eleven (T ¹¹) key determinants of compliance	
The T¹¹ factors:	
<i>Spontaneous compliance dimensions</i> (factors that affect the incidence of voluntary compliance – that is, compliance that would occur in the absence of enforcement):	
T1.	<i>Knowledge of rules:</i> Target group familiarity with laws and regulation, clarity (quality) of laws and regulations.
T2.	<i>Cost-benefit considerations:</i> Material and non-material advantages and disadvantages resulting from violating or observing regulation.
T3.	<i>Level of acceptance:</i> The extent to which the target group (generally) accepts policy, laws, and regulations.
T4.	<i>Normative commitment:</i> Innate willingness or habit of target group to comply with laws and regulations.
T5.	<i>Informal control:</i> Possibility that non-compliant behaviour of the target group will be detected and disapproved of by third parties (i.e. non-government authorities), and the possibility and severity of sanctions that might be imposed by third parties (e.g. loss of customers/contractors, loss of reputation).
<i>Control dimensions</i> (the influence of enforcement on compliance):	
T6.	<i>Informal report probability:</i> The possibility that an offence may come to light other than during an official investigation and may be officially reported (whistle blowing).]
T7.	<i>Control probability:</i> Likelihood of being subject to an administrative (paper) or substantive (physical) audit/inspection by official authorities.
T8.	<i>Detection probability:</i> Possibility of detection of an offence during an administrative audit or substantive investigation by official authorities. (The probability of uncovering non-compliance behaviour when some kind of control is applied).
T9.	<i>Selectivity:</i> The (increased) chance of control and detection as a result of risk analysis and targeting firms, persons or areas (i.e. extent to which inspectors succeed in checking offenders more often than those who abide by the law).
<i>Sanctions dimensions</i> (the influence of sanctions on compliance):	
T10.	<i>Sanction probability:</i> Possibility of a sanction being imposed if an offence has been detected through controls and criminal investigation.
T11.	<i>Sanction severity:</i> Severity and type of sanction and associated adverse effects caused by imposing sanctions e.g. loss of respect and reputation.
Source: Dick Ruimschotel, Compliance Methodology Consultants, Amsterdam and But Klaasen, Ministry of Justice, the Hague.	

Figure 2. Table of Eleven

3.3.2 Principles of the Case for Compliance

NACUA, based in the U.S., is “the premier organization in the field of higher education law and a primary source of information on legal developments facing colleges and universities” [11].

The organization has set the three “Principles of the Case for Compliance”: (1) The Legal Case for Compliance, (2) The Value Case for Compliance and (3) The Business Case for Compliance [12]. Figure 3 illustrates these cases.

A. The Legal Case for Compliance: Universities should have ethics and compliance programs to ensure they fulfill their U.S. and international legal and regulatory obligations.
B. The Value Case for Compliance: Ethics and compliance programs enhance the university's community culture.
C. The Business Case for Compliance: Academic, business and administrative processes benefit from ethics and compliance programs.

Figure 3. Principles of the Case for Compliance

4. RESULTS

4.1 Compliance Performance

Applying the Outcome Pattern Matching technique of Trochim (1989), the Company and its Information Systems follow Pattern A or are Fully Compliant to R.A. 8792.

However, it is Partially Compliant (High) to all the five pillars of R.A. 10173.

Table 5 shows the summary of results.

Table 5. Summary of Outcome Pattern Matching Results

	Applicability	Theoretical Pattern	Observed Pattern	%	Match
Electronic Commerce Act of 2000					
Short Title and Declaration	0	N/A	N/A	N/A	N/A
Electronic Commerce in General	0	N/A	N/A	N/A	N/A
Legal Recognition	10	20	20	100%	Pattern A
Communication	9	18	18	100%	Pattern A
Carriage of Goods	2	4	4	100%	Pattern A
e-Transactions in Government	0	N/A	N/A	N/A	N/A
Final Provisions	3	6	6	100%	Pattern A
Data Privacy Act of 2012					
Commit to Comply	4	8	6	75%	Pattern B
Know Your Risk	4	8	5	63%	Pattern B
Write Your Plan	7	14	8	57%	Pattern B
Be Accountable	15	30	18	60%	Pattern B
Be Prepared	3	6	4	67%	Pattern B

4.1.1 Compliance Performance of the Company to R.A. 8792

A scoring mechanism to analyze the Compliance Performance of the Company through evidences has been designed to systematically observe the patterns in its IS. The scoring system is shown in Table 6.

Table 6. Scoring System

Score	Description
2	With documented or physical evidence, or common practice
1	Verbal confirmation from resource person or informal practice
0	No evidence

Through Pattern Matching technique, it has been determined that the Company is Fully Compliant with all the applicable provisions of R.A. 8792. Table 7 shows the results for Outcome Pattern Matching. The Company has recognized electronic data messages and signatures as a legal basis. It has been incorporating security and audit trails in its electronic communications and IS. Further, contracts and transport documents of the Company follow the regulations stated in the R.A. Finally, the Company is obligated to lawful access and confidentiality of the data communicated through electronic means.

Table 7. Outcome Pattern Matching Results for R.A. 8792

R.A. 8792	Theoretical Pattern	Observed Pattern	%
CHAPTER II. LEGAL RECOGNITION OF ELECTRONIC WRITING OR DOCUMENT AND DATA MESSAGES			
6. Legal Recognition of Electronic Data Messages			
6.1 Legal Recognition of Electronic Documents	2	2	
8. Legal Recognition of Electronic Signatures	2	2	
9. Presumption Relating to Electronic Signatures	2	2	
10. Original Documents	2	2	
11. Authentication of Electronic Data Messages and Electronic Documents	2	2	
12. Admissibility and Evidential Weight of Electronic Data Messages and Electronic Documents	2	2	
13. Retention of Electronic Data Message and Electronic Document	2	2	
14. Proof By Affidavit	2	2	
15. Cross-Examination	2	2	
TOTAL	20	20	100%
CHAPTER III. COMMUNICATION OF ELECTRONIC DATA MESSAGES AND ELECTRONIC DOCUMENTS			
16. Formation and Validity of Electronic Contracts	2	2	
17. Recognition by Parties of Electronic Data Message or Electronic Document	2	2	
18. Attribution of Electronic Data Message	2	2	
19. Error on Electronic Data Message or Electronic Document	2	2	
20. Agreement on Acknowledgment of Receipt of Electronic Data Messages or Electronic Documents	2	2	
21. Time of Dispatch of Electronic Data Messages or Electronic Documents	2	2	
22. Time of Receipt of Electronic Data Messages or Electronic Documents	2	2	
23. Place of Dispatch and Receipt of Electronic Data Messages or Electronic Documents	2	2	
24. Choice of Security Methods	2	2	
TOTAL	18	18	100%
PART III. ELECTRONIC COMMERCE IN SPECIFIC AREAS			
CHAPTER I. CARRIAGE OF GOODS			
25. Actions Related to Contracts of Carriage of Goods	2	2	
26. Transport Documents	4	4	
TOTAL	6	6	100%
PART V. FINAL PROVISIONS			
30. Extent of Liability of a Service Provider	2	2	
31. Lawful Access	2	2	
32. Obligation of Confidentiality	2	2	
TOTAL	6	6	100%

4.1.2 Compliance Performance of the Company to R.A. 10173

Using the same methodology discussed in the previous section, it is uncovered that the Company is Partially Compliant (High) to R.A. 10173. The results are shown in Table 8.

Table 8. Outcome Pattern Matching Results for R.A. 10173

R.A. 10173	Theoretical Pattern	Observed Pattern	%
Pillar 1: Commit to Comply: Appoint a Data Protection Officer (DPO)			
Sec. 21 of the DPA, Section 50 of the 50, Circular 16-01, and Advisory 17-01			
Appoint an individual accountable for compliance			
Notarized designation of a DPO/COP, filed with the NPC	2	2	
Evidence that DPO/COP recommendations are taken into consideration when making decisions	2	2	
Contact details are easy to find (e.g. on website)	2	1	
Continuing education program for the DPO/COP	2	1	
Total	8	6	75%
Pillar 2: Know Your Risks: Conduct a Privacy Impact Assessment (PIA)			
Sec. 20(c) of the DPA, Section 29 of the IRR, Advisory 17-03			
Know the risks represented by the processing to the rights and freedoms of data subjects			
Up-to-date organizational inventory of processes that handle personal data, including the list of process owners	2	1	
PIAs have been conducted, and are owned and kept up-to-date by the process owner	2	1	
Stakeholders (those involved in the information life cycle) have been consulted as part of the PIA process	2	2	
PIA includes a privacy risk map, a list of controls, an implementation plan, and a monitoring/evaluation milestone	2	1	
Total	8	5	63%
Pillar 3: Write Your Plan: Create Your Privacy Management Program (PMP)			
Sec. 11-15 of the DPA, Sections 21-23 and 43-45 of the IRR, Circulars 16-01 and 16-02			
Processing of data is according to privacy principles of transparency, legitimate purpose, and proportionality			
Personal data is processed as per Sections 12 and 13 of the DPA	2	1	
Privacy principles are embedded into HR, Marketing, Operations, Security, and IT policies, are cascaded throughout the organization, and are updated as needed	2	1	
Data handlers have security clearance and privacy training	2	1	
Privacy notices are posted where appropriate (e.g. on website)	2	1	
Data sharing agreements are in place	2	1	
Tools in place to monitor compliance of the organization	2	2	
Records of data processing are maintained	2	1	
Total	14	8	57%

R.A. 10173	Theoretical Pattern	Observed Pattern	%
Pillar 4: Be Accountable: Implement your Privacy and Data Protection (PDP) Measures			
Sec. 16-18 and 38 of the DPA and Sections 17-24, 34-37 of the IRR and Circular 16-04			
Upholding the rights of data subjects			
Data subjects are apprised of their rights through a privacy notice	2	1	
Consent is obtained prior to the collection and processing of data	2	1	
Data subjects are provided a means to access their data	2	1	
Data subjects are provided a venue to correct/rectify their data	2	1	
Data subjects know who to complain to if their rights are violated	2	1	
Complaints are acted upon quickly (within 30 days)	2	1	
These rights are upheld when invoked by the lawful heirs or assigns of the data subject	2	1	
Sec. 20.a-e, 22 and 24 of the DPA, Sections 25-29 of the IRR, Circular 16-01			
Maintaining confidentiality, integrity, and availability			
Data protection risks have been identified and documented	2	1	
Appropriate and up-to-date organizational, physical, and technical controls are in place to manage these risks (e.g. ISO-IEC 27002)	2	1	
Data protection policies are cascaded throughout the organization and updated as needed	2	1	
Vulnerability scanning is conducted at least once a year	2	2	
Business continuity drills are conducted at least once a year	2	1	
For data stored outside the Philippines, location of foreign country is defined	2	2	
For personal data stored in the cloud, NPC recommends that provider is ISO-IEC 27018 compliant (from Circular 16-01)	2	2	
For digitized personal data, NPC recommends 256-bit AES for data at rest and in transit (from Circular 16-01)	2	1	
Total	30	18	60%
Pillar 5: Be Prepared: Regularly exercise your Breach Reporting Procedures (BRP)			
Sec. 20.f and 30 of the DPA, Sections 38-42 and 57 of the IRR, Circular 16-03			
able to report breach within 72 hours			
Formation of a data breach response team with clearly defined roles and responsibilities	2	1	
Clearly defined and up-to-date incident response procedure	2	2	
Breach drills are conducted at least once a year	2	1	
Total	6	4	67%
TOTAL	66	41	64%

For Pillar 1, the Company’s challenge area is the continuing education of DPO. Its Data Privacy organization is developed in-house with existing roles and responsibilities on top of its new role. PIA (Pillar 2) is being conducted on a per need basis and is currently an ad hoc practice for the Company. The organization is laying the groundwork and is starting to write its PMP (Pillar 3). PDP (Pillar 4) measures are commencing to ensure that the rights of data subjects are upheld and that confidentiality, integrity and availability are maintained. Finally, the Company has contracted ethical hackers to begin practicing its BRP (Pillar 5).

4.2 Improving Compliance Performance

As shown in Table 9 and applying the Benchmarking Process of Elmuti and Kathawala (1994) and using (1) T11 and (2) the Principles of the Case for Compliance as standards of excellence while comparing it with the results of Compliance Performance of the Company, various recommendations can be derived to improve its compliance performance, specifically with R.A. 10173. T11 is designed for policy makers and regulating agencies and for main reason, it is a best practice standard to use. Similarly, the Principles of the Case for Compliance is a set of best practice standards used by universities and colleges. These institutions maintain their commitment to compliance with the law and ethical systems.

Table 9. Benchmarking Results

Standards of Excellence	Existing Performance	Recommendations
Table of Eleven		
<i>Spontaneous compliance dimensions</i>		
T1 – Knowledge of rules	The Company has established a Data Privacy Office to educate and be educated on the laws and regulations of data privacy. This office is composed on 2 team members, a head and a compliance officer.	Since R.A. 10173 is already in its 2 nd year, there are local organizations that have built its competencies around the law. It would be prudent for the Company to contract consultants and experts who could help with the acceleration of the familiarity to the law.
T2 – Cost-benefit considerations	Prior to the promulgation of the R.A., the Company, particularly its Information Technology Division,	The Company should elevate the information security and data privacy strategy to the corporate

Standards of Excellence	Existing Performance	Recommendations
	has already been committing to run a secure and resilient infrastructure through its Technology Strategy. This includes information security and privacy.	level.
T3 – Level of acceptance	The Company has high level of acceptance to the provisions in the R.A.	
T4 – Normative Commitment	The Company has been in existence for more than 60 years and it has been committed to abide by the prevailing standards and laws both internationally and locally. It has an established governance systems to ensure compliance to all other laws.	The Company should maintain its culture of social responsibility and service to the country through continuing commitment to comply with the local and international regulations.
T5 – Informal Control	The Company is aware of the risks involved if the non-compliance is detected by non-government third parties such as customers, suppliers and partners.	The Company should maintain its good relationship and reputation with third parties to retain their trust.
<i>Control dimensions</i>		
T6 – Informal Report Probability	The Company has a large market share, has wide relationship with third parties and has several products and services. There is a probability that an offence, if any, may come to light other than during an official investigation and may be officially reported.	The Company should have a more integrated Information Systems to consolidate its products and services in order to easily manage data, information and transactions.
T7 – Control Probability	The Company is an established organization and there is a high probability of being subject to audit and inspection.	The Company should accelerate its momentum in complying to the R.A. by increasing the awareness of the organization through its employees and subsequently to its processes and tools.
T8 – Detection Probability	<No information/outside the Company's control>	
T9 – Selectivity	<No information/outside the Company's control>	
<i>Sanctions dimensions</i>		
T10 – Sanction Probability	<No information/outside the Company's control>	
T11 – Sanction Severity	The R.A., its IRR and toolkit have clearly defined the sanctions and penalties of offences. The Company is aware of these.	Similar to the recommendation in T6, the Company should accelerate its data privacy programs to ensure compliance, bearing in mind the sanctions of offences.
Principles of the Case for Compliance		
Case A – Law	The Company has established governance systems, auditing systems (internal or self-governance, external and ad hoc).	Similar to other laws, the Company should always take into account the sanctions and penalties of offences to the R.A.
Case B – Value	The Company is aware of the sanctions and penalties of the R.A.	Taking the recommendation from NACUA that “compliance program based primarily on mandated submission and obedience will not be well received. Instead of submission and obedience...compliance programs as a reflection of an organizational culture that is defined by norms or beliefs shared by the...community. [12] Aligning this with the Vision, Mission and Values and visible support of the leadership of the Company may improve its compliance performance.
Case C – Business	The Company is aware of the sanctions and penalties of the R.A.	“A compliance program can help protect ...from fines and penalties, false claims, reputational loss, operational loss and disruption, and agency and court imposed compliance programs... effective compliance programs can increase the effective of business processes” [12] Associating this with financial risks may improve the Company's compliance performance.

5. CONCLUSIONS

Revisiting the research objectives and questions presented at the start of the study, it can be concluded that through the application

of Outcome Pattern Matching methodology (Trochim, 1989), the Company is Fully Compliant with the applicable sections of R.A. 8792. It is, however, Partially Compliant (High) to R.A. 10173 with challenge areas in all the five pillars, specifically, in the continuing education of DPO, performing a corporate-wide PIA, formalizing its PMP, fully maintaining confidentiality, integrity and availability, and continuous practice of its BRP.

Further, using the Benchmarking Process (Elmuti and Kathawala, 1994), recommendations that could improve the compliance performance of the Company to R.A. 10173 have been cited. Using T11 and its dimensions as best practice standards, the following actions can be considered:

- Elevating the information security and data privacy strategy to the corporate level instead of containing it to a specific division,
- Maintaining its culture of social responsibility through continuing commitment to comply with the local and international regulations,
- Maintaining good relationship and reputation with third parties, including customers and suppliers, to retain their trust,
- Increasing awareness of the organization through its employees and subsequently to its processes and tools; this could be done by contracting consultants and experts with the law, and
- Having a more integrated Information Systems to consolidate its products and services in order to easily manage data, information and transactions.

In reference to Principles of the Case for Compliance, the Company should take into account not just the legal case of the R.A., i.e. considering the sanctions and penalties of offences but also its value-based ethics. This means aligning its Vision, Mission and Values and having visible support of its leadership. The business case of compliance should also be counted, i.e. the financials risk associated with non-compliance as well as the financial opportunities accompanying compliance.

6. FUTURE RESEARCH CONTRIBUTION

This work is limited to a large Filipino Company. However, the methodology and approach discussed in this research study could also be applicable to other large organizations and small to medium enterprises to help these organizations cope with e-commerce challenges and data privacy requirements.

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Assessing Compliance of Philippine State Universities to the Data Privacy Act of 2012: The Case of Caraga State University

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ABSTRACT

The Philippine Data Privacy Act of 2012 (DPA of 2012) defined the rights of Filipino citizens to data privacy and created the National Privacy Commission to monitor compliance, by both public agencies and private organizations, to the said law to ensure data protection and rights of privacy of its citizens. This study aims to explore and explain why and how public universities of the Philippines, with the Caraga State University as the subject, would comply with DPA of 2012. Using a single case holistic design with common rationale, and pattern matching as an analytic technique as adapted by Yin's method and design. This study has shown that the e-Commerce Act, another law legislated previously, is a moderating factor in compliance with the Data Privacy Act, and that general deterrence and legitimacy of regulations has a compelling casual effect on complying with the DPA of 2012. Factors such as (1) lack of awareness, (2) lack of resources, and (3) low priority in the agenda are found to be critical factors in complying with DPA of 2012. It was also found that the Caraga State University is only partially compliant (Medium-High) to the provisions of DPA 2012.

CCS Concepts

• **Social and professional topics** → **Computing / Technology policy** → **Privacy policies.**

Keywords

Data Privacy; Data Privacy Compliance; e-Governance; Personal Information.

1. INTRODUCTION

1.1 Background of the Study

The modern use of digitized personal data on business databases, be it private business or public organizations, and the ease by which this personal information may be abused or misrepresented necessitated the protection of the same to ensure fair use, storage and rights of access by citizens of a country [1]. To legally secure such rights, the Philippine Congress enacted Republic Act 10173 which is also

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known as the Data Privacy Act of 2012 [2]. This law defined personal information, among others; and how and when such data maybe collected and stored in databases as well as who has the right to access, modify and delete, and under what particular circumstances these actions may be carried out [3]. Success of the implementation of this law depends largely on the compliance of juridical entities that collect, store, access, aggregate, edit or otherwise process these data [4].

The State Universities and Colleges (SUC) of the Philippines are mandated to nurture the young minds of the country to promote democratic principles among the youth who are expected to take the reins of government and private organizations in the future. The Caraga State University (CarSU) is one of these SUC members mandated to integrate democratic principles in its instructions to the youth within its sphere of influence. This study aims to discover the challenges and best practices of the Caraga State University in its commitment to promote democratic principles in its endeavours in compliance to the Data Privacy Act of 2012. Using qualitative approach in a case study technique, this paper shall provide the results of an empirical investigation on the level of compliance to DPA of 2012 as CarSU is fulfilling its commitment to protecting the rights of data privacy to its main clients, the students, and the faculty and administrative staff members of the university.

1.2 Related Literatures

Several acts of congress and related laws were reviewed in this study, as shown below.

1.2.1 Acts of the US Congress

The United States Congress enacted the Privacy Act of 1974 creating for the Office of the Privacy Commissioner whose function is to ensure the security and protection of the personal rights of individual US citizens regarding their access to personal records stored in federal agencies, ensuring that citizens' rights are not trampled on by authorities in their pursuit of criminal activities and the like [5]. This law was made decades before the proliferation of personal computers and even the use of Internet and on-line transactions. Since the advent of on-line business transactions and the like, the US Congress later passed another bill which passed into a law supplementing the original Privacy Act of 1974 that is known as the e-Governance Act of 2002 [6].

1.2.2 Commonwealth Privacy Acts

The Commonwealth of Canada and the Commonwealth of Australia also promulgated their own privacy acts to secure and protect their citizens' personal information. As with other countries they defined policies on data collection, use and disclosure, information quality

and security, access and correction, anonymity, trans-border data flows, and sensitive information.

1.2.3 Acts of the Republic of the Philippines

Besides Republic Act 10173, which is also known as the Data Privacy Act of 2012 shortened to DPA of 2012, the Philippine Congress also enacted other legislations required for the implementation of DPA of 2012 or related to it. First, was the enactment of RA 8792, also known as e-Commerce Act of 2002 [3]. RA 8792 was designed to promote the universal use of electronic transaction in the government and general public [4] by providing the ability to recognize authenticity and reliability of electronic documents. This law that was legislated a decade earlier is a pre-requisite to DPA of 2012, otherwise DPA of 2012 becomes inapplicable. The RA 10175, known as “Cybercrime Prevention Act of 2012”, was enacted to define cybercrime, provided measures for the prevention, investigation, suppression and imposition of penalties for such cybercrimes. With the widespread use of online business transactions over the Internet there has been the necessity to define what is legal and not legal actions over the Internet and to deter actions deemed illegal.

The Philippine privacy act, patterned after the UE Directive 95/46/EC, aims to secure and protect the individual citizen’s personal information as collected, processed, and stored by either private or public organizations [2]. The law also provides the steps by which individuals may take in case they believe that their rights have been violated. This republic act (RA 10173), was approved on August 15, 2012, but its implementing rules and regulations was not promulgated until August 24, 2016. Republic Act 10173 is composed of 45 sections grouped into nine chapters as shown in Table 1.

Table 1. Compositions of RA10173

Chapter	Sections	Description
1	1 - 6	General Provisions
2	7 - 10	Creation of National Privacy Commission and its role and functions
3	11 - 15	Processing of Personal Information
4	16 - 19	Rights of the Data Subject (Individual)
5	20	Security of Personal Information
6	21	Accountability of Transfer for Transfer of Personal Information
7	22 - 24	Security of Sensitive Personal Information in Gov't
8	25 - 36	Penalties
9	37 - 45	Miscellaneous Provisions

This law mandated that the Privacy Commission shall monitor compliance of any juridical entity involved in the processing of personal data on their information systems. To fulfil this mandate, it is now required that data processing systems, both private and public entities, involved in accessing, processing or transmitting information of at least 1,000 individuals be registered with the Commission [7].

1.2.4 Data Privacy Accountability & Compliance

The NPC 2017 Privacy Toolkit prescribes five important steps that DPOs must do to ensure compliance with the law. The Commission calls them as the Five Pillars of Data Privacy Accountability and Compliance by which an agency or organization shall make data

privacy protection a reality for its constituents. These Pillars are 1) Commit to comply by appointing a DPO; 2) Know your risks by conducting a Privacy Risk Assessment; 3) Be accountable by Developing your Privacy Management Program and Crafting your Privacy Manual; 4) Demonstrate compliance by implementing Privacy and Data Protection measures, and 5) Be prepared for breach by regularly exercising your Breach Reporting Procedures [7]. The Toolkit provided that the appointed DPO shall be accountable to ensure the compliance of the Personal Information Controller (PIC) and the Personal Information Processor (PIP). PIC refers to “a person or an organization who controls the collection, holding, processing or use of personal information and as well as instructs another person or an organization to collect, hold, process, use, transfer, or disclose personal information on his or her behalf”, while PIP refers to “any natural or juridical person or body to whom a PIC may outsource or instruct the processing of the personal data”. A case study by Celis compared two national agencies’ compliance to the data privacy law found that the level of compliance is strongly moderated by the agency’s level of ICT use in its transactions [8]. Another study by Ching compared another set of two national agencies discovered reasons for compliance to the data privacy law such as maintaining good reputation and legitimacy of the act [9].

1.3 Research Questions and Objectives

The general objective of this research is to uncover the state of compliance of the Caraga State University with the DPA of 2012. Thus, the main research question is, “How CarSU is implementing and integrating the provisions of RA 10173 to its Information Systems and Business Processes?” To answer this big question, the following specific research questions need to be answered first:

1. What are the requirements CarSU complied with on the September 8, 2017 deadline?
2. What are the information security controls and/or strategies being integrated to its information systems in compliance with pertinent provisions of DPA of 2012?
3. How do the determinants of compliance affect CarSU's compliance with the DPA of 2012?
4. What level of compliance to the Data Privacy Act of 2012 CarSU has achieved before the deadline set by NPC on September 8, 2018?

1.4 Scope of the Study

This research study focused on one state university of the Philippines, the Caraga State University (CarSU) as the subject of the case study, regarding its compliance with the Data Privacy Act of 2012, as prescribed by the National Privacy Commission (NPC). In this study, the main resource person for CarSU is Dr. Rolyn C. Daguil, director for ICT Center of the Caraga State University. He facilitated the preparation and submission of all CarSU documents required by NPC including the compliance efforts to DPA of 2012.

2. METHODOLOGY

This research study was conducted using the qualitative method that employed case study technique. According to Runfola, a qualitative case study is a means for researchers to explain the connection between the contexts in which a phenomenon exists [10]. Because the main research question of this study starts with a how question, this makes it an exploratory approach [11].



Figure 1. Operational Case Study Model

And since the specific research questions are what type of questions, this also makes it an explanatory approach. Since there is only one state university being studied, it becomes a single holistic case study (Figure 1).

Furthermore, pattern matching designed by Trochim [12] is applied in this research to analyze the gathered data, information, and documents, which follows the process pattern matching diagram as shown in Figure 2.



Figure 2. Process Pattern Matching

As defined by Trochim and Yin, pattern matching is a technique wherein the observed patterns are compared against the predicted patterns [13]. As designed in this study, there are five (5) patterns with which to compare and determine the status of compliance of a state university against the requirements mandated by DPA of 2012, as shown in the Table 2.

Table 2. Compliance Pattern

	ISSP	5 Pillars	Matched Status
Pattern A	High	High	Fully Compliant
Pattern B	Medium- High	Medium-High	Medium-High Compliant
Pattern C	Medium- Low	Medium-Low	Low-Medium Compliant
Pattern D	Low	Low	Low Compliant
Pattern E	Very Low	Very Low	Not Compliant

To facilitate easy computation of Compliance Status, the following scoring system is adapted: “High” is given the numerical score of five (5), “Medium-High” is 4, “Low-Medium” is 3, Low is 2, and “Very Low” or “N/A” is 1, as shown in Table 3 – Description of Levels of Compliance. Scores for the ISSP and the five pillars ratings are of the same weight and are summed up. The product is then divided by six (since there are 5 pillars ratings + 1 ISSP rating) to obtain the average. The average is rounded up to the nearest integer which should be between 1 and 5.

Table 3. Description of Levels of Compliance

Score	Adjectival Description	Description of Level of Compliance
5	High	The SUC member is fully compliant to all requirements of the data privacy law
4	Medium-High	The SUC member has exerted much effort to protect data privacy and has complied with most of the requirements
3	Low-Medium	The SUC has complied with a significantly number of the requirements
2	Low	The SUC is beginning to show discernible evidence of compliance with data privacy law
1	Very Low or N/A	The SUC member has made very little or no effort to comply nor show any evidence of compliance

For a SUC member to be Fully Compliant (Pattern A), the SUC's ISSP must score “High” (numerical score of 5) and its Five Pillars compliance must also be “High” or another score of five (5). Otherwise, its Matched Status of compliance could be only Medium-High Compliant (Pattern B), describing a SUC that has exerted much effort to protect data privacy but has not yet fully complied with all requirements; Low-Medium Compliant (Pattern C), describes a SUC that has significantly complied with the requirements; Low Compliant (Pattern D), describes a SUC that is beginning to show discernible evidence of compliance with data privacy law. Pattern E (Not Compliant) describes a SUC member that has made very little or no effort to comply nor show any evidence of such efforts. Numerical scores are summed up and average (mean) is taken.

3. FINDINGS

The Caraga State University has a list of information systems used to perform its daily transactions. Table 4 shows the list with other pertinent information such as presence of personal data labelled as “Yes/No”, Office Responsible or IS Owner, Internal Processor and External Processor. As shown in Table 4, there are nineteen (19) information systems (IS) used by the Caraga State University to run its operations daily. Out of this nineteen ISS, fifteen (15) deals with personal data both that of the students and the faculty & staff of the university; those are labelled 'Y' in the “Yes/No” column.

All of these systems are used every working day for transactions. Ten of these fifteen systems are LAN-based systems, meaning they are accessible only on-campus. Only the Grade Submission, Grade Query, Executive Dashboard and the CarSU Portal are accessible via the Internet and, thus, accessible also from anywhere in the world. All nineteen information systems are password protected. All systems have been developed and fully functional, but not all have been utilized. The Itinerary Maker and Cash Advance Liquidator systems belong to this category. These have been fully functional for a while but the Accounting Office which was the target owner is still hesitant to use them.

So, they are still being parked and taken care of the by ICT Center that developed them. The ICT Center that developed most of these information systems and maintains them is well-organized and manned by highly skilled IT professionals led by its director, Dr. Rolyn C. Daguil.

Table 4. List of Information Systems used by CarSU.

Caraga State University (CarSU)					
No.	Information Systems ISSP 2013-2015	Presence of Personal Data			
		Yes/ No	Responsible Office / Owner	Internal Processor	External Processor
1	Accounting System	Y	Accounting Office	Acctg Personnel	COA
2	Budget Planning System	N	Budget Office	Budget Officer	COA
3	Expenditure System	Y	Accounting Office	Accountant	COA
4	Payments Collection	Y	Cashier's Office	Cashier	COA
5	Human Resource	Y	HRMO	HRMO Officer	DBM, CHED
6	Payroll System	Y	HRMO	HRMO Personnel, Accountant	DBM, COA
7	Procurement System	Y	Supply Office	Supply Officer	COA
8	Inventory system	Y	Supply Office	Supply Officer	COA
9	Executive Dashboard	N	Office of the President	Office of the President	N/A
10	CarSU Portal	N	ICT Center	ICT Center, Univ. Community	Gen. Public
11	Itinerary Maker	Y	ICT Center	ICT Center, Faculty, Admin	N/A
12	Cash Advance Liquidator	Y	ICT Center	Registrar's Office, ICT Center	N/A
13	Matrltn & Payments	Y	Accounting Office	Accountant	COA
14	Grade Query	Y	Registrar's Office, ICT Center	Student, Registrar	Parents
15	Grade Submission	Y	ICT Center	Faculty, Registrar	N/A
16	Enrolment System	Y	Registrar's Office, ICT Center	Departments, Colleges, Students	N/A
17	OPAC	N	Library	Students, Librarian, Gen. Public	Gen. Public
18	Book Loan System	Y	Library	Students, Librarian	N/A
19	Student Database System	Y	Registrar ICT Center	Faculty, Depts Registrar, Accting	N/A

A pattern matching analysis was conducted to analyze the data obtained from archival documents and triangulated via interviews. The empirical data were compared to the predicted pattern in Table 2 – Patterns of Compliance. Table 5 presents the results of pattern matching analysis.

Table 5. Pattern Matching Results

Case	Caraga State University			
Source	Archival Records			Inter-views
Events	Before Enact- ment of DPA 2012	After Enactment of DPA 2012 But Before NPC Took Action	After Enactment of DPA 2012 and After NPC Took Action	After Enactment of DPA 2012 and After NPC Took Action
Evidence	ISSP	ISSP	ISSP	ISSP
Rating	High	High	High	High
Evidence	DPO	DPO	DPO	DPO
Rating	N/A	Low- Medium	Medium- High	Medium-High
Evidence	PIA	PIA	PIA	PIA
Rating	N/A	Low- Medium	Medium- High	Medium-High
Evidence	PMP&PM	PMP&PM	PMP&PM	PMP&PM
Rating	N/A	Low- Medium	Medium- High	Medium-High
Evidence	PDPM	PDPM	PDPM	PDPM
Rating	N/A	Low- Medium	Medium- High	Medium-High
Evidence	BRP	BRP	BRP	BRP
Rating	N/A	N/A	N/A	N/A
Match	Pattern D	Pattern C	Pattern B	Pattern B

The Five (5) Pillars: 1) DPO – Data Privacy Officer **2) PIA** – Privacy Impact Assessment **3) PMP & PM** – Privacy Management Program & Privacy Manual **4) PDPM** – Privacy and Data Protection Measures **5) BRP** – Breach Reporting Procedure

The results show that through all four “Events” in this study, the university's ISSP has been completely in-place and rated “High”. However, Before Enactment of DPA 2012 CarSU's compliance to the Five Pillars of NPC, is evidently shown that the university has “N/A”, meaning, CarSU has not yet done any measures relative to Data Privacy Act of 2012, except for password protection for all its information systems, and the result is Pattern D which is *Low Compliant*. After the Enactment of DPA of 2012 but Before NPC Took Action, CarSU has already done some improvements and showed “Low-Medium” status. During the Enactment of R.A. 10173 and After NPC Took Action, the university have further improved its efforts to comply, and the rating is “Low-Medium” all throughout the Five Pillars since the university has provided these measures; except for pillar number five (5) - *Breach Reporting Procedures*, which was rated “N/A”, since CarSU has not yet submitted an annual report on breaches to NPC. The resulting match is an improvement from the previous period which is Pattern C, that is, *Low-Medium Compliant*. During Enactment of DPA 2012 and After NPC Took Action, Caraga State University further improved its rating to Pattern B for data obtained from archival records and this was validated / triangulated by information gathered from interviews. Interview data yielded the same result which is *Pattern B or Medium-High Compliant*. This means that CarSU has exerted much effort to protect data privacy but has not yet fully complied with all requirements of NPC. One of those requirements not yet complied with is that of Pillar number 5 - *Breach Reporting Procedures*.

The information systems strategic plan (ISSP) is a mandatory document of the e-Commerce Act. Here it is shown to be a pre-requisite to any efforts to comply with DPA of 2012. Without it, organizations cannot even begin to appreciate the DPA of 2012.

4. CONCLUSIONS

Based on the findings and pattern matching results, before enactment of DPA 2012 and before NPC took action, CarSU was already somewhat compliant using user accounts and passwords to secure and identify legitimate information system users. However, as far as DPA 2012 and NPC requirements were concerned, there was no basis because CarSU already computerized some of its transactions more than a decade before DPA of 2012 and NPC came to existence. When DPA was finally legislated in 2012, the university immediately begun complying and as evidently seen, CarSU's status continuously improved from Low Compliant to Low-Medium to Medium-High Compliant. Although, the university is not yet fully compliant, the trend suggests that CarSU may not take very long until is it fully compliant. This is due to a strong line-up of highly skilled IT professionals running the ICT Center of CarSU. Also, the determinants of compliance, such as general deterrence and legitimacy of regulations also has a compelling casual factor in CarSU's compliance with DPA of 2012.

5. FUTURE WORK

It is recommended to conduct a follow-up research study on the state of compliance of CarSU after the March 8, 2018 deadline given by NPC to determine if CarSU has improved its compliance status from medium-high to fully compliant. Further, it is recommended that similar studies be conducted in other SUC members of the Philippines to determine their compliance level to the data privacy law. Doing so may prod other SUCs in the country to improve their level of compliance to the privacy law.

6. ACKNOWLEDGMENTS

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Digital Technologies of Industry 4.0 in Management of Natural Disasters

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ABSTRACT

Data collection and provisioning, horizontal and vertical integration, cloud computing, big data analytics, mobile and social technologies, IoT (Internet of Things) are some of the essential components of the fourth industrial revolution. The synergy between cloud technologies and mobile applications globally changes every aspect of how organizations work today. This change has never been so tangible and fast. Mobile devices and sensors, cloud technologies and geographical information systems are digital technologies - factors in Industry 4.0. Natural disaster data acquisition through mobile units and sensors via internet, data management and data analysis are targets, which will be solve by digital technologies and system integration. The survey suggests an approach to management natural disaster and crisis, interoperability with existing IT systems, and decision support.

CCS Concepts

• Information systems → Information systems applications → Decision support systems → Data analytics

Keywords

Information system; Data bases; Data processing; Data analytics; Cloud computing; Mobile; Natural disasters.

1. INTRODUCTION

Recently in the world and in particular in Bulgaria there is a reported increase in the number and intensity of disasters caused by natural phenomena or human activities. An increase is observed in the adverse effects of disasters on social relations, economic growth and sustainable development [1, 2]. The rise of new digital industrial technology, known as Industry 4.0, is a transformation that makes it possible gather and analyze data across machines, enabling faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs. This manufacturing revolution will increase productivity, shift economics, foster industrial growth, and modify the profile of the workforce—ultimately changing the competitiveness of

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companies and regions [3].

The first main problem in the cases of natural disasters is the missing or not complete data about the terrain, the available roots to approach the scene of the disaster, the coordination of the rescue operations, the locations of stocks where needed equipment, medicines and other needed goods are located and many other details. The effective collecting, storing and delivering the needed data on-line can be done only with specialized computer information systems on appropriate high-speed data bases.

The second obvious requirement is the whole warnings, communication and data processing structure should be fully accessible in the case of disaster although data centers, communication hubs and even power supply are down.

The third problem is the need to get current data of the environment of the disaster from working local sensor devices that continue to send data to the information systems and rescue staff helping to investigate the current situation and to get much more online data that could build a real picture of what has happened and what the current situation is.

The aim of the article is to review the current state of the art in the data processing and information science and to suggest technologies that must be able to solve the problems. They are used for the development of an integrated information system for natural disasters management with the help of modern information technologies. The system is designed on the principle of modules that implement interaction with GIS, analytical databases, cloud and mobile platforms. It is based on ISO/IEC 31010:2009 Risk management - Risk assessment techniques [4] and ISO/31000:2009 Risk management - Principles and guidelines [5].

2. THE ESSENCE OF INDUSTRY 4.0

The rise of new digital industrial technology, known as Industry 4.0, is a transformation that makes it possible gather and analyze data across machines, enabling faster, more flexible, and more efficient processes to produce higher-quality goods at reduced costs. This manufacturing revolution will increase productivity, shift economics, foster industrial growth, and modify the profile of the workforce—ultimately changing the competitiveness of companies and regions [3].

Advanced digital technology is already used in manufacturing, but with Industry 4.0, it will transform production. It will lead to greater efficiencies and change traditional production relationships among suppliers, producers, and customers—as well as between human and machine. According to “Boston Consulting Group” [6], nine technology trends form the building blocks of Industry 4.0: big data and analytics, autonomous robots, simulation, horizontal and vertical system integration, the

industrial internet of things, cybersecurity, the cloud, additive manufacturing, augmented reality.

This new organization of the industry is based not only on robots but also on different kinds of sensor devices that can exchange real time data over IP protocol with computer driven systems. The technology and experience with these sensors can be also successfully implemented to collect data in disaster areas.

Over the past two decades, a new digital revolution unfolds. Increasing the capacities and joining the data transfer, computation and storage capacities and the extent to which digital technologies penetrate the economy lead to transformation phase, based on Internet of Things (IoT). According to a report by the International Union (ITU) and Cisco Systems, the current IoT technology is rooted in their potential to solve some of the world's most pressing problems. Information and Communication Technologies (ICT) such as Mobile Units, Internet and Big Data have greatly increased their contribution to global development projects by improving end-to-end performance and service delivery [7].

Cloud and mobile technologies are the Industry's 4.0 most widely used components and enable organizations and users to gain access to applications from anywhere in the world on demand [8]. The most important benefits of cloud technologies are cost savings, technical staff and end-user efforts. Cloud service providers offer newer solutions with a number of innovative features [9]. The largest companies in the world that offer cloud services and related products are Amazon, Google, Salesforce, Microsoft, Oracle.

The technologies and the experience connected with the Industry 4.0 and IoT can be used as corner stone of the solving the third problem (online data from the disaster scene). The next issue is the hosting of the different kind of the data and applications.

Data centers can be destroyed in case of disaster. There are many known technologies for high availability capabilities but all of them are location oriented and rely on classic communication media which can be destroyed by disaster. A good solution of this problem are the Cloud Databases and Applications that are in remote Data Centres. The combination with the applications via satellite communication channels can made this component very robust.

Structured and unstructured databases are used to store data. The database itself is defined as an organized set of data stored for a long time and designed for use by various applications through effective access and support tools [10]. The big IT companies Oracle, SAP, IBM offer in their portfolio of services and products, cloud services and database management technologies. Database as a service (DBaaS) is an architectural and operational approach that allows IT vendors to provide database functionality as a service to one or more users. DBaaS architectures provide the following user functionalities:

- Installing and managing custom-made database instances for a pay using self-service mechanisms;
- Automated monitoring and observation of definitions, attributes and quality of service level defined by the service provider;
- Fine-tuning the use of the DBaaS service, allowing full reporting and accurate billing for each individual user.

For example, the DbaaS architecture of Oracle 12c provides a large container database where users can plug or unplug one or more pluggable databases to build their applications. Also, the Oracle Cloud Platform (Fig. 1) offers a wide range of software tools that provide a variety of cloud services for application development.

Oracle Times Ten In-Memory Database is a full-featured relational database that runs in the application tier, storing all data in main memory. This dramatically reduces latency and increases throughput. An early construct of the In-Memory concept is the Times Ten Database of HP (1995), acquired by Oracle (2005). All data reside in the large RAM and there are no disk devices. Because of the lack of hard disk operations the response time was without latency and very quick. Only changes of the data are stored in transactional log and persist on disk. Also snapshots of the data base are stored on the disk. These two kinds of disk files ensure recoverability of the database. The Times Ten DB is often used in the telecommunications (especially by packet switching systems), in market transactions, by the police and fire services. Times Ten can be used either as autonomous DB or as Caching Option for standard Oracle DBs. When Times Ten is used as Caching Option a set of standard Oracle tables or subset of rows and columns can be stored in the memory and so the access to these objects is extremely fast. Time Ten is fully SQL based DB and also the procedural language PL/SQL is implemented. So it is very easy to use it using standard application interfaces [11].



Figure 1. Oracle Cloud Platform [11]

Technology Integration, an element of Industry 4.0, uses the synergy effect of interactions between them and encourages the development of complete software platforms such as ESRI's new GIS platform - ArcGIS Pro [12] that supports the entire urban development and management cycle. It includes urban environment research, modeling and analysis, scenario development, public discussion, decision making, urban processes management and quality administrative service. The platform integrates and processes all data types: images, tables, terrain data, 3D, real-time data, Big Data, LiDAR capture, and data from new sources: sensors, drowning, satellites, new maps web and mobile applications. The ArcGIS Pro application enables Smart Mapping, tools for quickly and easily creating 3D models, visualization and analysis, including spatial-time and statistical, animations, easy and fast online sharing, image processing, data management and integration [13].

The World Economic Forum annual report 2016-2017 reflects 12 factors for successful countries' competitiveness in the context of evolving technologies, digitization and the Industrial Revolution [14]. Public institutions are one of these factors. The legal and administrative framework in which individuals, companies and governments interact determines the quality of public institutions in a given country and makes a strong

contribution to competitiveness and growth. It has an impact on investment decisions and on the organization of production and plays a key role in the ways in which societies allocate benefits and bear the cost of development strategies and policies. Institutional digital management systems for disasters and accidents are also important for the sound and sustainable development of the economy and society [15].

In the paper an approach is presented for development of an integrated information system for natural disasters management with the help of modern information technologies based on GIS designed and developed by the authors [16]. It uses numerous programs which interacts with GIS, analytical databases, cloud and mobile platforms. Due the specific circumstances by a natural disaster that are different from normal data processing, important enhancements are proposed to insure the high availability of the data accessing and processing.

3. RESOURCE EVALUATION FOR THE INTEGRATED INFORMATION SYSTEM PROJECT

The geographical location, natural features and the economic situation predefine the high vulnerability of our country to diverse natural disasters, which may cause considerable human, environmental and material losses.

Certainly, in today's global climate change, the role of information and communication technologies is becoming an indispensable element in the systems of protecting the life, health and property of the population, environment and critical infrastructure [17, 18]. Internet technologies for disaster management are used in our country, but still insufficient. Leading research centers in Europe, USA, Australia, etc. actively work on these issues [17, 19, 20, 21, 22]. Various information systems are available that include a variety of risk assessment tools for natural disasters using databases and geographical information system (GIS) [15, 16].

In well managed administrations, continuous monitoring of key indicators for land and environment and key risk indicators is a part of preventive activities. Monitoring is improved by including information to identify and assess risks and to designate responsible employees for the identified risks.

The project for an integrated information system for management of natural disasters has to be implemented at several levels which correspond to the administrative structure in the country. In the first level, an integrated database is used, which is a centralized basis supporting up-to-date information at national level. At the second level, regional structures have the opportunity to introduce and use information and to coordinate actions at the regional level. The lowest level of the system is the municipal level, which is the main source of up-to-date information in the integrated system at national level because events (as natural disasters) occur locally and most crises occur locally. Such a large software project, such as building an integrated information system for managing natural disasters at national, regional and municipal level, requires a lot of resources: financial, human, time and expert. The objective of the economic assessment is to evaluate the contribution of the public sector project and the priorities of the project to the development of society. Through the economic assessment of monetary costs, the necessary work time, the required qualification of the project experts, and an estimate of the time required for development, reflect the real costs of the administration and evaluate the benefits to society.

The administration of a highly developed economics can afford to start the project using the most appropriate software platforms such as ArcGIS Pro and Oracle 12c for a centralized database and start designing the project from a national to a local level.

Although it requires a lot of investment, such a project will prove its benefits over time.

The project development approach that does not require much financial resources, but a human one - good team of developers and experts can start from the lowest level of the system and use open source software: QGIS as geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data, PostgreSQL as database, operating systems Linux and Android, the software package R for statistical analysis, Python for programing, cloud environment for development and implementation. The project is developed in a cloud environment, using IaaS in data center. In the project includes a module for mobile processing and interaction. The responsible employees are able to interact or collaborate with one another in dialogue via social media as creators of content generated by users in a virtual environment, to receive a reports or analysis, to insert data in screen forms and manage the situations.

4. INTEGRATED INFORMATION SYSTEM FOR NATURAL DISASTERS MANAGEMENT

The lowest level of the integrated information system for management of natural disasters is the municipal level, which is the main source of up-to-date information in the integrated system at national level because events occur locally and most crises occur locally. The most common natural disasters in areas of a municipality are floods, landslides and forest fires. Earthquakes are monitored by specialized institutions at national level.

According to official data of the State Agency for Metrology and Technical Surveillance in the country there are nearly 5300 dams, over 4500 are owned by the municipalities (total 264 municipalities and 28 regions in the country) [23].

Most of the small dams have no technical documentation and a control-measuring system. The main problem with the dams is the lack of control-measuring systems and funds in the municipalities for monitoring and maintenance.

Another problem is landslides that are activated during heavy and prolonged rains and they can block the transport infrastructure or disrupt the integrity of homes and buildings. Fires, which often cover wooded areas around a populated area during a dry hot summer season, cause a lot of damage to the environment, to rural areas and to the population.

According to the above problems the integrated information system supports data acquisition about floods, landslides and forest fires through mobile units and collects data in database.

The database of settlements in the municipality, agricultural land and forest fund keeps relatively static data for the objects in the perimeter of the municipality pertaining to a certain date point (the period of new municipality structure). Data can be used to track trends and forecasts.

The GIS as a part of the integrated information system for management of natural disasters and crises includes 3 components: database - geographic (geodata); maps - interactive maps demonstrating objects from the Earth's surface and relationships between these objects; models. Based on the developed cadastre

of the settlement (property, infrastructure) there are objects, which are important for the management of crisis events, are marked and traced events that threaten the environment and the population in the region of the municipality. The GIS uses a centralized data storage that contains specialized information about structures, crises, events, critical infrastructure, and operations that represent the actions in the crisis events. The GIS data is graphical (vector and raster) and nongraphic (attribute). The attribute data describes the numeric and textual characteristics of the graphic elements. The relationship between them is determined by common indicators. Raster data is scanned maps and images (aerial photographs). Settlement data is presented in digital form as text ASCII files that contain graphic and semantic (descriptive, alphanumeric) information.

Graphics information is contained in graphical blocks describing different layers: cadastre - for cadastral data, agricultural land, forest areas. Tables in the cadastre layer contain data about: landed properties; property rights, rights holders, building data, standalone buildings, streets, neighborhoods and residential complexes, address data, locations, property documents, farm property data, forest property data.

The database - the source data for the municipality are vector and discrete graphics data, attribute (tabular) data, land parts layout patterns, or land division. The basic graphic data is in the standard ZEM format, and the tabular (cadastral) - in the XLS, DBF, TXT format.

The analytical database is designed using architecture logical data marts and a real-time data warehouse (DW). The logical data center and real-time data warehouse architecture (Fig. 2) is practical only for moderately large data warehouses or when using high-performance storage technology. This architecture has the following unique features [24]:

- Logical data marts are not physically separate databases but rather different relational views of one physical, slightly denormalized relational data warehouse.
- Data is loaded in the data warehouse rather than in a separate staging area to utilize the high-performance computer systems that demonstrate the power of the data warehouse technology when performing cleaning and transformation operations before loading the data.
- New data marts can be created quickly because the technology does not use physical data or databases for data marts, and they are logical views on a physical database. Data is always up-to-date because it is created as a data view in the data warehouse in real time. The ETL (extract, transform, load) process works in near real-time.
- Data marts are always up to date because data in a view is created when the view is referenced; views can be materialized if a user has a series of queries and analysis that need to work off the same instantiation of the data mart.

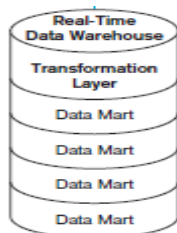


Figure 2. Architecture logical data marts and real-time DW

The real-time data warehouse aspect of the data warehouse architecture means that the source data systems, decision support services, and the data warehouse exchange data and business rules at a near-real-time pace because there is a need for rapid response.

The database contains data about the cadastre of the settlement, statistical and macroeconomic data (demographic and business data), specialized data (parameters and measurements) for the objects cause natural disasters in the area of the municipality.

The database schemas store attribute and spatial information about the objects of the common map of the cadastre:

- Infrastructure data: plumbing network and facilities, sewage network and facilities, low-voltage network and facilities, high-voltage network and facilities, gas pipelines, oil pipelines and other networks and facilities, adjoining objects, texts, contingencies;
- Regulatory data: neighborhoods, plots, buildings, neighborhood boundaries, plot boundaries, curbs, lines;
- Other data on the cadastre: detailed points, boundaries, buildings, real estate (real estate - landed property), geodetic data, subject-owner and related parties, title of ownership;
- Addresses (area, street, neighborhood);
- Data on agricultural land: landed property, entity, legal document, real estate right;
- Municipal ownership data: public, private.

The demographic data in database, which is stored in the municipal administration and the NSI [23], are the number of population by place of residence, the number of population by age group, the number of families by number of family members, the number of people employed by employers/students/retired persons.

The Business data in database, which is stored in the NSI [13], the trade register in the country and other business organizations, are presented as business demographics by age, by business sector, by type of premise (micro, small, medium, large), by status (active, born, survivors, dead) by type of data.

The upload process works with data from local Excel file formats and inputs the data into the corresponding database schema by first checking for correctness and conflicts with the data already entered. Users, depending on the access rights granted to them, can insert data from screenshots, view data in different views: in graphical form or tabular representation based on database queries, use them for reference in other functions of the integrated information system. Data can also be entered from mobile devices. A module for inputting data from sensors tracking certain indicators of objects in the region of the municipality, which is observed for the prevention of natural disasters, is developed.

Data storage is the process of integrating internal and external data and processing it in order to be easily accessible for decision-making. Data processing may include the storage of aggregated data (e.g. storage of aggregated data by observation and by month or by region and by month) in addition to the raw data. Data can also be stored in a format that is understandable to data users.

The speed and performance of application software are the result of synchronized work between the various integrated modules. In addition to the connection, the application modules also relate to data stored in the general data warehouse for all areas of the application.

The centralized analytical database contains the data that the various software modules of the information system work with.

The statistical analysis module, which is part of the system, uses the R software package integrated into the application that allows both analyzes and forecasts based on available data. The R integrated software uses a linear pattern or a generalized linear pattern. R, for example, creates regression graphs of available data for more than 2 years.

The results achieved in the design and development of the integrated information system, as well as its improvement and upgrading in the future, are aimed at:

- Dynamic tracking of processes and trends in areas threatened by floods, landslides or fires;
- Investigation and monitoring of ecological environmental problems;
- Population management and activities at increased risk of natural disasters;
- Planning preventive actions to prevent possible natural disasters;
- Recovery assessment after fires, floods, landslides.

5. CONCLUSION

The paper proposes an approach for development of an integrated information system for natural disasters management based on the GIS module, R statistical package as analysis module and data warehouse. The applications use some components of modern technologies in Industry 4.0 as cloud environment, mobile platform and internet of things. The information system is designed on the principle of modules that implement interaction with GIS and analytical database. By managing the dataflow, processing and transformation of verified information from various sources, the system is responsible for natural disasters monitoring and situation awareness, and for the timely and accurate dissemination of information on emerging risks and threats to police, emergency services and administration.

The developed information system could successfully assist all stakeholders about risk objects monitoring and natural disasters management before, during or after the occurrence of natural disasters. This system could be considered as a unified platform on the local level, which is the main source of up-to-date information because events occur locally and most crises occur locally.

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