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Evaluation of the Maturity Level of Information Technology Security Systems Using KAMI Index Version 4.2 (Case Study: Islamic Boarding Schools in Yogyakarta Special Region Province)

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***Abstract*— The development of information technology worldwide has changed very rapidly. There has been a data theft on the information system belonging to one of the most prominent Islamic Boarding Schools in the Yogyakarta area. Thus, special attention is needed to evaluate information technology security using the Information Security Index version 4.2. The research methods include extracting information, literature study, data collection, data validation, data analysis, and recommendations. The evaluation results are at the basic framework fulfilment level with a value of 343; the electronic system category has a low status with a value of 15 and 5 improvements; the governance category, the risk management category, the framework category, the asset management category, and the information security technology category, have a maturity level II status with 12, five, eight, four, and eight recommendations respectively, while the supplement category for third party security areas with a value of 60%, securing cloud infrastructure services 56% and protecting personal data 61% with 14 recommendations.**

Keywords*— *information technology; data theft; information security; extracting information; recommendation

1 INTRODUCTION

The progress and development of information technology in the world are changing very rapidly; the impact of this development requires all elements of both public service organizations and especially Islamic Boarding Schools (Pondok Pesantren) to constantly adapt and be able to implement advances in information technology to support and become a medium of convenience. Information systems are essential in helping business strategies in the education division. Evidence that information technology is developing can be seen from many users of existing internet services. According to BPS (Badan Pusat Statistik/ Central Bureau of Statistics) data quoted from the results of the latest Susenas (Survei sosial ekonomi nasional/ National social, economic survey) 2021 survey data collection: 62.10% of the population in Indonesia has and can access the internet in 2021. This indicates the high use of internet services; this will bring a new culture with a climate of freedom and openness of public information and acceptance of information on technological developments and advances towards changes in the information society [1].

Indonesia still needs insight into the importance of information. Quoted from the research in 2021, the Global Cyber Security Index is a valid basis for measuring the commitment of several member countries to cyber security at the world level. In 2020 Indonesia was ranked 24th out of 194 countries, which is good news because in 2018 Indonesia was ranked 41st. Meanwhile, some ransomware is simple and can lock a system in a way that is not difficult for a knowledgeable person to reverse, more sophisticated malware exploits a technique called crypto-virus ransomware [2].

Information theft has become a global issue and all corporations also governments worldwide have taken necessary measures to secure their essential assets [3]. To reform the government institution, it is Good Corporate Governance as a necessity. One of the efforts is the development of electronic government to improve public service quality [4]. There are many cases of information technology crime; one of the cases regarding information security is the leakage of private data and various critical information belonging to an agency or organization. Quoted from the Gemalto Chimielarz report [5]. In the first semester of 2017, there were 1,901,866,611 data leaks due to misuse and illegal access. This means that every day, there are 10,507,550 leaked and lost data. A classification of around 74% is cases of data leakage incidents about identity theft, while the rest is based on the perpetrators of the incident, around 74% of which are perpetrators from external parties (malicious outsiders) who try to exploit and retrieve data illegally. The development of information technology that has been felt to date, is in line with the results of research. It is quoted from the reports of the digital literacy survey in the province of Yogyakarta by the Ministry of Communication and Information of the Republic of Indonesia in 2022, that the province of Yogyakarta has the highest digital literacy index value, which is at the level of 3.72 on a scale of 1 to 5. The greater the score value obtained, the digital literacy index of the people in the province can be assumed to be of good value [6].

The growth and development of information technology that is very fast and systematic are accompanied by computer crimes with various motives and techniques that grow very fast, compared to other criminal cases that can cause and have an impact on severe damage in the political, economic, or social sectors [7]. Of the various cases and phenomena of information crime, in 2017, the world of education received special attention from the international community because existing reports showed an increase in data leaks which had a large number compared to other sectors and fields [5]. One standard that can be used to measure an organization's information security maturity level is the KAMI index. The index refers to ISO standard ISO/ IEC 27001 and it was developed by The Ministry of Informatics, and Communications [8]. This resulted in disturbed services to the public. Therefore an information security audit is a necessity [9]. Cyber security can be understood as a step and effort to protect against theft or damage to hardware, software, or private data stored on the system [10]. Planning for what might happen makes it possible to identify critical areas that need to be protected in a system [11]. The ability to analyze the level of completeness and maturity of the implementation of information security for an organization, the index can describe the readiness of the current information security framework [12].

Regarding No. 4 of 2016 in Article 7 of the Minister of Communication and Informatics Regulation, every SPBE organizer must implement information security which obeys the regulation [13]. Benefited from the fast development of information technology and supporting several aspects of life, on the other hand, however, it is directly proportional to the risk of cyber security, such as data theft, data loss/damage, and obstruction of information flow in handling information technology security [14].

The purpose of this KAMI index is a tool and guideline to minimize risk, ensure the continuity of business processes that are carried out proactively, to limit the various impacts of various information security violations. It is also a tool to describe readiness, so the KAMI index is not projected to scrutinize the feasibility of the existing security model [15] [16][17]. Information Security Management System (ISMS) is an instrument created and designed to determine the important parts that have an impact on the sustainability of an organization and the distribution of information security controls that can be used in protecting information as an asset in ensuring data confidentiality [18]. Information security is a crucial characteristic of the fast development of information technology in government agencies [19]. In running an organization or agency, it should remain and refer to determining policies (determining, implementing, operating, monitoring, reviewing, maintaining, and improving) in the context of the overall activities of the organization and the possibility of various problems from existing risks [20]. Information security management system has various aspects of information security that are covered and cover information security in an information system in an organization or agency.

The implementation of e-Government, which is to represent clean, effective, transparent and accountable governance, is currently constrained because there is no regulation of e-Government Security [21]. Information

security is a guard against various threats that may occur in efforts to ensure or guarantee business continuity. The aim is to minimize business risks and organizational processes, which in turn may maximize and accelerate decision making and business opportunities [22].

The research to be carried out has contributions and benefits for each boarding school. That is a research sample to be able to evaluate its information security technology and can be used as an assessment indicator related to the security condition of boarding school information technology for the government at the regional office level of the Ministry of Religion of the Special Region of Yogyakarta and the Directorate of Early Education and Islamic Boarding Schools of the Ministry of Religion of the Republic of Indonesia which can be used as an evaluation related to the description of the condition of the maturity level and completeness of boarding school information technology security. In addition, researchers will provide several recommendations for improvement if the results of the evaluation score carried out using the information security index version 4.2 are less than the threshold score set by the National Cyber and Crypto Agency (BSSN), namely at the III + maturity level on a level I to V scale.

At the research stage, researchers will identify information systems, then conduct an assessment using the KAMI 4.2 Index on information systems in the Islamic boarding school environment in the province of Yogyakarta Special Region to find out how much the level of security maturity of the information technology system is, after conducting an assessment using the KAMI index, the evaluation data will be processed to determine the average score value of the maturity level of the information security system according to the categorization based on the KAMI 4.2 index, classify the final evaluation status and provide recommendations based on the KAMI index version 4.2 in each Islamic boarding school in the province of Yogyakarta Special Region.

2 METHOD

The research method is the stage or flow that will be used to carry out steps in determining the results and discussion. This methodology makes the research more structured, directed, and systematic. The flow of the research method that will be carried out in research on evaluating the maturity level of information technology security systems using the KAMI version 4.2. The research flow is as described in Figure 1.

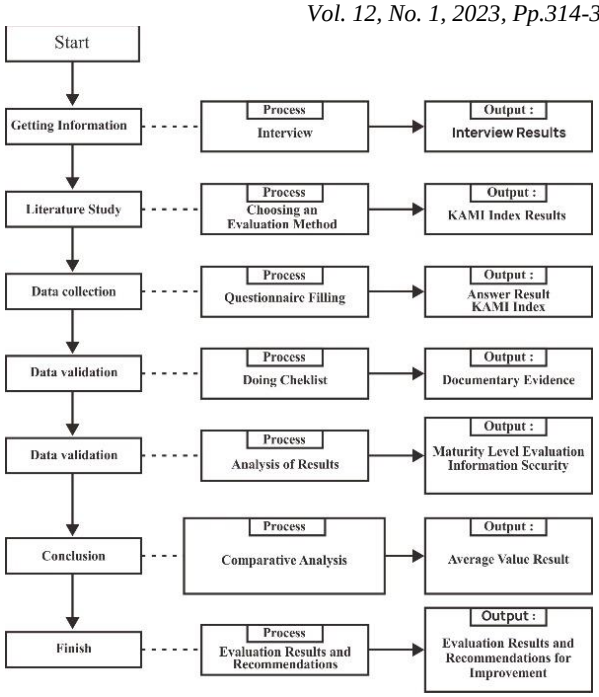

Figure 1. The flow of research methods

Figure 1 shows the flow of research methods with an explanation of the first step, starting to do research and digging up information by mapping and determining research sample objects that match the respondent's criteria, then conducting interviews with the head of the information and communication technology infrastructure at the boarding school which is the object of research. The second step was conducting a literature study using the latest relevant journals and previous research and then choosing the Information Security Index (ISI) evaluation method. Step three is collecting data by filling out questionnaires with respondents selected based on responsibilities following the questionnaire category at the boarding school, which is the object of research. Step four, verify the data through the checklist technique, where this verification is used to ensure that the data provided is in accordance with the actual situation. The fifth step is analyzing the data obtained through the calculation of the questionnaire results using the KAMI Index formula, conducting a checklist, and then comparing the evaluation results at each boarding school which is the object of research related to the average value, the highest value and the lowest value using the calculation formula that the KAMI Index has standardized.

2.1 Seeking Information

The initial step taken in this research is to explore information by mapping and determining the research sample object following the respondent's criteria and then interviewing the head of the information and communication technology infrastructure sector at the boarding school, which is the object of the research. Then the interview results will be poured onto paper, and the respondent's signature is required as proof that the interview has been conducted and will be documented.

2.2 Literature Study

The literature study process is carried out by searching and studying the theoretical foundations and findings of previously conducted research—theories related to research problems using the KAMI Index. In addition, it must also know the field conditions that will generate data, the system used in the field, and how to process the data that has been obtained. In this process, the researcher determines several research objects spaces. Including:

2.2.1 *Determining the Research Population and Sample*. The population is a generalization area consisting of objects/subjects that have certain qualities and characteristics set by researchers to study and then draw conclusions [23]. Meanwhile, according to Sukardi, the population consists of the target population and the access population. The target population is the population planned in the research plan, and the access population is the number of group members who can be found in the field and not the target population [24]. Sample research is used to facilitate writing in conducting research; a sample is a portion or representative that will be examined [25]. A good sample is a sample that has a population or representative, meaning that it describes the state of the population to the maximum. If the population is less than 100, then it is better to take all, and if the population is more than 100 people, it is better to take 10 to 15% or 20 - 25% or more [26]. Given the population, in this case, the number of boarding schools in the province of Yogyakarta Special Region is 417, the researcher decided to take a sample of 10% of the population. So the selection is 417 x 10%: 100 = 42 boarding schools. The number of pieces in this study has fulfilled the minimum justification requirements for research samples based on the explanation above. To minimize and anticipate licensing that fails and cannot be done on each sample research object, the researcher decided to take the number of research objects, more than 10% [26] of the total boarding school population of 58 boarding schools in the Special Region of Yogyakarta. In contrast, the research evidence will be included in the attached sheet. This shows that the more samples used in this study, the closer the level of validity of the data studied. The sampling technique used in this study is a non-probability sampling technique of purposive sampling type, according to Sugiyono [27].

2.2.2 *Characteristics of Research Sample Respondents.* The characteristics of the respondents who made the research sample are one of the characteristic instruments of the purposive sampling technique, which is one of the variables that support the process of determining the research sample under the research focus [28]. The population in this study is all boarding schools in the province of Yogyakarta Special Region as many as 417 boarding schools. The data on the number of Islamic boarding schools researchers got directly from the information of the head of the Directorate of Early Education and Islamic Boarding Schools of the regional office of the Ministry of Religion of the Special Region of Yogyakarta province. To facilitate writing in conducting research, sample research is used; a sample is a portion or representative that will be examined. A good sample is a sample that has a population or representative, meaning that it describes the state of the population to the maximum. If the population is less than 100, then it is better to take all, and if the population is more than 100 people, then it is better to take 10 to 15% or 20 - 25% or more. Given the population, in this case, the number of boarding schools in the province of Yogyakarta Special Region is 417, the researcher decided to take a sample of 10% of the population. So the selection is 417 x 10%: 100 = 42 boarding schools. The number of pieces in this study has fulfilled the minimum justification requirements for research samples based on the explanation above. In this case, the researcher provides characteristics of the research sample respondents under the focus of this research, namely in the field of information technology security in each research object. First, the boarding school already has WiFi network access. Second, the boarding school already has an internet-based information system management (website-based application, android or IOS). Third, the boarding school already has a staff or head of field who focuses on managing the boarding school technology information system. Fourth, the boarding school already has a minimum of 300 students and has been registered at the regional office of the Ministry of Religion of Yogyakarta Special Region province. Fifth, the boarding school has been established for at least 3 years from the date of establishment until this research was conducted.

2.2.3 *Research of Time.* In this study, researchers divided the research time into several parts so that the process of evaluating information technology security in each research object at the boarding school, which was the research sample, could be measured for accuracy in completion according to the permission given by each boarding school. The division of the research time progress is marked in green in each column of the table based on the calculation of the time period in one week as found in the description of Table 1.

Table 1. Research Timeline

Progress	**December 2022**				**January 2023**			
	M1	M2	M3	M4	M1	M2	M3	M4
Start Seeking Information	✓	✓						

Conduct Literature Study	✓						
Conduct Data Collection		✓	✓	✓			
Validating Data			✓	✓			
Analyzing Data				✓			
Making Conclusions					✓		
Finish							✓

2.2.4 *Location of Research.* This research was conducted at boarding schools in the Special Region of Yogyakarta province which were included in the object respondent category. The research began by extracting initial data and continued by conducting a literature study in December 2022. The list of research object locations can be seen in Fig. 2.

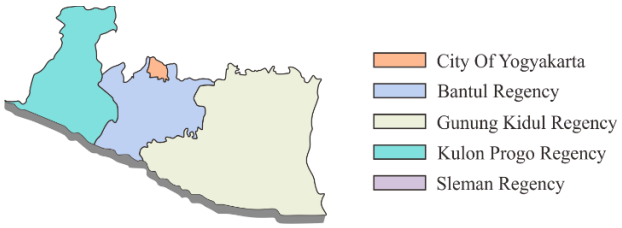

Figure 2. Location of research

2.2.5 *Subject and Object of Research*. The subjects and objects of this research are boarding schools that are included in the characteristics of research object respondents in the Yogyakarta Special Region province. All boarding school institutions in the province of Yogyakarta Special Region will be the main subject because, in the evaluation using the KAMI Index, all research objects that are included in the characteristics of the research object respondents will be evaluated for information security; this can be seen from filling out the questionnaire provided by the information security KAMI index along with the calculation of the score value.

2.3 Conducting Data Collection

The following are the methods used in collecting data for the preparation of this research. Then at the last stage of data collection, a checklist will be carried out to confirm the questionnaire data that has been filled in and at the final stage the respondent must fill in the identity data in accordance with the guidelines for filling out the OUR index questionnaire. To strengthen the research evidence on each respondent of the research object, the researcher asked to document the process of filling out our index questionnaire in the form of a photo with the researcher. In the process of collecting data, the researcher divides it into two stages, namely the process of filling out the questionnaire and the process of checking the OUR index questionnaire. The explanation is as follows:

2.3.1 *Completing the Questionnaire*. In this stage, the KAMI index questionnaire was distributed to previously determined respondents covering 7 aspects, including; Electronic Systems category, information security governance, information security risks, information security framework, information security asset management, technology and information security, and supplement categories consisting of securing third party involvement, securing cloud infrastructure service providers (cloud services) and protecting personal data. Each aspect has a different assessment. In the electronic system category area, the score is 0-2 with low, high, and strategic information. At the same time, the rest uses a 0-3 assessment which includes; not done, in planning, in implementation, or partially and fully implemented [29].

2.3.2 *Verifying the Questionnaire*. After conducting the questionnaire, data verification of the results is needed to ensure the accuracy of the data with the actual situation. The technique used to verify the data, namely Checklist, is done to dig up information and get evidence of the data that has been obtained previously through questionnaires. Evidence from the Checklist requested is all questions from respondents who answered "In Implementation / Partially Implemented" and “Fully Implemented” in each area.

2.4 Analyzing Data and Recommendations

The data analysis method refers to the use of the KAMI Index attached to the Guidelines for Implementing the Information Security Management System Based on the Information Security Index [29]. The results of the score summation for each area is presented in two instruments, namely a table of values for each area and a radar diagram with five axes according to the security area. Then the calculation is carried out to determine the threshold for achieving the level of maturity starting from I to V.

3 RESULT AND DISCUSSION

3.1 Data Collection

Anticipate permits that fail and cannot be carried out on each sample research object; considering the population, the number of boarding schools in the province of Yogyakarta Special Region is 417, the researcher decided to take a sample of 13% as many as 58 boarding schools in the province of Yogyakarta Special Region with a percentage of 3% margin of error due to failed permits and cannot be done as many as 16 boarding schools, so the total sample validation in this study is 10% of the total population, namely 42 boarding schools. Table 2 shows the results of valid sample data.

Table 2. Results of Sample Validation

District/City	Number of Islamic	Sample	Margin Error	Sample Valid

	Boarding Schools			
Yogyakarta City	36	10	2	8
Sleman Regency	166	23	8	15
Bantul Regency	108	9	1	8
Kulon Progo Regency	66	9	3	6
Gunung Kidul Regency	41	7	2	5
Quantity	**417**	**58**	**16**	**42**

From the results of the validation of this research sample, the researchers then verified the data for filling in the evaluation audit related to the level of information security maturity using the KAMI index questionnaire which covers seven categories of Electronic System Categories used by Agencies, Information Security Governance, Information Security Risk Management, Information Security Framework, Information Asset Management, and, Technology and Information Security and Supplement categories which include three areas, including evaluation areas for aspects of Securing Third Party Service Provider Involvement, Securing Cloud Infrastructure Services and Personal Data Protection. The recapitulation of the evaluation results of each valid sample object in this study will be given a score in accordance with the standardization of the KAMI index, and the calculation results will be included in the recapitulation data of the results of the information security evaluation of all valid sample objects of research.

3.2 Data Recapitulation Results

In this section, researchers carry out the process of verifying the KAMI index, which will be included in the results of data recapitulation of the results of evaluating the level of information security maturity in each valid sample research object. In this process, the researcher carries out the verification process by checking the questionnaire that has been provided by the KAMI index, along with the automation of the calculation of the status value. The data recapitulation process includes the name of the institution and the institution's statistical number, the full address of each boarding school which is a valid sample of research, the identity of the name of the person in charge, and the filler of the KAMI index questionnaire, the contact number of the person in charge, proof of attachment of evaluation results using KAMI index, proof of attachment of photo documentation and finally proof of research permission letter.

3.3 Analysis of KAMI Index Data Evaluation Results

The process of analyzing the evaluation results using the KAMI index has been carried out through a number of questions covering seven areas, including the category of electronic systems used by the Agency, information security governance, information security risk management, information security framework, information and technology asset management and information security and finally the supplement category which covers the evaluation area for aspects of securing the involvement of third-party service providers, securing cloud infrastructure services (Cloud Service) and protecting personal data.

The results of the evaluation analysis will refer to the results of the KAMI index verification data that has been carried out on each valid sample research object, then the calculation results will use the KAMI version 4.2 Index tools which include the seven areas described above, after recapitulating the score results on each valid sample research object, the researcher will provide an analysis of the level of maturity of information security from the results of the average value of the entire category and the researcher will provide an evaluation analysis of the average value based on each category of the seven areas of the KAMI version 4.2 index, then after that the researcher will provide the results of the final evaluation status of the entire value that has been validated based on the final evaluation status category using the KAMI version 4.2 index. The results of the evaluation analysis for the seventh category, namely the supplement category which includes three areas, will be analyzed in the form of a percentage (%) with the objective of maximum achievement in accordance with the standardization made by the KAMI Index version 4.2.

3.3.1 *Maturity Level of Electronic Systems.* At this stage, researchers provide the results of data analysis in each category based on the KAMI index for the results of evaluating the maturity level of information technology security of boarding schools in the province of Yogyakarta Special Region in the electronic system category (Figure 3). The data analysis carried out is by collecting the score results from each boarding school that is the research respondent, after which the data recapitulation of the questionnaire assessment results using the KAMI index tools version 4.2 is carried out, then the researcher analyzes the data by looking for the average value score of each boarding school that is the research respondent. The classification status of the score assessment that has been carried out refers to the standardization of existing values in the KAMI index tools version 4.2. The classification of score status in the electronic system category can be seen in Table 3.

Table 3. Classification of KAMI Index Score Version 4.2

Lower		Final Scores		Readiness State
10	15	0	174	Not Eligible
		175	312	Basic Framework Fulfillment
		313	435	Fairly Good
		536	645	Good
High		**Final Scores**		**Readiness State**
16	34	0	272	Not Eligible
		273	455	Basic Framework Fulfillment
		456	583	Fairly Good
		584	645	Good
Strategic		**Final Scores**		**Readiness State**
35	50	0	333	Not Eligible
		334	535	Basic Framework Fulfillment
		536	609	Fairly Good
		610	645	Good

After recapitulating the data using the KAMI index tools version 4.2, the researchers analyzed the average value score of each boarding school that was the research respondent for the electronic

system category. The graph of the average value of the electronic system category can be seen in Figure 3.

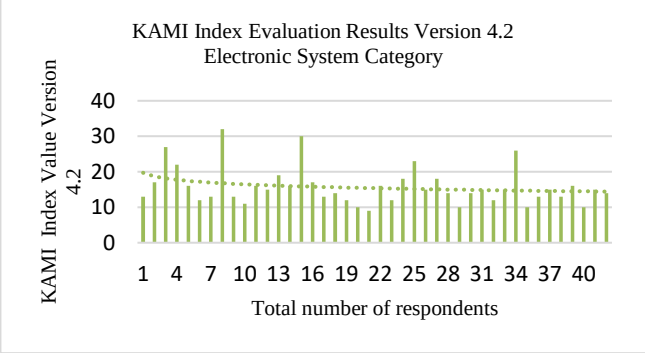

Figure 3. Average category score of electronic systems

Analysis of the data obtained shows that the electronic system of Islamic boarding schools in the province of Yogyakarta Special Region has a low maturity level status; this is evidenced by the average value obtained by each Islamic boarding school that the research respondent is at a score of 15. Therefore, the electronic system of Islamic boarding schools in the province of Yogyakarta Special Region must be immediately improved by the manager and can be a consideration for related parties such as the government so that they can provide policies that can support and help improve the electronic system.

3.3.2 *Maturity Level of Governance.* In this category, researchers provide the results of the evaluation analysis of the maturity level of information technology security of boarding schools in the province of Yogyakarta Special Region for the information security governance category. The classification for the category of the maturity level of information security governance refers to the standardization of KAMI index, including Level I (Initial Condition), Level II (Basic Framework Implementation), Level III (Defined and Consistent), Level IV (Managed and Measured), Level V (Optimal), To help provide a more detailed description, this level is added with intermediate levels - I+, II+, III+, and IV+, so there are a total of 9 maturity levels. The score mapping of the results of the questionnaire answers can be seen in Table 4.

Table 4. Score Mappings

Status of Security	**Category of Security**		
	1	2	3
Not Performed	0	0	0
In the Planning	1	2	3
In Application or Partially Applied	2	4	6
Comprehensively Applied	3	6	9

After recapitulating the data using the KAMI index tools in the information security governance category, researchers analyzed the average value score of each boarding school that was the research respondent for the governance category. The graph of the average value of the governance category can be seen in Figure 4.

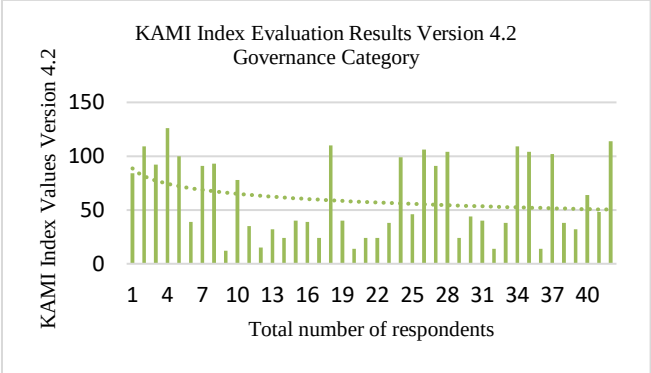

Figure 4. Average score of governance category

Analysis of the data obtained shows that the average value of information security governance of boarding schools in the province of Yogyakarta Special Region has a maturity level status of II, which means that it is still at the stage of implementing the basic framework. Therefore, the information security governance of Islamic boarding schools in the province of Yogyakarta Special Region must immediately evaluate, improve and improve the status of information security governance by the manager.

3.3.3 *Maturity Level of Risk Management.* In this category, researchers provide the results of evaluation analysis in the category of maturity level of information security risk management of boarding schools in the province of Yogyakarta Special Region for the category of information security governance. The graph of the average value of the information security risk management category can be seen in Figure 5.

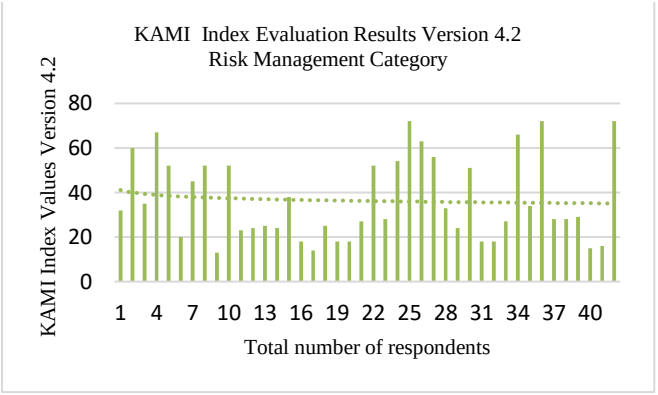

Figure 5. Average score of risk management categories

Analysis of the data obtained shows that the average value of the information security risk management category of boarding schools located in the Yogyakarta Special Region province has a maturity level status of II, which means it is still at the basic framework implementation stage. Therefore, information security risk management must immediately be evaluated and improve the status in the category of information security risk management by managers and the government to be able to support and assist the course of improvement in the management of information security risks of boarding schools.

3.3.4 *Maturity Level of the Framework.* In this category, the researcher provides the results of the evaluation analysis in the category of the maturity level of the information security framework of boarding schools in the Yogyakarta Special Region province for the information security governance category based on the categories in the KAMI index. The graph of the average value of the information security asset management category can be seen in Figure 6.

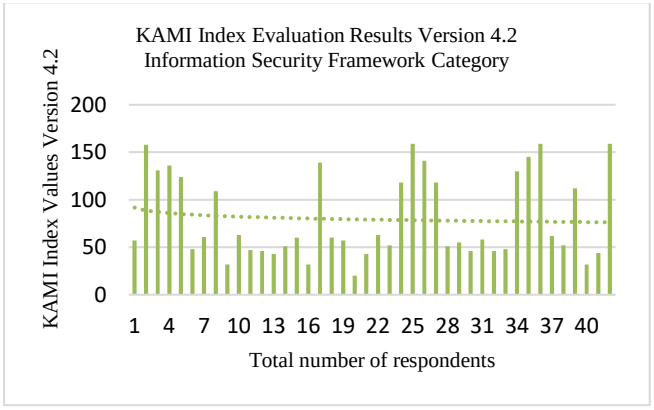

Figure 6. Average of framework category

Analysis of the data obtained shows that the average value in the category of the information security framework of boarding schools located in the province of Yogyakarta Special Region has a maturity level status of II, which means that it is still at the basic framework implementation stage. Therefore, the information security framework must be immediately evaluated and improved in the category of information security framework by the boarding school manager.

3.3.5 *Maturity Level of Asset Management.* In this category, researchers provide the results of evaluation analysis on the category of maturity level of information security asset management of boarding schools in the province of Yogyakarta Special Region for the category of information security governance based on the categories in the KAMI index. The graph of the average value of the information security asset management category can be seen in Figure 7.

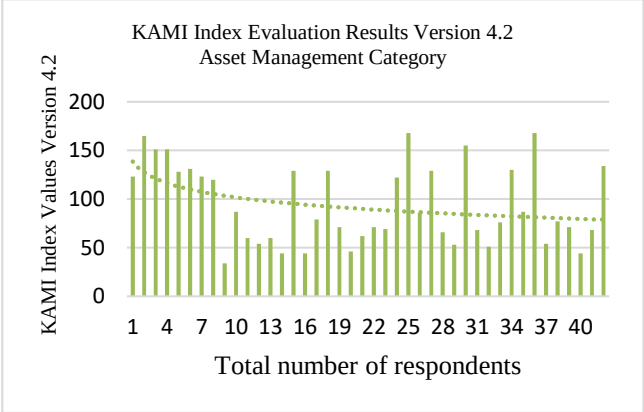

Figure 7. Average of asset management categories

Analysis of the data obtained shows that the average value in the category of information security asset management of boarding schools located in the province of Yogyakarta Special Region has a maturity level status of II, which means that it is still at the stage of implementing the basic framework. Therefore, the management of information security assets must immediately be evaluated and improve the status in the category of information security asset management by the management of Islamic boarding schools.

3.3.6 *Maturity Level of Technology.* In this category, researchers provide the results of evaluation analysis on the category of maturity level of technology and information security of boarding schools in the province of Yogyakarta Special Region for the category of information security governance based on the categories in the KAMI index. The results of data recapitulation can be seen in Fig. 8.

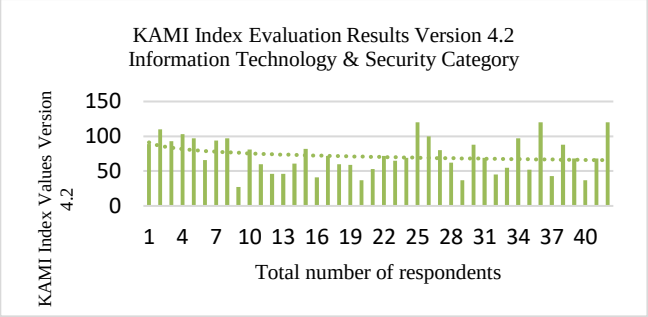

Figure 8. Average value of technology category

Analysis of the data obtained shows that the average value in the category of technology and information security of boarding schools located in the province of Yogyakarta Special Region has a maturity level status of II, which means that it is still at the stage of implementing a basic framework. Therefore, the management of information security assets must immediately

evaluate and improve the maturity status in the category of technology and information security by the management of Islamic boarding schools.

3.3.7 *Maturity Level of Supplements*. In this category, researchers provide the results of evaluation analysis in the supplement category, which includes three categories, namely: The results of the evaluation assessment of the readiness of securing third-party involvement, securing cloud infrastructure services, and protecting personal data are conveyed in the form of a percentage at each boarding school in the province of Yogyakarta Special Region. The classification of the percentage score in the supplement category refers to the standardization of the KAMI index Researchers made a data analysis table by listing the number of questionnaires given according to the KAMI index, recapitulating the percentage score for each boarding school that was the respondent (Figure 9).

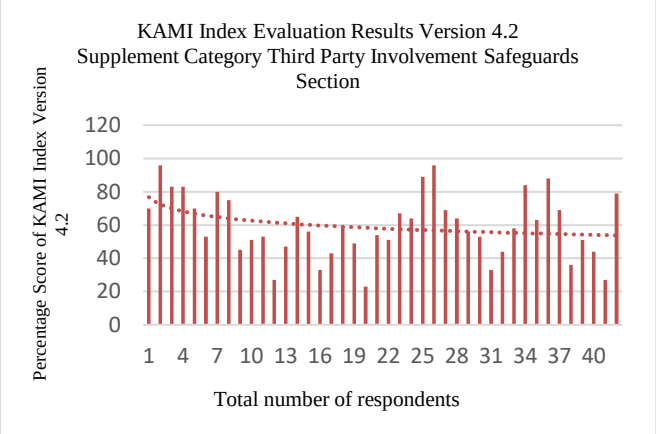

Figure 9. Average value of third-party security area

Rapid technological developments and dynamic business patterns lead to the emergence of new information security risks. The involvement of third parties in the supply chain of boarding school services creates risks related to the existence/involvement of these external parties. Analysis of the average percentage value obtained in the third-party involvement security area is 60%. This percentage value needs to be increased periodically so that the readiness value of securing third-party involvement based on KAMI index can be evaluated on an ongoing basis to ensure the security of boarding school information. The average value graph for the cloud infrastructure service security readiness area can be seen in Figure 10.

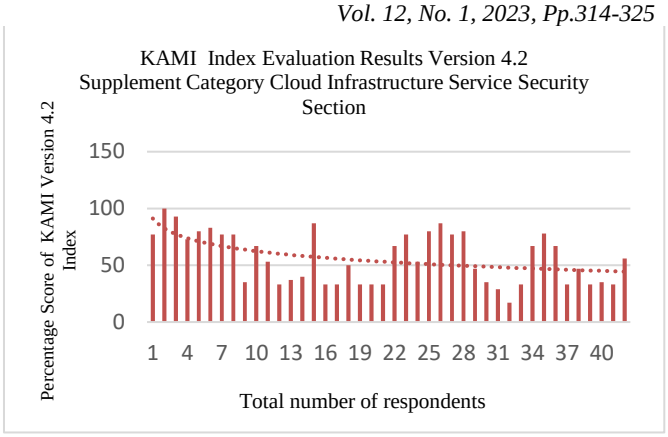

Figure 10. Average value of cloud infrastructure service security area (cloud)

Cloud infrastructure-based services provide opportunities for efficiency, and very significant performance improvements for boarding schools, but risks related to data that is in the control of the third party (service provider) need to be mitigated. Analysis of the average percentage value obtained in the cloud infrastructure service security area (Cloud) of 56%. This percentage value needs to be increased periodically so that the readiness value in the cloud infrastructure service security area based on KAMI index can be evaluated on an ongoing basis and can be used as a mitigation step to ensure the security of boarding school information that uses cloud infrastructure services. The average value graph for the readiness area for securing personal data protection can be seen in Figure 11.

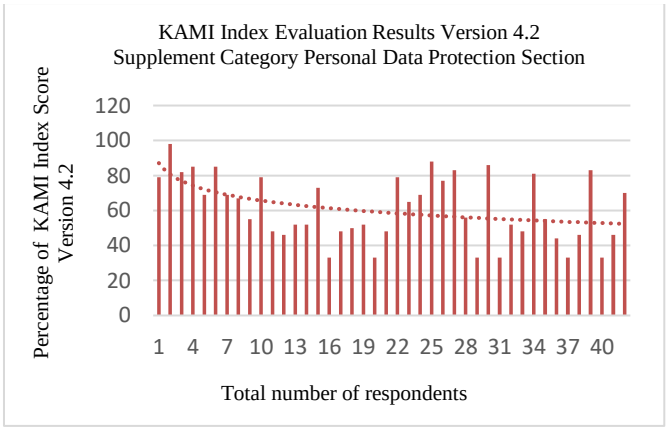

Figure 11. Average value of personal data protection area

The enactment of regulations related to the protection of personal data by many countries requires a framework that specifically addresses how personal data that exists/is used in boarding schools is secured in accordance with applicable legal requirements, therefore the protection of personal data to ensure information security is very important for every boarding school. Analysis of the average percentage value obtained in the personal data protection area is 61%.

3.4 Result Final Evaluation Status

In this category, researchers provide the results of the final evaluation analysis of each boarding school in the province of Yogyakarta Special Region. The data analysis is carried out by collecting the results of the final evaluation score from each boarding school that is the research respondent, after that the data recapitulation of the results of the final evaluation questionnaire assessment using the KAMI index tools; then the researcher analyzes the data by finding the average value score of each boarding school that is the research respondent. The score classification for the final evaluation refers to the standardization of the KAMI index. The graph of the average score value for the final evaluation results can be seen in Figure 12.

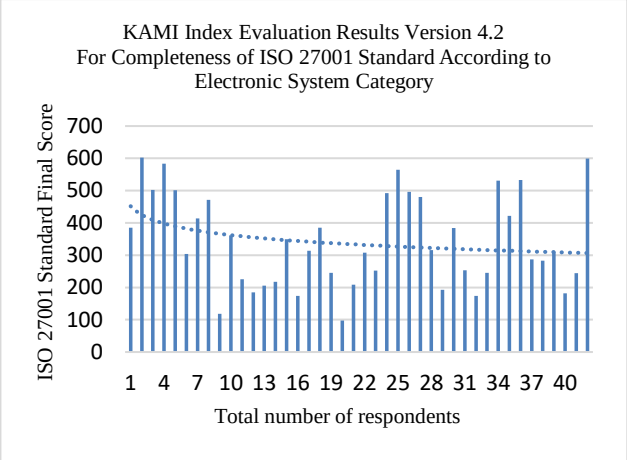

Figure 12. Average value of final evaluation results

Analysis of the data obtained shows that the average value of the final evaluation score of the maturity level of information security technology of Islamic boarding schools in the province of Yogyakarta Special Region has a readiness status at the basic framework fulfillment level with a final average value of 343. The average value for the maturity level and the results of data recapitulation from this evaluation can be seen in Table 5.

Table 5. Results of the Average Value of KAMI Index

No.	Category	Evaluation Status	
1	Electronic System	Lower	
2	Management	Level II	
3	Risk Management	Level II	
4	Frameworks	Level II	Average II
5	Asset Management	Level II	
6	Information Technology and Security	Level II	
7	Supplements (Safeguards):		
	Third-Party Involvement	60%	
	Cloud Infrastructure Services	56%	
	Personal Data Protection	61%	
8	Completeness of ISO 27001 SE Standard	343	
9	Final Evaluation Results	Basic Framework Fulfillment	

Analysis of the results of the evaluation of the maturity level of the information technology security system of Islamic boarding schools in the province of Yogyakarta using the KAMI index is at an average value for the electronic system category with a low status, while for the average value of the maturity level it is at maturity level II status, this is below the minimum threshold recommended by the KAMI index which is at least maturity level III, while for the supplement category which includes three areas including: the area of securing third party involvement gets an average percentage score of 60%, the area of securing cloud infrastructure services (cloud) gets an average percentage score of 56%, the area of protecting personal data gets 61%, for the average score for the completeness of the application of the ISO27001 standard of 343, while for the status of the final evaluation results using the KAMI index, the status level is at Basic Framework Fulfillment

3.5 Recommendations for Improvement

Based on the calculation of the questionnaire, analysis of each area of the KAMI Index and the current condition of information technology security at boarding schools in the province of Yogyakarta, to increase the level of maturity of information technology security to be able to meet the standardization of the level of maturity of information technology security in accordance with the KAMI index, recommendations are needed. The KAMI index evaluation tool is not intended to analyze the feasibility or effectiveness of existing forms of security, but rather as a tool to provide an overview of the state of readiness (completeness and maturity) of the information security framework to the leaders and managers of the boarding school. The following are recommendations to be used as evaluation material to improve the level of maturity of information technology security in accordance with the category area of the KAMI Index.

4 CONCLUSION

Based on the results of research that has been carried out, it can be concluded that the level of completeness and maturity of information security of Islamic boarding schools in the province of Yogyakarta is still low. The cause of the low level of completeness and maturity of information security is that, on average, Islamic boarding schools have not implemented all the requirements set regarding information security standardization or are still in the planning stage. The low level of completeness is indicated by the average value of the final evaluation results with a total value of 343 which is marked in red on the bar chart; this means that the level of completeness and maturity of information security is at the status of fulfilling the basic framework.

The results of the level of completeness and maturity of information security divided into 7 (seven) categories including: electronic system category with an average value of 15 which means low, governance category with an average status of maturity level II, risk management category with maturity level status II, risk management category with maturity level status II, framework category with maturity level status II, asset management category with maturity level status II, information security technology category with

maturity level status II, while for the supplement category is divided into 3 (three) areas including; for the third party security area with an average value of 60%, securing cloud infrastructure services (cloud) 56% and protecting personal data by 61%. Based on the results of the analysis, to increase the level of completeness and maturity of information security in accordance with the target threshold set, namely III + which is used as a requirement for ISO 27001 certification readiness, the boarding school in the province of Yogyakarta special area gets several recommendations, including; for the electronic system category, there are 5 recommendations, the governance category has 12 recommendations, the risk management category has 5 recommendations, the framework category has 8 recommendations, the asset management category has 4 recommendations, the information security technology category has 8 recommendations, while the supplement category has 14 recommendations. So, the total improvement recommendations are 42 recommendations to be used as guidelines and evaluations for Pesantren managers and policymakers. Overall, any company needs to re-evaluate the capacities of its security management in the current situation and assess the implications on information security [30].

AUTHOR'S CONTRIBUTION

Bad'ul Hilmi Arromdoni is the first author who digs information, conducts literature studies, collects data, selects evaluation methods, verifies data, analyzes data, and provides recommendations for improvement, Muhammad Taufiq Nuruzzaman is the second author who provides suggestions and input on the concept and focus of the research. Shofwatul 'Uyun and Bambang Sugiantoro as reviewers and enriched the manuscript.

COMPETING INTERESTS

In accordance with the publication ethics of this journal, Bad'ul Hilmi Arromdoni, Muhammad Taufiq Nuruzzaman, Shofwatul 'Uyun and Bambang Sugiantoro as the authors of this article declare that this article is free from conflict of interest (COI) and conflict of interest (CI).

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