ISSN (Printed) : 2579-7271
ISSN (Online) : 2579-5406

Risk Assessment and Risk Mitigation of E-Learning Implementation in The Middle School using Failure Modes and Effects Analysis (FMEA)

Feby Artwodini Muqtadiroh[1], Eko Wahyu Tyas Darmaningrat[2], Riza Nadia Savira[3]
Departemen Sistem Informasi, Fakultas Teknologi Informasi, Institut Teknologi Sepuluh Nopember (ITS)
Jalan Raya ITS, (031) 5999944
e-mail: feby.artwodini@gmail.com[1]

Abstract

An e-learning implementation is part of software implementation. In Software Development Life Cycle (SDLC), implementation is the phase after software being develoved and tested. Unfortunately, even software has been developed and tested, there has been quite number of failure stories in the implementation of e-learning.E-learning implementation concerns with three main activities: delivery, support, and feedback. To assure the success of e-learning implementation, it requires careful plans and proper and systematic implementation phases since there will a quite degree of possibilities of uncertainties and risks that may hinder successful implementation of e-learning.

One of the methods adoptable to prevent failures in e-learning implementation is risk analysis. Due to those purposes, this research contributed to any institutions planning to implement e-learning to be better prepare and identify what kind of risks that may arise in the process of e-learning implementation and proper risk mitigation plan in order to be able to prevent the failure.

This research has identified 24 risks that may hinder successful implementation of e-learning. And for those risks there will be choosen the high-risk activity in implementing e-learning using the Failure Modes and Effects Analysis (FMEA). There are 3-prioritized risks; very high, high, fair. And this research focuses on the very high and high degree of potential RPN are: resistance from the users due to non-involvement in the process of need identification leading to generation of final products that are not in compliance with the users, lack of policies to obligate the adoption of e-learning in learning processes, and unwillingness of the users to change to use e-learning.

Keywords*: e-learning implementation, risk analysis, risk priority, RPN, FMEA, mitigation plan*

1. Introduction

Systems Development Life Cycle (SDLC) in system engineering and software engineering concerns with the process of designing and modification system, model and methodology that are adopted for developing the systems. It also a pattern adopted to develop a software system and comprises phases of planning, analysis, design, development, trial, implementation, deployment and maintenance.

The implementation phase is to assure that the users can take benefits from the implementation of the completely developed software. The processes in the implementation phase comprise delivery, support and feedback [1]. The delivery covers handing over of software in form of codes related to the software, installation guides, including manual book and user guide to users. The support comprises an activity that, when applied, will enable well-controlled software application and successful procedure executions to ensure that the system consistently operates well. The activities in the support phase concern with training users. Finally, the software implementation phase pertains to feedback. The feedback is addressed by the users to the software system developer to enhance and perfect the system. This implementation process will be applied to the implementation process of e-learning as well. Because e-learning is one of software applications in the field of education.

The early success of e-learning implementation starts from proper and systematic planning and designs. In IT Management Project (ITMP), a project is defined as new activities, accordingly the degree of uncertainties and risks are very high. Due to such high degree of uncertainties, it will be more difficult to estimate the amount of recourses and time to complete a project [2], including e-learning project implementation at schools.

In fact, a software project is subject to quite number of reciprocal limitations: scope of project, time and costs (triangle of constraints). In order that, the project implementation is supposed to run well and be better directed, it call for proper monitoring and control to identify

whether the implementation already runs well and is in compliance with the set goals and objectives [3].

The same happen in some favorite middle schools in one of regencies in East Java province (SMP Negeri 1 Jember) that never use e-learning as a media of learning. The administrators of those high schools greatly expect that the application of e-learning will better ease the teaching-learning process (distribution of materials online, collection of assignments, online quiz, teaching learning video, and alike) and school quality improvement). Almost 86% of the students in SMP Negeri 1 Jember were treated as objects of research. In fact, they have already been familiar with the application of information technology, including internet, as teachers in those favorite high schools often give assignments to the student to search for learning materials through internet media, although not all of them are familiar with information technology application. Such a fact may lead to risks in the course of application of e-learning.

The research was to assess and mitigate risks arising in the process of e-learning implementation at middle schools. In order to attain such research objectives, 2 research methods were adopted: Failure Modes and Effects Analysis (FMEA) and Project Management Body of Knowledge (PMBOK). FMEA is adopted as it is a proactive and systematic team-based approach for identifying failure probabilities in the process/design by calculating the Risk Priority Number (RPN) for each possible failure and identified one [4]. An RPN is an accumulation of severity, opportunity, and detection for classifications of effects of each type of failure potencies [5]. A PMBOK is adopted top prepare a comprehensive project risk management including its mitigation procedures. The PMBOK is adopted as a guide to a project management execution focusing on project risk management, including e-learning project implementation at middle schools. The project risk management through PMBOK provides complete and structured step-by-step guides [6] used in this e-learning implementation project.

From previous studies, risk analysis methods are widely used for physical projects such as the construction of buildings [7], medical care [8], manufacturing production [9], including for the development of software mega projects risk analysis [10]. But there is no discussion of risk analysis related to the implementation of e-learning project. So that the contribution of this study is to help schools that will implement e-learning, so avoid the failure of the identification of risks that might arise from in the beginning. And helping schools reduce the risks involved by providing a list of risk mitigation for the implementation of e-learning.

2. Literature Review

Academic research on e-learning is increasing in recent years. Research on e-learning is focusing on the evaluation either on the use of good evaluation, evaluation of preparedness, successful evaluation in using e-learning, as well as on measuring the effectiveness of the use of e-learning. Unfortunately, a study of inhibiting the successful implementation of e-learning viewed from the perspective of risk management has not been much discussed.

E-learning carries out many advantages for the organization and the stakeholders. The main advantage of e-learning to motivate users of the efficiency study covering: access flexibility, on-demand availability, personalized instruction, timely content delivery, content standardization, increased convenience, accountability, self-pacing, confidence, and interactivity. Further advantages of e-learning is the reduction of costs, consistent provision of learning materials, and enhancement of university tracking [11]–[16].

To determine the success of e-learning as well as to anticipate the failure of implementation it is necessary to identify and control the risks of various uncertainties or the possibility of inhibiting the success of e-learning, it is important to have an e-learning measurement Risk Measurement to provide a guarantee of quality use of e-learning.

[17] shows the results of an interesting study related risks and ways of handling e-learning system in Indian universities. They declared the main threat of e-learning system and the risks to be aware of is the risk of a student, risk of material provider (author), risk of teachers, management risk and the risk of the development team of e-learning system. They showed some techniques to minimize risks by using: firewalls access control, digital right management in e-learning assets, cryptographic algorithms, and digital watermarking.

[18] stating that there are still some technical problems when using Moodle is largely caused by hardware and software, the limitations of server used. But they did not leave method of solving the technical. Instead they focus on the analysis of student habits and use of communication features in Moodle and the possible reasons. In addition, they dig a student's

overall opinion and commentary on e-learning and their experience of technical problems on Moodle. The survey indicates either a technical problem of student to use Moodle and administration, largely due to the hardware and limitations and server software is used. Problem which can be identified include: connection problems, slow response when many users are connected to Moodle, the current difficulties open or download a certain file types on a particular browser.

[19] found a successful e-learning requires environmental, teaching skills, mastery of course material, technical support, content interaction and awareness instructors to continue learning. E-learning instructors should be aware of what technology is available to students in work using e-learning systems before developing the subject matter. E-learning system must also be compatible with the material delivery mechanisms. That the instructor should focus on capturing and maintaining detailed student profile and select the type of learning that is appropriate to the resources available, delivering existing knowledge, academic goals, learning styles, and background of the students. Instructors should make decisions about the type of activities and concepts that are allowed and can be accepted by the students to comply with the process of selecting the right technology that has been provided by e-learning, and these things are important in the design of learning, because it covers a lot of issues pedagogical [20].

The framework proposed by [21] in **Figure 1** stresses on 4 challenges to attain successful e-Learning implementation.

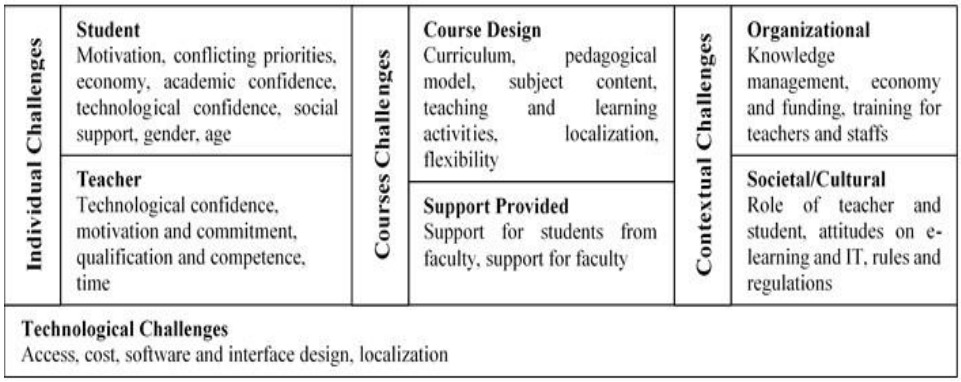

Figure 1. Framework on Challenges of e-Learning In Developing countries [21]

In fact, there are plenty of researches on the evaluation and Critical Success Factor (CSF) of e-learning. However, little has been discussed about risk management. The previous research has been discussed about the risks of using e-learning but only focusing on the technical side [18], not much to discuss in terms of management for sustainable use of e-learning in the long term. For this reason, this study will present preliminary research of the case study at the middle school to measure the risk to minimize the failure of e-learning implementation.

3. Research Method

This part describes the methodology that will be used during the research. The researcher focused on identifying the risks that may occur at the time of the implementation of e-Learning. The methods used in the implementation of e-learning was based on PMBOK for the Project Risk Management body of knowledge [22] consists of several stages: risk management planning phase, risk identification phase, risk analysis phase, and risk response planning or risk mitigation

3.1. Risk Management Planning Phase

In this phase the researcher will identify and analyze the needs based on Project Charter and Stakeholder Register documents. The information from both documents is treated as input in each early risk management planning. Having studied the related documents and discussed with the team experienced in developing e-learning project implementation, it generates an output in form of a risk management plan document.

3.2. Risk Identification Phase

It is a phase describing about what risks will drive impacts to e-learning implementation project. The benefit offered in this phase is an availability of documentation on identified risks that is adoptable to prove that the project team is capable of anticipating all possible risks.

The activities undertaken during the risk identification phase cover interviews with some experienced as IT Project Managers in e-learning developments and directed to the school management. The interviews address some questions to experienced IT Project Managers about some issues related with e-learning project and confirmed to the school management.

This phase will identify dome possible risks in the process of project implementation from an initiation until a closing of e-learning project implementation.

3.3. Risk Analysis Phase

With reference to the previously prepared risk registers the risks are assessed or analyzed in 2 (two) phases. The first concerns with qualitative analysis to identify probabilities of risks and their impacts. The second is weighing using FMEA. FMEA is based on identified weighing on the frequency of risks **(OCCUR/O),** number of causes of risks **(DETEC/D)** and degree of risk impacts **(SEV/S)** and accompanied with treatment or measures for risk handling based on the level of risks and supported with recommendations on the most reliable standards of references and well documented.

3.3. Risk Mitigation Plan Phase

Risk mitigation plan is a process for planning how to prevent and cope with risks that may arise along the course of the implementation of e-learning project. Having prepared the risk register, it is a time to prepare a strategy how to handle risks, both negative and positive ones. The final results will be a mitigation plan and contingency plan for each of identified risks.

4. Results and Analysis

This section presents the results of the implementation of the risk identification presented in risks register of implementation of e-learning, as well as the calculation of risks (risks assessment) and RPN calculation and determination of priorities for each risk of e-learning implementation.

4.1. Risk Register

Risk register is generated from the results of field observations to high schools and interviews with experts of IS/IT development project managers.

The observation is a method of data collection by directly observing the studied objects. It is supposed to give clear descriptions on the problems and risks that may arise. The observation is conducted by scrutinizing the following state of conditions:

1. Current school supports: number and area of computer laboratory, number of competent computer instructors and number of student available at school.
2. Computer laboratory: computer networks, condition and number of computer units, computer network cabling, possible hole/gap in computer laboratory rooms that may lead to problems (such as: leakage, bugs or plantations that may penetrate the computer laboratory rooms, and alike), room temperature and security instruments.

The interviews communicated questions on obstacles commonly arising during the course of the IS/IT project implementation. The questions addressed were focused on some issues related with project scope, project schedule, project costs and project purposes, project standard adoption. Project controls and communication problems.

The Risk Register for the project of e-learning implementation can be found in **Table 1**. There are 24 risks identified in e-learning implementation.

Table 1. Risk Register of e-Learning Implementation

Risk ID	Activity Category	Reference	Risk Identification	Causes	Impacts
D-01	**Delivery**	Project Charter Document	Unable to install software at schools	Traffic accidents when traveling to schools	Extra costs for compensating physical and moral damages
D-02	**Delivery**	Project Charter Document	Unable to install software at schools	Team member's illness, etc.	Outsources of project team members capable of installing software at schools in order to prevent negative impacts during project implementation.
D-03	**Delivery**	Project Charter Document	Unable to install software at schools	Lack of communication with schools	Delayed e-learning installation, extra costs and time for installation, etc.
D-04	**Delivery**	Documents of analysis on readiness of high schools to implement e-learning	Disturbed implementation process	Low commitment from schools	School un-contactable when project will be implemented
D-05	**Delivery**	Documents of analysis on readiness of high schools to implement e-learning	Unusable (inaccessible) features	Bugs in software	Extension of estimated time due to repairs and rechecking
D-06	**Delivery**	Documents of analysis on readiness of high schools to implement e-learning	Resistance by users	User uninvolved In process of needs identification, leading to final products that are not in compliance with the user's needs	Some users unwilling to use e-learning
D-07	**Delivery**	Documents of analysis on readiness of high schools to implement e-learning	Resistance by users	User unwilling to change (being comfortable with current/previous activities) too much	Some users unwilling to use e-learning
D-08	**Delivery**	Documents of analysis on readiness of high schools to implement e-learning	Resistance by users	No policies from principals ordering e-learning implementation in teaching learning process	When user 1 (teacher) unwilling to use e-learning program, there will be certainly user 2 not using e-learning program.
D-09	**Delivery**	Interviews	Unsuitable user interface designs	Inconsistent expectations by schools	Revision required → possible increase of costs and time
D-10	**Delivery**	Interviews	Available feature not complying with users' needs	Lack of foreign language (English) competence	Revision required to change foreign language version into Indonesian language version → possible increase of costs and time
S-01	**Support**	Interviews	Incomprehensive user guide for trainees	Inaccurate estimation of time made available for preparing user guide	User guide available to users not covering all features
S-02	**Support**	Documents of analysis on readiness of high schools to implement e-learning	Users' difficulties in using e-learning programs without supports from others	User guide in language difficult to understand by trainees	– User guide revision to make it easier to understand by trainees – Extra costs for re-checking user guide.
S-03	**Support**	Documents of analysis on readiness of high schools to implement e-	Not all trainees completely attending training process	Unrepresentative number of facilities and supports	Longer training processing time when compared to the estimated one.

		learning			
S-04	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User unable to access e-learning program when attending training	No Internet Browser in hardware	Training not running well
S-05	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User unable to access e-learning program when attending training	Low internet speed	Requiring longer Training time compared to the estimated one
S-06	**Support**	Documents of analysis on readiness of high schools to implement e-learning	Failing training delivery	User confused how to use e-learning and unwilling to use it	Assumed to have wasted time, costs and energy
S-07	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User facing troubles when using e-learning program	Lack of experience in using e-learning program	User unwilling to use e-learning program
S-08	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User unaccustomed to prepare materials electronically	First time e-learning implementation at school	User unwilling to use e-learning program
S-09	**Support**	Documents of analysis on readiness of high schools to implement e-learning	Users' difficulties in using e-learning programs without supports from others	Lack of experience in using e-learning program	User unwilling to use e-learning program
S-10	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User facing difficulties when solving problems arising while using e-learning	Lack of experience in using e-learning program	User unwilling to use e-learning program
S-11	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User doubtful whether he/she can use e-learning program properly	First time e-learning implementation at school	User unwilling to use e-learning program
S-12	**Support**	Documents of analysis on readiness of high schools to implement e-learning	User doubtful whether he/she can use e-learning program properly	Competence of user in using information technology	User unwilling to use e-learning program
F-01	**Feedback**	Documents of analysis on readiness of high schools to implement e-learning	Request from users for further training	Competence of user in using information technology	Requiring more time, efforts and trainers compared to the estimated ones.
F-02	**Feedback**		Request from users for further training	User confused with e-learning adoption, despite having attended training programs	Cost overrun and delayed/longer project completion

4.2. Risk Assessment

The calculation of risk value is based on qualitative analysis and quantitative analysis.

4.2.1. Qualitative Analysis

After the risks have been identified, followed up with assessment of the identified risks through PRN calculation by multiplying the values of Severity, Occurance and Detection. The data presented in this section gathered from the interview from the school management and the judgement from some experts in implemententing e-learning at schools.

In this phase an FMEA method will be adopted. It is the first step to take in a study on system reliability. This method involves reviews to many components, assembling and subsystems adoptable to identify modes, causes and effects of failures. Failure mode is defined as a failure, in term of either physical specification or infrastructure, that may happen or failure affecting business processes. With reference to the failure mode, the impact of a failure in a process and its influence the organization is analyzed. In this context, the FMEA refers to a process to detect identified risks while the business process is taking place.

The method adopted in the FMEA is calculating the Risk Priority Numbers (RPN) for each type of failure. An RPN is an accumulation of values of severity, opportunity and detection (with the scale 1-10) to classify the effects of each of type of failure potentials. Details of each standard calculation can be found in **Table 2**.

Table 2. Severity, Occurance (Probability), Detection [5]

Effect	**Severity of effect**	**Ranking**
Hazardous without warning	very high severity ranking when a potential failure model affects safe system operation without warning	10
Hazardous with warning	very high severity ranking when a potential failure model affects safe system operation with warning	9
Very High	System inoperable with destructive failure without compromising safety	8
High	System inoperable with equipment damage	7
Moderate	System inoperable with minor damage	6
Low	System inoperable without damage	5
Very Low	System inoperable with significant degradation of performance	4
Minor	System inoperable with some degradation of performance	3
Very Minor	System inoperable with minimal interference	2
None	No effect	1

Probability of Failure (occurance)	**Failure Prob**	**Ranking**
Very High: Failure is almost inevitable	More than 1 time/day	10
	1 time/day	9
High: Repeated failures (often)	1 time/3-4 days	8
Moderate: Quite common failures	1 time/week	7
	1 time/2 week2	6
	1 time/month	5
Low: Quite rare failures	1 time/3 months	4
	1 time/6 months	3
Remote: Failures is unlikely	1 time/year	2
Almost impossible	1 time/few years	1

Detection	**Description of detection**	**Ranking**
Absolute Uncertainty	Detection of risk is almost impossible to do, and unable to be controlled	10
Very Remote	Very difficult to detect the risks, very difficult to control	9
Remote	Difficult to detect the risks, difficult to control	8
Very Low	Quite difficult to detect, quite difficult to control	7

Low	Able to be detected with extra effort, able to be controlled with extra effort	6
Moderate	Able to be detected, Able to be controlled	5
Moderately High	Fairly easy to detect, fairly easy to control	4
High	Easy to detect, easy to control	3
Very High	Very easy to detect, very easy to control	2
Almost Certain	Able to be detected easily and clearly, very easy to control	1

And the calculation of RPN:
RPN = SEV x OCCUR x DETEC
Abbreviation remarks:
S/SEV : Severity (degree of risk severity)
O/OCCUR : Occurance (frequency of risk happening)
D/DETEC : Detection (degree of detected risks)

The following are the results of RPN calculation for risk management in the process of e-learning implementation at high schools.

Table 3. RPN Calculation for Risk Analysis of e-Learning Implementation

RISK ID	CALCULATION			RPN
	S	O	D	(S x O x D)
D-01	5	6	3	90
D-02	5	5	3	75
D-03	6	4	3	72
D-04	5	4	4	80
D-05	5	5	3	75
D-06	9	5	5	225
D-07	8	6	4	192
D-08	7	6	4	168
D-09	5	6	3	90
D-10	5	5	3	75
S-01	6	4	4	96
S-02	5	7	3	105

RISK ID	CALCULATION			RPN
	S	O	D	(S x O x D)
S-03	6	4	4	96
S-04	6	5	3	90
S-05	5	5	3	75
S-06	4	5	5	100
S-07	5	7	3	105
S-08	5	5	4	100
S-09	4	6	4	96
S-10	4	6	4	96
S-11	4	5	4	80
S-12	4	5	4	80
F-01	3	6	4	72
F-02	3	6	4	72

4.2.2. Quantitative Analysis

The qualitative analysis must precede a quantitative analysis. Not all risks need to be analyzed quantitatively. A quantitative analysis needs to be conducted when a prioritized risk, based on numerically ranked risks, will negatively affect the implementation of e-learning programs. Next, the risks are documented in a Probability and Impact Matrix [23], in form of boxes in a mapping utilized for charting the probability of each event of risks and its impacts to the project when the risks happen. This matrix provides solutions that help identifying various risks and offers effectively prioritized solutions.

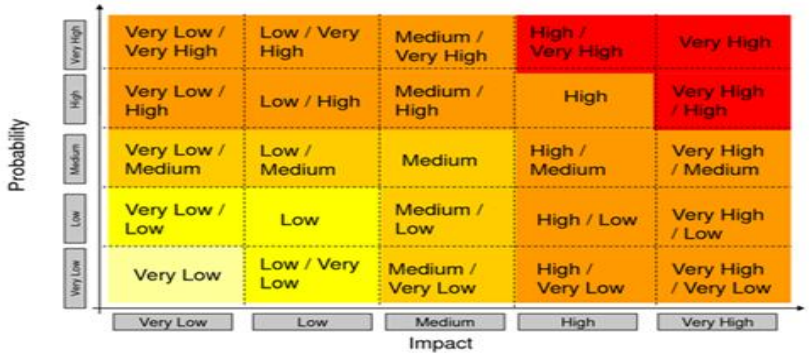

Figure 2. The Probability and Impact Matrix to Analyze Risks [23]

4.3. Risk Priority

The RPN calculation will be followed up with RPN value identification and priority categorization. The determination of priority will be based on the final 5 level of RPN value for each risk. If the final RPN value is <20 the degree of priority will be very low. If the RPN value is <80, the degree of priority will be low. If the RPN value is <120, the degree of priority will be fair. If the RPN value is <200, the degree of priority will be high. If the RPN value is >200, the degree of priority will be very high [24].

Table 4. Risk Priority for e-Learning Implementation

Number	Priority	Sum	Risk ID
1.	Very High	1	D-06
2.	High	2	D-08, D-07
3.	Medium	14	S-02, S-07, S-06, S-08, S-01, S-03, S-09, S-10, D-01, S-04, D-09, S-11, S-12, D-04
4.	Low	7	D-02, D-05, D-10, S-05, D-03, F-01, F-02
5.	Very Low	0	-
Total of Risks		**24**	

4.4. Risk Mitigation Plan

The risk handling is supposed to be able to properly manage and handle the type of risks and costs of risks whose nominal have been calculated in order to be able to identify the solutions and risk bearers. There are some ways to handle risks based on classifications of types of risks, namely [25]:

1. Acceptable Risk (**Accept**): The risk can be handled and coped with by the individual/organization as the consequence is relatively minor.
2. Avoidable Risk (**Avoid**): The risk can be handled by taking an alternative action as the consequence can be assumed to be less, even nil.
3. Mitigated Risk (**Mitigate**): The risk, whose negative impacts can be reduced by minimizing the probability of its occurrence or consequence.
4. Transferable Risk (**Transfer**): The risk can be transferred to other parties, either partially or wholly. In business, it is common to cover the risk by insurance.

The determination of actions to take against the risks will generate a reference and descriptions about how to cope with each risk with different impacts and frequencies. See **Table 5** to know The **Risk Mitigation Plan** sorted based on degree of risk priority.

Table 5. Risk Mitigation Plan for e-Learning Implementation

Risk ID	Level	Action	Mitigation
D-06	Very High	Avoid	Involving users at the earliest, from the first meeting (on needs identification) since they are the ones using the e-learning program and it is necessary to identify the exact needs and expectations of the users.
D-08	High	Mitigate	The principal gives directions on the implementation of policy and oblige the adoption of e-learning program in the teaching learning processes.
D-07	High	Avoid	The developer advises to the client (in this case: school) about the policy to be executed.
S-02	Fair	Avoid	Prior to training delivery, the Project Manager assures that the language used in the user guide is easy to understand by the trainees.
S-07	Fair	Mitigate	Preparing the user guide in video so that users can follow the step-by-step instructions presented in the video.
S-06	Fair	Avoid	- Delivering training properly - Assuring that the materials given to the users are easy to understand - Directing and confirming the benefits of e-learning adoption. - Requesting feedback from users concerning the weaknesses in the e-learning program
S-08	Fair	Mitigate	Planning to deliver training on how to prepare teaching-learning materials

			electronically.
S-01	Fair	Mitigate	Making quick revisions before training delivery so that the users can easily understand the training materials in the sessions.
S-03	Fair	Mitigate	Delivering the training programs in different times or more training venues.
S-09	Fair	Mitigate	Inserting 'Troubleshooting' feature so that the users can identify the problems they face and find proper solutions using the feature.
S-10	Fair	Mitigate	Inserting 'Troubleshooting' feature so that the users can identify the problems they face and find proper solutions using the feature.
D-01	Fair	Avoid	– Assuring that the vehicle used for travelling to the clients (in this case: schools) is in good and safe conditions. – Stopping the vehicle when the driver is sleepy or exhausted.
S-04	Fair	Mitigate	Before delivering training program, checking the instruments, tools and equipment that will be used.
D-09	Fair	Mitigate	Modifying user interface in compliance with the users' expectation.
S-11	Fair	Avoid	For a better training achievement, delivering training programs in groups based on the level of competences of each user.
S-12	Fair	Avoid	Delivering training on regular basis and with coaching once in a while (a user well skilled in using IT teaches other unskilled users)
D-04	Fair	Avoid	The project charter execution is supposed to prevent low commitment between both parties.

4. Conclusion

The conclusions drawn from the analysis of risk that may arise in the e-learning implementation process are as follows:.

1. This research found that there are 24 risks of e-learning implementation that need to watch out for failure can be avoided. 10 risks during delivery process, 12 risks during support process, and 2 risks during feedback process. Accordingly, it could be concluded that the support process brought the most risks compared to the other processes did and followed by delivery process. This is closely related to the principle of assistance in the support process. At a time when users encounter problems while using e-learning, the help system is highly expected. This means that the help from the e-learning implementer in the form of documents must be established before the e-learning system is provided.
2. Based on 24 risks in e-learning implementation project, it generated 3 risk priorities weighing on the risk potentials using FMEA methods: very high degree, high degree, and fair degree. This reseacrh focuses on the ***very high*** and ***high degree*** of potential RPN identified as important elements in this research are: resistance from the users due to non-involvement in the process of need identification leading to generation of final products that are not in compliance with the users, lack of policies to obligate the adoption of e-learning in learning processes, and unwillingness of the users to change (feeling too comfortable with the existing methods of learning). In fact, all of the high risks are included in the delivery process related to user resistance.
3. Both of which indicate that the importance of e-learning implementation activity is on delivery process and support process. That an e-learning implementer should focus on the complete delivery of e-learning products, especially documentation and guidance (support) from the e-learning implementer. So e-learing is able to be used in the future learning and be sustainable.

References

[1] J. S. George, J. F. Hoffer, and J. A. Valacich, “Essentials of System Analysis and Design,” in *3rd ed.: Upper Saddle: Prenticre Hall*, 2006.
[2] A. L. Ghozali, “The Concept and Understanding of Project Management,” *Teknik Informatika Politeknik Indramayu*. 2014.
[3] Yulianto and A. Tjahyanto, “Risk Project Management for the Software Development of MyBIZ 2,” in *Prosiding Seminar Nasional Manajemen Teknologi VII ISBN : 978-979-99735-4-2*, 2008.
[4] Suryanto, S. Gondodiyoto, N. I. Desi, Aryanto, and E. Triana, “The Evaluation of Project Management,” *CommIT*, vol. 3, no. 2, pp. 82–85, 2009.
[5] M. IMCA, “Guidance on Failure Modes & Effects Analyses (FMEAs),” *IMCA (The International marine Contractors Association)*. 2002.
[6] M. Villacourt, “Failure Mode and Effects Analysis (FMEA): A Guide for Continuous Improvement for the Semiconductor Equipment Industry,” in *International SEMATECH*, 1992.
[7] Q. Guo, Z. Tian, and L. Zeng, “Notice of Retraction Analysis on Risk Management Based on the Method of FMEA of EPC General Contractor Projects,” in *International Conference on Management and Service Science*, 2010.
[8] E. Engineering, “The Application of FMEA method in the risk management of medical device during the lifecycle,” in *2nd International Conference on E-business and Information System Security*, 2010.
[9] J. J. Paschkewitz, “Risk Management in Lean Product Development,” in *2014 Reliability and Maintainability Symposium*, 2014, pp. 1–6.
[10] G. Cândea, S. Kifor, and C. Constantinescu, “Usage of case-based reasoning in FMEA-driven software,” *Procedia CIRP*, vol. 25, pp. 93–99, 2014.
[11] K. C. Ekwunife-Orakwue and T. L. Teng, “The impact of transactional distance dialogic interactions on student learning outcomes in online and blended environments,” *Comput. Educ.*, vol. 78, pp. 414–427, 2014.
[12] I. Esteban-Millat, F. J. Martínez-López, R. Huertas-García, I. A. Meseguer, and Rodríguez-Ardura, “Modelling students’ flow experiences in an online learning environment,” *Comput.Educ.*, vol. 71, pp. 111–123, 2014.
[13] K. Kruse, “The Benefits and Drawbacks of E-Learning,” *http://www.elearningguru.com*, 2002. .
[14] J. P. Lorenzetti, “How e-learning is changing higher education: a new look,” *Distance Educ. Rep.*, vol. 22, no. 7, pp. 4–7, 2005.
[15] J. G. Ruiz, M. J. Mintzer, and R. M. Leipzig, “The impact of e-learning in medical education,” *Acad. Med.*, vol. 81, no. 3, pp. 207–212, 2006.
[16] E. T. Welsh, C. R. Wanberg, K. G. Brown, and M. J. Simmering, “E-learning: emerging uses, empirical results and future directions,” *Int. J. Train. Dev.*, vol. 7, no. 4, pp. 245–258, 2003.
[17] N. Barik and S. Karforma, “Risks and Remedies in e-learning system,” *Int. J. Netw. Secur. Its Appl.*, vol. 4, no. 1, 2012.
[18] M. Holbl and T. Welzer, “Students’ Feedback and Communication Habits using Moodle,” *Electron. Electr. Eng. Technol. Sci.*, vol. 102, no. 6, pp. 63–66, 2010.
[19] L. Uden, I. T. Wangsa, and E. Damiani, “The Future of E-learning: E-learning Ecosystem,” *Digit. Ecosyst. Technol. Conf.*, pp. 113–117, 2007.
[20] A. . Goldberg, “Exploring Instructional Design Issues with Web-Enhanced Courses: What Do Faculty Need in Order to Present Materials On-Line and What Should They Consider When Doing So?,” *J. Interact. Online Learn.*, vol. 4, no. 1, pp. 40–52, 2005.
[21] A. Anderson and A. Gronlund, “A conceptual framework for e-learning in developing countries: A critical review of research challenges,” *EJISDC*, vol. 38, no. 8, pp. 1–16, 2009.
[22] J. D. F. Sanchez, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition*. Project Management Institut.
[23] Dumbravă, V, “Using Probability–Impact Matrix in Analysis and Risk Assessment Projects,” *J. Knowl. Manag. Econ. Inf. Technol.*, no. December, pp. 76–96, 2013.
[24] K. Stillings, “Advanced Failure Mode Effects Analysis,” 2010.
[25] A. Husen, *Project Management*. Yogyakarta, Indonesia: Andi Offset, 2009.