A preliminary investigation of information system using Ishikawa diagram and sectoral statistics

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Abstract. A preliminary investigation is a problem-solving procedure. The Ishikawa diagram illustrates the cause of the problem in a particular group of causes. Several studies have used Ishikawa diagrams in problem-solving procedures where the branches of the causes include some components of the information system. The purpose of this study is to conduct a preliminary investigation of information systems using Ishikawa diagram and sectoral statistics. This study uses the System Development Life Cycle method which is limited to preliminary investigation phase. This study has mapped all the components of the information system in the Ishikawa diagram as the branches of causes which grouped into 4M. Sectoral statistics determine the percentage of problems for each cause and category. Preliminary investigation produces several alternative solutions for clients/owners of sectoral statistics regarding categories and causes that have a percentage within the specified range. The percentages make determining the critical causes more measurable.

1. Introduction

The preliminary investigation was the first phase of SDLC (System Development Life Cycle) as a problem-solving procedure [1]. System analysts implement SDLC to solve problems on six components of the information system that include hardware, software, data, networks, procedures, and human [2, 3]. System analysts ensure that all components continue to support the provision of up-to-date information [1], and improve work efficiency and effectiveness [4, 5, 6, 7, 8, 9, 10].

The use of Ishikawa diagrams to build an understanding of the components problems and solutions is not a new idea. Ishikawa diagrams (known as a fishbone diagram or cause-and-effect diagram) used as a tool to map the cause of the problem [11, 12, 13]. Hardware, software, and human become a category of causes in the Ishikawa diagram for computer troubleshooting, which each category has branches [14]. The procedure of computer maintenance become a category of causes for computer services troubleshooting [15]. The solution for component problems mapped in Ishikawa Diagram such as awareness and training that can improve skills and benefits [16], and avoid misuse of data that cause financial loss and reputation [17].

These studies mapped out some of the information system components as a cause in the Ishikawa diagram. This research will make an Ishikawa diagram in which the branches of cause include all components of the information system. The purpose of this research is to carry out a preliminary investigation to find the problem in the components of information systems using Ishikawa diagram and sectoral statistics [18].

2. Methods

This study follows the preliminary investigation phase of the SDLC which include preliminary analysis, propose alternative solutions, describe the costs and benefits, and submit a preliminary plan [1]. The use of Ishikawa diagrams in the preliminary analysis phase through a series of activities: stating the problem, collecting the specific causes, and ensuring the importance of the identified causes /critical causes [19].

Problems to be solved with Ishikawa diagrams are within the scope of the information system components. The specific causes include human, hardware, software, network, procedures, and data that grouped into four categories / 4M (Man, Machine, Methods, and Materials). Several kinds of literature that discuss the components of information systems are used to determine the primary and secondary causes.

Component data presented in the table obtained from sectoral statistical documents. The table is used to ensure the importance of the identified causes. Documents used in this study captures the problem of information system in one of the local governments in Indonesia. Percentage units are used to express component issues and will appear as descriptions of the primary or secondary causes associated with the component.

If the primary cause contains several secondary causes, then the percentage of primary causes is the average percentage of secondary causes. The percentage of categories is the average percentage of primary causes, and the percentage of problems is the average percentage of categories.
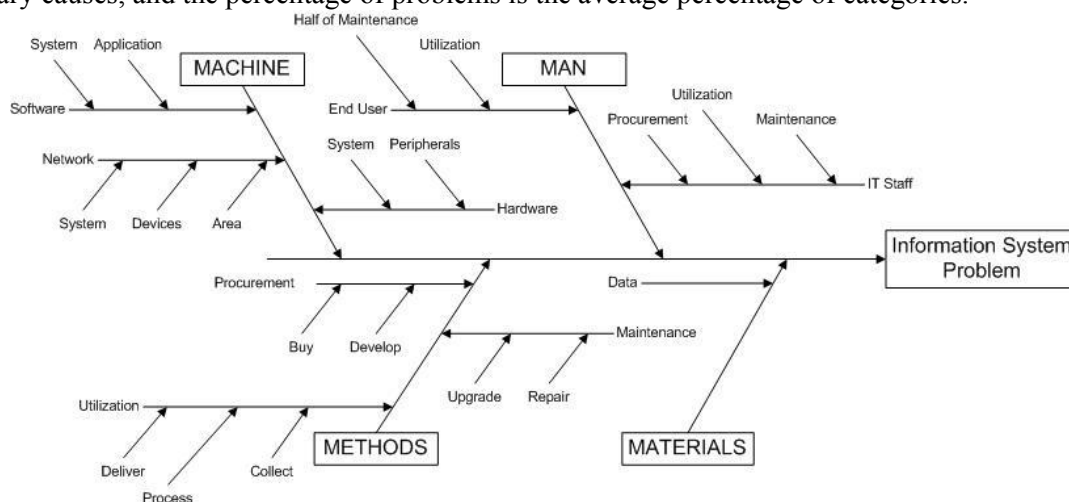
Figure 1. Ishikawa diagram that contains the specific cause of information system problems.

Solutions are created only for causes or categories that have a percentage within the range specified by a government as a research client. All alternative solutions are presented in the report, complemented by an explanation of costs and benefits.

3. Results and discussion

The specific causes of information system problems included six components of the information system and grouped into four categories:
- Man: everyone involved in the process, which includes end users and specialist users / technical staff [20, 4];
- Machine: the PC (personal computer) software (system and applications) [21, 1], hardware (systems and peripherals) [22, 1], and network (system, device, and area) required to complete the work [23, 24];
- Materials: data used to generate information [20]; and
- Methods: includes problem-solving procedures [1] and information system activities [20] includes three procedures below :

a. Procurement, including purchasing or manufacturing activities in preliminary investigation phase up to system development which is only done by technical staff;

b. Utilization, Information system activities including collecting (input, storage), processing (processing, control), and deliver (output) in the phase of system implementation that can be done by technical staff or end users; and

c. Maintenance, including upgrades or repair in the maintenance phase that can be done by technical staff or end users.

The specific causes and categories are further mapped into the Ishikawa diagram as shown in figure 1. Thus the research succeeded in mapping six components of the information system as a cause in the Ishikawa diagram, refining other research that only mapped hardware, software, human, and procedures [14, 15]. Each primary cause has branches (secondary causes) as in previous studies [14].

The client limits the preliminary investigation to the machine category with the percentage range from 50% to 100% or above 50%. Data on machine problems derived from sectoral statistics as shown in table 1.

Table 1. Machine data from sectoral statistics.

Primary Cause	Secondary Cause	Compo-nents	No Proble-matic	Proble-matic
PC Software	System	Operating System	152	388
		Driver	118	442
		Utility	169	994
	Application	Model	-	103
		Source Code	-	103
		Manual	1	102
		Installer	7	96
PC Hardware	System	Desktop	744	38
		Portable	419	23
	Peripherals	Scanner	5	1
		Faximile	4	-
		Printer	62	27
		All in one Printer	57	8
		Speaker	5	-
		Headset	-	-
		Webcam	-	-
		UPS	4	2
		External Hard Disk Drive	-	-
		External Optical Disk Drive	-	-
		Proyektor	52	1
Network	System	Building Entrance	14	61
		Equipment Room	3	72
		Teleco. Enclosure	10	65
		Work Area	49	26
		Backbone Cabling	59	16
		Horizontal Cabling	21	54
	Device	Bridge	15	-
		Router	110	1
		Switch	51	-
		Hub	60	9
		Access Point	69	3
		Modem	41	-
	Area	Local Area Network	47	28
		Campus / Metro Area Network	-	75
		Wide Area Network / Internet	10	65

Percentage of system software problems is the number of problematic devices (operating systems, drivers, and utilities) divided by the total number of devices (problematic and not problematic). Percentage of software problems is the averages percentage of system and application problems. The same way is used to determine the percentage of problems for other causes and categories, so the results as shown in figure 2.
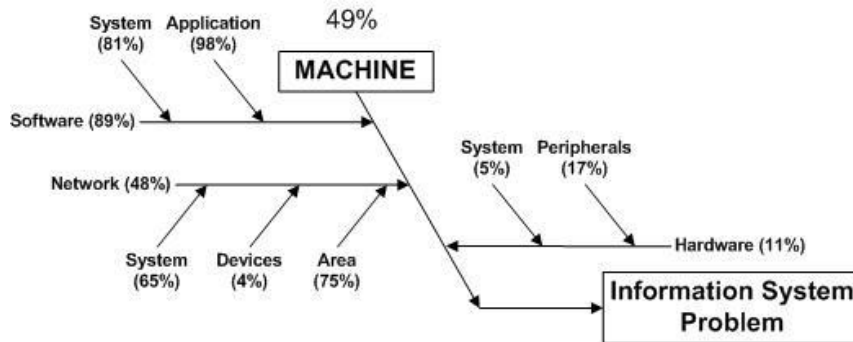
Figure 2. Machine category percentage.

Based on the specified percentage range (above 50%), the primary cause that needs to be solved is software (89%) which includes secondary cause system (81%) and application (98%). These percentages make determining importance of the critical causes more measurable.

Based on sectoral statistics, system software is problematic because there are no operating system and driver backups, and no utilities installed. The problem is due to the gap of knowledge and skills in the end user. Therefore the first alternative solution is the capacity building program for end users [16]. The gap can also cause system software untreated, so the second alternative solution is device maintenance and support program implemented by information technology department's [4].

The application software is problematic because of incomplete development documentation. The first alternative is to create a documentation standard as a reference in the preparation of contract documents. According to the capability maturity model, organizations with software engineering capabilities at level 3 (defined) have software process standards that include management and engineering activities, as well as documenting the process [25].

Moreover, the second alternative is to create a policy that defines the operation associated with the software process by the performance of the organization. Performance describes the time, cost, quality and flexibility desired by the organization. With the policy, the operations manager can make efforts to increase if the desired level of performance has not been achieved [26].

4. Conclusion

This study has succeeded in making Ishikawa diagram based on the literature, where the primary and secondary causes include the six components of information systems and divided into 4M categories. This study has made alternative solutions for each secondary cause that has a percentage of the problem within the range specified by the client. Percentage describes component problems according to sectoral statistics. The component problem data taken from sectoral statistics is limited to machine category, so this study does not present the percentage of overall information system problem.

References
[1]   B K Williams and S C Sawyer 2012 *Using information technology: a practical introduction to computers & communications* (Boston: McGraw-Hill Education)
[2]   M Grimsley and A Meehan 2007 e-Government information systems: Evaluation-led design for public value and client trust *European Journal of Information Systems* **16**(2) pp. 134-148

[3]   A Pamoragung, K Suryadi and M A Ramdhani 2006 Enhancing the Implementation of e-Government in Indonesia Through the High-Quality of Virtual Community and Knowledge Portal in *6th European Conference on e-Government* Marburg

[4]   R K Rainer, C G Cegielski, I Splettstoesser Hogeterp and C Sanchez Rodriguez 2013 *Introduction to information systems* (John Wiley & Sons)

[5]   A Rahman, C Slamet, W Darmalaksana, Y A Gerhana and M A Ramdhani 2018 Expert System for Deciding a Solution of Mechanical Failure in a Car using Case-based Reasoning *IOP Conference Series: Materials Science and Engineering* **288**(2017) p. 012011

[6]   C Slamet, A Rahman, A Sutedi, W Darmalaksana, M A Ramdhani and D S Maylawati 2018 Social Media-Based Identifier for Natural Disaster *IOP Conference Series: Materials Science and Engineering* **288(**2017) p. 012039

[7]   C Slamet, A Rahman, M A Ramdhani and W Darmalaksana 2016 Clustering the Verses of the Holy Qur'an using K-Means Algorithm *Asian Journal of Information Technology* **15(**24) pp. 5159-5162

[8]   W B Zulfikar, Jumadi, P K Prasetyo and M A Ramdhani 2018 Implementation of Mamdani Fuzzy Method in Employee Promotion System *IOP Conference Series: Materials Science and Engineering* **288**(2017) p. 012147

[9]   Y A Gerhana, W B Zulfikar, A H Ramdani and M A Ramdhani 2018 Implementation of Nearest Neighbor using HSV to Identify Skin Disease *IOP Conference Series: Materials Science and Engineering* **288**(2017) p. 012153

[10]   D S Maylawati, W Darmalaksana and M A Ramdhani 2018 Systematic Design of Expert System Using Unified Modelling Language *IOP Conference Series: Materials Science and Engineering* **288**(1) p. 012047

[11]   Z Yun 2015 The study of CDM-BSC-based data mining driven fishbone applied for data processing in *2015 IEEE International Conference on Signal Processing, Communications and Computing (ICSPCC)* Ningbo

[12]   L Liliana 2016 A new model of Ishikawa diagram for quality assessment in *IOP Conference Series: Materials Science and Engineering*

[13]   M Robson 2002 *Problem-Solving in Groups* (Aldershot: Gower Publishing Ltd.)

[14]   Y C Hung and S H Ye 2010 Implementing fuzzy message requirement classifiers system into the computer troubleshooting learning in *2010 Seventh International Conference on Fuzzy Systems and Knowledge Discovery* Yantai

[15]   S Phiphopsuthipaiboon and S Boonsiri 2016 Business Process Reengineering–A Case Study on Computer Center Service in *In MATEC Web of Conferences* Lucerne

[16]   R Cahyana 2016 Memfungsikan Telecenter sebagai Pusat Pembangunan Ekonomi Digital di Wilayah Perdesaan dengan Melibatkan Relawan Teknologi Informasi in *Temu Ilmiah Nasional Peneliti* Bogor

[17]   D Ki-Aries and S Faily 2017 Persona-centred information security *Computers & Security* pp. 663-674

[18]   Badan   Pusat   Statistik   2018   *Statistik   Sektoral*   [Online].   Available: https://sirusa.bps.go.id/index.php?r=site/sektoral. [Accessed 20 January 2018].

[19]   D N Card 1998 Learning from our mistakes with defect causal analysis *IEEE Software* **15**(1) pp. 56-63

[20]   J A O'Brien and G Marakas 2005 *Introduction to information systems* (McGraw-Hill, Inc.)

[21]   J C Wetherbe, E Turban, D E Leidner, and E R McLean 2007 *Information technology for management: Transforming organizations in the digital economy* (New York: Wiley)

[22]   M Meyers 2017 *CompTIA A+ Guide to Managing and Trouble Shooting PCs* (New York: McGraw-Hill, Inc.)

[23]   J S Beasley 2009 *Networking 2nd Edition* (Boston: Pearson Education)

[24]   A Mikalsen and P Borgesen 2002 *Local Area Network Management, Design and Security*(West Sussex: John Wiley & Sons Ltd)

[25]   R S Pressman 2001 *Software Engineering: a Practical Approach* (the McGraw Hill Companies Inc.)

[26]   S Brown, K Blackmon, P Cousins and H. Maylor 2001 *Operations Management: Policy, Practice and Performance Improvement* (Woburn: Butterworth-Heinemann)