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Integration of Webqual Method to Importance Performance Analysis and Kano Model to Analyze System Quality of E-Government: Case Study LAPOR!

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Abstract

The management of public complaints in many institutions in Indonesia has not been managed effectively and integrated. Each institution works partially and not coordinated well. This causes duplication of handling complaint, or worse is a complaint possibly not handled by any of institution, due to the reason that the complaint is not their authority. For this reason, the Government of the Republic of Indonesia established a S4N-LAPOR!. Meanwhile, there are still some deficiencies in LAPOR. This research purpose is to analyze/evaluate LAPOR using an integration of Webqual method to Importance Performance Analysis (IPA) and Kano model. This research is only carried out by analyzing web-based LAPOR services. The questionnaires are distributed to 159 respondents. The webqual method is used to determine the dimension and attributes, while the IPA and Kano model is conducted for data analysis. The integration from the results of both data analysis shows that there are 14-attributes out of 23 that need to be the priority for LAPOR improvements.

Keyword: LAPOR, Webqual, IPA, Kano, e-government

Introduction

E-government is the use of information and communication technology in the process of governance to realize an effective, efficient, transparent, accountable and easily accessible to all parties (citizens, businesses, and others). E-government gives so much benefit, one of them is to enable community creation and gives citizens or businesses the possibility to participate and contribute actively in governmental discussion for the decision-making process (Joseph 2015). Generally, public service is always related with the performance and program in implementation of e-government. Public service has a central role in many aspects of human life, and as the functions in maintaining the existence and growth of the community, the nation and the state.

Indonesia is a Southeast Asian nation made up of thousands of volcanic islands. It is one of the biggest developing countries with over 257 million citizens. Therefore, providing balanced services is challenging for Indonesia. However, the fact that internet penetration has reached over 40% of the

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total population and the rapid developments in Information and Communication Technologies (ICTs) in Indonesia have been giving an important role for providing balanced public services for all citizen through e-government. Through the e-government, the citizens can interact with the government anytime and anywhere without the necessity for physical travel to government offices and agents.

One of the e-government that has been provided by Indonesia's government is LAPOR. LAPOR is an online portal where public can directly report their problem concerning public services, send their complaint regarding public servant, and monitoring government's development program. However, LAPOR's performance has several limitations, such as LAPOR's publication has not been good enough in terms of people awareness about this platform. This lack of publication and people awareness also reflected from the number of users that are relatively not significant enough. Total users are only 891.257. This number contrasts with the total internet users which reached 171 million. The rating of LAPOR application on the Apple App Store is 2.9, and Play Store is 3.9 out of 5.0 scale and many users are still disappointed over the services and features provided by LAPOR.

This is really unfortunate that LAPOR has potential use for the citizen, as commonly the citizen does not know how and to whom their aspiration or complaint of the public sector report should be addressed due to the common one-way interaction for current complaint system. Therefore, this research aims to analyze the performance of e-government, in case study is LAPOR, in Indonesia. The evaluation will be using integration of Webqual Method to define the requirement needed, and Importance Performance Analysis and Kano model as the data analysis process to measure the satisfaction and find possible improvements.

Literature Review

E-government

The World Bank defines e-government as the use by government agencies of ICT like wide area network, the internet and mobile computing that have the ability to transform relations with citizens, businesses, and other arms of government (Al-Nidawi et al 2018). The main emphasis of e-government is not the implementation of new ICT systems to automate the traditional public service processes or add a new online service delivery channel per se, but rather it aims at improving transparency, accountability, and governance of the public sector services and in so doing it can improve government performance and create new public value for citizens and businesses (Al-Hujran et al 2015).

The Indonesia's government had committed to spending US$6.78 billion for e-government development from 2014 to 2019 (Sabani et al 2018). With the implementation of such an initiative, the e-government in Indonesia was supposed to be developed progressively. In fact, the United Nations (UN) published the EGDI (E-Government Development Index) ranking based on the 2018 survey, which Indonesia ranked 107th out of 193 UN member states, shown in Figure 1 (Widowati 2018).

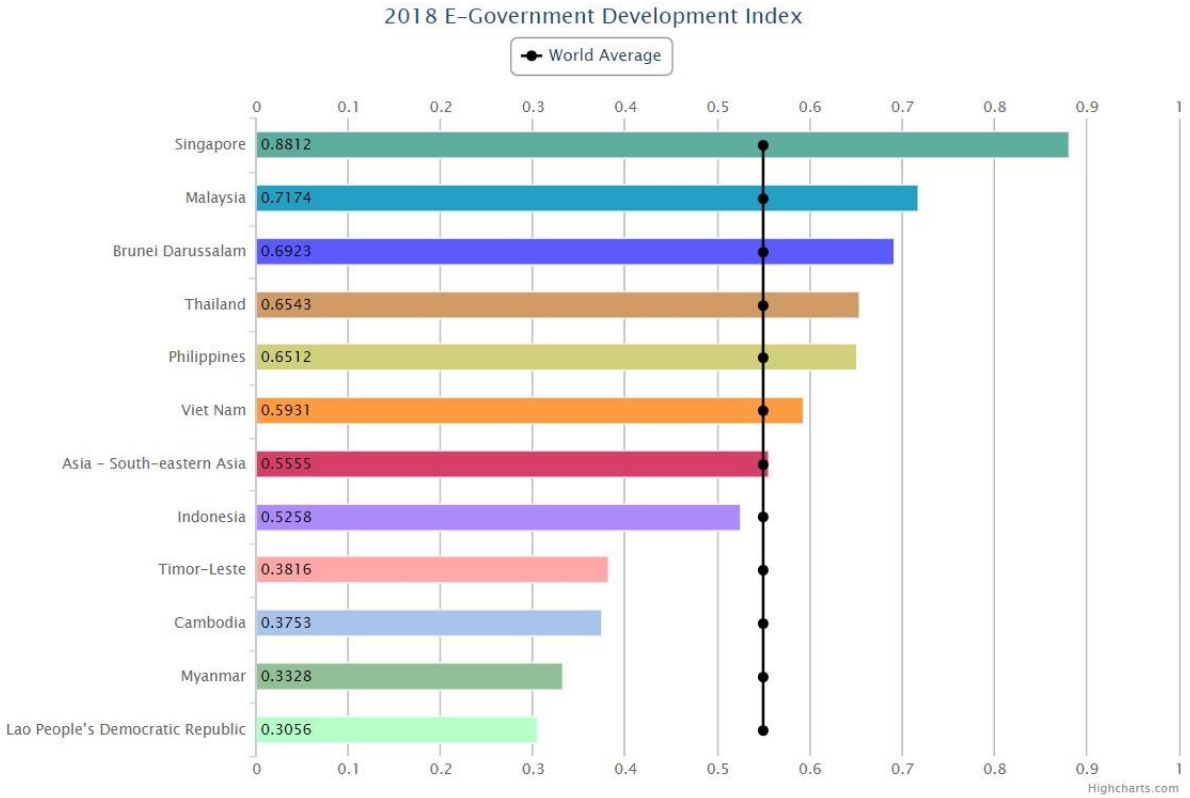

Figure 1. 2018 E-Government Development Index (Widowati 2018)

LAPOR

LAPOR! is a G2C e-government by Indonesian government which established as the public service complaint management system (Indonesian: Sistem Pengelolaan Pengaduan Pelayanan Publik Nasional - SP4N) based on 'Peraturan Presiden Nomor 76 Tahun 2013' and 'Peraturan Menteri Pendayagunaan Aparatur Negara dan Reformasi Birokrasi Nomor 3 Tahun 2015'. It is is first initiated in 2011 by UKP-PPP. SP4N-LAPOR! is now managed by Ministry of Administrative and Bureaucratic Reform (Indonesian: Kementerian Pendayagunaan Aparatur Negara dan Reformasi Birokrasi) as public service regulatory, Presidential Staff Office (Indonesian: Kantor Staf Presiden) as regulator of national priority program, and Ombudsman Republik Indonesia as regulator of public sevice (LAPOR 2020).

LAPOR!, shown in Figure 2, is an online portal where public can directly report their problem concerning public services, send their complaint regarding public servant, and monitoring government's development program. LAPOR! has been connected with 34 Ministries, 96 Institutions, and 493 Regional governments in Indonesia. The number of users by January 2019 is 801,257 and total reports that have been submitted are 1,389,891 (LAPOR 2020).

The public can send aspiration/report/complaint on LAPOR! through various media including the site www.lapor.go.id, SMS 1708, and mobile application. The report will be verified by the administrator for clarity and completeness then will be forwarded to the institution. LAPOR! will publish each report that has been forwarded to the relevant institution and giving the user continued notification. The authorized institution who handled the complaints is given maximum 5 working days for internal coordination and formulation for following-up the report. If the institution has met the final response, they will inform the reporter in follow-up page (LAPOR 2020).

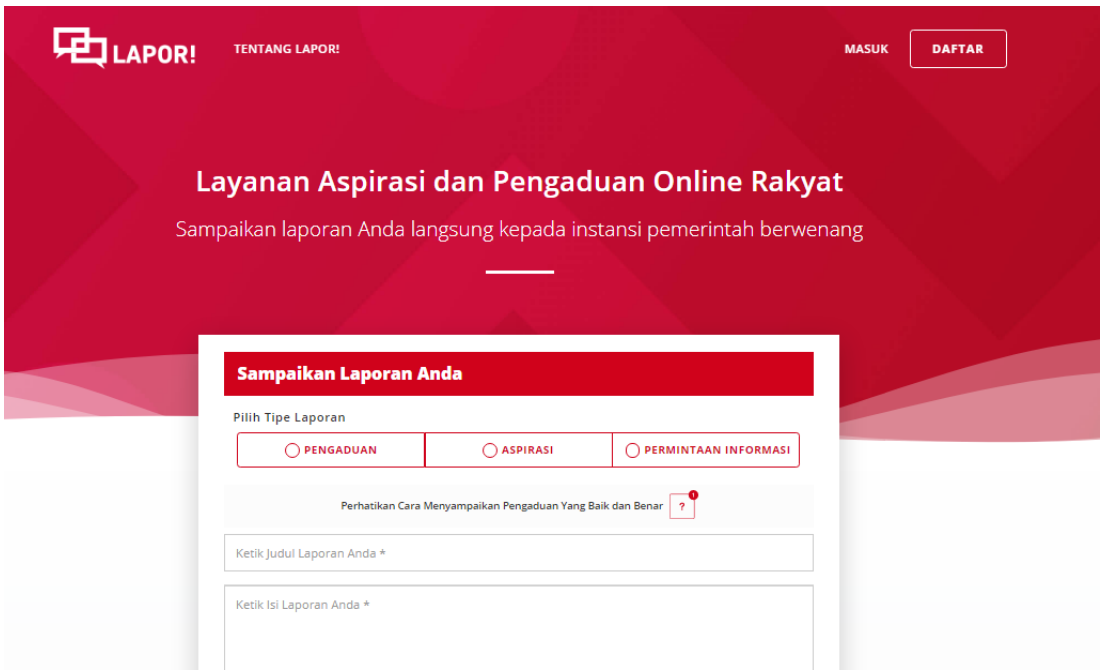

Figure 2. Lapor Home Page (LAPOR 2020)

Webqual Method

Webqual is an instrument for assessing user perceptions of the quality of websites based on end-user perception. This method is a development of SERVQUAL which was widely used before in measuring service quality. The webqual instrument has been under development since the early part of 1998 and has experienced several interactions in the preparation of dimensions and questions (Andry et al 2019). The method has evolved via a process of iterative refinement, starting from webqual 1.0 to webqual 4.0.

The following is an explanation of the three dimensions of webqual 4.0 (Arnes and Hanum 2019):

1. Usability Quality, namely the quality dimension related to site design and usability. This dimension includes appearance, interface, ease of use, ease of understanding, ease of navigation, and displays an attractive visual form.
2. Information Quality, which is the dimension of the content of information on the site (conformity of information with user objectives), such as the accuracy of the information, context, format, and its relevance.
3. Service Interaction, namely the dimensions of quality of service interactions experienced by users that are manifested by trust and empathy, for example, a sense of security during the transaction, information security, product delivery, personalization, and communication with site owners.

Importance Performance Analysis (IPA)

Importance-Performance Analysis (IPA) is a technique for analyzing customer satisfaction towards an organization's product or service as proposed by Martilla and James in 1977. IPA measures the satisfaction from customer satisfaction surveys based on two components of product or service attributes: the importance of a product or service to a customer and the performance of an organization in providing that product or service (Martilla and James 1977).

For a considerable period, IPA has been used as a tool for understanding customers' needs and desires to develop marketing strategies to respond to them. IPA is widely used in many areas in which customer satisfaction is a key to a thriving business including higher education, government service, tourism, convenience store and bank service (Phadermrod et al 2016).

The IPA used a Cartesian model in which the mean for performance (perceptions) and importance (expectations) are plotted for each variable, shown in Figure 3. The IPA gives a better explanation of graphical view of the dimension the company should give more attention and priority since it presents as four quadrants I, II, III, IV (Padlee et al 2019):

1. The first quadrant, concentrate here, indicates low performance on attributes of high importance, thereby highlighting priority areas requiring immediate improvement.
2. The second quadrant, keep up the good work, represents high performance on attributes of high importance thereby indicating that the current quality should be maintained.
3. The third quadrant, low priority, represents low importance and low performance, suggesting that these attributes require only a limited amount of attention.
4. The fourth quadrant, possible overkill, represents high performance on attributes of low importance, thereby indicating an opportunity to redirect resources to areas of greater priority.

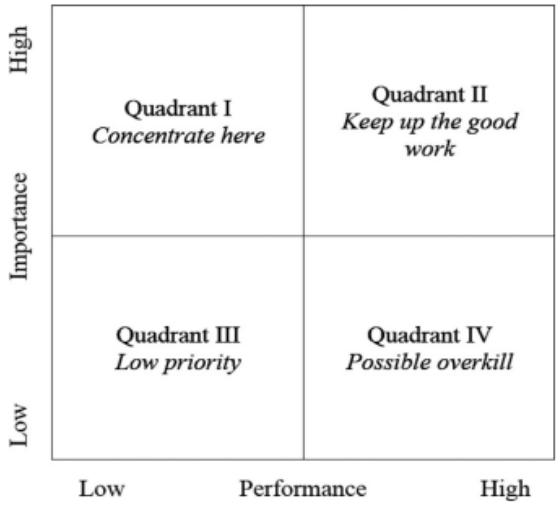

Figure 3. IPA Matrix (Padlee et al 2019)

Kano Model

Kano model was first proposed by Professor Noriaki Kano, an expert on quality management in Japan. Inspired by Herzberg's two-factor theory, Kano and his colleagues at the Tokyo Rika University in Japan presented Kano's theory of attractive quality to understand how customers' perceive and evaluate product or service quality (Materla et al 2019). The model believes that "satisfying" is not simply in opposition to "dissatisfying" and that product attribute fulfillment can influence customer satisfaction in a nonlinear way.

Consequently, the Kano model is used to analyze product attributes for customers' requirements mainly in six different situations (Dou et al 2016):

1. A: Attractive, customer satisfaction will not decrease even if requirements in this category are not fulfilled. However, fulfilling these requirements will drastically increase customer satisfaction.
2. O: One-dimensional, fulfilling requirements in this category increase customer satisfaction. Conversely, not fulfilling these requirements decreases customer satisfaction.
3. M: Must-be, customer satisfaction will not increase even if requirements in this category are fulfilled. However, not fulfilling these requirements drastically decreases customer satisfaction.
4. R: Reverse, fulfilling requirements in this category decreases customer satisfaction as customers have no such requirements.
5. I: Indifferent, customer satisfaction will not change regardless of whether requirements in this category are fulfilled.
6. Q: Questionable, requirements in this category should be ignored because there is a paradox when explaining them.

To be able to categorize requirements or quality attributes into these groups, it is necessary to use the Kano questionnaire. It contains a pair of questions for each requirement. One question is worded positively to find out how the respondent would feel if the product met the specific requirement. The second question is worded negatively to shows how not fulfilling the requirement affects the (dis)satisfaction of the respondent. There are five options for the respondent, ranging from very satisfied to very dissatisfied (Madzík et al 2019). The particular types of requirements in this coordinate system have the form of curves, shown in Figure 4 (Shahin et al 2013).

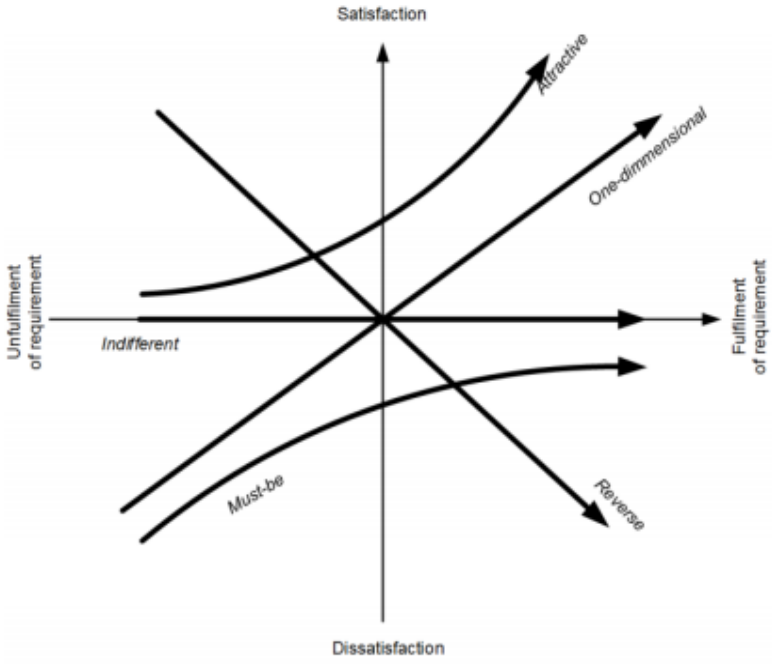

Figure 4. Kano Categories (Shahin et al 2013)

Methodology

Research Design

Figure 5 illustrates the flow design of this research. First, the problem statement and research objective are determined to find focus, purpose, and limitation of this research. Next, the sample as the participants of this research is determined. Then the next process is searching for the appropriate method as the researcher needed. After that the questionnaires are prepared, it divided into 2 types: (1) Webqual questionnaire, and (2) Kano questionnaires. Both questionnaires are distributed to the sample as the respondents. Then data is collected as the result of questionnaires. The result data then are analyzed by using by Importance Performance Analysis (IPA) and Kano model. After the data analysis process, the conclusion of the research is drawn.

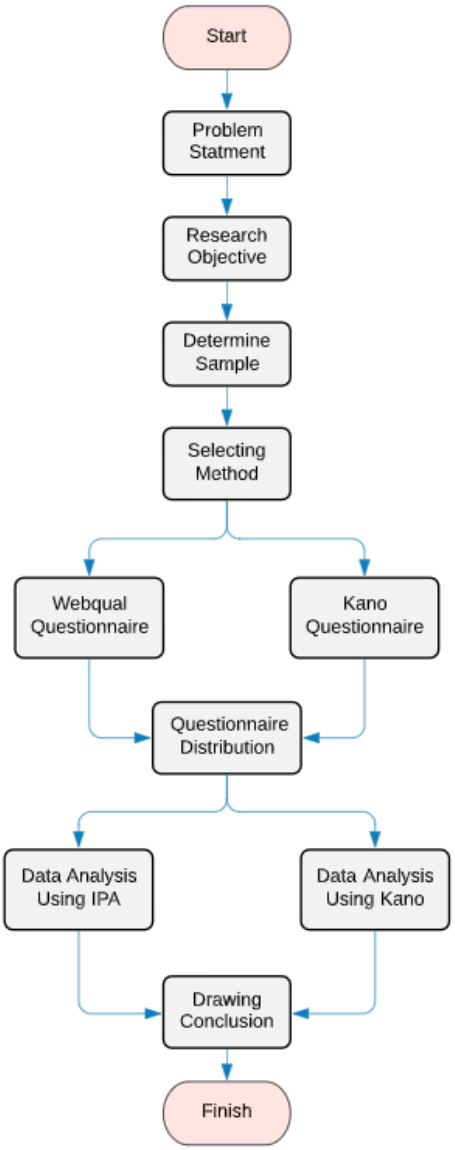

Figure 5. Research Design

Population and Sample

Population of this research is the number of users registered in LAPOR website (891.257 users in February 2020). While the sample is obtained using the Slovin equation (Equation 1):

$$n = N / (1 + N (e)^2) \qquad \text{Equation (1)}$$

Where:

n = sample
N = population
e = error sampling

$$n = 801.257 / (1+801.257) (0.1)^2 = 99.987 \text{ respondents}$$

From the above calculation shows that the number of respondents needed to fulfill the minimum number of criteria is 100 respondents, while this research conducted in 159 respondents.

Research Variable

Variables used in this research as measurement instrument is Webqual 4.0 method. Table 1 shows the details of Webqual dimensions used in this research which are the item code, and attribute. It consists of 23 items used as instruments for Webqual and Kano's questionnaires. The Webqual method consists of dimensions as follows (Barnes and Vidgen 2002):

1. *Usability* is draws in the human computer interaction. It is concerned on how a user perceives and interacts with LAPOR, such as navigation, and ease of use, to accomplish goals in efficient and effective way.
2. *Information Quality* indicates quality of the content of a website. This dimension illustrates the quality of information that presented on LAPOR from users' perspective, as it should be accurate, up to date, and coherent.
3. *Service Interaction* indicates the quality of service and interaction experienced by users when they use website for more important transaction. It also has a strong relation to trust, and empathy. For LAPOR this dimension relates to how LAPOR handle the complaints, and security of the information.
4. *Overall View* is an additional dimension, to ask the user perceived of the overall view of the website.

Table 1. Research Variable

Dimension	Item code	Attribute
Usability	U1	Easy to learn to operate
	U2	Interaction is clear and understandable
	U3	The site easy to navigate
	U4	The site easy to use
	U5	Attractive appearance
	U6	Appropriate to the type of site
	U7	Conveys a sense of competency
	U8	Creates Positive experience
Information Quality	IQ1	Provides accurate information
	IQ2	Provides believable information
	IQ3	Provides timely information
	IQ4	Provides relevant information
	IQ5	Easy to understand information
	IQ6	Information at the right level of detail
	IQ7	Information in appropriate format
Service Interaction	SI1	Good reputation
	SI2	Safe to complete transactions
	SI3	Personal Information feels secure
	SI4	Sense of personalization
	SI5	Sense of community
	SI6	Communicate with the organization who handle the complaint
	SI7	Confident that the complaint will be delivered as promised
Overall view	O1	Overall view of the website

Scale

The scales used in this research are:

1. Webqual questionnaire
   - *Importance* to measure the quality that user desired, for example: "I feel that LAPOR is easy to learn to operate", the answer options use Likert Scale of 1 to 5 as follows: 1 = Very not Important; 2 = Not Important; 3 = Neutral; 4 = Important; 5 = Very Important.
   - *Performance* to measure perceived of the current quality from user perceived, for example: "How important that LAPOR is easy to learn to operate?", the answer options use Likert Scale of 1 to 5 as follows: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree.
2. Kano questionnaire
   - *Functional* to determine the feeling perceived by user to have a feature, for example: "How do you feel if LAPOR is easy to learn to operate?"
   - *Dysfunctional* to determine the feeling perceived by user not to have a feature for example: "How do you feel if LAPOR isn't easy to learn to operate?"

   The answer options for both of the questions use Likert Scale of 1 to 5 as follows: 1 = I like it that way; 2 = It must be that way; 3 = I am neutral; 4 = I can live with that way; 5 = I dislike it that way.

Results

Demographic Characteristic of the Sample

All the respondents of this research are LAPOR users which have been questioned in questionnaire as the criteria of respondent. Characteristics of respondents are shown in Figure 6. Regarding the gender, 53% equals to 84 participants are female, and 47% equals to 75 participants are male. Based on age group, there is none participant less than 18 years old; 18 to 25 years old is 56 participants (35%), 26 to 35 years old is 49 participants (31%), and more than 35 years old is 54 participants (34%). Regarding the occupation, 17 are students (11%), 70 are civil servants (44%), 35 are private employees (22%), 3 are entrepreneur (2%), and others is 34 participants (21%). Based on last education, senior high school is 24 participants (14%), diploma is 13 participants (8%), bachelor degree is 75 participants (48%), master degree is 45 participants (29%), and doctoral degree is 2 participants (1%).

Test Instrument

Test instrument is conducted by Reliability test and validity test. The tests are done to the result of data collected from both Webqual (performance and importance) and Kano (functional and dysfunctional) questionnaire in 23 attributes. It is conducted by using program application namely SPSS as the tools.

1. Reliability Test

   Reliability refers to the consistency of a measure. Cronbach Alpha is used to measure the reliability of the data. Table 2 shows that the Cronbach alpha score for all the data in 23-attributes is greater than 0.60, therefore the data is reliable.

Table 2. Reliability Test Result

Webqual Cronbach's Alpha		Kano Cronbach's Alpha		No. of Items	Description
Performance	**Importance**	**Functional**	**Dysfunctional**		
0.972	0.960	0.964	0.975	23	Reliable

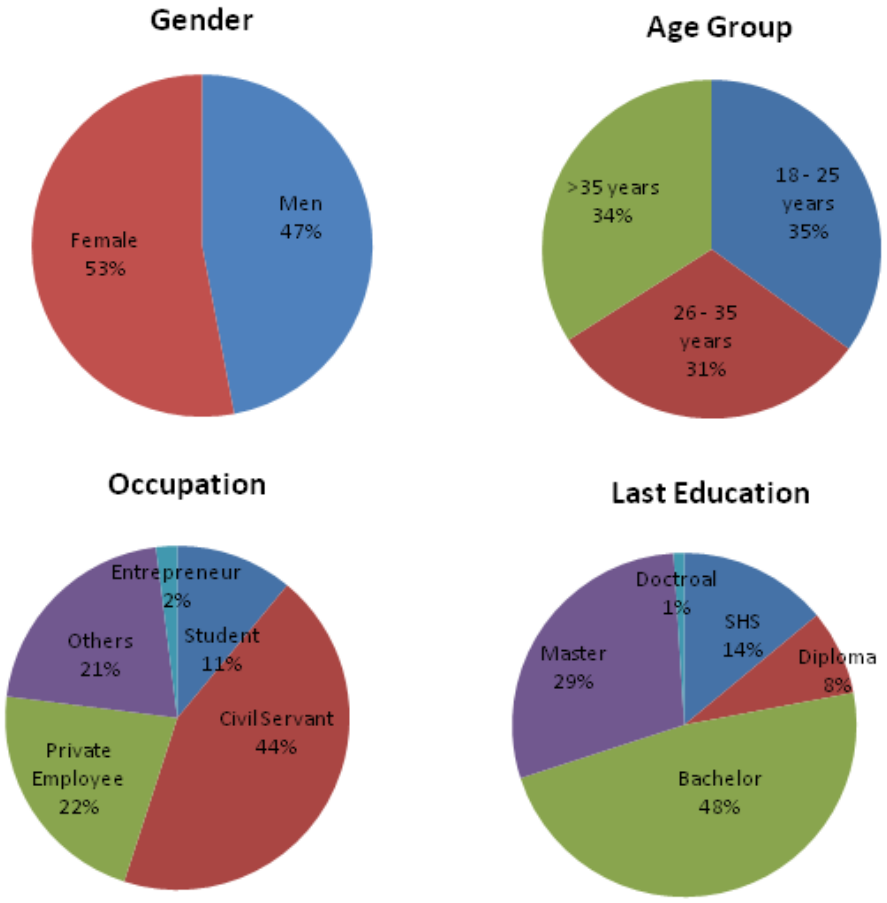

Figure 6. Demographic of Sample

2. Validity Test

   Validity is often defined as the extent to which an instrument measures what it asserts to measure. Corrected coefficients by Pearson is used to determine wheatear the data is valid or not. Table 3 shows that the validity score for all data in 23-attributes are in between 0.6 to 0.8. From the r Table for df = (N-2) = 157, and sig (2 tailed) 0.01 = 1% is 0.2037. It can say that all of the data are valid, r > 0.2037.

Data Analysis for Webqual and IPA

After data collection process throughout the questionnaire using Webqual method, the following process is data analysis using importance performance analysis. It consists of analysis of GAP and analysis of quadrant IPA.

1. GAP Analysis

   Table 4 shows the results of GAP score. GAP analysis is conducted to see the difference of *performance* and *importance* score using Equation 2.

   Qi (GAP) = *perf* (i) – *imp* (i) Equation (2)

   Where:

   Qi (GAP) = GAP score
   perf (i) = Performance mean
   imp (i) = Importance mean

Table 3. Validity Test Result

Item Code	Webqual Rcount		Kano Rcount		R-table	Description
	Performance	Importance	Functional	Dysfunctional		
U1	0.676	0.606	0.615	0.731	0.2037	Valid
U2	0.758	0.655	0.648	0.811	0.2037	Valid
U3	0.795	0.599	0.661	0.800	0.2037	Valid
U4	0.817	0.601	0.688	0.811	0.2037	Valid
U5	0.758	0.745	0.790	0.832	0.2037	Valid
U6	0.781	0.69	0.721	0.777	0.2037	Valid
U7	0.784	0.736	0.766	0.851	0.2037	Valid
U8	0.779	0.704	0.759	0.658	0.2037	Valid
IQ1	0.782	0.750	0.811	0.745	0.2037	Valid
IQ2	0.780	0.813	0.797	0.769	0.2037	Valid
IQ3	0.804	0.822	0.795	0.825	0.2037	Valid
IQ4	0.803	0.792	0.811	0.902	0.2037	Valid
IQ5	0.826	0.730	0.776	0.902	0.2037	Valid
IQ6	0.842	0.829	0.765	0.747	0.2037	Valid
IQ7	0.848	0.798	0.783	0.829	0.2037	Valid
SI1	0.745	0.770	0.782	0.804	0.2037	Valid
SI2	0.830	0.749	0.766	0.883	0.2037	Valid
SI3	0.796	0.738	0.750	0.870	0.2037	Valid
SI4	0.789	0.790	0.762	0.832	0.2037	Valid
SI5	0.737	0.691	0.715	0.808	0.2037	Valid
SI6	0.803	0.749	0.766	0.808	0.2037	Valid
SI7	0.776	0.691	0.713	0.767	0.2037	Valid
O1	0.789	0.741	0.786	0.684	0.2037	Valid

2. Quadrant IPA Analysis

   Mean score of *performance* and *importance* in Table 4 is used to determine the position of each attribute on the Cartesian diagram. Figure 7 is the result of Cartesian graph. The diagram is divided into 4 quadrants, the X axis is *performance* and Y axis is *importance* for both of mean score for all attributes.

   The following is the placement of each attributes of the dimensions in the Importance Performance Matrix (Cartesian diagram):

   - Quadrant 1
     Atrributes that included in quadrant I (*Concentrate Here*) is considered as important but has low performance. This quadran defines which attributes needs to be the priority for improvement in LAPOR, which are *the site easy to navigate* (U3), *attractive appearance* (U5), *good reputation* (SI1), and *personal information feels secure* (SI3).
   - Quadrant II
     Atrributes that included in quadrant II (*Keep up The Good Work*) is considered as important and has good performance. This quadran defines which attributes that has meet respondents expecation in LAPOR so that this attributes only need to keep up the good work of the quality, which are *easy to learn to operate* (U1), *interaction is clear and*

understandable (U2), *the site easy to use* (U4), *creates positive experience* (U8), *provides accurate information* (IQ1), *easy to understand information* (IQ5), and *overall view of the web site* (O1).

- Quadrant III
  Attributes that included in quadrant III (*Low Priority*) is considered to has low importance and low performance. This quadran difenes which attributes in LAPOR that doesn't need much attention as the respondents has less expectation to this attributes, which are *appropriate to the type of site* (U6), *provides timely information* (IQ3), *information at the right level of detail* (IQ6), *information in appropriate format* (IQ7), *sense of personalization* (SI4), *sense of community* (SI5), *communicate with the organization who handle the complaint* (SI6), and *confident that the complaint will be delivered as promised* (SI7).
- Quadrant IV
  Attributes that included in quadrant IV (*Possible Overkill*) is considered to has low importance but good performance. This quadran difenes which attributes that is not very important but has good performance in LAPOR, which are *conveys a sense of competency* (U7), *provides believable information* (IQ2), *provides relevant information* (IQ4), and *safe to complete transactions* (SI2).

Table 4. GAP Results

Dimension	Item Code	Performance Mean	Importance Mean	GAP
Usability	U1	4.000	4.396	-0.396
	U2	3.881	4.390	-0.509
	U3	3.836	4.346	-0.510
	U4	3.950	4.503	-0.553
	U5	3.748	4.377	-0.629
	U6	3.792	4.270	-0.478
	U7	3.862	4.333	-0.471
	U8	4.013	4.459	-0.446
Information Quality	IQ1	3.893	4.352	-0.459
	IQ2	3.855	4.314	-0.459
	IQ3	3.824	4.289	-0.465
	IQ4	3.862	4.270	-0.408
	IQ5	3.893	4.396	-0.503
	IQ6	3.755	4.245	-0.490
	IQ7	3.755	4.327	-0.572
Service Interaction	SI1	3.742	4.371	-0.629
	SI2	3.843	4.289	-0.446
	SI3	3.723	4.377	-0.654
	SI4	3.830	4.333	-0.503
	SI5	3.736	4.195	-0.459
	SI6	3.811	4.289	-0.478
	SI7	3.723	4.258	-0.535
Overall view	O1	3.918	4.371	-0.453

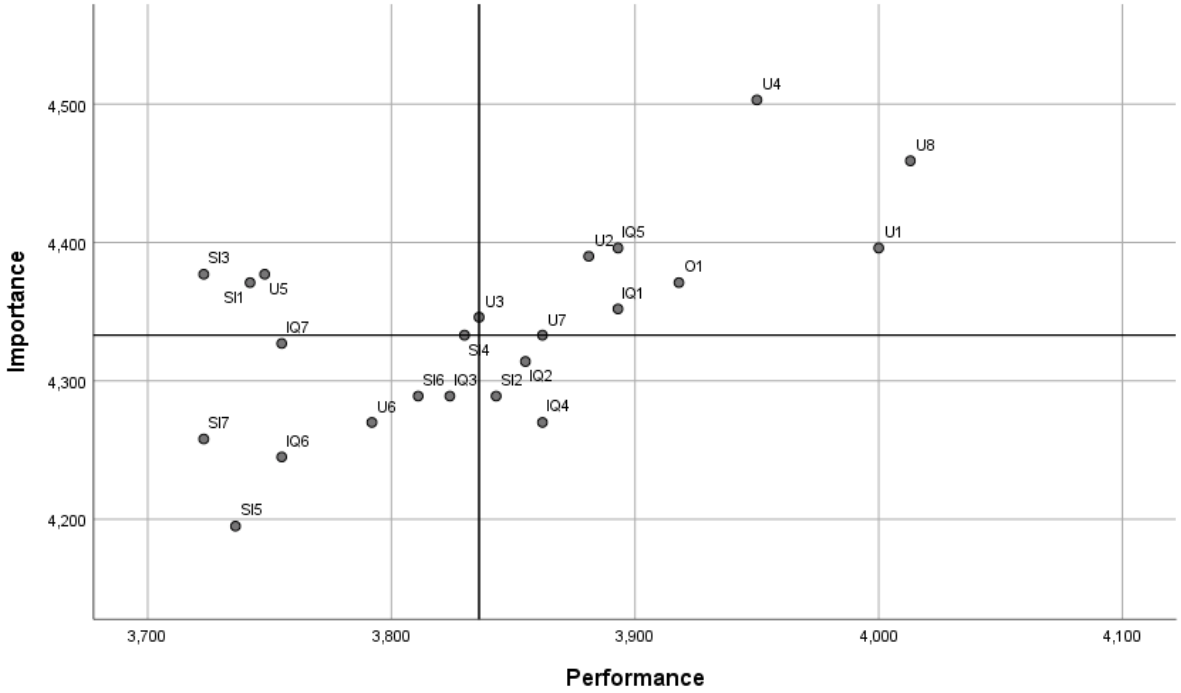

Figure 7. Cartesian Diagram of IPA for LAPOR

Data Analysis for Webqual and Kano

After data collection process throughout the questionnaire using Webqual method for dimension and attribute, the following process is the data analysis using Kano model. It consists of analysis of two-way quality model, and analysis of Kano quality Improvement Index.

1. Analysis of Two-Way Quality Model

   The result of the questionnaire obtained for *functional* and *dysfunctional* for each respondent is paired based on the Table 5 below. The result can be classified into six categories: A (Attractive), M (Must-be quality), O (One-dimensional quality), I (Indifferent quality), R (Reverse quality) and Q (Questionable quality). Table 6 is the result of the classification process based on the Kano evaluation table.

Table 5. Kano Evaluation Table

		Dysfunctional				
		Like	**Must-be**	**Neutral**	**Live With**	**Dislike**
Functional	**Like**	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live With	R	I	I	I	M
	Dislike	R	R	R	R	Q

Table 6. Kano Category Result

Dimensions	Item Code	Classification							
		A	M	O	I	R	Q	Total	Category
Usability	U1	44	37	33	38	3	4	159	A
	U2	42	36	37	38	3	3	159	A
	U3	45	41	28	36	4	5	159	A
	U4	37	38	46	30	2	6	159	O
	U5	44	23	39	41	7	5	159	A
	U6	43	30	29	49	5	3	159	I
	U7	32	38	37	46	2	4	159	I
	U8	35	51	41	26	1	5	159	M
Information Quality	IQ1	31	57	37	28	1	5	159	M
	IQ2	30	61	35	26	3	4	159	M
	IQ3	27	50	39	32	5	6	159	M
	IQ4	33	43	36	38	4	5	159	M
	IQ5	44	39	36	32	3	5	159	A
	IQ6	34	48	32	37	4	4	159	M
	IQ7	36	34	34	51	1	3	159	I
Service Interaction	SI1	30	38	49	35	3	4	159	O
	SI2	31	38	43	38	5	4	159	O
	SI3	31	39	45	35	3	6	159	O
	SI4	40	29	37	45	4	4	159	I
	SI5	36	28	37	49	5	4	159	I
	SI6	27	36	50	36	6	4	159	O
	SI7	28	44	47	36	1	3	159	O
Overall View	O1	36	51	41	26	1	4	159	M

2. Analysis of Kano Quality Improvement Index
   The score of each category for all 23-attributes in Table 6 is used to calculate the index of customer's satisfaction (SI) and index of customer's dissatisfaction (DI) (Equation 3 & Equation 4).
   Customer's Satisfaction (SI) = A+O / (A+O+M+I) Equation (3)
   Customer's Dissatisfaction (DI) = - (O+M) / (A+O+M+I) Equation (4)
   The calculation of both Index for each attributes is shown in Table 7.

The index of customer's satisfaction (SI) ranges from zero to one. The nearer the value is to one, the greater the impact of the meeting of the requirement on customer satisfaction, but the closer the value is to zero, lesser the influence. Table 7 shows that the top 5 improving satisfaction of LAPOR are the site easy to use (U4), attractive appearance (U5), easy to understand information (IQ5), good reputation (SI1), and communicate with the organization who handle the complaint (SI6). These attributes have great effects on increasing user satisfaction and reducing dissatisfaction and are highly concerned by users. LAPOR had better take these 5 attributes as top priority in enhancing their website quality.

Table 7. Kano Quality Improvement Index

Dimensions	Item Code	Improving satisfaction index	Reducing dissatisfaction index
Usability	U1	0.507	-0.461
	U2	0.516	-0.477
	U3	0.487	-0.460
	U4	0.550	-0.556
	U5	0.565	-0.422
	U6	0.477	-0.391
	U7	0.451	-0.490
	U8	0.497	-0.601
Information Quality	IQ1	0.444	-0.614
	IQ2	0.428	-0.632
	IQ3	0.446	-0.601
	IQ4	0.460	-0.527
	IQ5	0.530	-0.497
	IQ6	0.437	-0.530
	IQ7	0.452	-0.439
Service Interaction	SI1	0.520	-0.572
	SI2	0.493	-0.540
	SI3	0.507	-0.560
	SI4	0.510	-0.437
	SI5	0.487	-0.433
	SI6	0.517	-0.577
	SI7	0.484	-0.587
Overall View	O1	0.500	-0.597

However, one must also take the index of customer dissatisfaction into consideration. If it approaches value minus 1, the influence on customer dissatisfaction is especially strong if the product feature is not fulfilled. A value of about 0 signifies that this feature does not cause dissatisfaction if it is not met. The attributes of creates positive experience (U8), provides accurate information (IQ1), provides believable information (IQ2), provides timely information (IQ3), and overall view of the web site (O1) are ranked first 5 in influencing customer dissatisfaction in LAPOR. If these attributes are insufficient, users may feel strong dissatisfaction and it may arise the decrease in satisfaction when they are not fully fulfilled. LAPOR had better take these 5 attributes as top priority to decrease dissatisfaction.

Discussion

Since IPA and Kano model has the similar purpose, which is to analyzing customer satisfaction, the result of both data analysis process can be related to one another. The similar result intends to support each other's result, while the different result can be considered to enhance the result for more completeness and richness.

From the quadrant IPA analysis, the important quadrant for supporting customer satisfaction is quadrant 1 and quadrant 2. The quadrant 1 is referred to the attributes needs to be the priority for

improvement in LAPOR, while the quadrant 2 defines which attributes of LAPOR that need to keep up the good work of the quality.

While from the Kano model analysis, the index of customer's satisfaction (SI) referred to the attributes of LAPOR that have great effects on increasing user satisfaction which are highly concerned by users, while the index of customer dissatisfaction (DI) defines the attributes of LAPOR that make users may feel strong dissatisfaction when it is not fully fulfilled.

The results of both data analyzing process are similar even though it is not fully the same. So that the elaborate of the result is considered to summarize the attribute of LAPOR that needs to be focused on to enhance the system quality which leads to customer satisfaction. The attributes are easy to learn to operate (U1), interaction is clear and understandable (U2), the site easy to navigate (U3), the site easy to use (U4), attractive appearance (U5), creates positive experience (U8), provides accurate information (IQ1), provides believable information (IQ2), provides timely information (IQ3), easy to understand information (IQ5), good reputation (SI1), personal information feels secure (SI3), communicate with the organization who handle the complaint (SI6), and overall view of the web site (O1).

Conclusion

This research analyzes the requirement of the system quality that affect the customer satisfaction of LAPOR, as the online service for complaints provided by the government, using a Webqual 4.0 method. The measurement variables are usability, information quality, service interaction, and overall view. This research integrates Webqual method to Importance Performance Analysis (IPA) and Kano model as the data analysis process. Based on the GAP analysis of IPA shows that LAPOR has not fully meet the user's expectation of their system quality. The quadrant IPA analysis defines which attributes that needed to be focus for improvement which leads to customer satisfaction, while the analysis of Kano quality improvement index defines the attributes that affect user satisfaction and dissatisfaction. The integration of both data analysis process shows that there are 14-attributes out of 23 that need to be the priority for LAPOR improvements.

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Digital Humanities: Community Participation in the Balinese Language Digital Dictionary

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Abstract

In recent years, the capability of Balinese people to write and speak their mother tongue has declined significantly among the younger generations because of the growing influence and adoption of the national language, Bahasa Indonesia. It has spread rapidly among Balinese youth because it is considerably more straightforward than the Balinese language and is free of caste regulations. In this paper, we present the details of our digital humanities preservation research dealing with the Balinese language. We utilize community-based crowdsourcing to participate in expanding and enriching the BASABali Wiki digital dictionary in the form of an online competition. Ninety-six participants in 24 groups participated in our study, and their contribution populated 2686 new unique sentences to the BASABali Wiki digital dictionary. We also discuss the procedures employed to evaluate the digital dictionary: to receive feedback on the digital dictionary system and our approach to acquiring the knowledge of the community.

Keywords: Digital dictionary, balinese language, digital humanities, community-based crowdsourcing

Introduction

The island of Bali is one of the small islands of the Indonesian archipelago and has a diverse and rich culture. This island is also known as the most significant international and national tourist destination in Indonesia. The rich culture and heritage of Bali has become one of the most exciting attractions to people visiting this island. The Balinese people have maintained their heritage and tradition through religious ritual and daily practices. The Balinese cultural knowledge and practices have been passed down over generations through socialization: each generation learns by experience through ritual and tradition. However, as modern commercialism and standardization have started to replace the traditional

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mode of socialization to transfer cultural knowledge, with its poor documentation, there is great concern that the Balinese culture will vanish in the future (Covarrubias 2008; Pramartha and Davis 2016).

The phenomenon of the extinction of indigenous languages in Indonesia has become a significant concern for many scientists, especially linguists. Various efforts have been made to safeguard these indigenous languages from the process of extinction. This is a justifiable concern for Indonesia, which is recognized as the second-largest country in the world that practices indigenous languages, after Papua New Guinea. Some of these languages are classified as Austronesian languages, and some are non-Austronesian (Papuan) languages. The extinction of the language has implications not only for the linguistic domain, which focuses on the structural aspects of the language, but also the cultural knowledge that is attached to the language. This is because through language, a community's perspective can be understood, and the rules, traditions, and beliefs of an ethnic group can be shown (Dixon 1997).

The Balinese language is one of 719 living languages spoken in Indonesia and is mainly used on the islands of Bali and Lombok. According to the latest survey from the Summer Institute of Linguistics (SIL), only 707 mother-tongue languages are spoken in Indonesia. This number is based on the communities that continue to communicate using these languages. However, The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has registered only 143 languages from Indonesia on their database (Kemdikbud 2018).

There are three layers of the Balinese language: the low (*base bali sor*), common or middle (*base bali madya*), and high tongues (*base bali alus*). As one of the legendary anthropologists of Balinese culture writes, "The high and low tongues are distinct, unrelated languages with separate roots, different words, and extremely dissimilar character" (Covarrubias 2008). These three layers of Balinese language are linked to a hierarchy of castes that are regulated in the Balinese social system. The hierarchy of castes in the Balinese social system are: 1) *Brahmana*, a family of the high priests; 2) *Kshatriya*, mainly the royal family and kings, who acted as warriors in the past; 3) *Waisya*, a group who work as traders or government officials; and 4) *Sudra*, a group of people who generally work as farmers. Communicating in different layers of the Balinese language is vital in the Balinese social system and community.

Today, the Balinese people are experiencing a cultural heritage knowledge erosion: specifically, the use and understanding of Balinese language. This is due to the global cultural influence, and the extensive use of Bahasa Indonesia in all school grades makes this indigenous language preservation more challenging. Sooner or later, with a few people practicing and understanding the Balinese language, it and the related heritage are likely to vanish. Moreover, as the younger generation of Balinese have a limited understanding of the Balinese cultural heritage, they try to avoid using the different layers of the Balinese language in communication. A recent study has estimated that the current Balinese generation may be the last generation that can speak the Balinese language if no additional action is taken to preserve the language (Beratha et al. 2017).

Recently, Balinese language and culture strengthening initiatives undertaken by the public sectors have increased. The latest Balinese Governor, I Wayan Koster, releases a regulation number 10-year 2018 related to the use of the Balinese language, script, and customary clothes (*pakaian adat*) every Thursday. Also, these regulations force the public and private sector to write the title of the office or the event in the Balinese script. Through this regulation, since 2018, every February is used as a month to celebrate a Balinese culture, with many activities such as ancient text transcribing, Balinese storytelling, scriptwriting, and so forth.

To counter the Balinese language degradation within the younger generation, there are some initiatives supported by public organizations that aim to encourage young Balinese to continue their heritage. In 2013, a digital project (Tamiang) that aims to help Balinese people preserve their ability to use the Balinese scripts in a digital form was initiated by Pramartha and Dwidasmara (2014). This study is a collaborative project between Udayana University and Denpasar Vocational High School (SMKN1 Denpasar) with a research grant from the Denpasar City Council (the capital city of Bali). The Tamiang project focuses on developing a non-QWERTY computer keyboard that can be utilized to write Balinese

script in a digital form. Today, this project has received full support from Udayana University to produce a prototype and is expected to release and distribute the final product throughout all schools in Bali.

Today, the opportunities for cultural heritage and humanities preservation can be assisted by the adoption of digital technology such as mobile technology and the Internet. The rapid development and adoption of these technologies can connect those people who have and understand the cultural knowledge with people who want to learn heritage knowledge.

In this paper, we discuss our approach to preserving the rich and diverse Balinese cultural heritage by expanding the Balinese language digital dictionary in the form of a knowledge-based system (www.basabali.org) that can be accessed and learned by the student, community, and the Balinese younger generation, in particular, using a computing device, such as mobile device or computer, and the Internet. Using this knowledge-based system in the form of a digital dictionary, the community can contribute by adding, refining, and sharing heritage content related to the Balinese language. Moreover, much of the digital dictionary content relies on community participation in the form of crowdsourcing. Furthermore, this paper also adopted the Technology Acceptance Model (TAM) (Davis et al. 1989) to assess the ease of use and usefulness of the knowledge-based system in relation to the community contribution.

Literature Review

Digital Language Revitalization

Over the past few decades, the concern about language endangerment and cultural heritage loss has increased significantly. Many multi-disciplinary and collaborative projects have been developed that focus on language mitigation and large-scale diversity destruction due to globalization. The involvement of the community of native speakers in the project becomes essential to capture and understand the language and the cultural knowledge surrounding the language (Genee and Junker 2018).

Today, digital technology has become a commodity that is affordable and accessible to anyone. It is clear that many areas of the humanities have been supported by this digital technology; for instance, in indigenous language revitalization and reclamation (Galla 2016). Moreover, successful efforts in language revitalization around the world are mainly based on community initiative, commitment, and investment (Fishman 2001).

On the other hand, while some academic articles have mentioned that digital technology has improved language learning, there are few published studies on the integration between technology and indigenous language revitalization. Hermes and King (2013) suggest that to preserve the indigenous language using technology, the community should adopt this technology in three different areas:

1. Communication. The broad adoption of digital technology, such as the Internet, as a community communication medium, specifically for indigenous languages, provides a new context of usefulness. Also, the Internet enables the communication to reach not only locals but people on the other side of the globe.
2. Materials production. Digital technology enables users to produce, reuse, and share digital resources in the context of indigenous language easily.
3. Documentation. This last area has become important: documenting and archiving any knowledge in digital form performs a major role in supporting revitalization efforts.

A digital project on the revitalization of the endangered Torwali language used digital technology to develop a database to support knowledge-based systems. The initial project collected data from students, colleagues, friends and relatives of the author, without providing information on their background related to the language being studied (Ullah 2019). A significant work by Genee and Junker (2018) that focused on developing Blackfoot language resources and a digital dictionary, using web technology to capture and store the digital resources, has provided positive evidence of language revitalization. Their work involved and empowered community participation to add to and refine the resources. Both of these language preservation projects had a different approach and methodology to

our project, in which community contributions to preserve the language are in the form of a competition, and Balinese language experts are used to verify the participant contributions. Moreover, as previously stated, the complexity of the three different levels of Balinese language ("*basa bali alus*", "*basa bali madya*", and "*basa bali sor*") adds another challenge to the task of preservation in our study.

Crowdsourcing Approach in Digital Humanities and Heritage

In 2006, Howe introduced the term 'crowdsourcing' for the first time in Wired magazine to describe "the act of taking a job traditionally performed by a designated agent (usually an employee) and then outsourcing it to an undefined, generally large group of people in the form of an open call". This definition was then expanded by Brabham (2013), who suggested that crowdsourcing is something initiated by an organization, not by a group of individuals. Moreover, crowdsourcing is something that employs many people on the Internet (Mao et al. 2017).

Today, many cultural heritage organizations, such as galleries, libraries, archives and museums (GLAMs) have utilized this approach, which allows the public to participate in undertaking cultural heritage tasks. For instance, a study at the National Library of Australia utilized crowdsourcing to correct and transcribe almost 320,000 articles from The Australian newspaper, with seven million lines transcribed in just one year. Similarly, a project to transcribe approximately 124,000 Bentham manuscripts was hosted by University College London (Alam and Campbell 2017).

Initially, many people and organizations, especially in the cultural heritage domain, expressed doubts about utilizing crowdsourcing to achieve their goals. However, a study by Corney et al. (2010) provided substantial evidence on employing crowdsourcing in a cultural heritage project, specifically in translation tasks, and showed that crowdsourcing had a 77% success rate. Other studies, of the Bentham project (Causer and Terras 2014) and the Papers of the War Department project (Leon 2014), also agree that involving crowdsourcing in a transcription project leads to a higher success rate than when text on paper is scanned and automatically transcribed using computer software. Another study on capturing and annotating cultural objects by crowdsourcing claims that the various backgrounds and understanding among crowdsourcing employees will provide diverse points of view to capture the breadth and richness of the cultural resources (Constantinidis 2016).

Crowdsourcing typically comprises a large number of users or workforces on the Internet to solve a complex problem. However, including a specific kind of crowdsourcing, such as community-based crowdsourcing (CBC) (de Vreede et al. 2017) to work on a particular kind of problem or project will give a more successful outcome. A recent study by Pramartha et al. (2017) shows that CBC participation in populating Balinese cultural heritage knowledge, specifically on the Balinese traditional communication tool ("*kulkul*"), into a digital portal has contributed a significant amount of data to the digital portal with substantial quality. Moreover, the expert domain participation and their levels of experience and expertise are linked to the knowledge being acquired using the CBC approach.

Methodology

In this study, the researchers focused on acquiring knowledge of Balinese language from the community. A 24-hour online competition was conducted by the researchers, in which the participants were asked to populate as many sample sentences as possible either in the Balinese language high tongue ("*basa bali alus"*) or the Balinese language common tongue ("*basa bali madya*") to the BASABali Wiki digital dictionary and virtual library (details of the procedure explained in the next section). After the sample sentences were submitted to the BASABali Wiki digital dictionary system, submitted contents were checked for correctness by the Balinese language experts. The researchers focused this study in two different geographical locations: Bali (Universitas Udayana campus, Bali and STIKI STIKOM Indonesia), and in the city of Jakarta.

BASABali Wiki Digital Dictionary System

The BASABali Wiki digital dictionary system is a wiki-based system and a self-registered system that has been available online at www.basabali.org since 2014. This wiki serves as a digital dictionary for

the Balinese language and is expected to be the main reference for those who would like to learn and document the Balinese language in digital form. Within nearly five years there were 5,452 registered users with 12,654 Balinese words and sample sentences entered in the system. Currently, the BASABali Wiki contents rely heavily on the Balinese language expert team that works side-by-side to populate most of the content. Furthermore, the BASABali Wiki digital dictionary system is designed to support the public to contribute content using the Internet-based technology. This BASABali wiki digital dictionary system lacks a mechanism to control the populated data, meaning any registered user can post, edit, and delete any content at the wiki and publish it without anyone from the Balinese language expert moderating the content in advance. However, the expert team can delete edits from the public and revert to a previous version.

Participant and Cultural Expert Recruitment

In this study, we recruited participants from the student and staff network of the Udayana University and STIKI Indonesia, the Balinese community in Bali, and the Balinese community in Jakarta. The Udayana University was chosen for this project because of its standing as a repository of Balinese cultural knowledge and expertise. The STIMIK STIKOM Indonesia was selected because this School of Information Technology has a focus on supporting the preservation of Balinese cultural heritage using digital technology. The majority of students from both universities are Balinese. The Balinese community in Jakarta was invited because @america, the center for American culture in Indonesia, which is in Jakarta, was involved to support this study. Posters were placed around the university campuses and in high schools in Jakarta with a brief overview of the study and details of a contact person in charge of the competition.

Participant recruitment is shown in Figure 1. In order to participate, it was not mandatory to be part of this project that a participant be a student or staff member of the university or Balinese community. The only requirement was that the participants should be in groups of four or five people, and that any of the team members should have knowledge about the Balinese language. Participants who decided to be involved in the study were asked to fill in an online form to register their team details, including their members' information. Once the participants agreed to take part in this study, they were provided with a short training session, conducted either in-person or using a tutorial video that was provided on the website. The short training was conducted for a small number of groups by the research team in Denpasar. Participants that live outside the Denpasar city were provided with the tutorial video. There were 44 teams that responded to our invitation; however, during the competition only 24 teams comprising a total of 94 participants decided to compete. At the end of the study, all participants that interacted with and experienced the system were invited to take part in the evaluation by taking the online questionnaire.

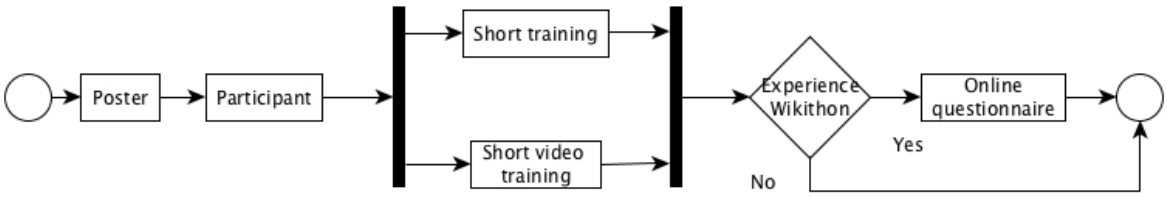

Figure 1. Participant recruitment

All data submitted by the participants was assessed by the Balinese cultural experts. We recruited eight Balinese language experts to assess all data submitted by the community and ensure that it was of sufficient quality:

1. Three professors from the Faculty of Culture and Art at Udayana University – Bali.
2. Two practitioners with more than 10 years' experience in the Balinese language.
3. A professor from Sekolah Tinggi Agama Hindu Negeri, Singaraja – Bali.
4. A senior librarian from Lontar Library at Universitas Udayana – Bali.
5. A senior editor of a Balinese dictionary at Balai Bahasa, Bali Province.

Each of the experts had more than 10 years' experience in their field.

Participants' Task

In this digital humanity knowledge acquisition study, as mentioned previously, the researchers ran the community participation in the form of an online competition over 24 hours. These 24 hours of community participation were divided into several sessions. In each session, the participating team had two hours to contribute their Balinese language knowledge to the wiki system. At the end of each two-hour session, the Balinese cultural experts acted as judges to review and assess the participants' contributions. The team that won each session was announced via the social media platforms Facebook and Twitter. Also, they were awarded a USD50 voucher that had been donated by a national and international organization that cares about Balinese culture.

All participants requested to submit their content to https://dictionary.basabali.org. Figure 2 is a flowchart of how the participants participated in the online competition. Usernames and passwords were provided by a member of the research team to the participants manually. This made it easier for the reviewer to evaluate participants' contributions and decide the winner for each session. Once the participants successfully logged in to the system, they were provided with random Balinese words without sample Balinese sentences to go with them. The participant was prompted to populate a Balinese sample sentence based on the random word that appeared on their screen. However, the participant could skip a word and continue to another random Balinese word if they did not understand the word or it was difficult for them to provide a sample sentence. Figure 3 is an example of a sample sentence being entered into the system by the participant. In an example shown in Figure 3, the participant populated the word "*lelucon*" (funny) into a sentence: "*Dalange ento ngawyang lelucon kanti tiang kedek ngakak*" (The puppeteer is telling a funny story and makes me laugh).

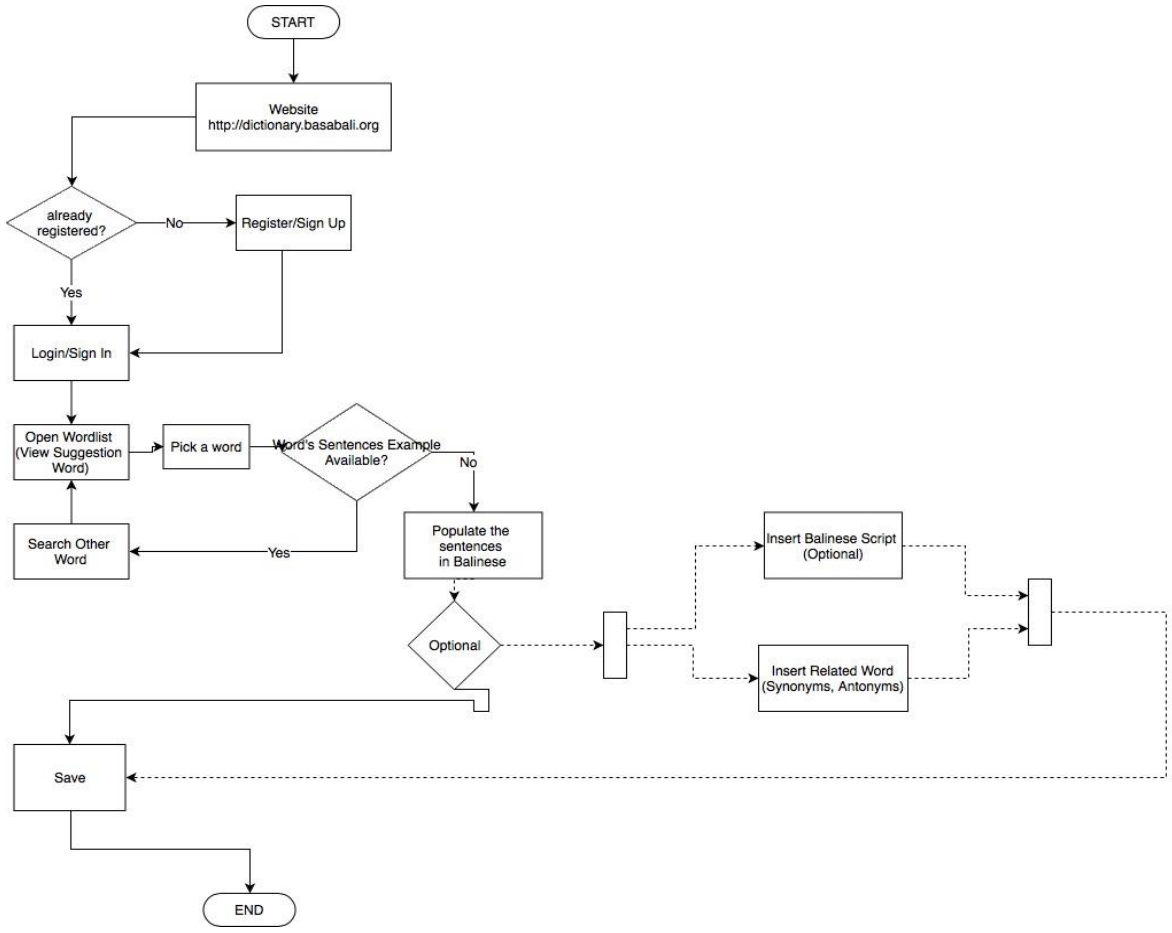

Figure 2. Participants' task

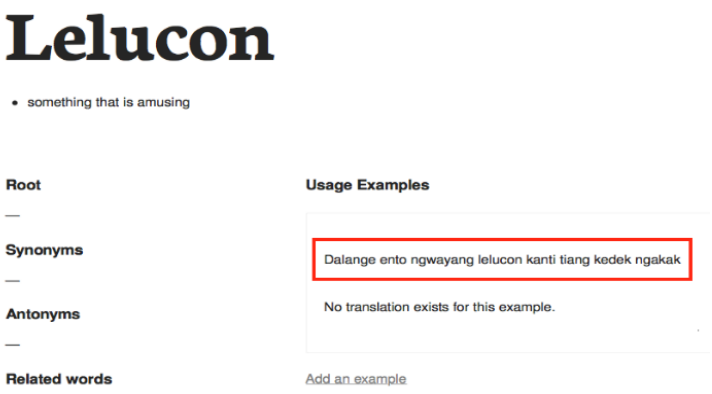

Figure 3. Example of populated sentence

Evaluation of Community-Based Crowdsourcing Contributions

Perceived Ease of Use and Perceived Usefulness

Technology Acceptance Model (TAM) is a model that is used to evaluate user acceptance of information systems (Davis et al. 1989; Hasanah et al. 2019). This model uses two variables – perceived usefulness and perceived ease of use (Suarta and Suwintana 2015) – to explain users attitudes toward using an information system (see Figure 4).

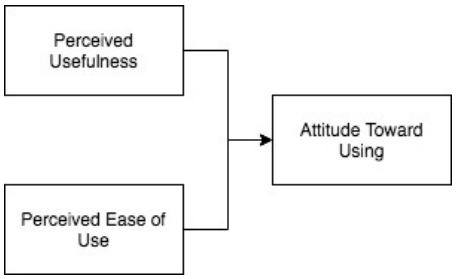

Figure 4. Technology Acceptance Model (TAM): Attitude toward using an information system

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance", and perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989). The perceived usefulness (PU) of the BASABali Wiki comprised six variables:

1. Using the BASABali Wiki would enable me to accomplish tasks more quickly.
2. Using the BASABali Wiki would improve my task performance.
3. Using the BASABali Wiki in my task would increase my productivity.
4. Using the BASABali Wiki would enhance my effectiveness in performing my tasks.
5. Using the BASABali Wiki would make it easier to do my tasks.
6. I would find the BASABali Wiki useful to finish my tasks.

The perceived ease of use (PE) of the BASABali Wiki included six variables:

1. Learning to operate the BASABali Wiki would be easy for me.
2. I would find it easy to get the BASABali Wiki to do what I want it to do.
3. My interaction with the BASABali Wiki would be clear and understandable.
4. I would find the BASABali Wiki to be flexible to interact with.
5. It would be easy for me to become skilful at using the BASABali Wiki.
6. I would find the BASABali Wiki easy to use.

The variables of the participants' perceived usefulness (PU) and perceived ease of use (PE) were measured using a 7-point Likert scale (1 = strongly disagree, to 7 = strongly agree). Aside from

responding to the PU and PE question, participants can add further suggestions and comments. The initial questionnaire of PU and PE were in English, and we provided the instrument to targeted participants in Bahasa Indonesia. To cope with different languages, we adopted the back-translation method (Brislin 1970) to make sure the reliability of the instrument when applying it in different languages.

Participant Motivation

This study relied heavily on community contribution to add, refine, and share digital humanities knowledge and content in the form of Balinese language. As previously mentioned, we offered a USD50 prize for the winning team in each session. A study by Litman et al. (2015) showed that participant contributions and the quality of work in a crowdsourcing project are related to monetary compensation (Litman et al. 2015). On the other hand, some projects in relation to humanities and cultural heritage preservation engage participants or volunteers without monetary compensation; instead, their participation relies more on the engagement of participants and their feeling of belonging to the culture being preserved (Alam and Campbell 2017).

Result

Evaluation is a critical step in this study to understand the participants' contributions. Specifically, in this study, the researcher evaluated the number of participants' contributions, which were the sample sentences entered into the BASABali Wiki digital dictionary system. Moreover, the participants' experience with the system was also evaluated to improve the performance of the BASABali Wiki digital dictionary system.

Community Contribution

As mentioned previously, all participants were provided with a list of computer-generated words that lack sample sentences. The program was designed such that only one group of participants would work on a given random word at any one time. Within 24 hours, 2686 new unique sentences were added (see Table 1). The percentage of contributions from each team is shown in Figure 5. All new and unique sentences created by the 96 participants in 24 teams that competed in this study were counted. In our observation on the system logs, four to eight groups participated in each two-hour session. By the end of each session, new sentences were checked by Balinese language experts for quality. The quality was checked using a simple three-point scale: 0 = incorrect, 1 = somewhat correct and 2 = correct. According to the experts, all sentences met the minimum standard to be published online for public consumption. The minimum standard was 'somewhat correct', which meant that the sentence submitted by participants could be understood, but the structure ("*anggah ungguh"*), such as whether they used the high tone for the sentence, or they mixed the tone, was not correct.

After all the participants had completed the online competition, they were invited to answer a small set of questions regarding the ease of use and usefulness of the BASABali Wiki digital dictionary system. The researchers adopted the instrument of two dimensions: perceived usefulness (PU) and perceived ease of use (PE) (Davis 1989).

The SPSS statistical analyses tool were used to analyse the outcome of the questionaire. In order to check the items consistency of the questionnaires, a relibility test (Cronbach's alpha) was conducted. Moreover, to conclude that BASABali Wiki digital dictionary system is useful and easy to use, a one-sample t-test was performed.

Table 1. Frequency of contributions

Groups	Number of unique sentences
Denpasar13	498
Karangasem3	395
Tabanan1	367
Denpasar17	332
Denpasar19	330
Denpasar11	244
Denpasar16	243
Singaraja2	92
Greenschool2	40
Denpasar18	32
Others	113
Total	**2,686**

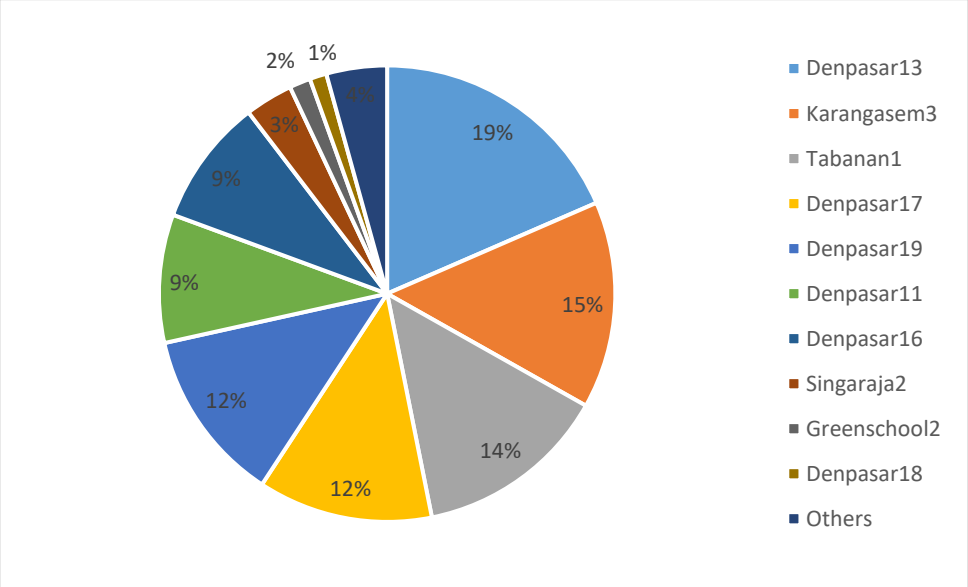

Figure 5. Percentage of contributions

Other analyses, such as Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy analysis, were performed to ensure that there was adequately high variability in the collected data for factor analysis. However, due to the limitations of the data collected the KMO outcome was low, below 0.5, indicating that the data was not suitable for Factor Analysis. A total of 16 participants from 11 different teams responded to our invitation to answer the questionnaire. A detailed characterization of these 16 participants is shown in Table 2. Cronbach's alpha was performed to assess the reliability of the items. As shown in Table 3, the reliabilities of the items are above the minimum threshold of 0.7 (Nunnally and Bernstein 1994), which the calculated alpha of perceived usefulness (PU) was 0.869 and perceived ease of use (PE) was 0.724. For ease of interpretation and to assess users' perceptions of the BASABali Wiki digital dictionary system, we grouped the participants' raw scores on each of the above two-component items (PU and PE) into samples PUAVG and PEAVG, respectively, and calculated the mean for each sample (Table 4). Moreover, we treated the above scores with equal weights due to the nature of our exploratory research(Hair et al. 1998; Tabachnick and Fidell 2001).

Table 2. Participant characteristics

Description	N
Participants	16
Gender	
Male	11
Female	5
Religion	
Hindu	15
Christian	1
Member of community	
Banjar	1
Youth community	9
Balinese orchestra	1
Other	1
None	4
Area of living	
City	10
Rural/suburb	6
Balinese Language literacy	
Poor	1
Moderate	11
Advanced	4

The results of analyses suggest that the users' perceived usefulness score for the BASABali Wiki was statistically considerably higher than the middle point of 4.0, $t(15) = 25.100$, $p = 0.005$, SD = 0.86, mean = 5.43. Similarly, the users' perceived ease of use score for the BASABali Wiki was statistically significantly higher than the middle point of 4.0, $t(15) = 43.859$, $p = 0.005$, SD = 0.53, mean = 5.81 (see Table 4 and Table 5). In conclusion, the results suggest that in general, the users perceived the usefulness and ease of use of the BASABali Wiki digital dictionary system to be positive.

Table 3. Reliability of Perceived Usefulness and Perceived Ease of Use

Reliability	Cronbach's Alpha	N of Items
Perceived Usefulness	.869	6
Perceived Ease of Use	.724	6

Table 4. One-sample statistics

	N	Mean	Std. Deviation	Std. Error Mean
PUAVG	16	5.4271	.86489	.21622
PEAVG	16	5.8125	.53011	.13253

Table 5. One-sample t-test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
PUAVG	25.100	15	.005	5.42708	4.9662	5.8879
PEAVG	43.859	15	.005	5.81250	5.5300	6.0950

Discussion

Participant Motivation

Aside from assessing the perceived usefulness and ease of use of the BASABali Wiki, the researchers asked participants about their motivation for this study by providing them with a separate question. Interestingly, none of the participants mentioned that the prize or money was their main motivation to participate in this competition. However, many of them clearly mentioned that they participated in the study to help by contributing their knowledge to preserve the Balinese language. This motivation is in line with Alam and Campbell (2017), who found that money is not the main concern for crowdsourcing participation in the cultural heritage domain.

In the present project, a community was involved as the main contributor to digital language preservation in the form of an online competition, and Balinese language experts were used to verify the participants' contributions. Our project is a bit different in approach and methodology from both the Genee and Junker (2018) and Ullah (2019) language preservation projects. Moreover, the complexity of the three different levels of Balinese language (*base bali sor, base bali madya, base bali alus)* was another challenge in the preservation project.

Conclusion

We have presented the details of our study on the digital preservation of the Balinese language using community crowdsourcing with a competition framework. Our contributions include digitization of the Balinese language by inviting the community to participate in an online competition to populate a wiki dictionary with Balinese sentences, making it available on the Internet and evaluating the community-based contribution.

Our study involved 96 participants in 24 teams from two universities in Bali, and Balinese communities in Bali and Jakarta, who populated content to the BASAbali Wiki digital dictionary system. In this study, online participants successfully generated 2686 new unique sentences in the BASAbali Wiki dictionary systems during 24 hours of online competition. At the end of the online competition, we evaluated the system features in term of ease of use and usefulness. The results indicate that, for the most part, the users perceived the usefulness and ease of use of the BASAbali Wiki digital dictionary system to be positive. Moreover, all participants clearly mentioned that money was not their main motivation. Instead, they wanted to contribute knowledge to digital humanities by preserving the Balinese language mother tongue in a digital form, indicating positive feedback on this project.

Currently, we work to promote this BASAbali Wiki digital dictionary system among the schools and communities in Bali. We expect the community is not only using and benefiting from the available content, but that the community should also contribute their knowledge to expand this system to be a living repository.

We acknowledge that our study has some limitations; for example, during the study we did not fully control the system environment to be available only to the participants. Other users were also able to access and write data to the BASAbali Wiki Digital dictionary system during the competition. Also, we should have registered every team member and provided each of them with a unique username, so that we could analyze each member's contribution and effort in greater detail rather than as an aggregate contribution of the team.

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Disclosure Statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Information and Communication Technology Recommendations for the Further Development of a Robust National Electronic Health Strategy for Epidemics and Pandemics

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Abstract

This paper aims to provide recommendations for information and communication technology strategy that can support government actions to overcome epidemics and pandemics in Indonesia. The method used in this research is a qualitative approach by conducting a narrative review and discussion with four experts in the field of information and communication technology. The results of this study are recommendations related to people, process, technology, and data. The recommendations are inspired by the success of Internet in establishing public and private collaboration. This research is intended to assist the government in formulating information and communication technology policies to support government and health organization actions to overcome epidemics and pandemics.

Keywords: Information and communication technology, recommendation, epidemic, pandemic, Indonesia

Introduction

The geography and demography of Indonesia compel the Indonesian government to create policies that leverage information and communication technologies (ICT) for the management of public health (Mahendradhata et al. 2017; Nugraha and Aknuranda 2017). The COVID-19 pandemic cruelly demonstrates the need for a sovereign, effective and efficient electronic health (e-health) infrastructure. While some national initiatives started as early as in the mid-eighties, in 2017 Minister of Health Regulation Number 46 primed the pump for the development of a national e-health strategy. Already multinational corporations are preparing their offer for a private e-health system (e.g. Deloitte Indonesia et al. 2019). However, as the regulation only defines the principles, to be operational there is a need to define and implement the detailed steps. Therefore, comprehensive, and integrated policies and regulations related to information technology and information systems are needed for all stakeholders in implementing e-health.

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Based on the World Health Organization (WHO 2017), the definition of an epidemic is a plague that spreads over a wider geographical area, whereas a pandemic is an epidemic spreading to several countries or regions in the world. The crisis caused by epidemics and pandemics made all organizations and communities work together to solve these problems. Epidemics and pandemics can cause crises in a country where the country's leaders will face unknown and poorly understood problems (D'Auria and De Smet 2020). Moreover, the involvement of the communities in utilizing the ICT also very much needed in overcoming this epidemic and pandemic problems (D'Auria and De Smet 2020).

To date, the fact that Indonesia is one of Southeast Asia countries that has the highest COVID-19 positive patients where more than 2 percent compared to the total number of cases divided by the total population and more than 1 percent of mortality rate compared to the total number of cases divided by the total population has put pressure on the Indonesian government to have faster action in detecting and handling COVID-19 patients (Gugus Tugas Percepatan Penanganan COVID-19 2020). To overcome COVID-19, the Indonesian government has issued several regulations, one of which is Government Regulation No. 21 of 2020 namely Large-scale Social Restrictions to stop the spread of COVID-19. In addition, The Ministry of Health has also issued the Regulation No. 9 of 2020 namely Large-scale Social Restrictions Guidance. Based on Ministry of Health Regulation No. 9 of 2020, the primary data that need to be managed for handling epidemics and pandemics are medical records and personal health records ("*resume medis*"), travel history, disaster areas and list of areas in surveillance, number of cases and local transmission events. Based on those regulations, data related to infrastructure (medical devices, medicines, health facilities, laboratories, pharmacies, funerals, etc.) and the availability of human resources for medical personnel, analysts, and information technology are also vital for evaluating and monitoring health services provided by the health service manager.

Considering the importance of ICT in managing the COVID-19 pandemic in Indonesia and to fill in the gaps where only few studies have been conducted to provide ICT recommendation for the development of e-health in Indonesia (Sudarto et al. 2018), this study aims to provide recommendations for ICT solutions that can support the government's actions to overcome epidemics and pandemics in Indonesia. This research intends to assist the government and health organization in Indonesia and other countries that have the same characteristics as Indonesia in developing ICT policies to deal with epidemics and pandemics, especially COVID-19.

Literature Review

Public Health

Public health is what we as society do collectively to assure the conditions in which people can be healthy (IMO 1998). According to the States of America Center for Disease Control and Prevention (2011), public health has three core functions: assessment, policy, and assurance (Figure 1). Assessment consists in monitoring health as well as investigating, diagnosing, and solving health problems and health hazards in the national community. Accurate and periodic assessment of the community's health status consists of identification of health risks, attention to vital statistics and disparities as well as identification of assets and resources. Public health assessment use of methods and technology to interpret and communicate data. Diagnose and investigate health problems include the timely identification and investigation of health threats, availability of diagnostic service and response plans to address major health threats. Moreover, in the assessment process, health education and health promotion should be conducted within the community to support healthy living (e.g. using social marketing and media advocacy).

Policy development is conducted to protect health and guide public health practice. The scope of policy development includes community and state improvement planning and emergency response planning. Policy development consists in developing policies and plans to support both individual and community health efforts, mobilizing community partnerships and actions to contribute to the assessment as well as preparing people through information, education, and empowerment.

Assurance consists in enforcing laws and regulations that protect health and ensure safety, making sure that health services are available and provided, assuring a competent workforce and infrastructure, evaluating

the effectiveness, accessibility, and quality of health services and researching for new insights and innovative solutions to health problems. In order to make sure that health services are available and provided, several actions should be done such as identification of populations with barriers to care, effective entry into a coordinated system of clinical care, ongoing care management and culturally appropriate and targeted health information for at risk population groups. Furthermore, continuing education and life-long learning to assure a competent workforce should be conducted by leadership development and cultural competence. Evaluation must be ongoing and should examine personal health service, population-based services, and the public health system. The most important linkages between public health practice and academic/research settings deem required to find innovative solutions to health problems.

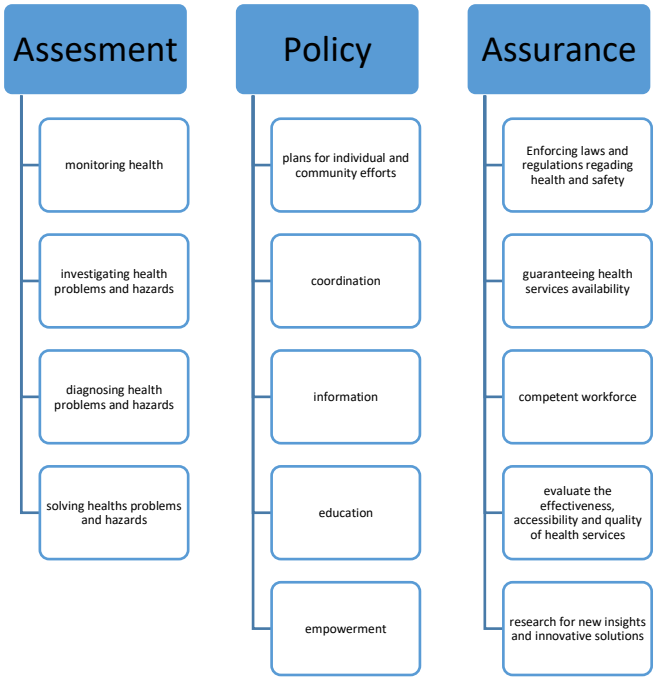

Figure 1. Public health functions (United States of America Center for Disease Control and Prevention 2011)

Information systems and health information systems

While different authors (e.g. Bardhan et al. 2020; Kang'a et al. 2017; Silver et al. 1995), considering different levels of granularity and choosing different emphasis, count different numbers of main components of an information system, we retain the following four: people, processes, technology and data (Figure 2). People include the general population or community, health workers, and researchers (Bardhan et al. 2020; Kang'a et al. 2017). Technological advances and regulatory shifts are transforming healthcare practices from being provider-centered to being patient centered, providing care that is respectful of and responsive to individual patient preferences, needs and values, and ensuring that patient values guide all clinical decisions (Bardhan et al. 2020). Furthermore, online health communities could provide patients feedback that can spawn medical innovation and creative insights (Bardhan et al. 2020). Thus, according to Kang'a et al. (2017), the people's issues are information and training and availability.

Processes bring issues like availability, software engineering and system design principles and requirements (e.g. privacy by design), design, operating and reporting standards, open source, security, data migration, algorithm explainability and responsibility (Kang'a et al. 2017). Those issues could be classified into design, implementation, and assurance of IS/IT development. According to Bardhan et al. (2020), there is critical need for connecting multiple health systems and data, including physiological signals (heart rate, blood pressure, etc), genomic biomarkers, electronic health record, radiology, and patient-reported social media content. Thus, system interoperability is also critical to develop a health information system. Hence, technologies include hardware and software for sensing, communication, computing, and control (Bardhan et al. 2020; Kang'a et al. 2017). Data brings issues such as open standards, quality, integrity, confidentiality,

privacy, ownership, and cost (Bardhan et al. 2020; Kang'a et al. 2017). According to Bardhan et al. (2020), patient privacy must be protected to ensure the acceptance of technology.

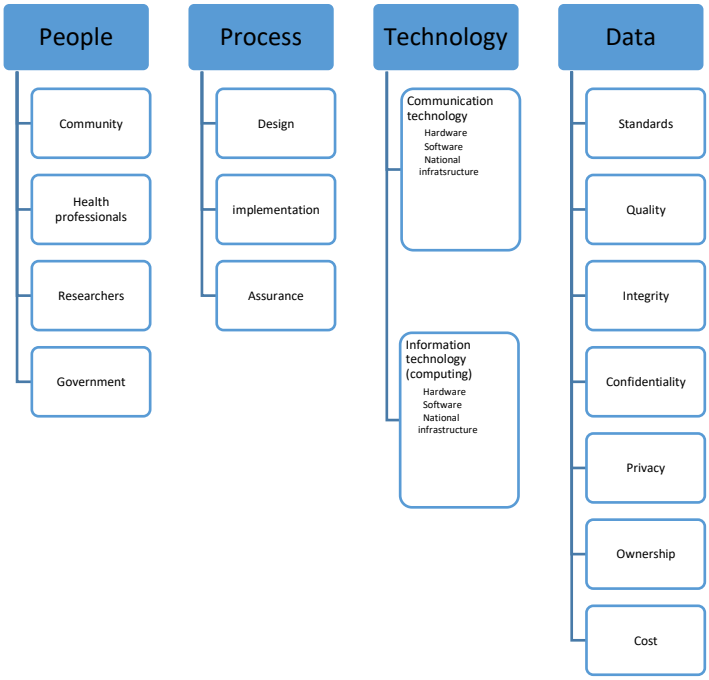

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Figure 2. Information systems principles (Bardhan et al. 2020; Kang'a et al. 2017; Silver et al. 1995)

Silver et al. (1995), considering a functional system theoretic approach, recommend another perspective for the proactive design of information systems and their reactive analysis. The model that they propose considers information technology as an interaction between the information system and five elements of the organizations: the external environment, the strategy, the structure and culture, the processes and the information (and communication) technology infrastructure. The model induces a methodology that considers the following essentials: system effects, organizational context, features of the information system, fit between the features and the organizational context and the implementation process. In the case of a national health information system, these elements correspond to the foreign countries and foreign and international companies and organizations, the public health policy, and the national, public, and private, ICT infrastructure, respectively.

Methodology

We propose a methodology for the formulation of recommendations for the further development of a robust national e-health strategy from the point of view of ICT. The methodology is particularly designed to address the urgency arising from epidemics and pandemics. The methodology is principled: it identifies individual issues as the intersection between the components of the national health information system, to be understood as the de facto aggregation of people, processes, technology and data involved in and concerned by public health, and the three functions of public health, assessment, policy and assurance. We propose to adopt seven ethics principles and eight design principles to define the recommendations.

Further, this research uses a qualitative approach by conducting a narrative review and discussion with four experts in the fields of ICT. Prior to reviewing scientific publications papers, authors conducted reviews on Indonesia's regulations as well as other countries' and international agencies' regulations to develop recommendations that can comply with these regulations. The inclusion criteria used in the narrative review are by selecting online databases that focus on health research, selecting keywords and screening the full-text paper obtained. The online databases used are MEDLINE/PUBMED and SCOPUS. Keywords used are related to health information technology, epidemics, and pandemics. Following the review, analyzing and considering the relevant prevailing regulations and previous researches with respect to the subject

matters, the next step is to obtain inputs from four experts in ICT, who have more than 15 years experiences in their relevant fields which two of them are also lecturers at the Faculty of Computer Science University Indonesia. After the online interview with the experts, we classified the inputs by grouping the recommendations into people, processes, technology, and data. We analyze the data using content analysis to organize the meaning from data collected and to draw conclusions from it. Finally, we validated our results by conducting an online interview with those experts.

Result

State of Indonesia e-health

At present, the Ministry of Health has developed several e-health applications such as public health center information systems, hospital management information systems, health referral information systems, emergency information system and telemedicine that can be used by the public health care facilities. In addition, the Ministry of Health in collaboration with the National Health Social Security Agency also developed claims applications including COVID-19 data reporting applications. Public health care facilities also develop their own information systems in the management of health services. The private sector also participates in developing health and mobile health information systems that can be accessed by health care facilities and their patients. Further, the Ministry of Health also has a health service facility performance reporting application where every health care facility is required to report on their activities annually. These applications can be used to assist the government in performing public health functions according to the States of America Center for Disease Control and Prevention (2011).

In Indonesia, there are several implementing regulations on e-health covering the aspects of health, development of information system/information technology, health information system, and COVID-19 (Figure 3). Currently, there are 17 implementing regulations on e-health. Regulations on health in general are governed by the following regulations: Presidential Regulation No. 72 of 2012 on the National Health System, Minister of Health Regulation No. 269 of 2008 on Medical Records and Minister of Health Regulation No. 73 of 2016 on Pharmaceutical Services Standards at Pharmacies. Presidential Regulation No. 72 of 2012 provides the definition of the National Health System as a health management that is carried out by all components of the Indonesian people in an integrated and mutually supportive manner to ensure the highest possible level of public health. Minister of Health Regulation No. 269 of 2008 describes that a medical record is a file containing records and documents about patient identity, examination, treatment, actions, and other services provided to patients. Minister of Health Regulation No. 73 of 2016 regulates the standards for pharmaceutical services in pharmacy includes the management standards for pharmaceutical preparations, medical devices and consumables, and clinical pharmacy services.

Regulations covering the aspect of Information System/Information Technology are regulated under 3 regulations with focus on electronic transaction and disclosure of public information. Law No. 11 of 2008 on Information and Electronic Transactions provides that Information Technology and Electronic Transaction utilization shall be implemented under the principles of legal certainty, benefit, prudence, good faith, and freedom to choose technology or technology neutrality. Further, Government Regulation No. 82 of 2012 on the Implementation of Electronic Transactions and Systems implementing in more details on the electronic system and transaction operation. Law No 14 of 2008 on Disclosure of Public Information regulates the procedures and requirements for disclosure of information to the public.

In relation to the health information system, there are 6 implementing regulations have been issued. Minister of Health Regulation No. 46 of 2017 on the National E-health Strategy provides the national e-health strategy is implemented through a framework that includes 7 (seven) components, namely: governance and leadership; strategy and investment; services and applications; standards and interoperability; infrastructure; regulation, policy, and policy fulfillment; and workforce. Minister of Health Regulation No. 92 of 2014 stipulates the implementation of data communications in the integrated Health Information System. The arrangement of data communication implementation in integrated Health Information System aims to guarantee the availability, quality, and access of priority Health Data and other Data Loads; optimize the flow of health data from districts/cities and/or provinces to the Ministry of Health or vice versa; and

realize the implementation of an integrated Health Information System. Minister of Health Regulation No. 82 of 2013 defined the Hospital Management Information System as a communication information technology system that processes and integrates the entire hospital service process flow in the form of a network of coordination, reporting and administrative procedures to obtain information precisely and accurately, and is part of the Health Information System. Regulation of the Minister of Health No. 1171/Menkes/Per/VI/2011 regulates Hospital Information Systems as a process of collecting, processing, and presenting hospital data. Minister of Health Regulation No. 31 of 2019 requires the Community Health Center Information System should provide information to help the decision-making process in implementing community health center management in achieving its activity objectives. Regulation of the Minister of Health No. 20 of 2019 stipulates the implementation of Telemedicine services between health care facilities. Telemedicine carried out between one health care facility and another can be in the form of a consultation to diagnose, treat and/or prevent disease.

With respect to the handling of COVID-19, there are 5 regulations that have been issued by the government. Law No. 6 of 2018 defines Health Quarantine as an effort to prevent and ward off the entry or entry of diseases and/or public health risk factors that have the potential to cause public health emergencies. Government Regulation in Lieu of Law No 1 of 2020 stipulates state financial policy and financial system stability for handling COVID-19 pandemic and/or in the framework of facing threats that endanger the national economy and/or financial system stability. Government Regulation No. 21 of 2020 defines Large-Scale Social Restrictions as restrictions on certain activities of residents in an area suspected of being infected with COVID-19 in such a way as to prevent the possibility of spreading COVID-I9. Presidential Decree No. 11 of 2020 stipulates COVID-19 as public health emergency. Minister of Health Regulation No. 9 of 2020 stipulates large-scale social restrictions where to be able to set large-scale social restrictions, a province/district/city must meet the following criteria: a. the number of cases and/or number of deaths due to disease has increased and spread significantly and rapidly to several regions; and b. there are epidemiological links with similar events in other regions or countries.

Based on Kang'a et al. (2017), strategies required for assuring sustainable implementation of electronic medical records (EMRs) consists of people, process, and technology. Handayani (2017) conducted a study of several public and private hospitals in Indonesia that identified several shortcomings of the current situation. Issues that should be solved namely (Handayani et al. 2017; Springer 2020; Yulisman 2020):

1. Technology: not all of the stakeholders in charge of managing health services appropriately use health information systems and technology; insufficient IT infrastructure (software, hardware, network, security); inadequate practices or standards in technology management, especially for data exchange and security (e.g. Health Insurance Portability and Accountability Act (HIPAA), International Organization for Standardization (ISO), etc.)
2. People: the number and competence of IT human resources currently available is inadequate
3. Process: regulations and best practices related to data privacy, information flow, the openness of public data and the use of digital technology has not been formulated in detail to optimize the delivery of health services (preventive, detection, curative, rehabilitative and monitoring); the pattern of coordination between agencies still needs to be detailed and formulate in regulations such as standard operating procedures related to the task and their roles, especially the role of data keeper, health data management that has not been thoroughly defined
4. Data: difficulty in obtaining integrated, accurate, real time and complete health data

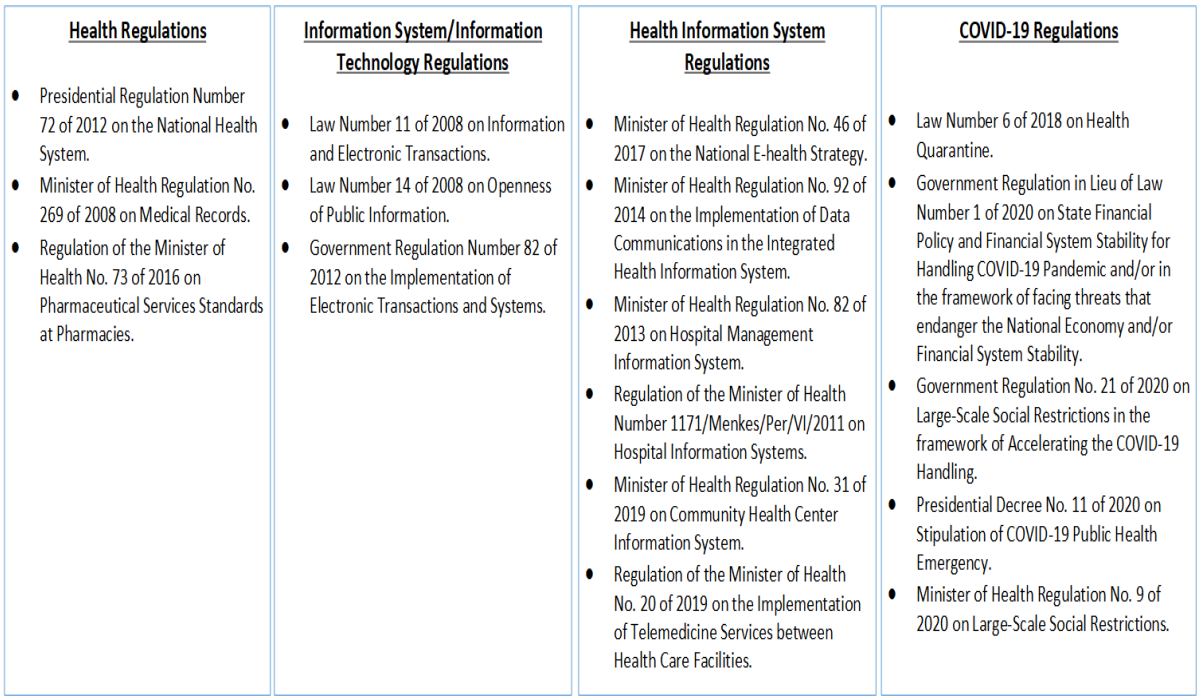

Figure 3. Indonesian Regulations Related to Health, IS/IT, and COVID-19

ICT Recommendations

Beauchamp and Childress (2001) proposed four principles of biomedical ethics. Schröder-Bäck et al. (2014) extended this philosophical basis to seven principles for public health ethics: non-maleficence, beneficence, health maximization, efficiency, respect for autonomy, justice, and proportionality. It is generally acknowledged that these ethics principles are largely compatible to different world views (e.g. Mustafa 2014) as well as with Indonesia's constitutional principles.

The goals and success of the Internet suggest considering similar design principles for a national e-health information system. Clark (1988) lists a primary goal, the choice of a federation of autonomous systems as opposed to the design of a centralized one, and seven second level goals: cost effectiveness, distribution, resilience and fault-tolerance, heterogeneity, openness and accountability. The recommendations are therefore made following the ethics and design principles indicated above for each of the intersections between the public health functions and the information system principles. The highest-level summary of recommendations is featured in Table 1 as a table of three time four themes. Further, this recommendation could be implemented both in the pandemic situation and in normal situation.

Table 1. Summary of Recommendations

	Assessment	Policy	Assurance
People	Provide adequate number of surveillance people	● Increase competency of ICT human resources (i.e. training) ● ICT literacy for society ● Training ICT researcher and new artificial intelligence technique for health (i.e. master and doctoral student)	● Formulation of career path ICT human resources in health care facilities ● Increase the number of ICT human resources
Process	Formulate integrated process to collect surveillance data from existing health technology	● Information Center formulation that can manage data and process flows for handling epidemics and pandemics (including managing hoax information) ● Integrated health information flow regulation definition ● Putting e-health as part of core research activities to ensure continues research and development of the system	● Determination of data standards (i.e. format, interface, interchange) that comply to HIPAA, ISO, or others. ● Approval budgeting mechanism for ICT spending in the event of an emergency ● Information Technology and data governance as well as enterprise architecture (EA) formulation which must refer to certain standards such as Control Objectives for Information Technologies (COBIT), The Open Group Architecture Framework (TOGAF), etc.
Technology	Appropriate use of digital technology (i.e. electronic medical records, electronic prescriptions, hospital information system, primary care information system, mobile health, telemedicine/telehealth, social network) to optimize end-to-end automated proceed in health facilities	● Development of open health data ● Development data analytic/business intelligence ● Developing e-health system that combines centralization and decentralization approaches.	● ICT infrastructure improvement (software, hardware, and network) ● Preparing roadmap for e-health to ensure incremental development of e-health and its adoption in health care practice
Data	Ensure the health organization has certification for security and privacy	● Improving system data quality by involving the community and determining an appropriate data approval mechanism	● Data privacy by design regulation formulation ● Ensure that the data is reliable and trustworthy to enable effective information exchange and collaboration between participating parties in e-health

Discussion and Implications

According to Figure 2 and consistent with Delone and McLean IS Success Model, the success of ICT implementation is largely determined by the quality of information, information systems and ICT services provided (Delone and McLean 2003). Further, in dealing with a pandemic, data surveillance is the basis for decision making in planning, implementing, monitoring, evaluating health programs and raising awareness and responding to extraordinary events that are fast and precise (Ghozali 2016). However, currently in Indonesia, it is still constrained by the small number of personnel who on charge in data surveillance (Ghozali 2016) and therefore the government and health organizations should provide adequate number of officers for data surveillance. Aside the number of surveillance human resource issue, the government should also formulate integrated process to collect and integrate surveillance data from existing health technology (i.e. electronic medical records, electronic prescriptions, hospital information system, primary care information system, mobile health, telemedicine/telehealth, social network). Hence, it is deem required for all health organizations to implement digital technology to optimize end-to-end automated proceed in health facilities. If these conditions can be satisfied, Indonesia could have an e-health system that can combine centralization and decentralization approaches. Centralization of standards is to achieve operability between different systems/health institutions, while the operation of the system can be decentralized and autonomous to promote system adoption and accommodate flexibility-especially in local health service level (Eason and Waterson 2013). It is required to improve ICT infrastructure and preparing roadmap for e-health to ensure incremental development of e-health and its adoption in health care practice to support the implementation of e-health system (Dixon 2007).

Further, Indonesia still has minimum number of ICT people in health industries (Oktara 2019). Therefore, the government and health organizations should increase the number of ICT human resources as well as formulation of career path ICT human resources in health care facilities. Moreover, the improvement of the quality of ICT human resources must also be supported by an increase in competence by providing ICT-related training by experts from universities (i.e. master and doctoral student) in order they can follow the trends of scientific development. Also, putting e-heart as part of core research activities in the health organization and universities could ensure continuity of research and development of the system.

Due to the increasing number of health information specifically during the pandemic, the formation of an independent national information and telecommunication technology for e-health structure that involves representatives from the private sectors, academia and central and local governments are also required including to manage hoax information. Thus, government should also define a) integrated health information flow regulation; b) determination of data standards (i.e. format, interface, interchange) that comply with HIPAA, ISO, or others; c) Information Technology and data governance as well as EA. Moreover, to ensure the overall implementation of ICT, the government and health organizations also need to establish an approval budgeting mechanism for ICT emergency spending.

The Government of Indonesia has issued Presidential Regulation No. 39 of 2019 concerning One Data Indonesia to establish accurate, up to date, integrated, accountable, easily accessed, and shared data, and is managed carefully, integrated, and sustainably. That regulation is the basis for the establishment of open health data in Indonesia where data control and preserve will be conducted at the central and regional levels. To improve the data quality, it is also required the government and health organization could involve community and determining an appropriate data approval mechanism.

Further, based on the Presidential Regulation No. 39 of 2019 and the AHIMA Data Quality Management Model (AHIMA 2011), the data principles that must be referred to in the development of IS and open health data are 1) data accuracy: the extent to which the data are free of identifiable errors; 2) data accessibility: the level of ease and efficiency at which data are legally obtainable, within a well-protected and controlled environment; 3) data comprehensiveness: the extent to which all required data within the entire scope are collected, documenting intended exclusions; 4) data consistency: the extent to which the healthcare data are reliable, identical, and reproducible by different users across applications; 5) data currency: the extent to which data are up-to-date; a datum value is up-to-date if it is current for a specific point in time, and it is outdated if it was current at a preceding time but incorrect at a later time; 6) data definition: the specific

meaning of a healthcare-related data element; 7) data granularity: the level of detail at which the attributes and characteristics of data quality in healthcare data are defined; 8) data precision: the degree to which measures support their purpose, and/or the closeness of two or more measures to each other; 9) data relevancy: the extent to which healthcare-related data are useful for the purposes for which they were collected; and 10) data timeliness: The availability of up-to-date data must be within the useful, operative, or indicated time. With the implementation of open health data, it is possible for governments and health organizations to develop analytic/business intelligence data. In addition, according to HIPAA, health organizations must have certification for security and privacy. Hence, data privacy by design regulation formulation is required to ensure the data is reliable and trustworthy to enable effective information exchange and collaboration between participating parties in e-health. Finally, to the best of our knowledge, few studies have been conducted to provide ICT recommendation for the development of e-health in Indonesia (Sudarto et al. 2018). Therefore, this study is expected to contribute ICT recommendations in formulating ICT policies to support government and health organization actions to overcome epidemics and pandemics.

Conclusion

We have proposed a methodology for the formulation of recommendations for the further development of a robust national e-health strategy from the point of view of ICT. The recommendations that we indicate in this paper are current but neither permanent nor complete as the public health landscape evolves. They illustrate the operationality of methodology. The methodology caters for this need for evolution and adaptability.

It appears to us, however, that the diversity and level of expertise needed to formulate such recommendations and plans in a timely manner requires the formation of an independent national information and telecommunication technology for e-health structure that involves representatives of the private sector, of academia and of central and local governments. We envision the role of such a structure to be the definition (policy), the evaluation (assessment) and the enforcement (assurance) of national open standards for e-health and the definition and promotion of a research roadmap, through the funding fundamental research and translational research projects. The structure, following our proposed methodology, should be concerned with people, processes, technologies, and data involved in public health from the information and telecommunication technology perspective. The national standards should guarantee the quality and availability of human resources and the effective and efficient interoperability of autonomous but open components of the national e-health system developed by the private sector, central and local governments as well as other national and international entities. The structure should also advise the government on decisions concerning the necessary compromises highlighted such as the balance between openness of the data and privacy for the citizens. The limitation of this study that we do not involve the health regulators and private health organizations; thus, future studies should enrich this study by involving all relevant health stakeholders to have better insights.

Acknowledgement

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The Implementation of Multiple Information Security Governance (ISG) Frameworks Strategy and Critical Success Factors in Indonesia's Oil and Gas Industry: Case Study of PT X

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Abstract

The oil and gas industry is one of the largest contributors to Indonesia's foreign exchange. Many people believe that information technology plays an important role in the oil and gas industry's success. However, implementing information technology to support the corporate business process brings vast information security risks. There is a need for comprehensive information security governance that can comply with information security standards and regulations. This research is conducted to evaluate the use of multiple ISG frameworks for implementing information security governance in a multinational oil and gas company. In detail, we evaluate the effectiveness of such a framework, assess its implementation maturity level, and identify the success and inhibiting factors for implementing ISG frameworks. This study shows that framework XYZ, as a multiple ISG framework, is effective to cover the controls of ISO 17799, COSO, and IT Risk Framework at once. Meanwhile, the observed case study indicated a lack of compliance of Framework XYZ followed by the invention of the gap between current ISG implementation efforts and company visions. Lastly, several success and inhibiting factors are identified in the ISG framework implementation at PT X.

Keywords: Information security, governance, multiple ISG frameworks, ISO 17799, COSO, IT Risk Framework, Framework XYZ

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Introduction

The oil and gas industry has a very significant contribution to Indonesia's economy. So far, oil and gas have contributed to the country's foreign exchange and has become an important source of state revenue besides taxes (Baskoro 2019). In its implementation, the oil and gas industry rely heavily on seismic data. Seismic data provides information on the position and depth of drilling, oil and gas content, and other essential information related to oil and gas. This data will determine the amount of production and the sustainability of the company. Therefore, seismic data can be considered as the most important asset of an oil and gas company and must be guarded so that it does not fall into the hands of competitors.

On the other hand, technological developments play a very vital role in improving the business process in the oil and gas industry. The use of information technology such as GPS, ERP, and SCM can help companies make decisions regarding the drilling locations and estimation of oil and gas content more accurately and quickly. Despite providing benefits and conveniences, the increasing use of information technology in the oil and gas industry also comes with huge risks. Data processing failure, communication network problems, data inaccuracy, and data theft are some examples of problems that can occur while using information technology. To reduce this risk, the oil and gas industry has several regulations such as the Sarbanes Oxley Act (SOX), Payment Card Industry (PCI), Gramm Leach Bliley Act (GLBA), and Health Insurance Portability and Accountability (HIPPA).

Compliance with regulation is needed to minimize business risks. To do so, one should implement proper information security governance. Information security governance (ISG) involves developing and integrating management structures and organizations with a reporting process that covers all aspects of successful security programs and provides assurance to business management that risks can be defined and managed appropriately (Ferguson et al 2012). ISG consists of several aspects, namely, leadership, organizational structure, processes, supervisory mechanisms, and technology (Solms 2007). ISG needs to be implemented to secure the confidentiality, integrity, and availability of the organization's electronic assets (data, information, software) from risks and threats (Solms 2007).

To achieve effective information security governance, management must establish and maintain a framework to guide the development and maintenance of a comprehensive information security program. There are several ISG frameworks that can be used as a reference, including ISO / IEC 17799, COSO, GMITS Guidelines, COBIT, and ISM3. However, often, the use of a single framework is not sufficient to meet regulations in the industry. On the other hand, implementing a combination of ISG frameworks can potentially sacrifice their effectiveness.

PT X is a subsidiary of PT X Group, the fifth-largest integrated energy company in the world based in France. In managing its information security, PT X created a distinct ISG framework called the XYZ framework, which adopts and combines several ISG frameworks at once. This study will examine the adoption of the XYZ framework as multiple ISG frameworks in the oil and gas industry, particularly at PT X, by focusing on three research questions as follows:

- Evaluate the effectiveness of adopting multiple ISG (XYZ framework) and its compliance with information security regulations
- Assess the maturity levels of multiple ISG frameworks implementation and identify gaps between the current maturity level and the expected maturity level
- Identify the factors that support and hinder the successful implementation of ISG

Literature Review

Information Security and Threats

Information security is defined as all matters relating to the protection and maintenance of confidentiality, integrity, authenticity, availability, and reliability of information (Calder 2012). Information security can also be defined as the steps required to detect, document, and counter threats to information (Boiko and Shendryk 2016). The prior definitions imply that information security is not only a technical problem but also related to management problems consisting of processes and people (Albert 2016). The purpose of implementing information security is to minimize threats that come

internally or externally. The threat is defined as anything that has the potential to cause loss and damage to information (Pfleeger and Pfleeger 2012).

Information Security Governance Frameworks and Standards

Information Security Governance (ISG) is part of corporate governance that produces a strategic direction, ensures that each goal is achieved, manages risks appropriately, uses organizational resources responsibly, and monitors the success or failure of corporate information security programs (Caballero 2014). ISG is implemented to ensure the confidentiality, integrity, and availability of an organization's electronic assets (data, information, software) and protect it from risks and threats (Solms 2007). To achieve effective information security governance, it is necessary to adopt a proper information security framework. The ISG framework can provide guidance in implementing a successful information security program, risk management, and monitoring. In addition, the ISG framework can also recommend controls needed to protect information as well as being used as an assessment tool for evaluating the implementation of information security. There are several ISG frameworks that are popularly used in the world of information security, including ISO 17799:2005, COSO, and the IT Risk Framework.

ISO 17799:2005, Code of Practice for Information Security Management is intended as a single point of reference in identifying the range of control required in situations where information systems are used in industry and commerce. ISO 17799 states that information is an asset that must be protected because it has the same position as other important business assets. ISO 17799 divides information security control into 11 areas, namely security policy, organization of information security, asset management, human resources security, physical and environmental security, communications and operations management, access control, information systems acquisition, development, and maintenance, information security. incident management, business continuity management, and compliance.

The COSO framework describes an integrated approach to evaluate management's internal control systems for achieving business objectives. COSO requires a formal risk assessment to evaluate the internal and external factors that affect organizational performance. The results of the risk assessment will determine the controls to be carried out by the organization. COSO focuses on financial controls that have implications for information security. COSO is divided into three dimensions, namely the control component, internal control objectives, and activities towards the organization. The control component consists of 5 aspects, namely risk assessment, control environment, control activities, information and communications, and monitoring.

The IT Risk Framework is one of the ISG frameworks published by ISACA in 2009 which focuses on risk management. The IT Risk Framework is a complement to COBIT which provides a series of controls for identification, governance, and management of IT risks. The IT Risk Framework consists of 3 domains, namely risk governance, risk evaluation, and risk response. The IT Risk Framework describes the IT risks that allow users to integrate IT risk management into the company's Enterprise Risk Management (ERM), thus enabling companies to re-evaluate risk management policies. In addition, the IT Risk framework can help to communicate decisions regarding risks level, the likelihood of risk, and tolerance for risk, as well as understanding how to handle IT risks.

Methodology

To answer the proposed research questions in this study, the authors carried out several stages described in Figure 1. First, an ISG multiple framework adoption strategy will be identified together with information security regulations. The analysis includes information security regulations that must be fulfilled and the ISG framework that will be used in ISG implementation. To find out how effective the implementation of this strategy is, we measure the effectiveness of ISG implementation based on four aspects, namely: organizational dependence on information technology, risk management, people and organizations, and information security program processes. After obtaining the effectiveness of the ISG application in the oil and gas industry, the maturity level of the ISG framework is then measured.

Finally, an analysis of the supporting and inhibiting factors of ISG implementation is studied based on human, organizational, and technological aspects.

Study Case: PT X

PT X is a subsidiary of the fifth-largest integrated energy company in the world based in France. PT X Group is a multinational energy company operating in 130 countries employing 130,000 staff. The scope of PT X's business is upstream operations which focus on exploration and production activities. The tight competition in the oil and gas industry both in the domestic and international markets has encouraged PT X to formulate a strategy in developing its business. The use of information technology is one of the critical factors for achieving the company's success.

PT X utilizes information technology to connect and exchange data and information between sites as well as with its Asia Pacific branch located in Singapore. The exchange of data and information takes place in real-time. To support all these business activities, an enormous investment in information technology has been made. To ensure the running of business processes and manage its investment in information and communication technology, PT X set up an Information System and Telecommunication division. Information System and Telecommunication division consists of several departments that handle specific aspects of information technology such as IT governance, telecommunications, and IT support. To protect data and information that constitute company assets, PT X has an information security organization controlled and managed by the Head Quarter of PT X Group. PT X Group has a commission responsible for information security called the Information Security and Control Committee (CSIC) based in France. CISC is responsible for formulating any policies related to information security, including determining ISG framework that needs to be followed throughout the organization.

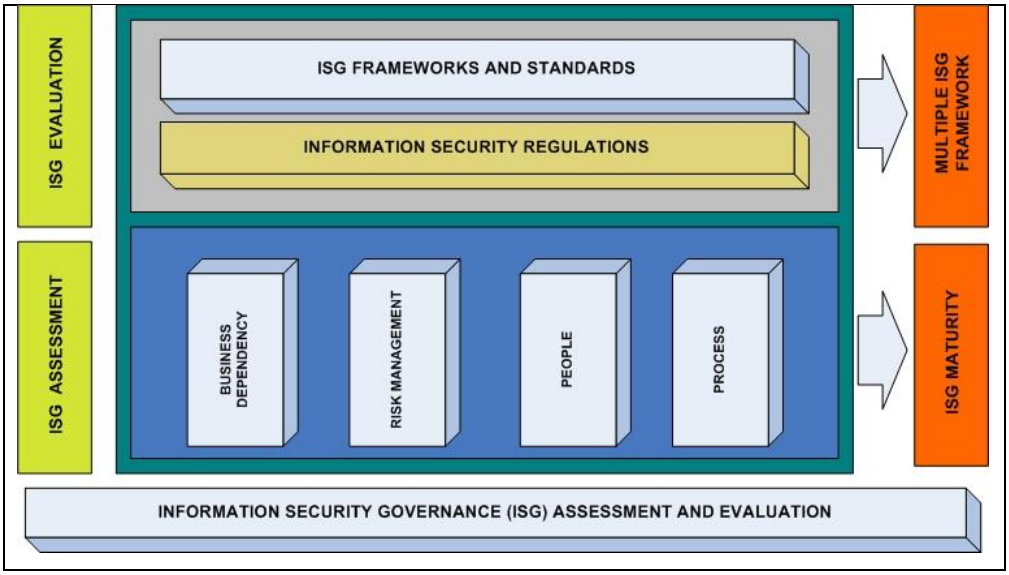

Figure 1. The Conceptual Framework – ISG Assessment and Evaluation

Research Instruments

As qualitative research, this study uses a list of interview questions as the research instruments. The questions are developed in semi-structured and open-ended question styles. The author divides the list of questions into three parts, namely, a list of questions to identify the application of multiple ISG frameworks along with information security regulations, a list of questions related to the evaluation of ISG implementation, and a list of questions related to supporting and inhibiting factors for ISG

implementation. The author also conducts pilot testing before starting to collect the data. Pilot testing is conducted to ensure that the questions are easy to understand and do not have multiple meanings.

Data Collection

Data collection for this study was carried out in two ways, namely in-depth interviews, and literature study. In-depth interviews are one of the qualitative research approaches used to deeply understand one's point of view on the topics being discussed. This method was chosen because the research objective was to determine the adoption of multiple ISG Frameworks, practices, and maturity levels of ISG implementation, as well as supporting and inhibiting factors for ISG implementation in the oil and gas industry in Indonesia. This study uses primary data and secondary data. The primary data were obtained by making direct observations in the field and conducting interviews with several key persons that manage information security at PT X. Meanwhile, secondary data were obtained through literature studies from journals, books, and the internet to collect data related to research on ISG implementation as well as supporting and inhibiting factors for ISG implementation. The secondary data used to support and strengthen the analysis of the research.

Data Analysis

1) Evaluating the Effectiveness of Multiple ISG Framework Implementation

The author measures the effectiveness of multiple ISG framework strategies by looking at the framework's ability to meet the information security regulations that must be followed. Comparisons were made using information security control variables from COSO, ISO 17799, and the IT Risk Framework. The three frameworks are used as a comparison because they have a control focus which includes information security management, risk management, and internal controls. The fulfillment of the comparative variables will show how effective the strategy used in covering information security regulations is.

Each framework will be compared and assessed based on 18 comparison variables. The scoring is conducted by evaluating two dimensions, which include the completeness of ISG process and the detailed standards in technical and operational terms. The horizontal dimension shows the completeness of the fulfillment of the 18 variables used as comparison variables for the ISG framework. The assessment is conducted by analyzing whether each framework has appropriate control for each variable. Meanwhile, the vertical dimension shows the extent of details of each procedure related to the technical and operational aspects. The assessment is carried out by analyzing the details of the technical and operational procedures of the variables. Table 1 and Table 2 show the scoring system for the first dimension and second dimension, respectively.

Table 1. ISG Process Compliance Level

Low	High	Compliancy
0	3	Very low
4	7	Low
8	11	Medium
12	15	High
16	18	Very high

Table 2. The Level of Technical and Operational Detail

Deepness	Score	Criteria
Low	1	Only a small number of controls can be fulfilled
Medium	2	Most of the controls can be fulfilled
High	3	All controls can be fulfilled

The total score for the technical and operational level of detail will be added up and the average value is sought to describe in general the results of the assessment so that it can be mapped into the low, medium, and high levels with the average value formula which can be seen in Equation 1. After obtaining the average value, based on the results of the assessment of 2 dimensions which include: the completeness of the ISG process and the level of technical and operational detail of each control, the mapping of the result is developed as shown in Figure 2.

$$\bar{x} = \frac{\sum x_i}{n} \quad (1)$$

Xi : the value of the level of technical and operational detail

n : number of comparison variables

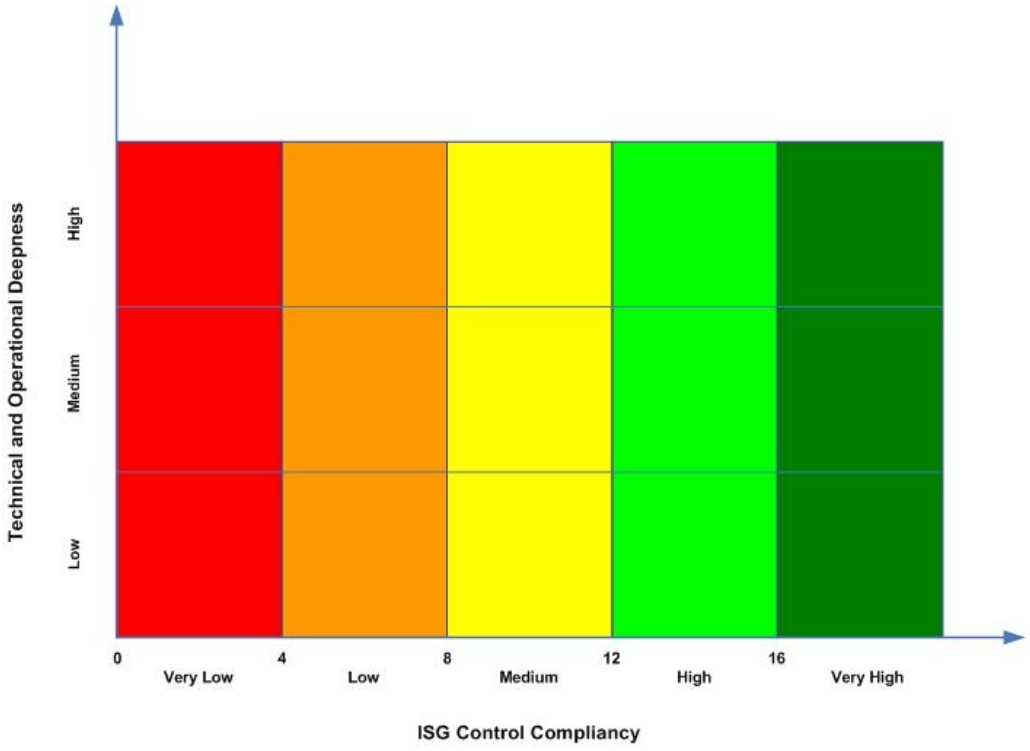

Figure 2. Mapping of ISG Process Completeness and ISG Technical and Operational Detail Level

2) Evaluating the Maturity Level of ISG Implementation

Data related to ISG implementation practices obtained from interviews were then analyzed using the ISG Assessment Tools published by the Corporate Governance Task Force to obtain a maturity level for ISG implementation. The Maturity level of ISG implementation is based on the answer to the interview question. Maturity level determination is divided into 4 parts, namely: Business Dependency Evaluation, Risk Management, People, and Processes. Table 3 shows an example of the maturity level scoring for each component.

3) Identifying of the Supporting and Inhibiting Factors for ISG Implementation

Data related to supporting and inhibiting factors for successful ISG implementation were obtained from interviews and then analyzed by conducting in-depth discussions between the authors and key persons. The author proposes a list of factors that influence the success of ISG implementation which is acquired from previous studies related to ISG. Then, the authors discuss each factor with the key persons to determine which factors play essential role. In the discussion, the key persons give arguments and

evidence related to the critical factors for the successful implementation of ISG. Next, authors and key persons jointly formulate the factors that greatly influence or inhibit the successful implementation of ISG. The formulation of the factors is based on the existing evidence which is highly experienced by the company.

Table 3. Level of Technical and Operational Detail

Aspect	Rating Ranges	Maturity Level	State
Risk Management	0 – 6	0	Not Implemented
	7 – 13	1	Planning Staged
	14 – 20	2	Partially Implemented
	21 – 27	3	Close to Completion
	27 – 36	4	Fully Implemented
People	0 – 9	0	Not Implemented
	10 – 19	1	Planning Staged
	20 – 29	2	Partially Implemented
	30 – 39	3	Close to Completion
	40 – 48	4	Fully Implemented
Processes	0 – 27	0	Not Implemented
	28 – 55	1	Planning Staged
	56 – 83	2	Partially Implemented
	84 – 111	3	Close to Completion
	112 – 136	4	Fully Implemented

Results

Evaluating the Effectiveness of Multiple ISG Framework Implementation

To comply with regulations related to information security in the oil and gas sector, PT X is trying to combine several ISG frameworks that are tailored to its business needs. PT X has a framework developed by the Information Security & Control Committee (CSIC), the highest structure of the PT X Group information security organization. This framework is called the XYZ Framework and applies globally to PT X Group. The author compares the XYZ Framework with ISO 17799, the IT Risk Framework, and COSO by mapping the controls of each framework against the comparison variables. There are 18 information security controls used in this study, as can be seen in Table 4.

Next, an evaluation of the completeness of the ISG processes is carried out from two dimensions (Knapp et al. 2011). The vertical dimension describes the level of detail or standard depth in technical and operational terms. Meanwhile, the horizontal dimension sees the compliancy of the ISG process, using a score scale of 1 to 18 which has been divided into 5 parts, namely very low, low, medium, high, and very high which have been described in the methodology chapter. The results of the 2-dimensional evaluation are then depicted in matrix form as can be seen in Figure 3.

Based on the matrix in Figure 3, it can be concluded that the XYZ Framework which is developed based on a combination of COSO, IT Risk, and ISO 17799 has compromised horizontal and vertical dimensions, but still better among other ISG frameworks. The XYZ framework as a tailored framework has a broader and more detailed spectrum of ISG processes. Conversely, ISO 17799 only focus on the detail and depth in defining ISG processes that are technical and operational in nature. Meanwhile, COSO has superficial details, despite the broad spectrum of ISG compliancy. Finally, the IT Risk Framework lacks a spectrum of compliance with ISG controls because it is only focused on risk management. The effectiveness of implementing the XYZ Framework as a multiple ISG framework is considered very high because it is able to cover more controls and meet several information security regulations and business interests at once. Therefore, the use of multiple frameworks such as the XYZ

Framework is considered better than adopting a single framework such as COSO, ISO 17799, and the IT Risk Framework.

Table 4. Results of Compliance Assessment of ISO 17799, COSO, IT Risk, and XYZ Framework

Information Security Control	ISO 17799		COSO		IT Risk Framework		Framework XYZ	
	Compliancy	Score	Compliancy	Score	Compliancy	Score	Compliancy	Score
Security Policy	High	3	Medium	2	Medium	2	High	3
System Access Control	High	3	Low	1	-	0	High	3
Communication and Operation management	High	3	Medium	2	-	0	High	3
System Development and maintenance	High	3	Low	1	-	0	High	3
Physical and Environmental Security	High	3	Medium	2	Medium	2	High	3
Compliance	High	3	High	3	Low	1	High	3
Human Resource Security	High	3	High	3	Medium	2	High	3
Security Organization	High	3	Medium	2	-	0	High	3
Asset Management	High	3	-	0	High	3	High	3
Business Continuity management	High	3	High	3	Medium	2	High	3
Information Security Incident Management	High	3	Medium	2	High	3	High	3
Risk Governance	-	0	-	0	High	3	Medium	2
Risk Evaluation	Medium	2	Medium	2	High	3	Medium	2
Risk Response	Medium	2	Low	1	High	3	High	3
Control Environmet	Medium	2	High	3	Medium	2	High	3
Control Activities	High	3	High	3	Medium	2	High	3
Information and Communication	Medium	2	High	3	-	0	High	3
Monitoring	Medium	2	High	3	Low	1	High	3
TOTAL	**17**	**46**	**16**	**36**	**13**	**29**	**18**	**52**
AVERAGE		**2.55**		**2**		**1.66**		**2.89**

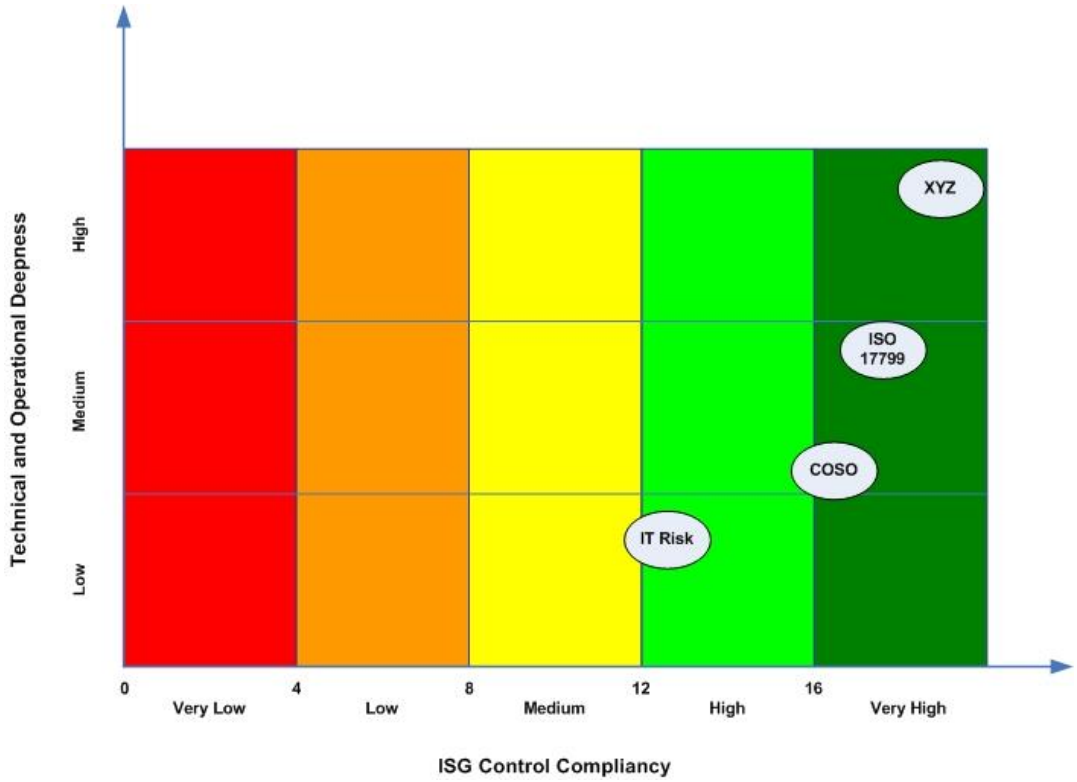

Figure 3. The Comparison of ISG Frameworks' Effectiveness

Evaluating the Maturity Level of ISG Implementation

The analysis of the ISG implementation maturity level can be used to determine the compliance of PT X with the XYZ Framework as a guideline for implementing the ISG. To find out the status of ISG implementation conducted at PT X, a level of maturity measurement was carried out which included (1) identification of business dependence on IT, (2) identification of risk management implementation, (3) identification of human aspects, and (4) identification of processes.

As previously explained, the measurement of maturity levels is carried out by adopting the ISG Assessment Tools issued by the Corporate Governance Task Force. Based on the evaluation results on the aspects of Business Dependency Evaluation, Risk Management, People, and Processes, the following results were found.

1) *Business dependency aspect*
   PT X's dependence on the use of information technology in supporting and serving its business processes is included in the "High" criteria with a value of 49. With its high dependence on IT use, information security occupies an important position in company policy.
2) *Aspects of risk management, people, and processes*
   Risk management, people, and processes as part of the aspects assessed and evaluated by the author are very important parts of a series of ISG controls. The fulfillment of these three aspects shows the effort of fulfilling the ISG implementation. The results of the evaluation and assessment of the aspects of risk management, people, and processes can be seen in Table 5. Based on the evaluation that has been done, it can be concluded that the aspects of risk management, people, and processes are included in the criteria "Needs Improvement" with a value of 169.

Table 5. Results of the Assessment of Risk Management, People, and Processes Aspects

Aspect	Current Maturity	Expected Maturity
Risk Management	22	36
People	40	48
Processes	107	136
TOTAL	**169**	**220**

Next, an analysis of the gap between the current maturity level and the expected maturity level is carried out in the aspects of risk management, people, and processes as can be seen in Figure 4. From the results of this evaluation, it can be concluded that PT X needs to make improvements and improvements to its ISG efforts. Additionally, the gap between the current maturity level and the expected maturity level shows that PT X does not comply with what has been established as an information security procedure in the XYZ Framework. Therefore, PT X must make improvements and reduce the maturity level gap by complying with and adhering to the XYZ Framework in implementing ISG.

Identifying of the Supporting and Inhibiting Factors for ISG Implementation

The existence of gaps in the expected maturity level and current maturity level in ISG implementation indicates that it is necessary to make improvements to the health of ISG implementation at PT X. Improvements should be supported by strengthening supporting factors and removing inhibiting factors for ISG implementation. Therefore, at the final stage of the research, the supporting and inhibiting factors of ISG implementation were identified at PT X by looking at 3 aspects, namely human aspects, organizational aspects, and technological aspects. Identification is done by conducting interviews and comparing the supporting and inhibiting factors for the implementation of the ISG adapted from previous research. The comparison results can be seen in Table 6.

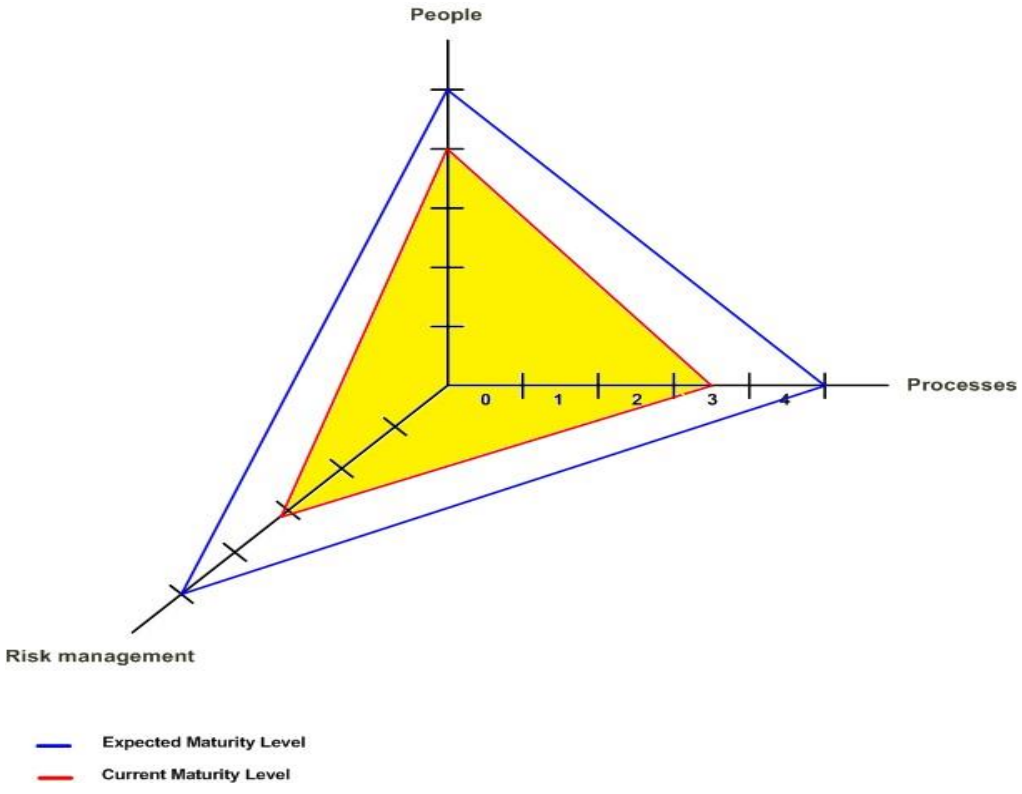

Figure 4. The Gap between Current and Expected Maturity Level

Table 6. Results of the Assessment of Risk Management, People, and Processes Aspects

Aspects	Related Research	Factors from Prior Research	Confirmed Factors	Remarks
Human	(Abu-zineh 2006; Furnell et al. 2009)	• Awareness and training programs • Motivation of employee • Culture • Communication of security issues	• Awareness and training programs	• Supporting factors for ISG implementation
Organization	(Abu-zineh 2006; Furnell et al. 2009; Kankanhalli et al. 2003)	• Risk estimation • Open environment and academic freedom • Top management support • Information Security Policy (ISP) • Job responsibility • Compliance with the information security standard • Business relationship with other organizations • Using service of information security external advisor	• Risk estimation • Top management support • Information Security Policy (ISP) • Job responsibility • Compliance with the information security standard	• Inhibiting factors for ISG implementation • Supporting factors for ISG implementation
Technology	(Furnell et al. 2009)	• Complexity of systems • Mobility and distributed access • Vulnerabilities (systems and application)	• Complexity of systems • Mobility and distributed access	• Inhibiting factors for ISG implementation

Based on the results of interviews and discussions between the author and the informants, it was concluded that the supporting and inhibiting factors for the implementation of ISG in PT X were influenced by the following:

1) *The human aspect*
   Awareness and training programs are supporting factors for the implementation of ISG at PT X.
2) *Organizational aspects*
   There are four determinants of ISG implementation which include: (1) risk estimation, (2) management support, (3) application of Information Security Policy (ISP), (4) division of job responsibilities, and (5) compliance with information security standards. Of the five factors, risk estimation is an inhibiting factor for the successful implementation of ISG at PT X, while management support factors, implementing ISPs, distribution of job responsibilities, and compliance with information security standards are supporting factors for the successful implementation of ISG at PT X.
3) *Technological aspects*
   There are two factors that greatly influence the implementation of ISG at PT X. These two factors are challenges and obstacles to ISG implementation which include: (1) complexity of information systems and applications and (2) mobility and distribution access.

Discussion

Based on the results of the evaluation of the ISG implementation, it was found that PT X's dependence on information technology was very high and still needed improvements in implementation efforts. Therefore, PT X should have made several improvements, especially in the aspects of risk management and security administration programs. Improvements can be made by adhering to the five bases of effective ISG implementation which consists of an alignment of strategies with business needs, resource management, risk management, performance measurement, and value delivery (Caballero 2014).

Meanwhile, the alignment between the ISG strategy and business needs must be made considering the high dependence of businesses on information technology. ISG's position as part of corporate governance shows the importance of ISG's position, for this reason, the ISG strategy should be aligned with the company's business needs. Furthermore, the management of resources owned by PT X has shown very good efforts. First, the classification of security and physical security are used in protecting company assets. Despite the goof efforts, improvements are still needed, especially in human resources aspects. For example, information security staff training must be carried out in order to improve the skills and qualifications of the staff, so as to increase work productivity.

Risk management is considered as an appropriate step to manage and reduce risk and the potential threats on information resources towards an acceptable level (Purser 2004). Increasing risk management efforts can be done by implementing the classification and identification of company information and assets. High dependence on the use of information technology should be followed by excellent risk management. The classification and identification of a company's critical assets can be used as a reference for decision making on ISG's efforts and for business impact analysis. The XYZ Framework has clearly defined risk management and classification of company critical information and assets, therefore it is time for PT X to comply with the procedures and guidelines in the XYZ Framework.

The implementation of security administration program efforts which include evaluation, review, and audit of information security programs on a regular basis is part of the performance measurement step. Performance measurement and evaluation is one of the bases for effective ISG implementation (Albert 2016; Bowen et al. 2006; Caballero 2014). The security administration programs at PT X are still very weak and are still in the planning stage. Security administration programs are very important in knowing the status of ISG implementation and measuring the extent to which the efforts that have been made are used as a basis for making improvements.

Value delivery is an important part that must be implemented in the application of ISG. Value delivery is enhanced by optimizing information security investments in support of organizational goals. In the case of PT X, it is appropriate for PT X to carry out a cost estimation of information security efforts and to have a strategy in calculating the cost-effective risk and investment in information security to an acceptable level. With improvements in the five aspects above, especially for the aspects of risk management and performance measurement, the implementation of ISG as part of corporate governance at PT X can be done optimally to protect company information security and in line with business needs.

Conclusion

This study evaluates the effectiveness of implementing the multiple ISG framework strategies when compared to the application of a single ISG framework. Effectiveness is measured by looking at the completeness of ISG processes and the level of compliance with information security regulations in the oil and gas industry. Based on the evaluation results, it was found that the multiple ISG framework XYZ strategy has better effectiveness compared to the adoption of a single ISG framework. This is because the implementation of the XYZ Framework as a strategy for multiple ISG frameworks is able to cover the requirements of the three ISG frameworks, namely ISO 17799, COSO, and the IT Risk Framework in meeting information security regulations and standards.

An assessment of the practice and adherence to the ISG implementation strategy shows that PT X has a high dependency on the use of information technology. With these criteria, ISG as part of corporate governance occupies an important position in company policy considering the importance of protecting information security as a company asset. Meanwhile, the overall evaluation results from the aspects of

risk management, people, and processes are included in the "Need Improvements" criteria. The results of the evaluation of the ISG framework implementation maturity level show a significant gap between the current maturity level and the expected maturity level. This gap reflects the inequality between ISG implementation efforts and company expectations of ISG implementation. Therefore, it is time to increase information security efforts considering the importance of information and data as company assets and the position of ISG as part of corporate governance.

Finally, this study has identified the supporting and inhibiting factors for the application of ISG at PT X, as a company engaged in the oil and gas industry. The identification of supporting and inhibiting factors is carried out by looking at three aspects, namely human aspects, organization aspects, and technology aspects. In the human aspect, security awareness and training programs are factors driving the implementation of ISG at PT X. The implementation of security awareness and training programs is deemed to be very helpful in the implementation of ISG because it forms the character of users who are aware of the importance of information security. In the organizational aspect, there are five factors that determine the successful implementation of ISG. Management support factors, implementation of Information Security Policy (ISP), division of job responsibilities and compliance with information security standards and guidelines are all supporting factors for ISG implementation. Risk estimation is an inhibiting factor for the implementation of ISG in organizational aspects. Risk estimation is an inhibiting factor because this business is still reactive, marked by the absence of information classification and critical asset data collection. In the technological aspect, the complexity of information systems and applications as well as mobility and distribution access are inhibiting factors for ISG implementation. The challenges and obstacles in this technological aspect are caused by the geographical conditions of PT X's operational areas which are scattered and located in areas that are difficult to reach.

This research has limitations. First, the limited number of case studies is one of the constraints and limitations of the research. This causes the research findings to be imperfect and requires additional data and analysis so that generalizations can be made to the research results. Furthermore, this study relies on interviews as a data collection method. Future research is expected to combine the results of the interview with the questionnaire (mixed method) to reduce the subjectivity of the processing and analysis results of the interview. Finally, this study only compares multiple XYZ frameworks with the ISO 17799 framework, COSO, and the IT Risk Framework. In the future, it is hoped that further research can enrich the framework that will be compared, such as COBIT and ITSM.

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Exploring E-learning Challenges During the Global COVID-19 Pandemic: A Review

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Abstract

The world is currently battling the coronavirus disease 2019 (COVID-19) that has been declared as a global pandemic since mid-March 2020. The pandemic has inevitably impacted social and economic activities of the nation, including those in the education sector. As the governments have mandated universities to close their campuses, learning activities has been forced to move online. In this difficult situation, many university administrators, lecturers, as well as students may find it difficult to adapt to the so-called "new normal" ways of learning. Hence, as this is an unprecedented situation, this study explores the challenges faced by universities as academic institutions, lecturers, and students. This study starts by conducting a literature review concerning the challenges in e-learning in context of a pandemic. Data collected are then analyzed qualitatively using inductive thematic analysis technique, resulting in a taxonomy of e-learning challenges during a pandemic. Our analysis shows that students are challenged by connectivity, e-learning system support, and technological and self-regulation issues. On the other hand, lecturers are being challenged by competency, operational, self-regulation, and isolation issues. Meanwhile, institutions identify financial support and change management as challenging issues. This study highlights the need for further investigation to address the aforementioned challenges in e-learning.

Keywords: E-learning, challenges, pandemic, COVID-19

Introduction

The coronavirus disease 2019, known as the COVID-19, was discovered in December 2019 (C. Huang et al. 2020) and declared as a pandemic in mid-March 2020 as the virus spread rapidly across the world (Sohrabi et al. 2020). The repercussions of such rapid spread force organizations of all types to shift their operations to online mode. Higher education institutions such as universities are no exception to this unprecedented situation. Many governments have mandated learning to be conducted exclusively online in lieu of face-to-face on-campus learning. However, it is also noted that such closure would

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have negative impact on students' learning (R. Huang et al. 2020), which may be addressed by delivering education online via the Internet through e-learning system.

E-learning systems such as in a form of learning management system (LMS) provide a learning platform that can facilitate interactive learning at anytime and anywhere as long as their users are connected to the system via the Internet. A well-designed e-learning system typically does not only provide learning materials, but also facilitate other activities such quizzes, written examinations, and discussion forum. It is common to suggest that properly designed e-learning materials may prove an efficient and effective alternative to materials that are delivered offline. As e-learning plays an increasingly critical role during the pandemic, the heavy reliant on the use of e-learning also becomes a challenge, not only for higher education institutions, but also students and lecturers.

Successful implementation of e-learning systems hinges upon addressing the challenges faced by the users. Examining the challenges in e-learning may guide various stakeholders such as higher education institutions and policy makers to fulfil the needs of e-learning system users i.e. students and lecturers in order to effectively implement e-learning. While there have been many studies have attempted to uncover challenges that hamper e-learning implementation in general (Aung and Khaing 2015; Selim 2007; Tarus et al. 2015), there have been limited studies that focus on exploring the challenges of delivering e-learning in the context of the pandemic. Given the importance of continuous learning in this difficult time, this study seeks to explore the challenges being faced by students, lecturer, higher education institutions during the COVID-19 pandemic.

Literature review

This section reviews the literature related to e-learning usage and subsequent challenges in implementing it. The success of an information systems is dependent upon acceptance of its users (Almaiah et al. 2020). There have been numerous studies on the literature of user acceptance of e-learning. Lack of consideration for factors that influence user acceptance of e-learning may prove to be challenges in e-learning. A study by Selim (2007) specify critical success factors (CSFs) for e-learning in higher education institutions. The CSFs are grouped into four categories, namely lecturers, students, information technology, and institution support. For lecturers, CFS include IT competency and attitude whereas in terms of information technology, CSFs include reliable infrastructure. For students, CSFs include time management and discipline, while for higher education institutions CSFs include technical support.

Another stream of literature that explores challenges in e-learning are in context of its implementation in specific cases. For instance, Tarus et al. (2015) explores challenges in implementing e-learning in Kenyan public universities. Involving lecturers and university staff as respondents, the Kenyan study reveals eight challenges, including inadequate ICT and e-learning infrastructure, financial constraints, lack of technical skills on e-learning development and extensive time required to develop materials, and lack of interest and commitment to use e-learning. The findings imply that these challenges must be addressed in order to successfully implement e-learning system.

Some of these challenges are in line with a review of studies on challenges in implementing e-learning in developing countries by Aung and Khaing (2015). This review of e-learning implementation in universities note that challenges include, inter alia, ICT infrastructure, lecturer's competencies, technical skills, ICT literacy, and awareness of e-learning benefits. Focused on the perspective of lecturers of in higher education institutions, Islam et al. (2015) identify five groups of challenges. These challenges include learning styles and culture, pedagogical e-learning, technical training, technology, and time management challenges. All in all, the literatures on challenges or factors that hinder implementation of e-learning boil down to three perspectives of e-learning stakeholders, namely students, lecturers, and higher education institutions. This informs our approach in reviewing the e-learning challenges in the context of pandemic from these three perspectives, which we delineate in the following section.

Methodology

This study is driven by a review question: "What are the challenges being faced in e-learning during the COVID-19 pandemic?" In order to answer this question and understand the challenges, we searched the extant academic literature as the source of data (see Figure 1). We queried the Scopus database in the end of August 2020. Scopus database was chosen as it indexes a wide selection of publications in multiple disciplines including other popular scholarly databases. The query string used for the search was "e-learning" AND "pandemic" AND "challenge". This query formulation is guided by the aforementioned review question. The query was entered into Scopus document search to yield articles for review. The search results are then refined by limiting publication date to year of 2020, which is the year of the beginning of the COVID-19 pandemic, resulting in 60 articles. In addition, the results were further limited by studies in that are in the final stage of publication, resulting in 49 articles. As inclusion criteria, articles should discuss e-learning in the context of pandemic. As exclusion criteria, articles that are not written in English and are of commentary or review type are not included. By applying these criteria, the results narrow down 16 articles. Furthermore, the full texts of these papers were then read to exclude those that focused solely on either e-learning, challenges, or pandemic. This results in final list containing seven articles. The full text of resulting articles obtained were managed using Mendeley reference management software and then re-read to extract challenges in e-learning. These challenges were then categorized inductively by coding based emerging themes using Atlas.ti and visualized using XMind. The emerging themes were then further grouped by categorizing them into three perspectives in e-learning, namely students, lecturers, and institutions, a similar categorization employed by Rasheed et al. (2020).

Results & Discussion

This section discusses the results of the review, specifically challenges in e-learning in the context of a pandemic. The discussion of these challenges is grouped into separate sub-sections in accordance to three main perspectives in the use of e-learning, namely students, lecturers and higher education institutions. These challenges for students, lecturers, and higher education institutions are also summarized in Table 1, Table 2, and Table 3 respectively. In addition, the identified challenges are also presented visually as a taxonomy as seen in Figure 2.

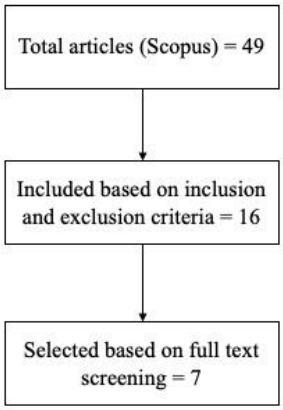

Figure 1. An overview of literature search results

Student's challenges

As e-learning necessitates students to study independently, they often find themselves challenged by self-regulation issues such as low motivation to study and ineffective communication with their fellow students (Rannastu-Avalos and Siiman 2020; Wan Hassan et al. 2020; Zhang et al. 2020). This self-regulation issue may be compounded should the students do not have adequate information and

communications technology (ICT) knowledge (Wan Hassan et al. 2020). Learning virtually poses as a challenge for students since they may find it difficult sense cognitive, social, teaching presences in e-learning systems (Rannastu-Avalos and Siiman 2020; Zulkefli et al. 2020). This is related to how well an e-learning system support those presences through use of appropriate features. In terms of e-learning system support, there are also other challenges with regard to overall user experience of the system. These include not only ease of use and usability aspects of the e-learning system, but also perceived availability of technical support and how well the system supports devices or equipment used by students (Almaiah et al. 2020; Wan Hassan et al. 2020; Zulkefli et al. 2020). In higher education institutions where there is not a standard system for delivering online learning, students may find themselves using various education platforms for different courses. This may also be a challenge for students (Al-Balas et al. 2020). Finally, as e-learning systems usually runs on the Internet, poor internet coverage or limited Internet data packages are also typical obstacles felt by e-learning students, especially those that come from developing countries with limited Internet connectivity and low bandwidth (Al-Balas et al. 2020; Farooq et al. 2020; Wan Hassan et al. 2020).

Lecturer's challenges

The pandemic comes a surprise to lecturer who find their way of teaching or general operations disrupted by the new way of learning. For lecturers who are not accustomed and trained to creating and delivering teaching materials for online platform, this may be a significant challenge (Farooq et al. 2020). Formal training in creating and delivering materials may be necessary for lecturers in conducting e-learning as it incorporates both instructional and visual design for the course materials to be effective. Operationally, lecturers find themselves spend more time preparing for e-learning compared to offline learning, thus higher workload with increasing volumes of learning materials (Rannastu-Avalos and Siiman 2020). As mode of delivery is entirely online, observing and maintaining students' engagement in both asynchronous and synchronous settings may also be difficult for lecturers (Farooq et al. 2020; Rannastu-Avalos and Siiman 2020). This situation may affect to assessment components being delivered e-learning system (Rannastu-Avalos and Siiman 2020).

Institution's challenges

In these trying times, higher education institutions must ensure that they sufficiently support e-learning usage, not only technically as required by students as discussed previously, but also financially. Financial support may come in a form of budgetary provision and ensuring that e-learning implementation project is not delayed (Almaiah et al. 2020). Such support may be foundational for an implementation of e-learning to be a success. Once the e-learning has been implemented, higher education institutions may also face a problem of a lack of adoption, which may stem from change management issues, such as lack of awareness and interests among users (Almaiah et al. 2020). In this pandemic, the issue of resistance to change is still an issue from the perspective of higher education institutions as the current situation forces learning and teaching activities to shift mode (Almaiah et al. 2020). Hence, educational institutions are encouraged to be able to leverage their knowledge of needs and challenges of students and lecturer in order to provide reliable e-learning system. While many studies have focused on the challenges faced by students and lecturers, as our review shows, there are limited studies documenting challenges faced by higher education institutions. When discussing these challenges for higher education institutions, lecturers, and students as distinct groups, it may seem that these challenges may be exclusive to each group. However, we find that these challenges are interrelated and may influence each other, such as those self-regulation issues for both students and lecturers we discuss in previous sub-section or how lack of training for lecturers may influence their ability to maintain students' engagement online. Therefore, there may be necessary to further examine of how these challenges are related and influence each other in order to implement e-learning successfully in the context of a pandemic.

Table 1. Previous studies on student's e-learning challenges during pandemic

Inductive challenge categories	**Inductive challenge sub-categories**	**Challenges**	**Literature**
Students	Infrastructure & Connectivity challenges	Poor internet coverage/infrastructure	(Al-Balas et al. 2020; Farooq et al. 2020)
		Limitation in internet data packages/ Internet connectivity and low bandwidth	(Al-Balas et al. 2020; Farooq et al. 2020; Wan Hassan et al. 2020)
	E-learning system support challenges	Lacking in suitable devices/technical equipment	(Al-Balas et al. 2020; Zulkefli et al. 2020)
		Variation of education platforms	(Al-Balas et al. 2020)
		Ease of use	(Almaiah et al. 2020; Wan Hassan et al. 2020; Zulkefli et al. 2020)
		Technical support/help availability	(Almaiah et al. 2020; Wan Hassan et al. 2020; Zulkefli et al. 2020)
		Accessibility	(Almaiah et al. 2020; Wan Hassan et al. 2020; Zulkefli et al. 2020)
		Social presence	(Zulkefli et al. 2020)
		Teaching presence	(Zulkefli et al. 2020)
		Cognitive presence	(Rannastu-Avalos and Siiman 2020; Zulkefli et al. 2020)
	Technological competency and self-regulation challenges	Lack of ICT knowledge	(Wan Hassan et al. 2020)
		Low motivation	(Rannastu-Avalos and Siiman 2020; Wan Hassan et al. 2020)
		Maintaining effective communication with peers	(Zhang et al. 2020)

Table 2. Previous studies on lecturer's e-learning challenges during pandemic

Inductive challenge categories	Inductive challenge sub-categories	Challenges	Literature
Lecturers	Competency & operational challenges	Lack of proper/formal training	(Farooq et al. 2020)
		Maintaining online learner's engagement/ Involving student is challenging	(Farooq et al. 2020; Rannastu-Avalos and Siiman 2020)
		Higher workload	(Rannastu-Avalos and Siiman 2020)
		Difficult to observe all students	(Rannastu-Avalos and Siiman 2020)
		Assessment issues	(Rannastu-Avalos and Siiman 2020)
		Lessons more concentrated in volume	(Rannastu-Avalos and Siiman 2020)
	Lecturer's self-regulation challenges	Learning difficulties	(Rannastu-Avalos and Siiman 2020)
		Lack of time management skills	(Rannastu-Avalos and Siiman 2020)
		Low motivation	(Rannastu-Avalos and Siiman 2020)
	Lecturer's isolation challenges	Working from home and maintaining work-life balance	(Farooq et al. 2020)
		Feeling of loneliness in a video lesson	(Rannastu-Avalos and Siiman 2020)

Table 3. Previous studies on institution's e-learning challenges during pandemic

Inductive challenge categories	Inductive challenge sub-categories	Challenges	Literature
Institution	Financial support challenges	Lack of financial support	(Almaiah et al. 2020)
		Projects delay	(Almaiah et al. 2020)
	Change management challenges	Lack of awareness	(Almaiah et al. 2020)
		Lack of interests	(Almaiah et al. 2020)
		Resistance to change	(Almaiah et al. 2020)

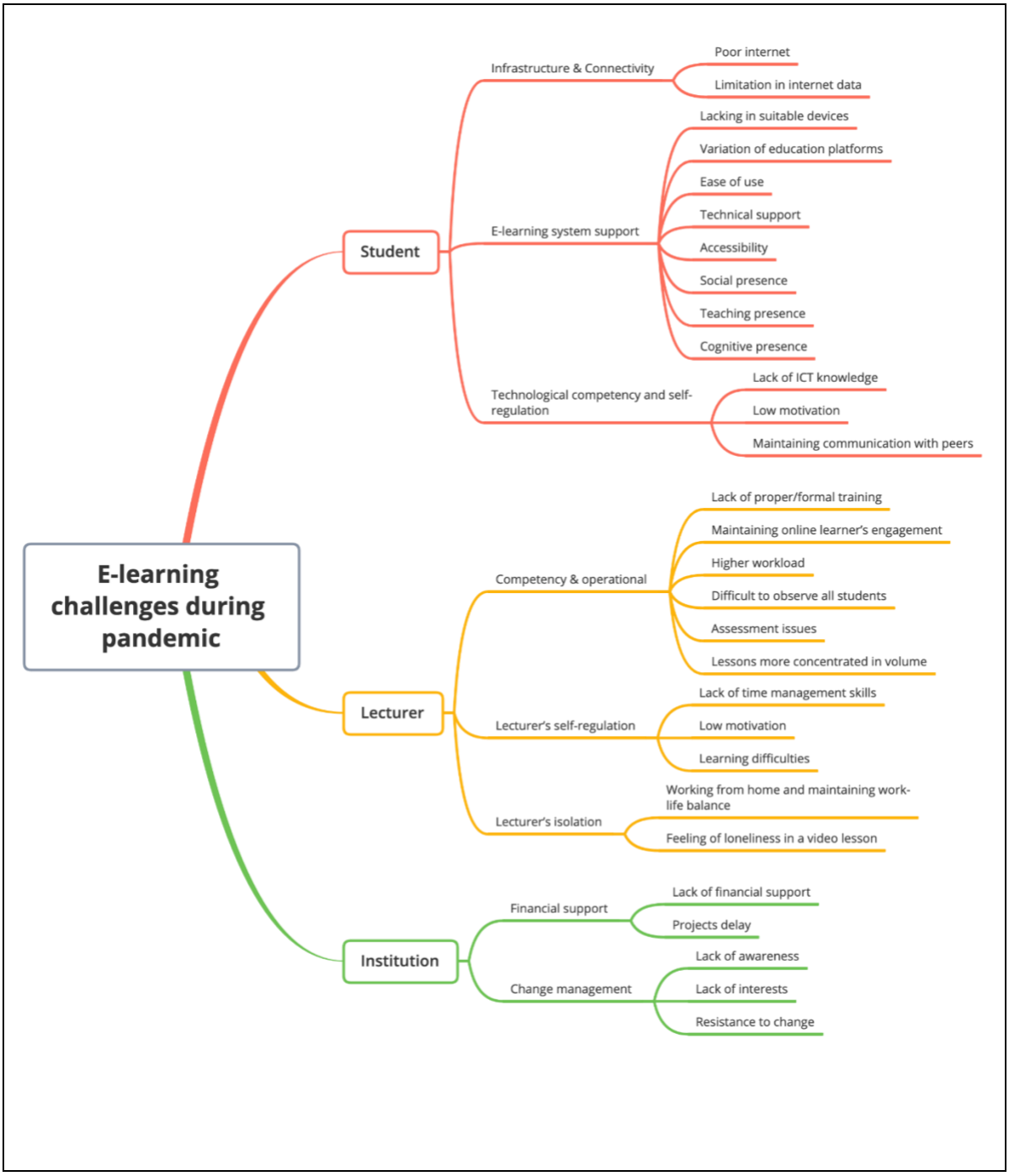

Figure 2. Taxonomy of challenges in e-learning during COVID-19 pandemic

Conclusion

This study presents a review exploring the challenges in e-learning during the global COVID-19 pandemic from the points of view lecturers, students, and academic institutions. Having examined 49 studies including the resulting seven studies from the Scopus databased in between January to August 2020, we identify and categorize challenges inductively into themes and grouped into the said points of view. We understand that students are being challenged not by the typical technological and self-regulation issues such as lack of ICT knowledge and low motivation, but also Internet connectivity and e-learning support issues. We also understand that some of the challenges faced by students are shared by lecturers especially those of self-regulation issues. Additionally, lecturers are hampered by competency and operational issues in delivering e-learning materials, such as lack of training,

maintaining student's engagement, and higher teaching workload. Furthermore, isolation issues such as loneliness in video lesson and maintaining work-life balance in a working from home setting are also concerns of lecturers. Finally, the global pandemic also brings about a range institutional challenges such as obtaining financial support and addressing the change management issues e.g. resistance to change and lack of interests in adopting e-learning. This study is limited by selection criteria it employed and scholarly database chosen. If we had accessed other databases such as Google Scholar with varied additional queries such as "online learning", we may have gotten more articles. However, this study may be adequate in conveying e-learning challenges during a pandemic as a reference for future research.

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