A Sustainable System Development Method with Applications

I Made Wiryana

I Made Wiryana, SSi, SKomp, MAppSc
AG Rechnernetze und Verteilte Systeme (RVS)
Technische Fakultät
Universität Bielefeld

email: mwiryana@rvs.uni-bielefeld.de

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Gutachter:
Prof. Peter B. Ladkin PhD, Universität Bielefeld. Deutschland
Prof. Dr. Kokou Yetongnon, Universite de Bourgogne, Dijon - Frankreich

Promotionauschuß:
Prof. Peter B. Ladkin PhD, Universität Bielefeld, Deutschland
Prof. Dr. Kokou Yetongnon, Universite de Bourgogne, Dijon - Frankreich
Prof. Dr. Ipke Wachsmuth, Universität Bielefeld, Deutschland
Dr. Thorsten Schneider, Universität Bielefeld, Deutschland

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vorgelegt von

I Made Wiryana

To the people in developing countries who still encounter many obstacles to utilize the advance of Information and Computer Technology.

To my beloved wife, Ernianti Hasibuan and my son Madhava Nitisara Wiryana.

Statement

The works in this thesis is based on research carried out at the Networks and Distributed System Working Group (AG RVS), Technischen Fakultät, Universität Bielefeld as well as the involved parties such as Air Putih Foundation, President Republic of Indonesia offices, Badan Meteorology dan Geofisika (BMG), Badan Pengkajian dan Penerapan Teknologi (BPPT), and Gunadarma University. To the best of my knowledge no part of this thesis has been submitted elsewhere for any other degree or qualification and it's all my own work unless referenced to the contrary in the text

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Abstract

Sustainable development is a development that meets the needs of present generation while not compromising the ability of future generations to also meet their needs. There are 2 cases of sustainability. Case-1 is due to the discrepancy of environment and Case-2 is due to the change of environment. User, usage context and cultural aspects play important roles in the sustainability of system. Different groups of user response differently to the same system. Understanding the cultural consequence contributes to better sustainability of a system.

A sustainable system always attempts to maintain the Quality of Service (QoS) delivered by system. A service - a meaningful set of capabilities provided by an existing or intended set of system to all who utilize it: subscribers, end users, network providers, and service providers – each seeing a different perspective of service. The definition, parameters and technologies of QoS are determined by level of QoS domain. The level model is defined with respect to design approach used in the level. Those levels are : QoS in infrastructure, QoS in network level, Software quality as QoS, Usability as QoS, Culturability, Acceptability and Actability.

The Lightweight Why-Because Analysis (LWBA) as an extension of Why Because Analysis (WBA) is introduced as a tool for sustainable system development. LWBA is a semi-formal analysis, that investigates constraints in a non-judgmental manner. LWBA is also used to understand the needs of new development method which focus on sustainability. The analysis covers also non technical aspects, such as human resource, regulation and organization. LWBA is also employed as an investigative tool during the ethnography studies, a development tool in the proposed development method, and also as an explanation and a communication tool.

A novel development named as Bandung Bandowoso System Development Method (BBSDM) is introduced. The name is referred to a particular class of project in an extreme condition with many constraints that is culturally widely accepted in Indonesia. This system development method is formalized by actively involving in the real development projects for public. The BBSDM is commenced by requirement elicitation and analysis which is triggered by Case-1 or Case-2 sustainability problems, as well as from examples provided by stakeholders. The next phase is service specification and also the organizational and learning strategy specification. Service refinement is employed during the implementation phase. Then, the service evaluation and sustainability analysis. The LWBA with the Lightweight Why Because Graph (LWBG) as the representation tool are used in the entire life cycle of BBSDM.

As proof of the proposed development method, the development of real projects which employ BBSDM are described. Those projects are: Indonesia localization in Distro WinBI, the Air Putih in Tsunami relief action activities, the development of Early Warning Information System (EWIS) in Indonesia, and development as well as operation of critical web site of President of Republic of Indonesia, Dr. Susilo Bambang Yudhoyono. The systems are developed with many constraints and limitations in a very short time. By employing the BBSDM, the systems can sustain and still provide the expected services.

The participatory action research is chosen to develop the BBSDM and by utilizing Internet as research tool to perform the ethnography study. The make use of LWBA as analytical tool in this research methodology is also a contribution as a new way in performing action research.

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Chapter 1

Introduction

1.1 Introduction

Internet has shifted from the place where the scientists meet, to the place where practically any body with different backgrounds can meet each other. As consequences, several risks and and threats appear in Internet. Internet also opens new opportunities for communication and coordination among individuals, business, and nations. Understanding social technical aspect of Internet assists in designing the Internet service and anticipate the Internet diffusion, even in countries with different socio-technical conditions and networking infrastructures.

There is widespread belief among international agencies and development specialists in the potential value of Information Technology (IT) to support economic and human development [Eric Shih, 2008]. Many people in development community believe that IT can serve as a catalyst to help poorer countries accelerate development [(UNDP), 2001]. However, driving factors of Internet diffusion are different for developing economies than for developed ones. The availability of investment resources such as loans and foreign aid, the level of complementary asses and openness to foreign investment all play a role in driving IT investment in developing countries. These factor can be influenced by national development policies as well as by financial aid from international development agencies.

The quality of the connectivity in underdeveloped and developing countries is far poorer than in the developed North. The more developed regions of the world

Table 1.1: Categories of Web Applications [Athula Ginige, 2201]

Category	Examples
Informational	On-line newspapers, product catalogs,
Interactive (user provided information or customized access)	Registration forms, customized information presentation, on-line games
Transactional	Electronic shopping, ordering goods and services, on-line banking
Workflow	On-line planning and scheduling systems, inventory management, status monitoring.
Collaborative work environments	Distributed authoring systems, collaborative design tools
On-line communities, marketplaces	Chat groups, recommend er system that recommend products or services, on-line marketplaces, on-line auctions
Web portals	Electronic shopping malls, on-line intermediaries

(measured by GDP or average income per citizen) command most of the Internet hosts; the greater the proportion of its citizens who own computers and have Internet access. Users in developing countries are unable to put onto the Internet content that can compete on an equal footing with the overwhelming content placed on the Internet by the developed countries of the West and North.

From simple text-based email and file transfer, Internet technology have progressed from static Web pages to dynamic Web pages, to Web-enabled database access, to streaming data, The various web applications can be categorized as in Tab 1.1. Application variety is an important driver for Internet diffusion. But it also introduce a challenge for interoperability. As proposed by Amitava [Amitava Dutta, 2003] for the Internet diffusion model, the Internet is considered a socio-technical phenomenon. The balance between technology drivers and society's ability to absorb the benefits of technology represent the control value pacing that growth.

Internet has been contributing big impact to the world and has fundamentally changed many aspects of our life. The number of computer hosts and the number of people connected to the Internet has been rising since the beginning of the Internet.

As shown by Fig 1.1 users in Asia is increasing than user in Europe or North America. Nowadays, accessing Internet is not done by using only desktop computer. Mobile devices such as cell phone, PDAs, netbooks has surpassed the number of desktop. In a country such as Indonesia, as well as India, many people has their first computer is their mobile devices [Underwood, 2008].

In developing countries, Internet is often considered to have a potential to accelerate and enable the development. Many developing countries attempt to copy what is going on in developed countries . Many applications, web sites, business models are copied directly into the developing countries. Some of them are success, but many of them are also not working. In developing the Internet services, they tend to neglect the difference situations between where the Internet service is designed and the local situation. I believe that the local aspects should be considered in developing the Internet service in the future. Neglecting the local aspects in designing Internet service is not a good option for penetrability of the Internet services.

The Internet has not diffused randomly but has spread in definite patterns, heavily constrained by the economic, socio-cultural, and political structures. Therefore, to provide the Internet services in the developing country such as Indonesia, the cost efficient approach should be the main consideration. The same technology or the same model of interactivity cannot be copied. User centered approach by focusing on cultural consideration should be more employed rather than only technological considerations.

1.2 Personal background and motivation

During my involvement in various IT projects in Indonesia. I witnessed some failures of the system development projects. As anecdotal evidence, I extract from my personal experience during a system development project in 1995.

> *In 1995, I was assigned as the software designer for the information system in the 9th Asian Athletic Championship in Jakarta. The system was designed to provide the information of the events, such as results, seeding, background infor-*

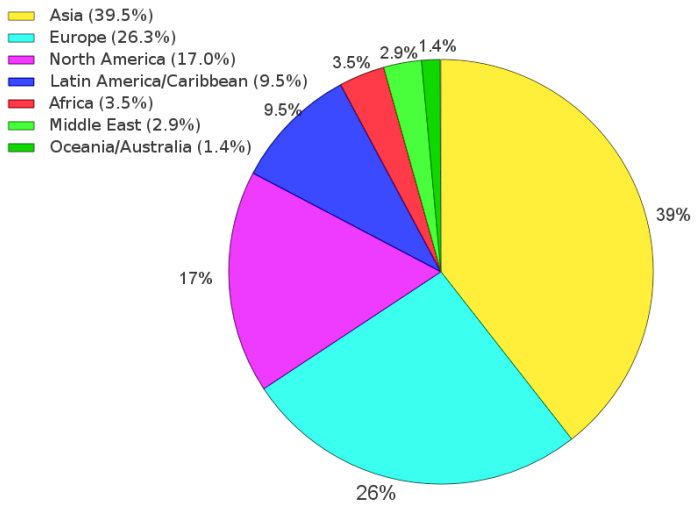

Figure 1.1: Internet users in 2008 [`www.internetworldstats.com`]

mation of athletes and other supporting information. The information system supported the media center for journalists. Users of system were journalists who could access the system directly. At that time, hypertext system such as WWW was still unknown in Indonesia.

I and my team, started the development from the scratch, we did not have any projects as example, as well as any design document. There is no software, hardware, networking facility in the location. The event organizers also had no idea, about their requirements. I had only 14 days for finishing the work. Thus, employing a standard system development such as waterfall was impossible. I could not gather and freeze the requirements. After 14 days I and my team could provide the information system, The system also delivered the information directly to the television.

We also provided computers for journalists. They could use the computer to get the information for supporting their work. The systems delivers information as expected, have a good menu system, rich information, but unfortunately only a small number of journalists used it. Most Indonesia journalists still waited for the hard copy of the results. We had to assign some personals to print results and distribute it to journalist in printed form.

The system was not failed from the technical point of view, because it could delivered the information as expected. However, only small number of users used

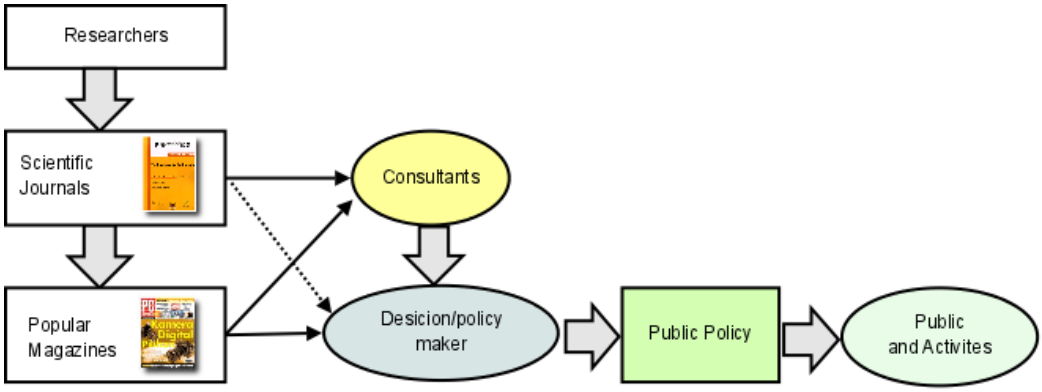

Figure 1.2: How idea flows in developing countries

it. Users were not ready to use such system. In this situation it is hard to judge how good is the system from the user point of view.

During my services as professional consultant, I faced many situation when the technical problem cannot be solved only using technical considerations. Moreover, during my works as IT consultants, I am also experiencing some failures of the IT project, due to the solution being proposed by the International consultants. The proposed solutions by those consultants are just copied from the other countries. Many solutions were developed using different assumptions of the real conditions, such as the users, infrastructures etc. Unfortunately, some projects in Indonesia are far from the ideal assumptions, for example limited budget, limited human resource as well as limited time and high expectation.

Other significant problem is the background knowledge gap between users and developers in developing countries. The communication gap between the system designers and the users continued to widen as computerized information system increasingly complex. Neglecting this gap produces the system that cannot be used effectively by users because they cannot understand the system. Thus, in this research I also considering how a design concept can be conveyed to the public effectively.

In Indonesia, a news methods or a new design follows different path to be known by public as in developed countries. As shown in Fig. 1.2, researchers via scientific publications have not a big direct influence with decision makers. The decision mak-

ers gather the information mostly from the popular magazines, or from consultants, Perhaps, only consultants read the scientific journals. This path shows why there is a big gap between users and developers in Indonesia. Many good practices or model are unknown among developers.

Thus, understanding how to reduce this knowledge gap between users and designers/researchers will contribute a significant role the development a good system. In this research I have some questions driven from my personal motivations :

- Is the user parts of the system or "environment" of the systems?
- Is the user education or communication to the users parts of the system developments ?
- Is a software development a merely product development process, or is it combined with a learning process for the parties who involve in the process ?

1.3 Definition of the problems

This research characterized by aim to balance the different aspects and requirements of people, organizations and technology which make up complex socio-technical systems within their social and natural environments, and within process of global networking. The symbiosis is not between a simple machine and a single user but is a mater of symbiotic relationships between network of users and network of machines.

Software engineering cannot be seen as pure development of technology, because it also induces a change process in the environment where it take places. This change process comprises organizational changes, technological changes, and change in the work structures of the different users. The critical success factor is to adapt constantly the planning to any changes.

Many development methods which claim user centered, actually still incorporate a certain single perception [Hannakasia Isomaki, 2005]. Users are seen as expert in the requirement specification, or as integral participant in the whole development process. Furthermore, in most existing user centered development methods, a user is

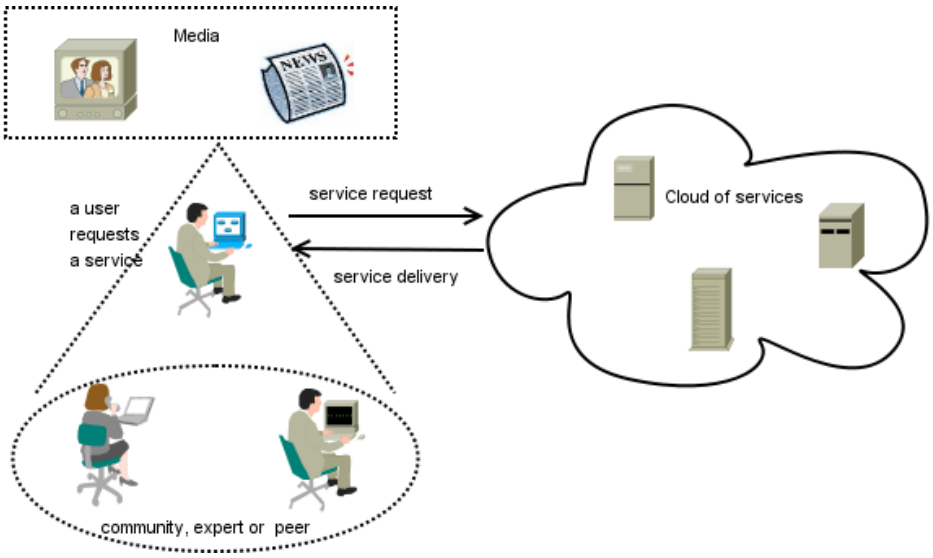

Figure 1.3: User view in this thesis

considered as an isolated human not as a social human being. However, I believe that single type of user perception is not enough for designing a good Internet services due to the heterogeneity of Internet users. In the Internet users are taking various role [Instone, 1996]:

- Information consumer
- Application user
- Information provider
- Information curator
- Information manager
- Entertainee

In this work, I consider users are part of a community and their social relationship, such as shown in Fig 1.3. As consequence of this assumption, users also are not free from influences of other users as well as the media in deciding how the use and how they judge the system. Thus, an influence of media or other users can dictate how the users perceives a services and determines the quality of services. The difference

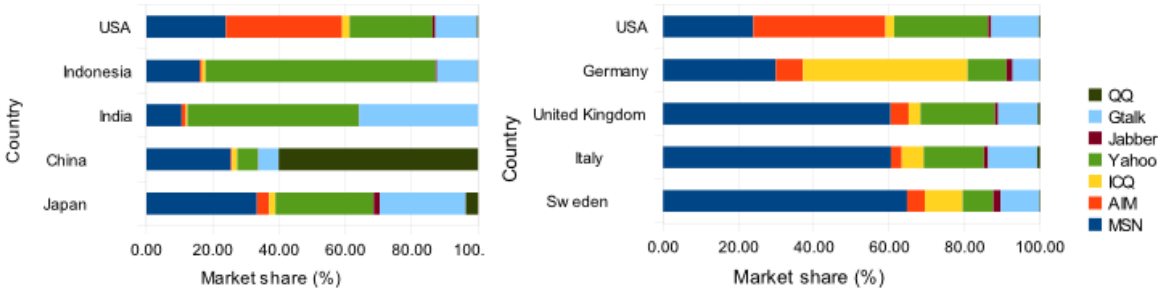

Figure 1.4: Market of messenger in Indonesia compare to Europe

acceptance of the Internet service is depends on the how groups of users view the services. The service quality perceived by user is not only dictated by the internal or external quality parameters of the services. A trust or perception of quality of Internet services is established through the "consensus" among users in those groups rather than via a relatively fair measurement. In a country such as Indonesia, where the Internet is a new thing, user has no idea about the service and its quality . The perceiveness of users about the Quality of Internet Services also is determined by the local or cultural aspects of the users [Kriengsin Prasongsukarn,],[Wendy Balber,].

As an example of non technical aspects of web applications and user preference is the market shared of Internet Messenger. It is shown in Fig 1.4, based on study performed by ComScore [`http://www.comscore.com`] . Although the detail of the data is still questioned, but it still shows the current tendency. In Asia countries, even though the Microsoft Operating System is still dominating the market, the MSN does not dominate the market. In Indonesia, Yahoo messenger still dominate the market. The big users of Yahoo Messenger in Indonesia, because the choice of Internet messenger is determined by *"friends"*. Which messenger used by most of friends will be chosen by the users. The quality is more or less determined by the consensus among friends.

It is very difficult to design the Internet service without considering the usage context of the system. As depicted in Fig. 1.5, typically, a system such as a simple web site, when is being designed, only technical aspects are considered. In the next phase, when the design is implemented, other considerations such as cost, organizations,

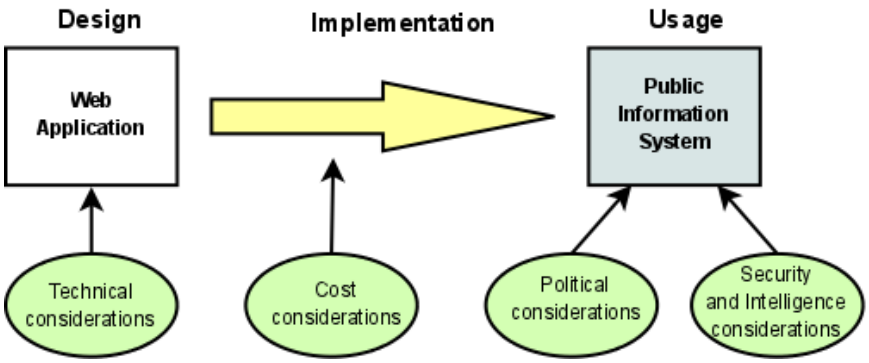

Figure 1.5: Context of usage

human resources to implement it have to be taken into account. However, when this simple web sites is used for a particular purpose, i.e. as Public Information System such as the official web sites of a President as developed by this research, other aspects have to be considered, such as the political considerations and security and intelligence. Security in this considerations is not only security of the system, but security in broader sense.

By considering users and the context of usage, this work introduces a broader view in designing Internet services. Designing an Internet Service that satisfies the Quality of Service (QoS) is not an trivial task. Quality of Services (QoS) now is viewed differently from different disciplines. There are some following problems such as :

- There are various approaches in dealing with Quality of Services (QoS) with their own considerations and terminologies. Occasionally, these terminologies are bounded to a particular type of products or particular type of implementation.

- There is structural problem an description used by the different approaches. Every approaches in different level of services, define the QoS differently with their own QoS parameters. Sometimes those parameters are conflicting each other.

- The development method ignores the cultural and user sides of the system.

Most of development methods, only consider that the different of culture of different users is only part of the internationalization and localization problem.

There is a need for a new development method as well as changes in the perceptions of the role of users in information systems development process. No existing development model adheres to encompass of this. Nowadays, it is often recognized that user need opportunities to influence the development process and to yields the system according to his/her own need and preferences.

1.4 Goal of this thesis

This thesis attempts to answer following questions:

- What is the most suitable system development method for a situation in where the circumstances of the place where the system will be deployed is different with the system is designed, for example in Indonesia. This development method has goal to reach the accepted quality of services. The method that developed should sustain in different situation as place or culture where the system is developed.

- What is the appropriate method to get users to use an particular Internet application by disseminating the idea to change the perception in Indonesia as a scientist.

- How a perception can be changed and particular quality parameter can be accepted widely

- To show how Internet can be used as a research tools to perform an ethnography study, as well as an object of the research.

- To show how the availability of source code affects the sustainability of the system.

1.5 Research Methodology

Computer science involves people solving problems. Computer scientist must perform more empirical studies that involve developers and users. Therefore, I believe that as computer scientist I should understand product, processes and relationships among them. Empirical studies involve many individuals and require laboratories to do good experimentation. Interaction among industrial, government and academic organization is also essential. Organizations and domains have different characteristics, goals, and cultures, and stakeholders have different need and profiles. Thus, the interaction with the public and users play a significant roles in the development model.

Technology and society influence each other reciprocally, technology shapes society, but society also shape technology [Brandt, 2007]. The development of modern-day technology is influenced and driven by technology producers, academic circles, influential social and institutional actors and various user groups. Without understanding the complexity within the system as well as the individual actors with them, the investigation of system cannot be performed well. Approaches such as Social Intelligence Design [Miura and Matsumura, 2009], or Social Informatics [Steve Sawyer, 2000], Ethnocomputing [Matti Tedre, 2006], are multi-disciplinary perspective which attempt to understand the interaction between the technology and social aspects surrounding the technology.

Instead of developing a method or prototype in a laboratory environment or doing proofing theoretically, I was able to devise and participate in significant development projects and actively developing various real solutions for users for their needs. In this work, users are considered not only a small group of users, but a big group of users as well as the public.

Users as member of public where the system being developed, actually have been taking part in a sequence of experiments. Users basically are learner who go through new experiences and learn to live and work with the new developed system. Thus, I evaluate new systems to the public as they are affected by the change caused by them. Subsequently I reflect on this experience and draw conclusions and develop

abstract concepts, which in turn may contribute to changing the technologies. The aim of such changes would be to achieve more acceptance concerning technology use and application. Improving quality in new situation which makes up a new set experiment.

I decided to choose this approach due to the different impact of the culture in developing model. As considered by Web Science [James Hendler, 2008], Web services always has impacts reciprocally with the user and its culture. Therefore, it is very difficult to model the development model without involving the real system with the real user in the real environment. Computer science requires more research which based on the results of real usage of the system .

In this work, I employ a **participative action research approach** . The action research such as defined by Kock [Kock, 1997] is :

> *"A general term to refer to research methodologies and projects where the researcher(s) tries to directly improve the participant organization(s) and, at the same time, to generate scientific knowledge"*

Action researches makes it possible for the researchers to apply theories in practice in realistic work situation and make a change in that situation, The ACTION brings about change in some community or organization or program, and the RESEARCH increases understanding on the part of the researcher, or the client . It is different with experimental research with fixed parameters in a controlled laboratory setting. In action research, projects are conducted in real life setting. The world is viewed not as a collection of independent objects, but as a collection of integrated, interactive, self-consistent and creative relationship of actors. The researchers involve the subject of the research as co-inquiries [Rasmussen, 2004]. This action research had been employed widely in Europa [Garibaldo and Rasmussen, 2004].

Action research uses extensively many qualitative approaches. In the qualitative studies, the data is usually being gathered directly, whereas the quantitative gathers data indirectly through an instrument, such as a survey or a web server log. Qualitative method is more suitable to answer question about why or how to fix a problem.

In this research, I try to perform to gather the qualitative data using Internet. I utilize the Internet to do establish conversations with many people who involve in this research, to track the development process as well as to use it as vehicle to change the perception of public.

This thesis attempts to provide a proof through the real experiments with the real results. In this research, I actively performing action to the public as users of system, and watch how the impact of my work in the public. The phases that I have performed during this research are :

1. **Actively communicate an idea to community**. During this phase, I attempt to use the Internet site, trade magazine, newspaper to deliver the idea to the public. To communicate in more effective I have to launch a new media for delivering the idea, such as the Internet web sites, or a magazine. However, written communication is not enough, thus I had to deliver the idea, approaches through various public lectures, conferences. They were not only the talks in academic settings, but also in various settings such as, industry, business, or public.

2. **Actively initiate a projec**t. To understand how the real project in Indonesia is established. I actively initiated some open source projects, most of them in localizations projects, which relates to the Chapter 4.

3. **Actively develop a project until being delivered to public**, To do the action part of this research, I involve in the system development. By involving in the preparation, requirement elicitation and analysis, design of the system until the implementation of system. These involvements provide opportunity for me to watch the interaction between various organizations in the development process.

4. **Actively maintain the project**. To understand the nature of the project, I participate actively in maintaining and operating the developed system.

5. **Retract from activity**. This phase is taken to study the sustainability of

projects without the involvement of the initiator. However, in some cases I cannot retract myself, due to some considerations, such as the importance of the project, for example in the President Web site. In some projects, I can retract from the involvement of projects, and watch how the system sustain to response of the changing.

The empowerment of the developers and users in development projects is important, as well as full participation on equal terms for everyone involved in project. This is not easy task, because of time limitation. However, before an ACTION can be performed I had to do the learning process to the users. However, this learning process should be adjusted with the cultural setting. The knowledge in the computer science itself should be adapted into cultural settings [Matti Tedre, 2003].

As many action researches [Cockburn, 2003], [Balla, 2001], this thesis has also been performed continuously over than 9 years and involving some real development projects. The time line of the research is shown in Fig. 1.6. The research activities consists of :

- **The publication activities**. This activities are performed in two different target : the popular publications and academic publication. Besides the publication, I also actively delivered my idea via various conferences, public lectures in various cities and occasions in Indonesia. It is also as a part of community learning in the proposed development method.

- **System development activities in various real projects**. I involved actively in various system development projects, the proposed method evolved and is developed during the development of projects. I did not impose a particular system development method, but try to refine what the people prefer to use and formalize it into the proposed system development method.

Action research is expected to have big impact directly with the research object, i.e. public. Usually impact factors in research mostly calculated using the impact of other researchers such as how many citations. As criticized by Maslov and Redner, even the

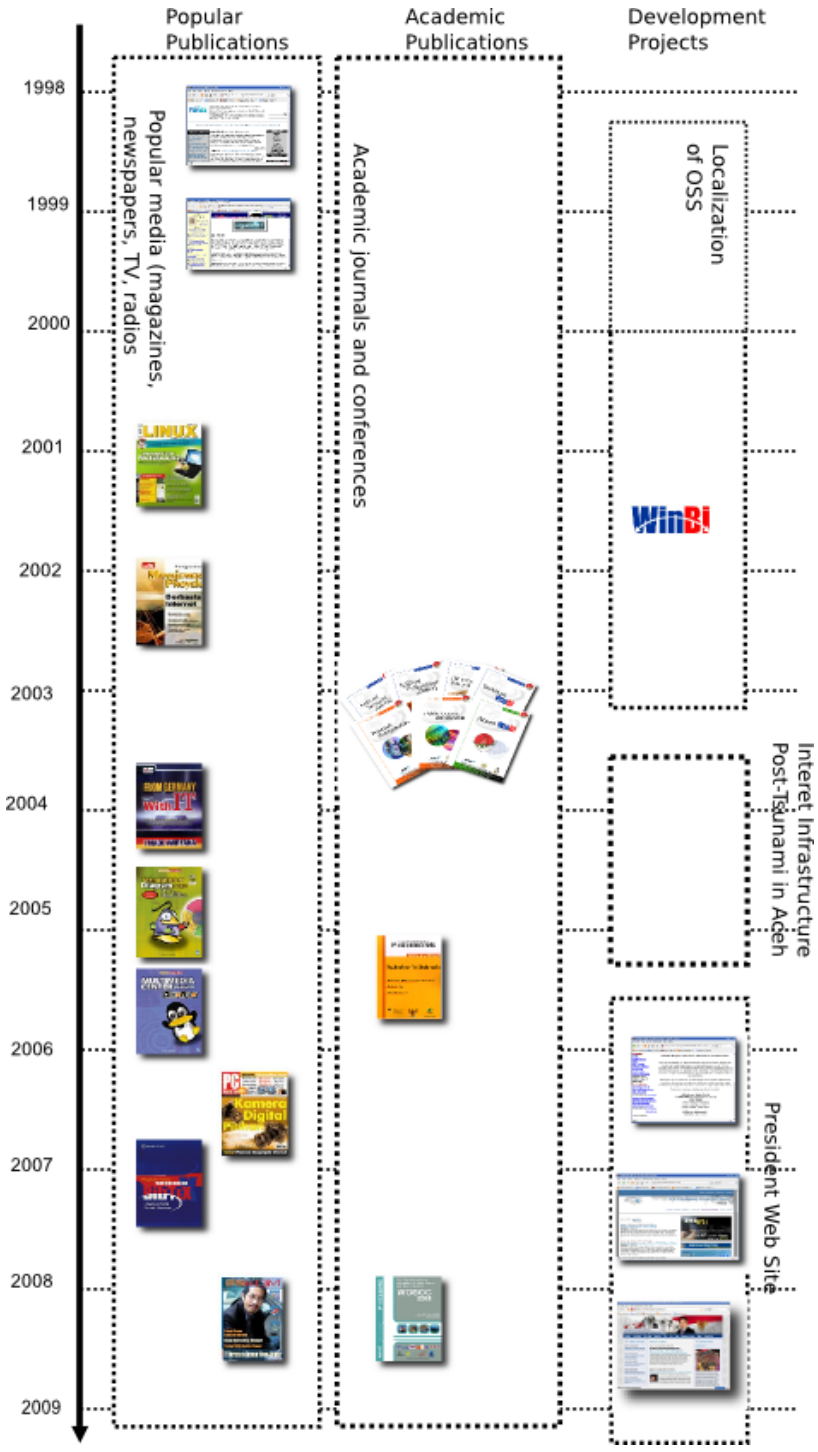

Figure 1.6: Research time-line

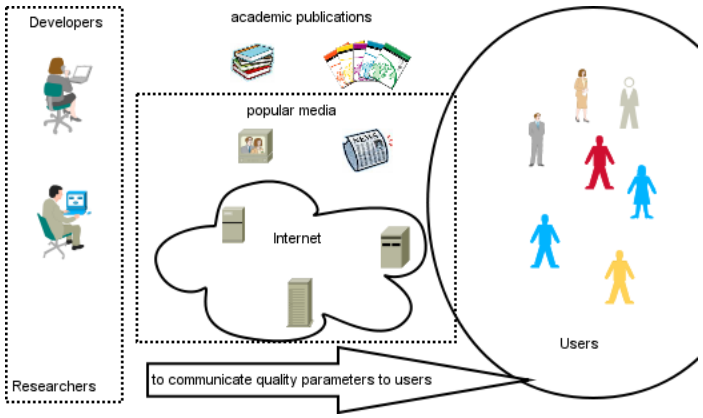

Figure 1.7: Publication method during the research

combination impact factors which uses Google's PageRank, does not show the "*real impact*" of the researchers works [S. Maslov, 2009]. All the citation measures device thus far pertain to popularity rather than to the not-necessarily-coincident attribute of intrinsic intellectual value.

Therefore, I decide the publishing method that may influence effectively to public during the journey of my research. Due to the condition in Indonesia, I choose the publication methods as shown in Fig 1.7. I conveyed my idea through the trade magazines, newspapers, web site more than the journal or conventional academic ways. The publications are part of the actions that I performed during my research. It was not only as a peer review mechanism, but it is used to be part of the action research itself.

In Indonesia, the availability of academic journal is very limited due to the journal cost. Moreover, academic journals are getting more expensive from year to year as shown in Tab, 1.2. Therefore, I believe that using academic journal to communicate and deliver the idea to the public in Indonesia is not efficient. Readers of academic journals are also very limited in compared with the trade magazines or other popular media. In developing countries academic journals are rarely accessed by the researcher, practitioners as well as the decision makers such as managements and

Table 1.2: Price increase of Journals [Frazier, 2002]

Subject	**Percent increase**
Business and Economy	56.9 %
Sociology	49.5 %
Technology	49.1 %
Engineering	48.9 %
Physics	35.8 %
Math and Computer Science	35.6 %
Language and Literature	16.9 %

bureaucrats. The little impacts of academic journals in Indonesia due to following conditions :

- The libraries in Indonesia cannot afford to subscribe the journals. Even in the developed countries, the journals purchase cost is too high for them [Theodore Bergstorm, 2 The high cost of academic journal limits the academy community access to those journals.

- The is no inter-library loan as well as union catalog in Indonesia, which enable between the researcher to share the publications [Basuki,]. The distribution of the academic journals is very limited in Indonesia.

To be useful scientific result need to be used, read, cited, shared, applied, and built upon. Dissemination research results using printed model has limitation. In this work , I also show that Internet can be used as an efficient way for publishing the idea or research result for a archipelago country like Indonesia, because it is relatively cheap and can be accessed widely [Odlyzko, 1995]. The reader number is bigger and the process of dissemination of idea is better than conventional publications. The same results also shown by the popular eLearning sites in Indonesia such as Ilmukomputer.com [Wahono,]. The Internet can provide an efficient mechanism for researcher in developing countries. However, the conventional publication method is still also used to deliver the idea to the academic community in Indonesia via various conferences and public lectures in various universities.

Furthermore in this research, Internet plays important role not only as tool to

perform the ethnography study but also as a vehicle to deliver my ideas during the research. Internet is also used extensively for the supporting development tools, as well as the research tools. Thus, using Internet it opens a possibility for doing action research in computer science.

I performed my research and works in wide context of system development. The proposed development method is not developed in the laboratory setting and tried in a small development activities, but it is already used in several development projects. The real projects which had been used for the study are:

- Various localization projects as well as the localization for a Linux distro in Indonesia, namely WinBI Projects.
- The Internet infrastructure development during Tsunami relief action as well as the Early Warning Information System development.
- The development and operation of Website of President of Republic of Indonesia.

In system research, publication is not enough as the scientific contribution. By demonstrating through software or other artifacts, it also demonstrates the scalability of solution [Bertrand Meyer, 2009]. However, since this approach is relative new, this approach still has some problems such as:

- This research method is considered as still immature.
- I cannot repeat the experiments or the actions.
- I use many qualitative methods in explaining the results.

1.6 Contributions

This research has yielded some contributions. I group the contributions as follow :

- Theoretical contributions :

  - Sustainability of systems
  - The level of QoS modelings
  - A system development method called Bandung Bondowoso System Development Method (BBSDM) which follows sustainable development model and to handle Bandung Bondowoso Project.

- Methodology contributions
  - The use of action research method which use Internet heavily as the communication and research medium.
  - The use of Internet to perform the field research.
  - The use of action research to solve the real problem of a particular users as well as scientific activities.

- Action contributions :
  - The first Indonesian Linux distro. This thesis drove the first Indonesia Linux distribution, namely Trustix Merdeka [eBizz Asia, 2003]. The Trustix Merdeka is a new technology adoption model in Indonesia, and it showed that this model can be used in Indonesia.
  - The first user interface in Indonesia language namely WinBI [Magdalena, 2004]. WinBI is the first translation effort in Indonesia which shows that using Open Source solution, developing country like Indonesia, which has many limitations can provide the solution to fulfill their local needs.
  - The design and development of the Early Warning Information System. The system is still used and operates seamlessly
  - The development, operation and the maintenance of critical web site, Web Site of President of Indonesia [`http://www.presidenri.go.id`]

- Also some publications were delivered to the public. These publications are used to achieved a phase in the research, not only to report the result of research.

1.7 Structure of this thesis

This thesis is presented in a format that is expected to be able to appeal to people, practitioners as well as researchers who want to learn about and explore the area of sustainable development model. This thesis is addressed in followings structures :

Chapter 1. Introduction. The background, motivations, goals as well as the research methodology are addressed in this chapter.

Chapter 2. The sustainability of system. I define what is the sustainability of system with various cases and the different examples that shows the sustainability problem. I also describe the analytical tools that I use for performing analysis, called Lightweight Why Because Analysis (LWBA). This tool is used extensively in this work.

Chapter 3. Quality of Service. The various definition of quality, services and also the Quality of services are described in this chapter. I address the various QoS model in several levels with respect to the design approach that is used in each level.

Chapter 4. Localization in Distro. This chapter is example of Case-1 sustainability problem. It is based on the experience during the development of the Indonesian Linux distribution. In this chapter I stress the sustainability problem of system development and analyze the technical and non technical aspect them using LWBA. I also introduce the need of change of system development in responding to the local needs.

Chapter 5. Air Putih in Tsunami relief action. This chapter is the background of the needs of a novel system development method that can be applied in particular situation. The basic idea of the proposed system development method is stated in this chapter. I use LWBA to understand the evolution of an ad hoc system development method.

Chapter 6. Early warning information system. This chapter states the sustainability problem that can take the people life. Furthermore, the development the system in very short time is also described in this chapter. I also focus on the implementation phase in the proposed system development methods. It is also an example how the development is driven by an incident. Starting from incident I show how LWBA can

be used to derive the requirement.

Chapter 7. Indonesia President Web site. This chapter described how the the proposed methods is employed and developed during a real projects. In this chapter, the evaluation of system as well as the sustainability of system are addressed. How LWBA can be used to solve the sustainability of system is described in this chapter.

Chapter 8. Comparisons and evaluations. This chapter evaluates the proposed method and the similar projects which used other existing development method. It also shown how the LWBA is used to do the system evaluation and comparison of other development methods. In this Chapter I also draw the strategy to evaluate and compare the system using LWBA.

Chapter 9. Bandung Bondowoso System Development Method. This chapter formulates the proposed system development methods in an integrated view. The characteristics of project that can be tackled using this novel system development model is also elaborated.

Chapter 10. Conclusion.

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Chapter 2

Sustainable Development

Trainer : It is a mouse, just like a normal mouse, it is cute, Just hold it

Participant: No, mouse is disgusting.

Trainer : OK, do not worry, just hold it.... Wait the minute, You hold it in the wrong direction... This is the tail, that is the head.

I often encountered this situation during my activity in delivery training to the people in Indonesia who had never learned, how to use computer. For them, the metaphor used by the designer, i.e. "*mouse*" is uncommon for them. For some people '*mouse*' may be a cute creature, due to the image from the Mickey Mouse. For people in other part of the world, mouse is just an enemy for them. Fig . 2.1 contrasts the real mouse and the "mouse" perceived by users in Indonesia.

This example show how some good designed systems cannot work in the implementation or a good system cannot be used as being designed. It occurs because the gap between the designer and users. This chapter addresses the sustainability system.

(a) Real (b) Computer

Figure 2.1: Real vs computer mouse

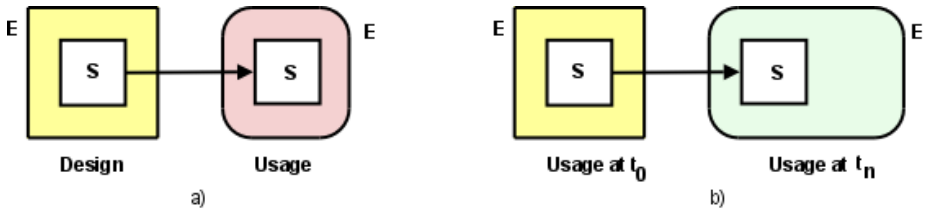


Figure 2.2: From design to implementation

The analytical tool that can be used for understanding the sustainability of system is also introduced in this Chapter.

2.1 Sustainability of a system

Although, sustainable design has not been considered as the part of design process in computer related disciplines, sustainable design has been used in other disciplines. It is known also as the design for environment (DfE), eco design or green design [Otto,]. Basically, the sustainable design is design strategy which has a goal to deliver the best (social, environmental and economic) performance or result for the least (social, environmental and economic) costs. It is the strategic use of design to meet and integrate current and future human needs without compromising environments.

In this design strategy, sustainability is generally defined as
[on Environment and Development, 1987] :

> *Development that meets the needs of present generation while not compromising the ability of future generations to also meet their needs.*

In a sustainable development model, understanding the user and the context of the use of system can produce a better system which can sustain to satisfy the future requirement. Most requirement engineering approaches still disregard the active user involvement during the whole project. The sustainability is only being taken into account in designing system after the context of usage play the role in the system not from the design phase.

Fig 2.2 shows the main problems why the sustainability factor should be considered

in designing and developing the system. As in Fig 2.2, I classified the world W into :

- E is the environment of the system. In this the work, environment is considered everything outside the system, such as users, organizations, physical/electric infrastructures. E is something that designer cannot fully controlled directly.

- S is the designed system. The designer can control the components in the system. The components of system will be designed in such a way to anticipate the environment of system.

The real E and S (in particular location, time, users group, computing environment) notated by E_{real} and S_{real} are not always the same with E and S that designer thinks during the design process, notated by E_{design} and S_{design}. During the design phase, the designer attempts to understand the real environment E_{real} by building a model of it, and it is called the E_{design}, the environment mental model. Basically the design strategy such as Domain Driven Design Development method [Eric, 2003] tries to understand this environment before designing the system.

The E_{design}, environment that the designer thinks during the design process

$$E_{design} = \{User_{design} \oplus Req_{design} \oplus Constrain_{design}\} \tag{2.1}$$

And the real environment E_{real}, where the system is used :

$$E_{real} = \{User_{real} \oplus Req_{real} \oplus Constrain_{real}\} \tag{2.2}$$

A design cannot sustain basically due to following factors :

- **Case 1 - Discrepancy of environment**. $E_{design} \neq E_{usage}$. There is different environment between the environment in design phase and environment where the artifact is used. For example, the system is used by users with very different cultural background, as well as the other technical constraints. People's aspiration and desires differ greatly across and between culture [Genevieve Bell. Mark Blythe, 200 It is already illustrated in Fig. 2.1.

- **Case 2 - Change of environment**. $E_{t_0} \neq E_{t_n}$. The different environment between the initial usage, E_{t_0} and the usage at some point of time in the future E_{t_n}. During the operation, at some point, users requires a change of the system. Sometimes it can be driven by new requirements, but also due to the change of users, i.e. users is more heterogen than the initial users.

To achieve the sustainable design there are two main strategies :

- The system is flexible enough to be customized. Thus, the system can be adjusted to accommodate the new environment. This strategy is used in the customization of software as well as the make use of Open Source components to satisfy local needs.

- The system is developed in the same environment. For example the development of INTERKOM in many cities in Indonesia [Baker, 2008], or the development of aAQUA in India to answer the need of farmers [Krithi Ramamrithham, 2008].

Both strategies is more or less similar with the sustainability strategy proposes in [Cecilia Briget Merkel, 2005] :

> *Sustainability as a dynamic process in which IT professionals, designers, and researchers work with community groups in way that give them greater control over technology in their organization.*

An example of the phenomenon to maintain sustainability evolution of system known as the **Continuous Ink Supply System** (**CISS**), shown in Fig 2.3, This CISS can be easily purchased in Indonesia or other Asian Countries, but it is rarely found in Europe. Many ink printers are designed so users have to changed their ink cartridge whenever the ink runs out. Some printers equip the cartridge with a special chip that tracks how many time it has been used.

Users found that this limitation can be circumvented by customizing the ink supply system. Users choose to customize the printer rather than to buy the new cartridge due to the economic consideration. Therefore, they start to customize the printer

Figure 2.3: Continuous Ink Supply System (CISS)

and add a special ink tank and supply system to fulfill their needs. They change the internal cartridges as well as the ink and also use the built-in auto reset chip. Using this customization users can use the printers more economics and the ink cartridge can be used for a longer time. This customization is out of the designer initial idea or the manufacturer. Users in particular place such as Asia find that this type of solution can match with their need. This customization is rarely found in Europe, because users in Europe seems does not accept this type of solution. Moreover, the economic constraints between Europe and Asian countries is different.

2.2 Cultural dependence

An extreme example how an artifact is used beyond the expectation of designer is shown in Fig 2.4. This pictures was taken in the street in Indonesia [`http://www.jimmysun.net/miscellaneous/mudik-naik-motor`], six persons ride the motorbike. people or other drivers relatively accept this '*abuse*'. The motorbike itself is initially designed for being used only for two persons. In this example, the design is being forced to sustain because the cultural dependence factors. The people in that area need a cheap transportation system for their family. The artifact itself is not changed or modified, only how to use the artifacts is different with what the designer think. The modification of how the motorbike is used is accepted in the users world, i.e.

Figure 2.4: Extreme example in sustaining the design

the transportation regulation is not enforced as strict as in the designer world. The absence of the strict law enforcement makes the change is possible to be implemented.

This cultural impact also appears in the Service Level Agreement (SLA) which often used to guarantee of Quality of Service (QoS). In Indonesia, the SLA is hard to be implemented because of :

- Some service terminologies are useless for users because users cannot understand them.
- Service Level Agreement is written in English.
- There are ambiguity meaning (mapping between terminologies are not good enough)
- Users complain based on their understanding in Indonesia language, for example the meaning of "reliability" (*handal*).

Even in the same language, i.e. English, various organizations define differently the level of compliance of an system implementation. The terminologies in RFC 2119 [IETF, 1997] to Indicate Requirement Level as :

1. `MUST`, `REQUIRED` or `SHALL`. It is an absolute requirement of the specification
2. `MUST NOT`, `SHALL NOT`. It is an absolute prohibition of the specification.

3. `SHOULD`, or `RECOMMENDED`. It may exist valid reasons in particular circumstances to ignore particular item, but the full implication must be understood and carefully weighed before choosing a different course.

4. `SHOULD NOT`, or `NOT RECOMMENDED`. It may exist valid reasons in particular circumstances when particular behavior is acceptable or even useful, but the full implication should be understood and the case carefully weighted before implementing any behavior.

5. `MAY`, or `OPTIONAL`. It is truly optional.

This requirement level cannot be easily be mapped to different language with the identical meaning. Different organization also define this conformance level differently such as ISO use different word and definition such as [Lyne Rosenthal, 2002]:

1. `SHALL`. It is strictly to be followed, and no deviation is permitted

2. `SHALL NOT`, It is converse of `SHALL`

3. `SHOULD`, It indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others

4. `SHOULD NOT`. It is converse of `SHOULD`

5. `MAY`, It is indicates a course of action permissible within the limits of the standard.

6. `NEED NOT`. It indicates a course of action is not required

7. `CAN`. The statement of possibility or capability, whether material, physical or causal.

8. `CANNOT`. Converse of `CAN`

There are more than 160 definitions of culture [A. L. Kroeber, 1952] In this work I choose to use the culture definition coined by Hofstede [Hofstede, 2001]*:*

> *Cultures is the collective programming of the mind, which distinguishes the members of one human group from another.*

In this definition, culture is known as knowledge, acquired through membership of a particular community. Examples: color, icons, etc. Therefore, culture can be defined as specific group of people sharing a distinctive set of values, symbols, rituals, heroes, etc, to different degrees the result of their interactions with other cultures. Culture can be categorized in different levels :

- National level according to one country
- Regional and/or ethnic and/or religious and/or linguistic level
- Social class level, associated with educational opportunities and with a person profession
- Organization or corporate level according to which the employees have been accustomed by their work organization

Hofstede defined the culture with 5 indices :

$$C = \{PDI, IDV, MAS, UAI, LT\} \tag{2.3}$$

where each index are defined as [Hofstede, 2001] :

- PDI, **Power Distance Index**: "*the extent to which the less powerful members of institutions and organization within a country expect and accept the power that is distributed unequally*". It indicates the acceptance of power inequality and dependence of subordinate on bosses. A country with small value of PDI subordinate and superior considers each other as essentially equal.
- IDV**, Individualism**: *"Individualism pertains to societies in which the ties between individuals are loose: every one is expected to look after himself or herself and his or her immediate family. Collectivism as its opposite pertains to society in which people from birth onwards are integrated into strong, cohesive*

in-groups, which throughout people's lifetime to continue to protect them in exchange for unquestioning loyalty". In a culture with high IDV, the personal accomplishment is more emphasized than group accomplishment.

- *MAS*, **Masculinity**: "*masculinity pertains to societies in which the gender roles are clearly distinct: femininity pertains to societies in which the gender overlap*". The culture with high MAS tends to have very distinct expectations of male and female roles in society.

- *UAI*, **Uncertainty Avoidance Index**: "*extent to which the members of culture feel threatened by uncertain or unknown situation*". In a culture with low UAI, there is less need for predictability and written/unwritten rules to guide work tasks.

- *LT*, **Long Term**, "*long term orientation stands for fostering of virtues oriented toward future rewards in particular perseverance and thrift, short term orientation stands for fostering of virtues related to the past and the present in particular respect for tradition and fulfilling social obligations*". This index focuses on the degree the society consider between the traditional value and forward thinking value.

The culturability index of Indonesia can be highlighted as follow:

- Indonesia has Power Distance (PDI) as its highest ranking Hofstede Dimension at 78. The high Power Distance (PDI) is indicative of a high level of inequality of power and wealth within the society. This condition is not necessarily forced upon the population, but rather accepted by the society as part of their cultural heritages. The average Power Distance for the greater Asian countries is 71.

- The second highest Hofstede ranking is Uncertainty Avoidance (UAI) at 48, compared to the greater Asian average of 58 and a world average of 64. This reflects a more moderated influence of this Dimension within the Indonesian society. Generally, a high Uncertainty Avoidance (UAI) indicates the society's

low level of tolerance for uncertainty. In an effort to minimize or reduce this level of uncertainty, strict rules, laws, policies, and regulations are adopted and implemented. The ultimate goal of this population is to control everything in order to eliminate or avoid the unexpected. As a result of this high Uncertainty Avoidance characteristic, the society does not readily accept change and is very risk adverse.

- Indonesia has one of the lowest world rankings for Individualism with a 14, compared to the greater Asian rank of 23, and world rank of 43. The score on this dimension indicates the Indonesian society is Collectivist as compared to Individualist. This is manifest in a close long-term commitment to the member 'group', is that a family, extended family, or extended relationships. Loyalty in a collectivist culture is paramount, and over-rides most other societal rules and regulations. The society fosters strong relationships where everyone takes responsibility for fellow members of their group

- The combination of these two high scores (UAI) and (PDI) create societies that are highly rule-oriented with laws, rules, regulations, and controls in order to reduce the amount of uncertainty, while inequalities of power and wealth have been allowed to grow within the society. These cultures are more likely to follow a caste system that does not allow significant upward mobility of its citizens.

- When these two Dimensions are combined, it creates a situation where leaders have virtually ultimate power and authority, and the rules, laws and regulations developed by those in power, reinforce their own leadership and control. It is not unusual for new leadership to arise from armed insurrection – the ultimate power, rather than from diplomatic or democratic change.

However, Hosftede model is a simplification the Culture, C itself is defined as combination between the **National Culture**, ($C_{national}$), **Occupational Culture** ($C_{occupational}$) and **Organizational Culture** ($C_{organizational}$):

$$C = \{C_{national} \oplus C_{organizational} \oplus C_{occupational}\} \tag{2.4}$$

The culturability index from Hofstede is very difficult to be applied in Indonesia. As criticized by Sweeney [McSweeney, 2002], Hofstede work focused on national level culture. The diversity in Indonesia in following aspects makes difficulty in applying directly the Hofstede culture index:

- **Religion**. There are 6 religions and various local beliefs. Indonesia is the world most populous Muslim country. Religion influences the values that used by users in accepting some metaphors. Some metaphors in user interface cannot be used due to the acceptance influenced by religion.

- **Language**. There are more than 400 local languages with various dialects. The official national language, Indonesian, is universally taught in schools, and is spoken by nearly every Indonesian. It is the language of business, politics, national media, education, and academia. It was originally a lingua franca for most of the region, including present-day Malaysia, and is thus closely related to Malay. Indonesian was first promoted by nationalists in the 1920s, and declared the official language on independence in 1945. There are 724 distinct languages and dialects. Most Indonesians speak at least one of the several hundred local languages (*bahasa daerah*), often as their first language. Javanese is the most widely-spoken. Papua has 500 or more indigenous Papuan and Austronesian languages. Some languages has their own scripts, such as Javanese, Balinese Bugise, and Batak. There is also language which has only 250 speakers, i.e. Bedoana in Papua [Basuki, 2007], These local language are shown in Tab. 2.1.

- **Ethnicity** : more than 300 ethnic groups as well there are big culture influence from Arabic, Indian, Chinese, Europeans. Different cultures have different emotional in the use language, even though they used the same national language [Heider, 1991]. This influence how the particular ethnic in Indonesia cannot

Table 2.1: Mother tongue speakers in Indonesia [Basuki, 2007]

No.	Language	Main Area	Speakers
1.	Java (Javanesse)	Central and East Java	70,000,000
2.	Sunda (Sundanese)	West Java	25,000,000
3.	Malay (Melayu*)	In Indonesia	10,000,000
4.	Madura (Madurese)	Island of Madura	9,000,0000
5.	Minangkabau (Minang)	West Sumatra	6,000,000
6.	Bali (Balinese)	Island of Bali	3,000,000
7.	Bugis (Buginese)	South Sulawesi	2,500,000
8.	Aceh (Acehnese, Achehnese)	North, Aceh province	2,200,000
9.	Batak Toba (Toba Batak)	Samosis island, and east, west of Toba Lake in North Sumatra	2,000,000
10.	Banjar (Banjarese)	Around Banjarmasin in South and East, South Kalimantan	1,800,000
11.	Makassar (Makassarese)	South Sulawesi	1,500,000
12.	Lampung (Lampomg)	Southern Sumatra	1,500,000
13.	Batak dairi (Dairi, Pakpak)	Northern, southwest of Lake Toba around Sidikalang, North Sumatra	1,200,000

Note : * Slightly different from those Malay spoken in Malaysia

accept a graphical symbol. As shown in Fig. 2.5, the mobile operator in Indonesia has to design the homepage or the picture for marketing material for Aceh. The picture chosen for entire Indonesia is not accepted in Aceh due to the Aceh cultural consideration.

Mostly people view that development method is free value, and free of context. It means the cultural background of developer, or users do not play significant role in system evaluation. In this work, the Hofstede index is used to understand the users, particularly to understand the constrains that produce from this cultural aspects. The cultural model deals will considering the issues how strategies, attitudes, habits and norm are influencing the use of artifact. Human context approach means accepting that any social entity has its own history.

Culturability, the merging of culture and usability, has implications for system design. In this approach usability must be redefined in terms of a cultural context, as what is user friendly for one culture can be vastly different for another cultures. Many

(a) For other regions in Indonesia (b) For Aceh

Figure 2.5: Different provinces have different preferences

of the icons, metaphors, shapes, colors of text and background, frame/text locations on screen, etc. employed in systems design are relevant to the culture of origin of the software, but does not has any meaning or opposite meaning for other cultures.

The culturability index can be used to consider following aspects in developing applications :

- Emphasis on the social/moral order and its symbol
- Focus on expertise, authority, experts, certification, official stamp or logos
- Motivation based on personal achievement.
- Rhetorical style
- Navigation oriented to exploration and control
- Graphics, sound, animation

The change how and who use computer will change also how the designer should design the computer system. The shift from system oriented to human context oriented design causes new considerations in choosing the appropriate system. A machine oriented design is mostly a deterministic system based on automated data processing. System is designed with deterministic behavior and definite boundary. Role of user is only described as behavior at the human-computer interface and ignored otherwise.

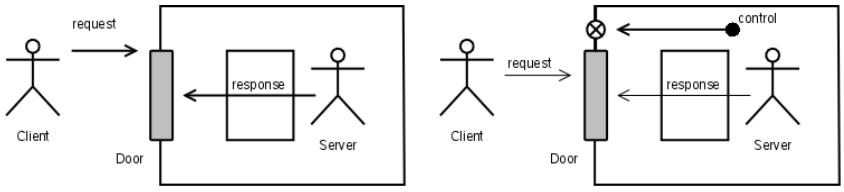
Mismatches between technology and user preferences usually is interpreted as the failure of users to understand or learn a well-working technology [Minaa Koskinen, 2005] or due to the lack of user training.

By applying human context approach, system development process is not only dictated by developers. Users play more active and important role. User acceptance plays more important role in evaluating the quality of system. Furthermore, user preferences are determined by the culture and the local context. Software must fit with this cultural and local context, without considering the cultural aspects some software products fail to satisfy the users [Liang et al., 2004]. Cultural aspects play important role as critical success factor for implementation of ICT [Kittipong Laosekathul, 2007].

An example of this influence is the acceptance of Enterprise Resource Planning (ERP) in China. Enterprise Resource Planning (ERP) designed in Western countries such as SAP, Oracle only has 24,4 % of China market, in compare their world market share of almost 70%. The 6 domestics ERP vendors hold 51.6% market share. [Huigang Liang, 2004]. Many ERP designed in Western country cannot satisfy the user needs in China, because those ERP are designed based on rule-based mature economic rather than relation-based governance system like in China. The ERP implementation in many Asian countries encounter some local related problems, such as expected user-specific reports. This reports is required based on the hierarchical model of the organization in Asia. There are also other cultural related problems, such as `ID_of_location`, in many Asian countries some buildings have multiple floor numbers missing, such as 13th floor. Some numbers are not preferred as the `ID_number` and some numbers are favorite number, such as 888. Developers and consultants need to adapt their products and services for different cultural markets [Davison, 2002]

2.3 Heterogeneity of users

Each user from different culture view service differently. As shown in Fig 2.6, a server serves a client, only one in a time. Before the client can request any service, he/she



(a) Basic system (b) Additional light

Figure 2.6: Knocking the door protocol

has to walk through the door. In this situation there are two possible protocols for doing that. The protocols are established via consensus in the society and it is cultural dependence.

As shown in Fig 2.6a, the initial basic systems consists of a person who sits in a closed room (P_i) and a person who asks something to the person in the room (P_o). How the interaction between the person P_i and P_o, is determined by where and in which culture. In some places and culture, such as in Indonesia or most Asian countries, the interaction appears as follow :

Fact 1. *Protocol 1 :*

- P_o knocks the door.
- P_o waits until P_i provides an answer. The answer may be Yes, or $Wait$.
- If the answer *Yes*, P_o client may open the door and comes in
- If the answer *No*, P_o client has to wait. Because it means the P_i is busy.

However, I experience in other country and culture such as in Germany, the common protocol is slightly different.

Fact 2. *Protocol 2:*

- P_o knocks the door and opens the door without waiting the answer from P_i
- However, before P_o request a service P_o has to wait the reaction of P_i
- If the answer Yes, P_o may request the service to P_i

- If the answer No and $Wait$, P_o has to goes out and waits outside the room

The problem appears when the system which was initially designed for the culture which accepts the protocol 2 now has to serve the people who come from culture who understand the protocol 1. I identify this problem in the immigration office in Bielefeld - Germany. To tackle this problem, the service room is modified for accommodating users who come from those different cultures. The modification is shown in Fig. 2.6b. Using an additional components (L) the protocol is changed but can be easier to be accepted by both cultures. The L can have two different values.

$$L = (green \mid red) \tag{2.5}$$

Fact 3. *Protocol 3 :*

- P_o monitors the L.
- If L is $green$, P_o knocks the door and comes into the room. The P_i will change the L to red. After that, P_o may request the service to P_i. After P_o finishes and goes out, P_i has to change L to $green$,again.
- If L is red, P_o has to wait outside until the L is $green$.

As the system has human as components, the acceptance will be determined also on how human accept those protocols, not only how efficient those protocols. For example, the Protocol 3 solves the heterogeneity of P_o. However, the P_i find that there is an extra work, i.e. controlling the L. P_i has to change the L whenever $P_i$has P_o in the room.

Providing a sign for the availability of services help users, but sometimes the sign is interpreted differently. An example is depicted in Fig. 2.7 which can be seen in the *Strassenbahn* (tram) in Bielefeld - Germany. In each tram, some seats have been reserved for people with wheel chair/child/senior. However, how passengers perceive and employ a '*protocol*' in responding to the person who is eligible to this place is different.

To explain the situation, I category passengers into two groups :

Figure 2.7: Place for disable person

- H_D, passenger who is in this category, such as parent with baby carriage, disable person or senior.
- H_N, other passenger who is not in this category,

Fact 4. *Reserved seat claim protocol 1.*

- H_D comes into the train. H_N sits in the reserved seat.
- Without being request by H_D, H_N offers the reserved seat to the H_D
- $H_D$accepts the offer and sits in the reserved seat. Or H_D does not accept the offer, and H_N sits again in the reserved seat.

Fact 5. *Reserved seat claim protocol 2.*

- H_D comes into the train. H_N sits in the reserved seat.
- H_D explicitly requests the reserved seat to H_N. Without requesting it H_N will not automatically provide those reserved seat to H_D
- H_N will give the reserved seat to H_D

In the system with human in the loop, the human acceptance plays important roles in system acceptance. Other example is the relation between queue and human culture. As shown in Fig. 2.8, if there are 3 service providers in the system, i.e $\{S_1, S_2, S_3\}$, the customers can be arranged into two different queue strategies.

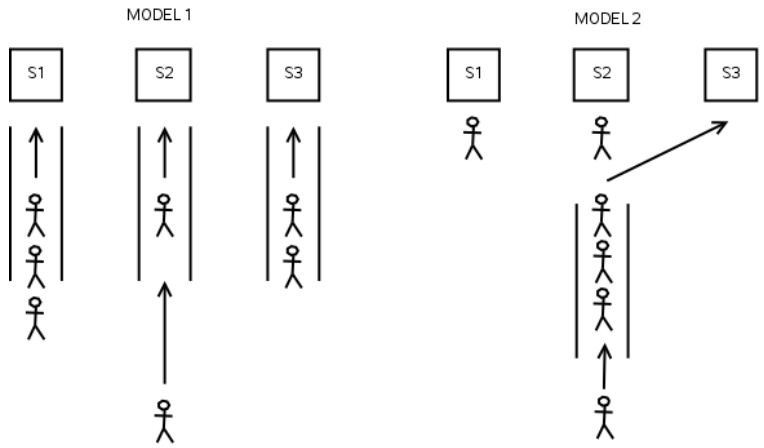


Figure 2.8: Queue and culture

- Strategy 1. In this model there are 3 queues $\{Q_1, Q_2, Q_3\}$ every customer who wants to be served chooses one from services pool $\{S_1, S_2, S_3\}$ and waits into queue in front of the services, $\{Q_1, Q_2, Q_3\}$
- Strategy 2. In this model there is only 1 queue (Q), All customers wait in this queue. Customers cannot choose the service, after waiting in the queue, customers can choose the free service provider

Based on the queue analysis, Model 2 yields a better queue mechanism, because average waiting time is lower than in the model 1. However, some people find that model 2 is better because the movement in queue is faster than in model 1. Customer prefers it. However, in other people do not satisfy with the Model 2 [Maister, 1985], because customers always see that queue in Model 2 (Q) always longer than queue in Model 1, $\{Q_1, Q_2, Q_3\}$.

$$Q \geq \min \{Q_1, Q_2, Q_3\} \tag{2.6}$$

Moreover, customers feel they have control in choosing the services. Customers can choose the service with shortest queue. It provides a better acceptance for some customers [Michael H. Rothkopf, 1987]. This different acceptance appears, as Deutsche Bahn (DB) introduced this new queue practice in the train stations in Germany since Expo 2000. Many customers are not satisfied with this new model. They feel that

the queue is unfair. In 2009, Deutsche Bahn introduces a new queue system again by using a waiting ticket system. The passenger can take the tickets and wait until they are called. They found this queue system is more fair and easier for them, but Deutsche Bahn has to invest in a new waiting system.

The waiting line experience in service facility significantly affects the overall perception of the quality of service provided [Mann, 1969]. This waiting time are influenced by two aspects: the objective time which based on reality, and subjective time based on perceptions [Agnes Durrande-Moreau, 1999]. The perceived waiting time is more important for users than the actual waiting time [Larson, 1987]. However, this perception waiting time is very cultural dependence, Thus, designing the system, as well as evaluating the system cannot be performed by neglecting the human factor. Only focusing on technical evaluation, a good system cannot sustain, because users do not want to use it due to the different perception of system quality. The social influence also determines how users accept and use a new system [Dada, 2006]

2.4 Different parameter and system boundary

Different culture determine boundary of the system differently. This my personal experience is used to illustrate this boundary problem.

> *One day, I left my key in the door of my office in Bielefeld University. In the next day, when I arrived at my office, I found a "post-it" note stickied at my door. It is written in the note by the security officer of University, that I left my key a day before. The security guard has taken the key and deposited it in Fundbüero (lost and found office). I picked the post-it notes and went to the Fundbüero.*
>
> *I showed the post-it notes to the people in Fundbüro and I got my office key. It was very simple, without any identity proof.*

Of course in other place, the above illustration will not be accepted. It illustrates that different cultures perceive different parameters, as well as difference boundary and parameters of system. Other example is shown in Fig 2.9 the security consideration of Automated Teller Machine. In Germany as shown in Fig. 2.9a, ATM can be found

(a) ATM in Germany (b) ATM in Indonesia

Figure 2.9: Security has different boundary

outside the building, such as in front of the bank. But in Indonesia most of ATMs is located in a closed room as shown in Fig. 2.9b. This difference is due to the different security consideration in two different places. In Indonesia, installing ATM outside the building is very risky. The ATM can be stolen [ANTARA, 2008],[INDOSIAR, 2008] or the people who withdraws the money can be robbed [Liputan6, 2002]. Therefore, banks decided to install ATMs in a closed room, and also with the security guard to watch the ATM and customers. In Germany, ATMs are now installed in a closed room due to other security and privacy consideration. It is not due to the robbery or ATMs can be stolen, but to avoid the customers being watched by somebody or installation of an extra device in ATM for capturing the customer data, known as skimming [[Zeitung, 2007]].

Other example that contrast the user expectation in defining the security of system is shown in Fig. 2.10. In some countries, such as Germany, user privacy is considered as highly important. The boundary between private and public property is strongly defined. The release of private data to the public is known as insecure situation for them. On-line shopping normally requires users to submit their identity or private data. For many of them this is a privacy problem, and known as a negative factor for the services as a whole. Even, some shops uses this fact as the marketing strategy as shown in Fig. 2.10. In the other hand, such as in Indonesia, the on-line shopping facility of the shop is known contribute as positive factor for the services. The shop advertise their on-line shopping facility as in Fig 2.10b.

(a) eShop as negative factor (b) eShop as positive factor

Figure 2.10: Online shop is negative quality ?

Understanding the boundary and users view of the system play more important role. Software engineering therefore cannot be seen as the pure development of technology. Software engineering is a task that induces a change processes in the environment where it take places. These changes of process comprises organizational changes, technological changes, and change in the work structures of the different users [Brandt, 2007].

Nowadays, people use the Web differently that the purpose which it was originally designed, sharing scientific information among a free scientists. As web application evolved, the demand placed on web-based system and the complexity of designing, developing, maintaining and managing these system have also increased significantly. The challenge is to overcome local constraints, including lack of ICT infrastructure, inadequate and unreliable power supplies, and a paucity of skilled, sometimes literate, local people. Also mind sets need to be challenged and visionary plans created, particularly in developing countries that are limited by their own political or economic constraints.

Majority the User Centered Design (UCD) are still focusing on how human interact with computers rather than how technologies can be assisted to support human skills and socially useful product [Rasmussen, 2007]. The contextual design is an approach to design product from an understanding how users use the artifact. The end users should be seen more holistically as physical, cognitive and social beings

2.5 Lightweight Why Because Analysis (LWBA)

Only considering technical aspects will not guarantee the sustainability of system. Therefore, non technical aspects such as organization and cultural aspects should also been taken into account. Thus it is required a tools to analyze those aspects in developing a sustainable system. In this work, I used extensively a modified version of Why Because Analysis (WBA).

Why Because Analysis (WBA) is developed by Peter B. Ladkin in Bielefeld University and has been used for incident analysis [Ladkin, 2001]. WBA is employed to perform root causal analysis, by finding the necessary causal factor of the incident. The counter-factual test is used to define necessary causal factor (NCF). In this development method, I used a modified version of WBA and called **Lightweight WBA** (LWBA). It is lightweight because the analysis is not so thorough and not formal as WBA. The main idea is to only identify the causal factors that can be changed in order to make a better system. The decision to use WBA is based on following considerations :

- The Why Because Analysis (WBA) had been proof formally as a tool for root causal analysis of incidents. It has also been used extensively for analyzing various incidents such as in transportation [Ladkin, 2000] and also computer security [Lars Molske, 2005]

- In employing WBA, non technical aspects such as human, cultural aspect, organization and regulations are taken into considerations. It yields a very powerful tool to analyze the system in real condition. In this works, I do not avoid the real constraints and real limitations of the system.

- The method is simple but comprehensive and intuitive to be used as communication tool for various type of stakeholders in the system. Most formal methods are just to difficult to be communicated with the 'normal users'. Even some developers who do not have strong computer science back ground cannot understand the results of analysis produced by formal methods. From my personal

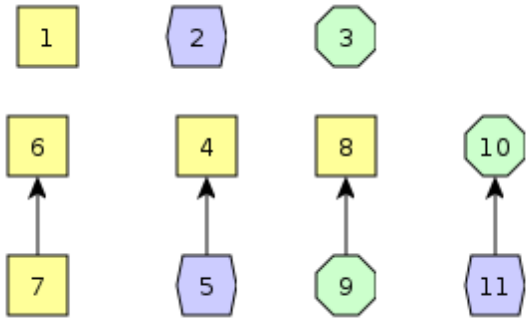


Figure 2.11: Nodes in Light Weight Why-Because Graph (LWBG)

experiences by employing the WBA in to the court [Post, 2004], the narration description in Why-Because Analysis can help to describe a complex system to the various type of people.

- The WBA is not bounded into particular tools. To enforce developers to use particular tools in very short time is a very difficult job. They do not want to learn a new tool, in order to employ a particular analysis methods. Even though there are special tools to perform the WBA such as YBToolset [`http://www.causalis.eu/`] , people can use whatever tools that they feel familiar, such as Visio, Dia, YeD, graphviz.

- The WBA is not bounded into particular programming paradigm. Some analyst methods, are bounded to particular programming paradigm, for example the UML is bounded to Object Oriented Programming (OOP) paradigm.

The analysis in LWBA has characteristics :

- Semi formal analysis. Why Because Analysis (WBA), is formal analysis.

- Basically the LWBA, finds the constrains of system. The constrains identifications is performed in a non judgmental way. Therefore, it is important to identify which node that can be changed by developers, or which node that requires an organization effort to change them.

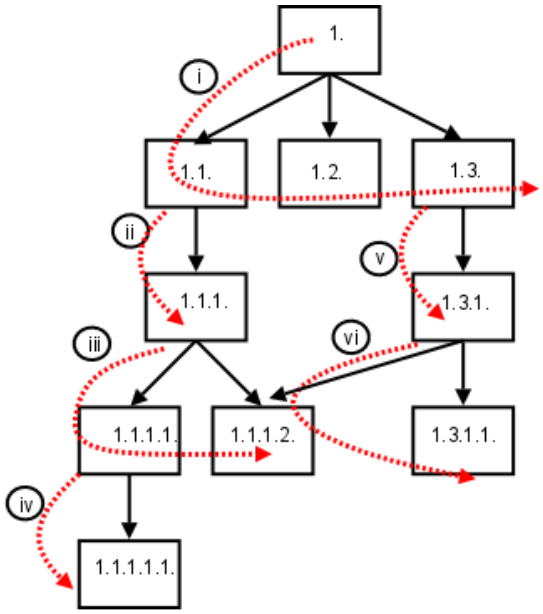
- The analysis will be performed by identifying the causal factor, as shown in Fig. 2.11. Nodes as causal factors will be classified into :

  - 1. is the general node. For example the node 6. has a causal factor node 7. which cannot be changed.
  - 2., is the node that its state can be changed by implementing software/hardware or organization/person. In the description of LWBG this node will be written as 2.◆. For example node 4. has the causal factor 5.◆. By implementing a software or change the node, the 4. can be avoided. Basically the designed system has to cover the nodes in this category.
  - 3. is the node that required to be changed, but it takes a longer time and not under developers control, such as organization change, a new regulation is developed, public awareness is developed. In the description of LWBG, this node will be written as 3.●. For example node 8. has causal factor 9.●. Developers understand that by changing the 9.● the node 8. can be avoided. However, the node 9.● required longer time to be established. Therefore, developer should find how to reduce the impact of this causality. These nodes will be part of organizational change and learning strategy.

To describe a LWBG, a traversal pattern as shown in Fig 2.12 can be used as a guideline :

1. Start with a top node, which is the main "preposition" that should be analyzed. Those statements can be :

   - An incident, for example a security incident, a performance problem or any unsatisfying factors.
   - A statement of evaluation conclusion.
   - A predicted unsatisfactory that want to be avoided.



(a) LWBG : Example

(b) Description of LWBG : Example

Figure 2.12: Example of LWBG

2. Traverse to the lower node and follow the nodes in the same level (nodes which are the NCF of the top node).

3. From the first node at that level, I traverse to the lower node and perform the same as step 2.

4. Find the node in this level which is the terminal node (do not have causal factor).

5. Describe the node when this node is terminal node (does not have causal factor)

This description is simple to be implemented using Wiki System. Each terminal node is implemented as a separate page in the Wiki system. Basically, the description of each nodes in LWBG are grouped into two categories :

- Description of node as the terminal node
- Description of node as causal factor of the node above of this node.

An example the LWBG is depicted in Fig. 2.12 and The LWBG description is guided via following patterns :

Description of LWBG : Example of LWBG

1 [*Label of node 1*]. The description of node 1.

- 1.1. [*Label of node 1.1*]. This description explains why the node 1.1. is the causal factor of node 1.
- 1.2. [*Label of node 1.2*]. This description explains why the node 1.2. is the causal factor of node 1.
- 1.3. [*Label of node 1.3*]. This description explains why the node 1.3. is the causal factor of node 1.

1.2. [*Label of node 1.2*]. Since the node 1.2 is terminal node, it has no NCF. The description is more detail information about the node 1.2. itself.

1.1. [*Label of node 1.1*]. More detail information about the role of node 1.1. in the system.

- 1.1.1. [*Label of node 1.1.1*]. This description explains why the node 1.1.1. is the causal factor of node 1.1.

1.1.1. [*Label of node 1.1.1*]. More detail information about the role of node 1.1.1. in the system.

- 1.1.1.1. [*Label of node 1.1.1.1*]. This description explains why the node 1.1.1.1. is the causal factor of node 1.1.1.

1.1.1.1. [*Label of node 1.1.1.1*]. Terminal node. it has no NCF. The description is more detail information about the node 1.1.1.1. itself.

1.3. [*Label of node 1.3*]. More detail information about the role of node 1.3. in the system.

- 1.3.1. [*Label of node 1.3.1*]. This description explains why the node 1.3.1. is the causal factor of node 1.3.

- 1.3.1.1 [*Label of node 1.3.1.1*]. This description explains why the node 1.3.1.1. is the causal factor of node 1.3.

1.3.1.1. [*Label of node 1.3.1.1*]. Terminal node, it has no NCF. The description is more detail information about the node 1.3.1.1. itself.

2.6 An example of unsustainable design

To provide a real example how to employ LWBA, I use the real example which is part of my research journey. In 2004, I attempted to establish a simple QoS measurement platform in Indonesia. This simple measurement platform measured the round trip time value from different ISPs which are connected to IIX in Indonesia. I collaborated with the APJII (Association of Indonesian Internet Service Providers), and installed the measurement servers in the IIX. In deploying the measurement system I considered following factors :

- Simplicity in considering the existing constrains and limitation. The measurement should be technically possible, i,e. do not require many equipment. The measurement should be simple because in this phase, I only want to demonstrate how important the measurement is, and what can people get from the continuous monitoring system

- Organizational coordination and communication problem among ISPs, regulator body, and other organizations. Installing the measurement devices in the IIX can crate a new problem. Some ISPs thinks that the measurement results can be used to judge the quality and it make the customer run away from their offered services.

- Accepted by various parties, It means that the measurement methods or tools used should be widely known and accepted. In this measurement I used “ping”

as the basic measurement tools. It is due to the fact that the ping has been widely accepted among users and network providers. The description about the acceptance of Ping is available in Chap. 3.

- There is a regulation that covers the need of measurement or at least unofficial permission from regulatory body.

I was interested in deploying the measurement as part of my research due to several encouraging factors:

- Regulator body started to be aware about the QoS measurement. Even though, there was no strict regulation which controls the QoS of networks providers.
- Indonesia ISP Associations (APJII) has been aware and supported the prototype of measurement

A prototype of measurement had been deployed in `http://tekukur.jis-wan.or.id`. This prototype was implemented using smokeping [`http://oss.oetiker.ch/smokeping/`] .This URL can only be accessed only via a proxy server with authentication. Basically by deploying this measurement prototype, I tried to understand some initial problems such as :

- To understand the hardware and network requirement.
- To understand non technical problem, such as the regulation, organization etc.

However, the measurement cannot sustain for a longer time. I stopped the experiment after there is a big security attack and some organizational problem. To understand the problem, I draw a LWBG as in Fig. 2.14.

Description of LWBG : Failure of measurement (See Fig. 2.14)

1. [*The measurement effort cannot sustain*]. After installing the system, I found that there was no sufficient organizational and technical supports and as well as there were a lot of attack in the system. This situation leads to the decision to discontinue the measurement.

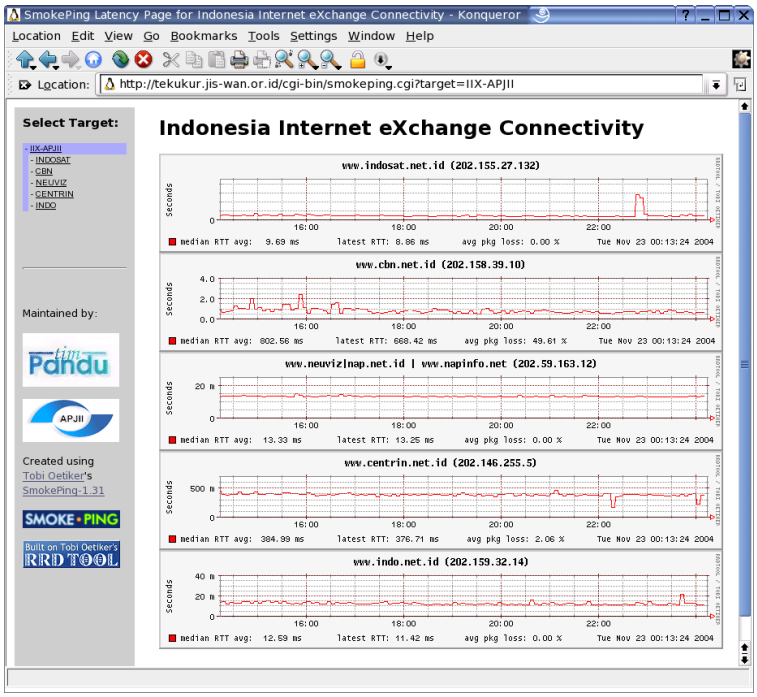


Figure 2.13: Prototype of measurement

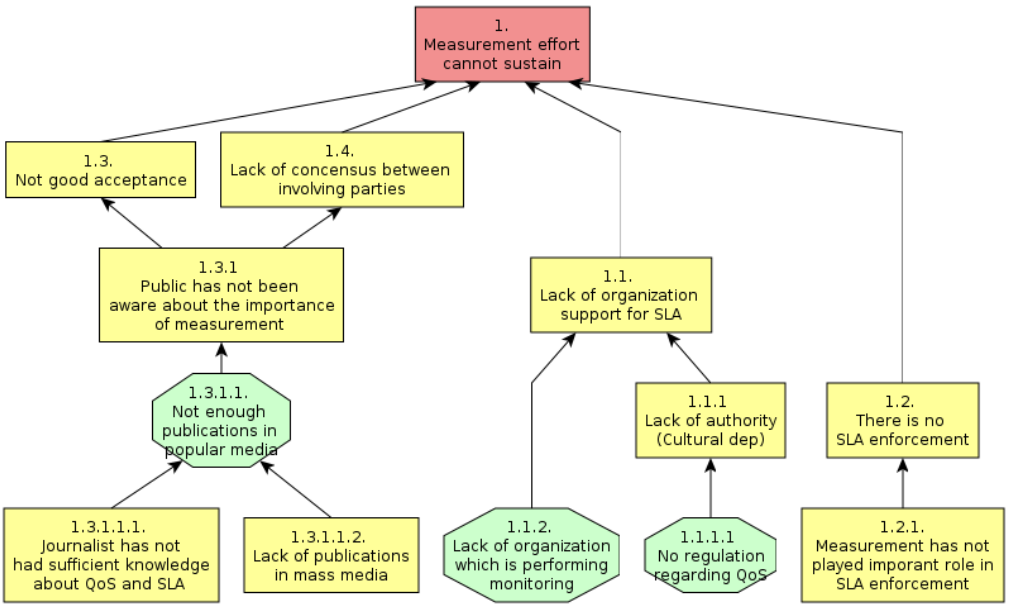


Figure 2.14: LWBG : Failure of measurement project

- 1.1. [*Lack of organization support for Service Level of Agreement (SLA)*]. Without a dedicated organization or institution which understands and tries to enforce the SLA, the measurement is very difficult to be performed. It require dedicated persons, dedicated equipment as well as networking resources.
- 1.2. [*There is no SLA enforcement*]. Without the SLA enforcement through regulation, there is no need to perform the measurement continuously and regularly
- 1.3. [*Not good acceptance*]. The measurement has not been understood as important part for keeping an acceptable services
- 1.4. [*Lack of consensus involving parties*]. Without the consensus, the measurement will be not accepted among those parties. Each parties do not find that the measurement should be supported since they do not agree and do not use the result.

1.1. [*Lack of organization support for Service Level of Agreement (SLA)*]. Until now there is no a dedicated organization which performed the measurement regularly. ISPs or network providers only perform the measurement as part of their maintenance effort.

- 1.1.1 [*Lack of authority*]. There is no regulation or consensus between ISPs,
- 1.1.2. ● [*Lack of organization which is performing monitoring*].

1.1.2. ● [*Lack of organization which is performing monitoring*]. In Indonesia there is no organization, company which perform the measurement regularly and continuously.

1.1.1 [*Lack of authority*]

- 1.1.1.1. ● [*No regulation regarding QoS*]. Without the regulation who should be performed the monitoring. In the society, where the PDI high, who is authorize to performed the measurement and to deliver the measurement is important. Otherwise, the different parties will not be accepted the measurement.

1.1.1.1. ● [*No regulation regarding QoS*]. There is only regulation regarding the QoS when an ISP applies the ISP license to the government . However, after ISPs operated, the quality for services being delivered to customers will not be monitored by the regulatory body [of Post and Telecommunication, 2002].

1.2. [*There is no SLA enforcement*]. In Indonesia Service Level Agreement (SLA) is still a new concept. Many ISP contracts in Indonesia have not provided the SLAs with the customers [INTERNUX, 2003], [Melsa, 2003].

- 1.2.1. [*Measurement has not played important role in SLA enforcement*].

1.2.1. [*Measurement has not played important role in SLA enforcement*]. In the ISPs contract, there is no description about the measurement that should be performed.

1.3. [*Not good acceptance*]. The measurement has not been understood as important part of guarantee the services

- 1.3.1. [*Public has not been aware about the importance of measurement*].

1.4. [*Lack of consensus involving parties*]. There was no formal consensus between involving parties in this measurement effort

- 1.3.1. [*Public has not been aware about the importance of measurement*].

1.3.1. [*Public has not been aware about the importance of measurement*]. Indonesia public still did not understand the need of measurement for the Internet Service Provider.

- 1.3.1.1. ● [*Not enough publications in popular media*]. Without the publication in popular media such as magazines and newspaper. Public will not understand the need of the measurement. The scientific journal will only be read by the scientist and in Indonesia the impact to the public is very low.

1.3.1.1.● [*Not enough publications in popular media*]. Most articles about computer technology in Indonesia still cover about the products, introducing new products or services from various vendors. Discussion more technical aspects is very rare. The computer magazine business itself in Indonesia is not very promising from business point of view. Therefore, they are still focusing on topics that attract many readers. More readers will bring more advertising.

- 1.3.1.1.1. [*Journalists have not had sufficient knowledge about QoS and SLA*]. Without many articles covered the important role of measurement in SLA enforcement. The regulator body, public will not be aware

- 1.1.3.1.2 [*Lack of publication in mass media*]. The QoS of network and the SLA has not been covered in media. Most of problem being discussed is only when there is a network problem.

1.3.1.1.1. [*Journalists have not had sufficient knowledge about QoS and SLA*]. Most of journalists in Indonesia who write about computer technology do not have the technology background in their education.

1.1.3.1.2 [*Lack of publication in mass media*]. Until now, the coverage of technology in Indonesia mass media is still low. Moreover, the number of technology related magazines are still low.

Improvement suggested by LWBA: Using the LWBA, I identify that some organizational change should be performed, if the measurement effort want to be established. Otherwise, the measurement effort end with the same result. The LWBG shows following organizational change that should be made:

- 1.1.1.1.● [*No regulation regarding QoS*]. The Indonesia government should develop the regulation that guarantee the QoS. This regulation protects consumers

- 1.1.2.● [*Lack of organization which is performing monitoring*]. A dedicated organizations should be formed and it should be independent.

- 1.3.1.1. ● [*Not enough publications in popular media*]. Effort to publish more articles that cover the importance of QoS and its measurement, is an important aspect to prepare a good sustainable measurement effort.

2.7 Summary

In this Chapter, it has been defined the problems of Sustainability as well as both cases of sustainability. The Case-1 is due to discrepancy of the designer and users environment, and the Case-2, that is caused by the change of environment of system. Users and cultural aspects play important roles in the system usage as well as the sustainability of system. Different groups of users response differently to a same system. Understanding the cultural consequence contributes to better system design.

Beside the parameters of system design, the boundary of system is also determined differently by different users. These differences are also contrasted in this Chapter. To analyze the technical and non technical aspect in system design, the Lightweight Why-Because Analysis (LWBA) is introduced. This tools is used to understanding the system better and to yield a sustainable system. An example about how to use the LWBA is also provided in this Chapter. This example also shows the unsustainable system due to non technical aspects, and these aspects can be identified by employing LWBA.

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Chapter 3

Quality of Service (QoS)

Quality of Service (QoS) terminology has been used and "*abused*". It has been used as a broad terminology as well as a very specific implementation, such as Web Services, QoS routing protocol. This chapter describes the various basic terminologies of Quality of Services. The definitions are addressed broadly to capture the various perspectives of the Quality of Services. In this chapter the model of QoS level is presented to provide understanding of the different between each concepts.

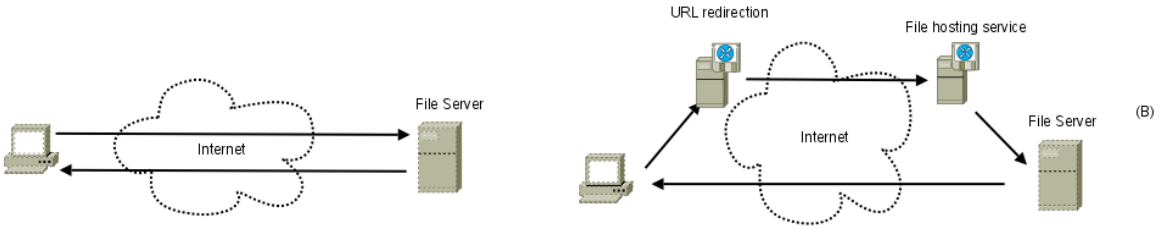
3.1 Service

Nowadays, consumers are becoming more demanded in their requirements. To them services means customer satisfactions, customer delight, service delivery, customer relationship etc [Sachdev, 2004]. Basically a service is defined as [Matinlassi and Kalaoja, 2002]:

> *A service is the capability of an entity (the server) to perform, upon the request of another entity (client), an act that can be perceived and exploited by the client.*

The *Quality Service Modeling Language [F. Dietrich, 2002]* defines in more detail *:*

- *A service* is defined as meaningful set of capabilities provided by an existing or intended set of system to all who utilize it: subscribers, end users, network providers, and service providers – each seeing a different perspective of service.



(a) Direct Client-Server (b) Via third party

Figure 3.1: Client - Servers

- *A telecommunication service is defined as* a service that is provided by the Global Service Network (GSTN) including cellular extension (wireless personal communication system)
- *An Internet service is* defined a service that is provided over Internet infrastructure. The Internet service can be classified as in Tab. 3.1.

A service specification defines functionality that service implementations expected to provide. However, different stakeholder need information at different levels of abstraction.

A *server* is a collection of object that provides a service. A server can be also a client for other server. In a composable services, a client perceives that the service is requested directly to the server as shown in Fig 3.1a. However, in the real implementation the services is performed via the other third party servers such as shown in Fig. 3.1b

3.2 Quality

Quality is viewed differently by various people or organizations. Following are definitions taken from various standards.

German Industry Standard DIN 55350 Part 11 :

> *Quality comprises all characteristics and significant features of a product of an activity which relate to the satisfying of given requirements.*

Table 3.1: Internet service classification [Vincenzo Marziale, 2001]

Category	**Attributes**		**Example**	**Protocols**
Client-server	Time dependence:	No real time	Email,	SMTP, POP,
	Symmetry:	Highly Asymmetric	file-transfer,	FTP
	Connectivity:	Point-to-point	telnet,	TELNET
	Rate:	VBR, ABR	web browsing,	HTTP
	Nature:	Classical Client-server Store and forward	enhance web browsing	S-HTTP
	User:	Machine or human		
Playback (Audio - video)	Time dependence:	Real Time No strict constrains on low transfer delay Limited delay variation (wrt buffer capacity)	Audio streaming	RTP, RTSP, RTCP
	Symmetry:	Highly Asymmetric	Video streaming	RTP, RTSP, RTCP
	Connectivity:	Point-to-point, Point-to-multipoint	Audio broadcasting	MULTICAST
	Rate:	CBR, VBR	Video broadcasting	MULTICAST
	Nature:	Store and forward		
	User:	Human		
Multimedia Conversational	Time dependence:	Real time Low transfer delay constraints Low delay variation constraints	Voice Video conference	RTP, RTCP
	Symmetry:	Symmetric	Data conference	T. 120
	Connectivity:	Point-to-point, Point-to-multipoint	Web games	
	Rate:	VBR, CBR, ABR	Chat (IRC)	
	Nature:	Conversational	Instant messaging	
	User:	Peers of humans	Unified multimedia messaging	
Supporting services	Time dependence:	No real time	Domain name service (DNS)	DNS
	Symmetry:	Symmetric	Network time protocol (NTP)	NTP
	Connectivity:	Point-to-point, point-to-multipoint	Dynamic host control protocol	DHCP
	Rate:	ABR, VBR	Lightweight Directory Access Protocol (LDAP)	LDAP
	Nature:	Signaling Call control, Session control, Network managements	RADIUS	SIP, H323, RADIUS
	User:	ISPs, Service providers, Content providers		

A feature according to DIN 55350 part 12, that property which allows a quantitative or qualitative distinction of a product or activity from its whole.

ANSI standard (ANSI/ASQC A3/1978) :

> *Quality is the totality of features and characteristics of a product or a service that bears on its ability to satisfy the given need.*

IEEE Standard for Software Quality (IEEE Std 729 - 1983). It is based on the ANSI standard and improves it with regards to satisfying customer expectations.

- The totality features and characteristics of a product or a service that bears on its ability to satisfy given need; for example : conform to specifications.
- The degree to which software possesses a desired combination of attributes.
- The degree to which customer or user perceives that software meets his or her composite expectations.
- The composite characteristics of software that determine the degree to which the software is use will meet the expectations of the customers.

Garvin had distinguished five approaches to obtaining a quality concept [A.Garvin, 1984]:

- **The transcendental approach.** Quality is recognizable and is a synonym for a consistently high standard of functionality product. In this sense, quality cannot be precisely defined or measured. They also postulate that quality can be evaluated only on the basis of experience. The concept of quality cannot be defined by implication, just as the concept of "*beauty*" cannot be defined by implication.
- **The production-related approach.** This approach believes that quality is precisely measurable. Quality differences mirror differences in the existing observable quantities of specific characteristics in a product. This approach allows the ranking of different products of the same category.

- **The user-related approach.** This view hold that quality is determined by the product user rather than by the product itself. According to this, product users have differing requirements and wishes, and those products which satisfy these needs best are seen as representing high quality

- **The process-related approach.** This approach relates quality to reliable execution of specifications, and holds the ideal view that an activity in the manufacture if a product should be carried out right first time. This approach is hold with today's economic and industry in mind. In the center is the production process, which is checked in order to reduce faults and revision cost.

- **The price/user related approach.** This approach involves a relationship between price and quality. In this context, a quality product is a product which is designed for a specific use at an acceptable price, or which conforms to specification at an acceptable cost.

3.3 Quality of Services

The service itself can be used as the tool to manage the competition through the quality of services. Service quality (in this work I use service quality and quality of service is interchangeable) has been known widely in various disciplines, from the marketing to computer science. Each discipline has their own definitions. Various authors tries to give the different conceptualizations about the service quality :

- Gronroo's [Gronroos, 1984]. Service quality has three components: structure-technical, functional and reputational quality

- Hedvalk, Paltschick [M. B. Hedvall, 1989], categorized into two dimensions: willingness and ability to serve, physical and psychological access

- Leblanc and Nguyen (1988)[G. Leblanc, 1988] five components of service : corporate image, internal organization, physically support of service producing system, staff/customer interactions, level of customer satisfactions

- Garvins (1988) [Garvin, 1988] defines nine dimensions of service quality : performance, features, conformance, reliability, durability, service, response, aesthetics, and reputation
- Oliver and Rust (1994) [Oliver, 1980] defines : functional quality, technical quality, and environment quality.
- PZB [A. Parasuraman, 1988] defines five dimension : tangibles (T), reliability (R), responsiveness (R), assurance (A), and empathy (E).

Quality of services is defined as a set of user perceivable attributes that make a service what it is [Martins and Hubaux, 1996].

ISO 95 QoS Framework, ISO/IEC/JTCI/SC21/WB1 N9680 :

> *Quality of Service (QoS) is a set of qualities related to the collective behavior of one or more objects*

Several generic definitions of QoS :

- QoS is user perceived performance or service experienced by the user [Franken, 1996].
- Quality is the totality feature and characteristics of a product or services that bear on its ability to satisfy stated or implied needs [ISO, 2000].
- QoS is a set of user-perceivable attributes, which describes a service the way it is perceived. It is expressed in a user-understandable language an manifest itself as a number of parameters, all of which have either subjective or objective values. Objective values are defined and measured in terms of parameters appropriate to the particular service concerned, and which are customer-verifiable. Subjective values are defined and estimated by the provider in terms of the opinion of the customers of the service, collected by means of user surveys [Mejbro, 1991].
- QoS is the degree of conformance of the service delivered to a user by a provider with an agreement between them [EURESCOM, 1999].

A quality of service is satisfied when all its performance metrics are satisfied.

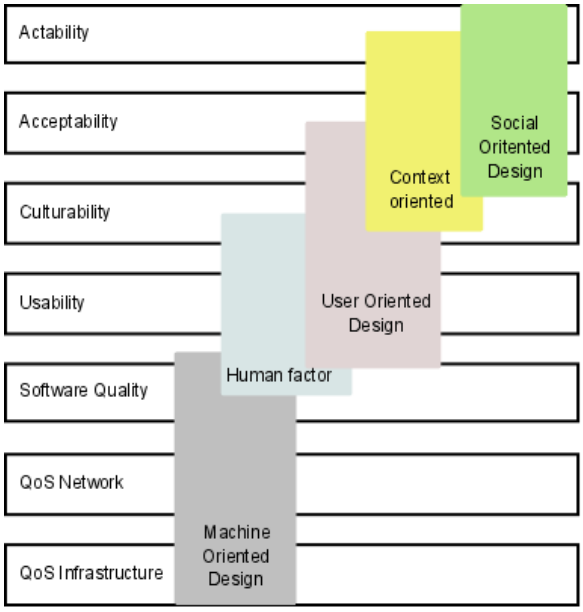


Figure 3.2: Level of QoS and the relation with design process

3.4 Level of QoS

QoS concepts is determined by the level of domain of service itself. Each groups of people or persons have their own perceptions about the QoS. I group the different approaches of QoS with respect to the design approaches as shown in Fig. 3.2.

In this QoS level model, each level has their own quality attributes. The parameter of Quality in level k can be written as :

$$\boldsymbol{P} = P_i^k \tag{3.1}$$

Quality is defined as the composition of this attributes :

$$Q = P_0 \oplus P_i ... \oplus P_{n-1} \oplus P_n \tag{3.2}$$

If the quality is additive model:

$$Q = \sum_{i=0}^{k} P_i \tag{3.3}$$

Quality gap model :

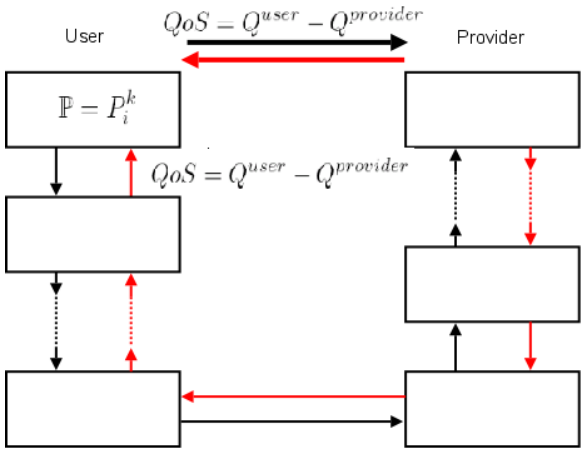


Figure 3.3: Problem different level of QoS

$$Q_{provider} = \mathcal{P}\left(P_i^k\right) \tag{3.4}$$

$$Q_{user} = \mathcal{U}\left(P_i^n\right) \tag{3.5}$$

$$QoS = Q_{user} - Q_{provider} \tag{3.6}$$

In this models, the Quality of Service (QoS) always depends on how users perceives the services and also the quality parameter of the services. However, there is always a problem due to different level of QoS domain. As shown in Fig. 3.3, user does not know that the provided service is not directly provided by the server in the same level as requested by user, but the service first provided by the server at the under the level of users and traverse until reach the real server.

Most measurements are performed by the Service Provider. The customer and service providers always argue each other about :

- Which parameter that reflects the service. Is the number of hit is really represents the Quality of Services ?
- The measurements are not valid, because the service providers can change the result easily. Is the log file used for calculating the analysis has not been mod-

ified by the service provider ?

3.4.1 QoS in infrastructure

Internet is a very complicated Wide Area Network. It is the most heterogeneous networking system. In this level, the QoS is an approach that enable networks to negotiate for specific requirement. It can be a connection admission control and/or routing optimization strategy. According to the QoS Forum, QoS in this level is defined as :[Kuipers, 2004]

> *Quality of Service is the ability of a network element to have some level of assurance that its traffic and service requirements can be satisfied.*

The Quality of Services attributes in this level are such as:

- Cell loss ratio (CLR); fraction of cells lost during transmission.
- Cell delay variation (CDV); maximum difference between end-to-end delays.
- Maximum cell transfer delay (max CTD); average end-to-end cell delay
- Mean cell transfer delay (mean CTD); average end-to-end delay.
- Minimum cell rate (MCR): minimum rate at which the networks cells.

In this level, the design process chooses the platform based on the QoS parameter. The Asynchronous Transfer Mode (ATM) lets an organization or user preselect a level of quality in terms of service, QoS can be measured and guaranteed in terms of the average delay at a gateway, the variation in delay in a group of cells (cells are 53-byte transmission units), cell loses, and the transmission error rate. ATM networks have considered the QoS from the beginning. However, the QoS very much depends on the selection of protocol stack for particular applications. TCP/IP is not designed for the QoS, TCP/IP is based on Best Effort Service.

QoS parameters that are usually covered by the Service Level Agreement [Megapath, 2006] in this level are:

- **Availability** (with and without fail-over). It is measured in minutes up-time over the calender month during which the service is provided. Many network providers using ping to measure the availability.

$$Availability_{month} = \frac{t_{month} - t_{unavailable}}{t_{total}} \tag{3.7}$$

- **Mean time to restore**. It is measured as the average time it takes to restore all outages for all customer during a calender month

$$MTTR_{month} = \frac{\sum ticket_{resolved} - \sum ticket_{opened}}{\sum ticket} \tag{3.8}$$

- **Round-trip Latency.** It is the round-trip response time from the service providers to the customer sites.

$$Latency = \frac{\sum_i^n (t_{response} - t_{sent})}{n} \tag{3.9}$$

- **Packet delivery.** It is measured as the percent of packet delivered from the service provider router to each customer sites during a calender month.

$$Packet\,delivery = \frac{\sum packet_{send} - \sum packet_{loss}}{\sum packet} \tag{3.10}$$

- **Automated outage notification**. It is the time which is required to notify the customer via an automated email or notification during a calender month.

$$Outage\,notification = \frac{\sum (time_{notification} - time_{ticket\,opened})}{\sum ticket_{trouble}}$$

- **Chronic outage**. It is considered as a series of 3 or more services outages, each outages has Time To Restore (TTR) more than a specified length.

- **Circuit speed** (% usable rate). It is usable data transfer rate across the customer.

- **Access circuit install interva**l. It is the period of time between when a

complete and accurate order for service is submitted by customer, and when the system is successfully activated and available.

3.4.2 QoS in network level

Internet offers the potential to break traditional barriers in communication and commerce, but the current service quality to users is often unacceptable. The original design goal of the Internet was to serve as a highly fault-tolerant data network for the defense community [Paul P White, 1997]. Today, Internet has four characteristics which is relevant to the QoS problem in network level [Ron Cocchi, 1993]:

- The overall bandwidth is quite limited. This limited bandwidth prevents the widespread usage of certain bandwidth-intensive applications from utilizing Internet.
- Internet has changed from restricted access to the unrestricted access. It is different from the study by Cocchi [Ron Cocchi, 1993] that states the Internet has restricted access. Now Internet has changed and every body can have an Internet access. Therefore, the behavioral form of Internet become so unpredictable.
- The Internet offers a single class of services, all packets are serviced on a best-effort, first-in-fist-out (FIFO) or also known as First-Come-First-Served (FCFS). However, in the Best Effort approach has problem as shown in Fig. 3.4. The packet is delivered without considering the characteristics of applications.
- There is no usage fees, users are not charged on the basis the number packet. Therefore, the price is not based on the volume of the traffic sent.

In the network levels the QoS is measured in following parameters:

- Availability (%)
- Throughput (bps) or bandwidth

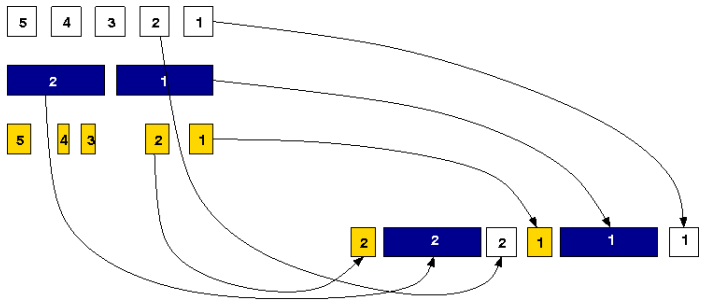


Figure 3.4: Problem of Best Effort Discipline

Table 3.2: QoS parameter sensitivity of various Internet applications

	Bandwidth	**Loss**	**Delay**	**Jitter**
Voice	Very Low	Medium	High	High
E-Commerce	Low	High	High	Low
Transaction	Low	High	High	Low
Email	Low	High	Low	Low
Telnet/ssh	Low	High	Medium	Low
Normal browsing	Low	Medium	Medium	Low
Serious browsing	Medium	High	High	Low

- Packet loss (% month)
- Latency (ms) or Delay (ms)
- Jitter

Each Internet application has different sensitivity to those parameters, as shown in Tab. 3.2. Many applications have different service requirements. For example, an email can tolerate the delay without user experiencing it. However. some other applications such as video, voice cannot tolerate a small delay. The range of applications, and the diversity of services requirements are likely to grow rapidly.

Internet Service providers has to establish a basis for a multi-service-level Internet in which different service levels are offered and a specific level of Quality of Service (QoS) can be guaranteed. Initially Internet does not offer any service differentiation mechanisms, until now the best-effort mechanism still dominates the Internet. And the IPv4 which is currently used only has Type-of-Service (TOS) field. But this field is optional, and not many services use it. Today two distinct Internet Protocol

architectures are used to change this situation :

- **Integrated Services Internet** (IntServ). It supports unidirectional end-to-end flows. The goal of IntServ is to develop a service model and standard protocol for Internet that supports the transport such real-time application flows as audio and video, as well as more traditional non -real time application flows, such as file transfer and transaction processing. All within a single network infrastructure. IntServ uses the RVSP protocol to reserve local resource for the communication. The reservation is maintained for a flow which is a one-way stream of data flowing to a known destination address and port. There are two classes of service in IntServ, These flow may request a certain QoS an may use :
  - **Controlled Load Service** [Wroclawski, 1997]: fixed delay bound
  - **Guaranteed service** [S. Shenker, 1997]: reliable and enhanced best effort service
- **Differentiated Services Internet** (DiffServ). It handles Internet traffic based on the notion of aggregated flows and fixed number of service levels of service. In the DiffServ there are different services such as :
  - **Premium Service**: low delay and low jitter,
  - **Assured Service**: better reliability, and
  - **Olympic service**: Golden, Silver and Bronze

In providing the services in network level, the customers now considering more QoS parameters, as shown in Tab. 3.4. The reliability and security parameter now are also considered, because many organization now rely on Internet services.

3.4.3 Software quality

Software quality as the quality of system has been explored in various literature. The standard consider this approach has also been well established. According to ISO:

Table 3.3: Comparison of IntServ and DiffServ [Helmut Kneer,]

	Best-effort	**IntServ**	**DiffServ**
QoS Guarantee	no	per data stream	aggregated
Configuration	none	per session (dynamic)	long-term (static)
Zone	entire network	end-to-end	domain-oriented
State Information	none	per data stream (in router)	none, in BB in edge router)
Protocols	none	signaling (RSVP)	bit field (DS Byte)
Status	operational	matured	worked on

Table 3.4: QoS parameters in network level

Category	**Dimensions**
Performance	response time
	delay
	latency
	throughput
	transactions per second
	jitter
Reliability	time to failure
	time to repair
	number of failure
Security	Anonymity
	Encryption
	Authentication

Software quality is the degree to which software possess a desired combination of attributes. This combination of attributes shall be clearly defined.

Factors that determine the software quality [ISO 9126]:

- **Efficiency**. An attribute that bears on the relationship of the level performance to the amount of resources used under stated conditions.
  - Time economy. Capability of software to perform specified functions under stated or implied conditions within appropriate time frames.
  - Resource economy. Capability of software to perform specified functions under state or implied conditions, using appropriate amounts of resources.
- **Functionality.** An attribute that bears on the existence of certain properties and functions that satisfy stated or implied needs of users.
  - Completeness. The degree to which software possesses necessary and sufficient functions to satisfy user needs.
  - Correctness. The degree to which all functions are specified.
  - Security. The degree to which software can detect and prevent information leak, information loss, illegal use, and system resource destruction
  - Compatibility. The degree to which new software can be installed without changing environments and conditions that were prepared for the replaced software.
  - Interoperability. The degree to which software can be connected easily with other system and operated.
- **Maintainability**. An attribute that bears on effort needed for specific modifications
  - Correctability. The degree of effort required to correct errors in software and cope with user complains.

  - Expandability. The degree of effort required to improve or modify the efficiency or functions of software. Testability. The effort required to test software.

- **Portability**. An attribute that bears on the ability of software to be transferred from one environment to another

  - Hardware independence. The degree to which software does not depend on specific hardware requirement
  - Software independence. The degree to which software does not depend on specific software requirement.
  - Installability. The effort required to adjust software to a new environment.
  - Reusability. The degree to which software can be reused in applications other than the original application.

- **Reliability**. An attribute that bears on the capability of software to maintain its level of performance under stated conditions for a stated period of time

  - Nondeficiency. The degree to which software does not contain undetected errors.
  - Error tolerance. The degree to which software will continue to work without a system failure that would cause damage to the users. Also, the degree to which software includes degrade operation and recovery functions.
  - Availability. The degree to which software remains operable on the presence of system failure.

- **Usability.** An attribute that bears on the effort needed for use (including preparation for used and evaluation of results) and on the individual assessment of such use by users.

  - Understandability. The amount of user effort required to understand software.

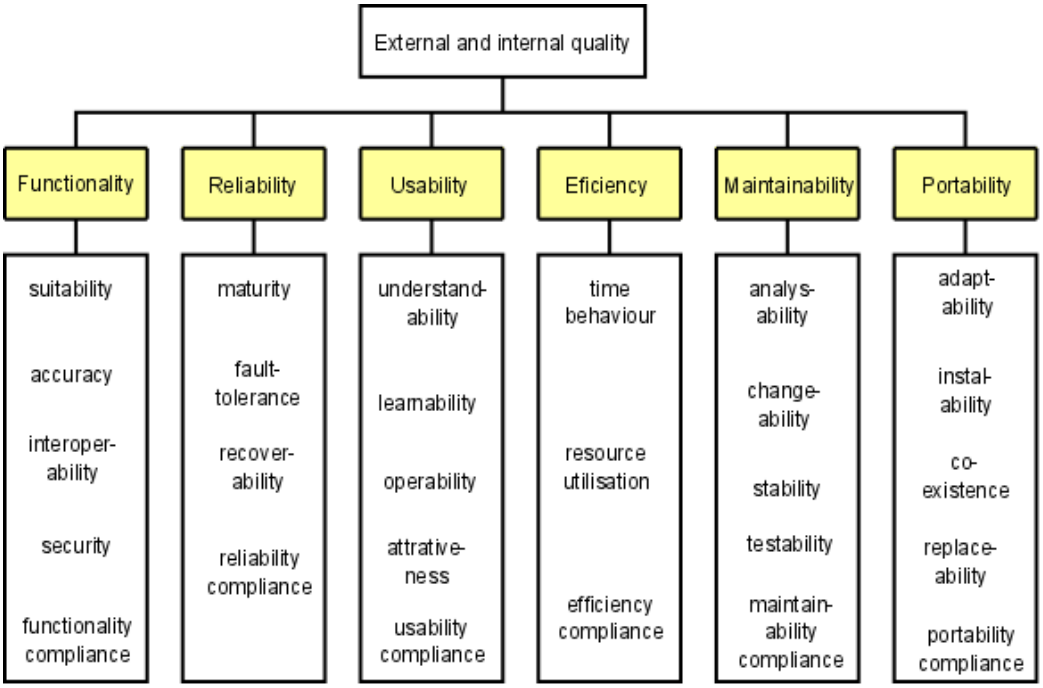


Figure 3.5: Software Quality - ISO 9126

- Ease of learning. The degree to which user effort required to understand software is minimized.
- Operability. The degree to which the operation of software matches the purpose, environment, and psychological characteristics of users, including ergonomics factors, such as color, shape, sound, etc.
- Communicativeness. The degree to which software is designed in accordance with the psychological characteristics of users.

3.4.4 Usability

Most of researches on QoS is system oriented focusing on traffic analysis, scheduling, and routing and only minor attention is given to user level QoS issue. It is no yet know how objective system quality relates to user's subjective perception of quality [A. Bouch, 2001]. Considering the user perception brings the usability concept as a form of Quality of Service, because usability is emergent quality of an optimum design which is reflected it the effective and satisfying use of the IT.

Basically, usability is the capability of human functional terms to be used easily and effectively by the specified range of users, given specific training, and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios. The usability of computers is measured by how easily and effectively computer can be used by a specific user, given particular kinds of support to carry out. Usability is a popular approach in Human Computer Interaction design. Some standards that relate to usability can be categorized in following :

- Product effect - Quality in use. (output, effectiveness, and satisfaction at the time of use of the product). Usability in context . ISO 9241-11, ISO 14598-1, ISO/IEC 9126-1,4
- Product attributes - Product quality (interface and interaction). ISO 9241 parts 10, 12-17, ISO.IEC 9126-3
- Process used to develop the product - process quality. User center process, ISO 13407
- Organization's capability, Capability of use, ISO 18529

According to ISO the definition of usability used in the standard are :

ISO/IEC 9126-1, 2000. Software Quality Evaluation Characteristics and Guideline for their Use, 1991.

> *The capability of the software product to understood, learned, used and attractive to user, when used under specified conditions.*

ISO 9241011, 1998. Guidance on Usability, Ergonomic, Requirements for Office Work with Visual Display Terminals (VDT), 1996.

> *The extent which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.*

IEEE Std. 610.12-1990. Software Quality Methodology, 1998.

> *The ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or components.*

According to this standard, measurement of system usability consists of three main attributes :

- Effectiveness. How well do uses achieve their goals using the system
- Efficiency. What resources are consumed in order to achieve their goals
- Satisfaction. How do the users feel about their use of the system.

There are still weakness in ISO 9126, which has not been fully addressed such as [Abran et al., 2003]:

- Unclear architecture at the detail level of the measures
- Some overlapping of concepts. It yields the difficulty for user community to grasp clearly.
- Lack of quality requirement standard
- Lack of guidance in assessing the results of measurement
- Ambiguous choices of measures

Combining various approach between the usability and software quality is known as **enhanced usability mode**l. The parameter of this approach is depicted in Fig. 3.6

From different type of audience, usability is defined as :

- For the end-user, usability is essential because it is a determined of performance: an applications, which feature good usability, will allow users to preform expected tasks faster and more efficiently.
- For managers, it is a decision point in selecting product, as this decision will determine the learnability of the chosen system, and the productivity of those who use it.

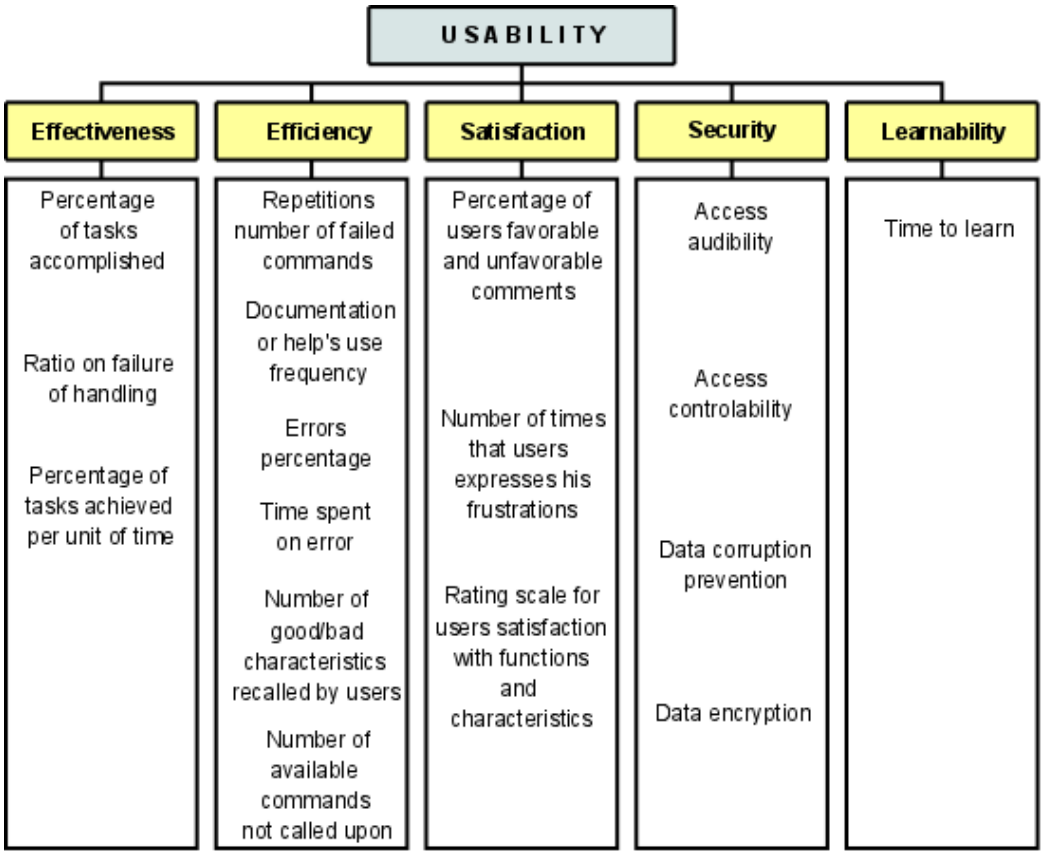


Figure 3.6: Enhanced usability[Abran et al., 2003]

- For software developers, usability describes the internal attributes of system including issues like design quality, documentation maintainability.

For Web applications, usability play important role as the Quality of Service. The web page quality attributes should be identify before the measurement or evaluation can be done, a method such as Card Sorts can be employed to investigate the web page quality attributes [Linda Upchurch, 2001]. The tree most important quality criteria of Web applications and underlying software are [Jeff Offutt, 2002]:

- **Reliability**. Web software has to work reliably, otherwise the business will not succeed. The user base of Web application is large and they expect the system work without the glitch. Moreover, since the competitor is only one-click-distance, users will change to the services offered by the competitor easily, if the system is not reliable.

- **Usability**. Users do not want to invest their time to learn how to use a web application. Furthermore, users of web applications do not have training time. The usable web site will create loyal user.

- **Security**. The defacement and denial of services are examples of many potential security flaws in web software applications. The breach of company web sites can yield significant losses, as well as loss of credibility with customers.

And additional important criteria included :

- **Availability**. It means that the web application should be always available for the users. It is more than just being up and running 24/7/365, but the web application should be accessible from different type of client, different web browsers, different devices such as mobile browser. By implementing specific features of specific browser only will limit the availability of web applications.

- **Scalability**. Virtually, the web application has unlimited number of users. The web applications should be designed to be able to handle the load that grow quickly, not only the number of users but also the number of services. Scalability is also directly influences other attributes.

- **Maintainability**. The big difference between the web application and the traditional software application is the more frequents new release, or update rate. The web application provide users immediate access to maintenance updates, small and big changes, and critical updates can be installed immediately. The web sites must have maintenance cycle of days or even hours. In performing the maintenance web applications cannot down for a long time.

- **Time to market**. There is always a pressure to make time to market is as short as possible. Otherwise, users will go to competitors. This attribute has big impact to other attributes as well. Some software engineering principles cannot be employed, simply because they are perceived as being too time-consuming and lacking a significant pay-off [Edward Hieatt, 2002].

The positive response of user can be achieve at least one of two way the attractiveness of the visual appearance or product's feature and the new improved functionality offered by the features of product [Richard L. Hazlett, 2006]. There is also the quality attributes such as hedonic and ergonomic [Marc Hassenzahl, 2000]

- **Ergonomic quality** (EQ) comprises quality dimensions that are related to traditional usability, i.e. efficiency and effectiveness. This quality focuses on task-related functions or design issues

- **Hedonic quality** (HQ) comprises quality dimensions with no obvious relation to the task user want to accomplish with the system, such as originality, innovativeness, aesthetic etc. They are not task-related, but user thinks this parameters as important quality aspect. The hedonic quality is perceived by users and plays a substantial roles in forming the judgment of appeal. It should be explicitly taken into account when designing the system. Aesthetic now plays important role in user acceptance. Among today consumers, there is a rise of aesthetic consciousness [Gajendar, 2008].

The QoS metric, such as response time, delay is no longer sufficient to describe the

Quality of Service (QoS) as perceived by users, customers and providers. Some heuristics metrics have been used to approach the user view of system, such as[Ed H. Chi, 2000]:

- the number of unique users,
- number of page visits,
- reading times,
- session length, and
- user paths.

Most Web log file analysis consists of simple descriptive statistics providing little insight into the users and use of a Web Site. Some research has tried to develop the content related measurement method such as the make use of Information Forging Theory [Ed H. Chi, 2000]. This metrics is appropriate for the site that has approach as an "information retrieval site" rather than an interactive application. When the WWW site is used for an eCommerce site, the value of it services is largely determined by the number of loyal customers and the number of transactions. Some metrics has been widely used to judge a Web Site from advertising measurement such as (Haar, 1999):

- Hit. It counts each request for data from a server, therefore a click from user can generate more than one hit.
- The page view. It tracks the number of individual HTML pages that were served up to Web surfers. But it still provides not many information about how many surfers responded to given ad.
- The click-through. It tracks the percentage customers responding to an online ad, but gave no information about the customers themselves
- Unique visitors. A site that does not know each users by a name track users by using the individual IP number and then adding them up.

- Site reachability. It based on user-group sample, rating companies. If 50 % of samples users visit a page on a specific site in a given month, the site said to have a 50% reach.

- Some new measurement such as, user locality, site behavior, registered users, length of stay, repeated visits.

A success of web site can be defined in various ways, depending of its goal. It can be return on investment, profitability, reliability, utility or competitive advantage [A. Phippen, 2004]. Companies and organizations are now adopting more customer-centric approach.

3.4.5 Culturability

Web-based product and services enable users to access complex data and function. Users of the web-products are from all around the world. Culturability, the merging of culture and usability, has implications for system design on the user perception of credibility and trustworthiness of websites. In this approach usability must be redefined in terms of a cultural context, as what is user friendly for one culture can be vastly different for another culture. The culturability also determine the user experience attributes in mobile data services [Boreum Choi, 2006].

As described in Chap. 2., culture influences how users behaviors in using the computer artifacts. This approach now is popular due to the use of web applications all around the word. Cultural bias is an issue for highly graphical or multimedia based product, web pages, This issue relating to [Richard Ishida,]:

- Difference in dialect

- Appropriateness of product/company names

- Culture-specific references

- values and taboos.

- Color and aesthetics

- Symbolism.
- Body language

The culturability index can be used to consider following aspects in developing applications :

- Emphasis on the social/moral order and its symbol
- Focus on expertise, authority, experts, certification, official stamp or logos
- Motivation based on personal achievement.
- Rhetorical style
- Navigation oriented to exploration and control .
- Graphics, sound, animation

Many of the icons, metaphors, shapes, colors of text and background, frame/text locations on screen, etc. employed in systems design are relevant to the culture of origin of the software, but do not have any meaning or opposite meaning for other cultures. Therefore, the design that consider to achieve good QoS in this level, the design of system user interface component should considered following aspects[Aaron Marcus, 1999]:

- Layout and orientation.
- Icons and symbols.
- Typography. Each group of users prefer specific font characters.
- Color. Each culture has their own color preferences such as shown in Tab. 3.5.
- Aesthetic. Different culture has different aesthetic value. A good accepted design in a country does not guarantee to be accepted as good design in other country

Table 3.5: Examples of differing cultural preferences [Aaron Marcus, 1999]

Item	**North American/European**	**Middle Eastern**	**Asia (China-Japan-Kora)**
Sacred colors	white, blue, gold, scarlet (Judeo-Christian)	green, light, blue (Islam)	saffron, yellow (Buddhism)
Reading directions	left to right	right to left	top to bottom

Item	**USA**	**France/Germany**	**Japan**
Web search	culture does not imply political discussion	culture implies political discussion	culture implies tea ceremony discussion
Sport references	baseball, football, basketball	soccer	sumo wrestling, baseball

- Language and verbal style.

Differences across cultures must be considered when determining proper user interface for online payment, security and assurance of sale and shipment. Furthermore, a good quality that is accepted in the related culture can make the users more loyal to the services.

In culturability approach, cultural makers have to be considered. Cultural makers are design elements that are culture and genre specific. National symbol, color, are cultural maker. There are significant cultural difference between user acceptance of interface for different cultural groups [Irina Kondratova, 2005]. However, the culture itself influences how the measurement of quality can be performed. For example in usability evaluation culture affects the the think-aloud protocol, questionnaire [Ravikiran Vatrapu, 2005].

3.4.6 Acceptability

As mentioned by Bouch et al [A. Bouch, 2001], the QoS from perspective uses and system level networks are different. From the service provider, QoS approaches the focus on optimizing the objective QoS may inform resource allocation mechanism at a system level. In addition to research into the partitioning network resources are claim that levying a charge of premium services is only way to reflect the value of quality to

users and provide economic incentives to service providers. Based on the acceptance model of services Parasuraman et al. initiated the method called SERVQUAL. In this model the service quality is defined as :

The ability of the organization to meet or exceed customer expectation

This definition focus on meeting the customer's need and requirement and how well the service delivered matched the customer expectation. SERVQUAL based on the assumption that a measure of service quality must be founded on a comparison between what customers feels about service and what is ultimately delivered. [James J. Jiang, 2003]

This methods use 22-item scale, which measure service quality based on five dimensions shown in Fig. 3.7. In SERVQUAL model, the service quality Q as the degree of discrepancy between customer normative expectation for services E and their perception of service performance P.

$$Q = P - E \tag{3.11}$$

PZB defined the model of Zone of Tolerance (ZOT) [A. Parasuraman, 1994]: the area between customer's adequate (would) and desired (should) service expectation, ZOT is the range in which customers do not complain service performance. PZB defined service quality in 3 column format :

- Q_{min}, minimum service level (would expectation)
- $Q_{desider}$, desired service level (should expectations)
- Perceived performance

$$ZOT = Q_{min} - Q_{desired} \tag{3.12}$$

The SERVQUAL method has been used extensively in various area, such as evaluation of Internet banking [Lia Patricio,], call center quality [Warren J. S. Staples,] The SERVQUAL method is also applied to evaluate the quality of web, the method

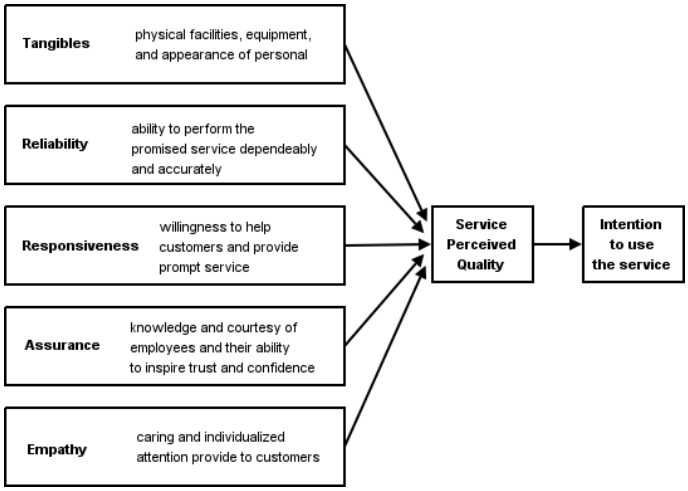


Figure 3.7: SERVQUAL method

known as WEBQUAL [Jos van Iwaarden, 2002], and Extranet known as EX-QUAL [Kenneth Cody, 1999] also for Airline services [Bozorgi, 2006].

SERVQUAL method uses questionnaire as tool to measure the quality of service as perceived by the customer. The SERVQUAL has two type of instruments. The first one is 22 statements for measuring the expectation. These statements are framed to describe the performance of an excellent provider and the service being studied. The second part, has the same items, but phrased to measure perception of the actual service delivered. This 22 items is developed based on the five dimensions of quality. One example is shown in Tab. 3.6, the SERVQUAL questionnaire for Information System (IS) service provider.

However, service quality approach is also influenced with the culture. The Service Quality approach as coined by Parasuraman is more from American Perspective. The more complete representation of service quality approach based on European perspective is stated by Gronroos, which include the other dimensions, such as dimensions, technical, functional and image [Gronroos, 1984]. In this approach, the corporate images also play a role in the experience of service quality.

To solve the acceptability of services, the Service Level Agreement (SLA) is defined and used. SLA's are plain natural language document, and it still must be manually provisioned and monitored. Basically, SLA is a bilateral agreement. In this bilateral

Table 3.6: SERVQUAL measurement for IS service provider [James J. Jiang, 2003]

Dimensions	No.	Attributes
Tangibles	E1:	They will up-to-date hardware and software
	E2:	Their physical facilities will be visually appealing
	E3:	Their employees will be well-dressed and neat in appearance
	E4:	The appearance of the physical facilities of the IS units will be in keeping with the kind of service provided
Reliability	E5:	When these IS units promise to do something by a certain time
	E6:	When users have a problem, these IS units will show a sincere interest in solving it
	E7:	These IS units will be dependable
	E8:	They will provide their services at the time they promise
	E9:	They will insist on error-free records
Responsiveness	E10:	They will tell users exactly when services will be performed
	E11:	Employees will give prompt service to users
	E12:	Employees will always be willing to help users
	E13:	Employees will be consistently courteous with users
Assurance	E14:	The behavior of employees will instill confidence in users
	E15:	Users will feel safe in their transactions with these IS unit's employees
	E16:	Employees will be consistently courteous with users
	E17:	Employees will have knowledge to do their jobs well
Emphaty	E18:	These IS units will give users individual attention
	E19:	These IS units will have operation hours convenient to all their users
	E20:	These IS units will have employees who give users personal attention
	E21:	These IS units will have the user's best interests at heart
	E22:	The employees of these IS units will understand the specific need of their users

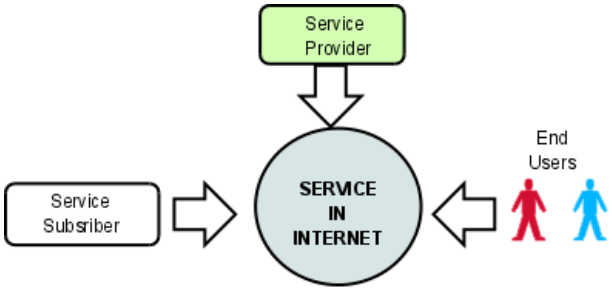


Figure 3.8: Parties in Internet services

contract usually is easy to define for each commitment who is obliged and who is beneficiary of the commitment. A clear definition of responsibilities is required.

Both parties which establish and sign SLA are known as signatory parties. Service providers and service customers are examples of signatory parties. Sometimes SLA also require the involvement of the third parties. The third parties acts in supporting role. for example, if one signatory party does not trust the other to perform a function correctly. The two parties define service level object with respect to parameters such as response time, throughput and downtime

Commonly used SLA include network availability, mean time to repair faults, network performance, system availability, help desk availability, system performance, installation time, customer satisfaction, network throughput, and application response time. The QoS measurement is performed by service providers. There has to be trust in the acceptance of SLA [Torsten Bissel, 2000]

The SLA usually consists of two parts :

- **General provisions**. This part define the substantive clauses setting out the legal basis for the cooperation. This part also serves as guidelines to the interpretation of the specific provision of agreement;

- **Specific provision**. This part is the actual technical service parameter which can be offered.

The SLA has following structure:

- **Parties**. Parties involved in the management of the Service. The signatory

parties as well as the supporting parties. The relationship of parties is not within the scope of this agreement.

- **Service Definition**. Describe the service properties, the obligation are defined. A common view of service is established within the SLA, the definition of quality parameters, how they are measured and computed. And how each lower level metrics are aggregated into higher level metric
- **Obligation**. Definition of service level that is assured with respect to the SLA parameters defined in previous sections. As well as the action under particular conditions are represented.

However some extra considerations should also be written in SLA document contents [Heiko Ludwig, 2003] :

- SLA parameters,
- The base metrics used as input to computer SLA parameters
- The algorithm for computing the SLA parameters
- The service guarantee
- The appropriate actions to be taken if a violation of these guarantee has been detected.

The detail of SLA documents normally consists of following items :

- **Term** - defines the period of time that the SLA will cover.
- **Scope** - defines the services covered in the agreement.
- **Limitations** - defines what must happen in order for the requested service levels to be provided.
- **Service-level objectives** - are the levels of service that both the users and the service providers agree on, and usually includes availability, performance and accuracy.

- **Service-level indicators** - the means by which these levels can be measured.
- **Nonperformance** - spells out what happens if the service provider does not meet the objectives in the SLA.
- **Optional services** - provides for any services that are not normally required by the user, but might be required as an exception.
- **Exclusions** - specifies what is not covered in the SLA. Reporting - is a key component of SLM.
- **Administration** - describes the processes created in the SLA to meet and measure its objectives and defines organizational responsibility for overseeing each of those processes.
- **Reviews** - establishes regularly scheduled reviews between the user and service-provider constituents of an SLA.
- **Revisions** - provides for any revisions necessary to keep the SLA extant for all parties.
- **Approvals** - Signatures on the dotted line: the SLA is signed, sealed and delivered.

SLA's define explicitly the relationship between service providers and consumers. SLAs also specify the service being provided, the cost of that service to the consumers, and the penalties imposed on the provider if it fails to provide the service. One big problem of SLA is the knowledge gap between providers, customer as well as end users. The knowledge gap is the mutual lack of knowledge about organizational structure and technical aspect of the application environment.

In Internet the SLA only solves the problem between the parties which bounded to the contracts, such as the web hosting company and telecommunication providers. However, the real users which use the services it self are not taken into consideration in the SLA. As shown in Fig. 3.9, users who use the services will contact to the

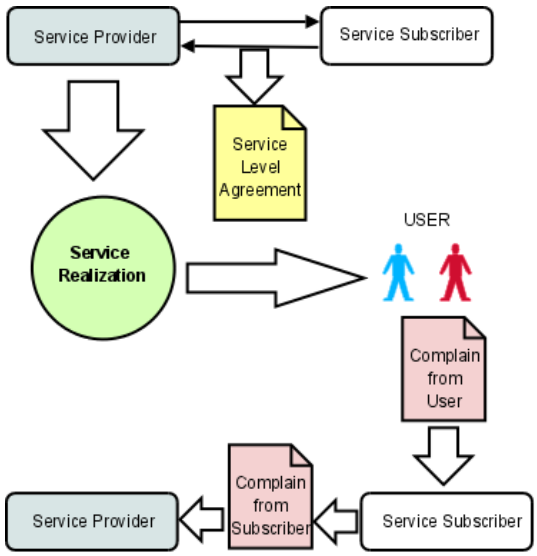


Figure 3.9: SLA problem in Internet services

service subscribers (from the user point of view, the service subscriber acts as service providers) whenever they do not satisfy with services. From user point of view, the service that being used is very bad and the service subscribe has breach the contract.

3.4.7 Actability

Actability is a new concept to extend the usability concept [Cronholm et al., 1999]. This approach combined the Human Computer Interaction with Language Action perspective (LA). LA emphasize what users do while communicating through an Information system. In this perception, an Information systems consist of :

- An action potential
- A record of earlier actions and other pre-requisites
- Action performed interactively by the users and system and/or automatically by the system.

Designing a system in this approach, means suggesting and establishing an action potential. This approach focus on users performing actions (tasks). The actability approach is an attempt to model the information system pragmatics [Goldkuhl and Agerfalk, 2000],

A pragmatics approach offer good possibilities for a deeper understanding of system as artifacts in organizational settings.

Actability is defined as [Cronholm et al., 1999]:

> *An information system's ability to perform actions, and to permit, promote, and facilitate the performance of actions by users, both through the system and based on information from the system, in some business context.*

The actability concept is developed for the Information system which categorized base on usage situations :

- **An automatic usage situation**. System performs action without any human intervention but according to instruction by, and on commission of some human actor, system is used as automatic machine.
- **An interactive usage situation**. System is used by user to perform the actions through the system. It is used as mechanical tool.
- **An consequential usage situatio**n. System is used to performance the actions based on information from systems. In this situation a system is used as a static tool

However, this concept can also be applied to other artifacts of computer based system. It start by considering the interaction loop of the system, such as:

1. User actions. It is represent the user's direct manipulation of objects.
2. System actions. It is the response of system to the user actions
3. Interpretation. It is the user's effort to understand what system achieved. It is just a feedback from the system to users.

Design process based on the actability, attempts to match the requirement of its users. It focus on actions and integrate the early prototyping with visual modeling. The design based on actability has following principles [Agerfalk, 2003]:

1. Action elementaries. An artifact is a system for handling an e-messages as results of e-action.

2. Recorded action. Participant's actions leave a record in the action memory.

3. Action potentiality. An artifact is the set of e-actions it affords and supports.

4. Structured action. Business rule determine what actions to take and when actions are taken.

5. Irrecoverable actions. Actions are formulated and executed reflectively during extended amounts of time.

6. Remote interpretation. Participants do not share the same physical environment

7. Delayed interpretation. Participants may perceive each other's action with considerable delay

8. Delayed feedback. Participants either produce or receive (but not simultaneously)

9. Delegated actions. Performers may take action on behalf of other people and their organization

Universal actability attempts to understanding the usability and the intercultural aspect in the information system in an holistic approach [Yetim, 2004].

3.5 Acceptance of measurement

There are two perspectives of quality measurement [Sachdev, 2004] :

- Internal measurement. It is defined as zero defect, doing it right the first time, or conformance to requirements

- External measurement. It is in terms of customer perception, customer expectation, customers satisfactions, customer attitude and customer delight. External

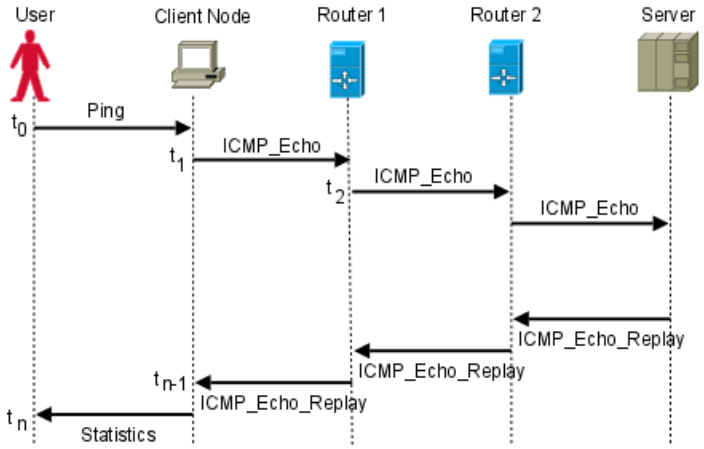


Figure 3.10: Ping protocol

measurement is now more important due to the customer awareness and growing customer expectation. The external service measurement such as coined by Parasuraman, Zehthaml Boerry (PZB) defines service quality as the degree and direction of discrepancy between consumer's perceptions and expectation in term of different but relatively important dimension of the service quality which can affect their future behavior.

3.5.1 Accepted measurement method

Ping is a well known program that is used to measure the connectivity. It is written by Mike Muss in 1983 for troubleshooting the behavior on IP network. Ping uses the ICMP packet as shown in Fig. 3.10. It is called Ping due to to its operation which is analogous to active sonar in submarines, in which an operator issues a pulse of energy at the target, which then bounces from the target and is received by the operator. The latency time is measured :

$$t_{latency} = t_{n-1} - t_1 \tag{3.13}$$

However, since 2003 due to the increasing use of ping for security attack such as flooding, or Denial of Services, many Internet Services Providers blocked the ICMP Type 8 (echo request) at their network boundaries. Excessive ping request also adds

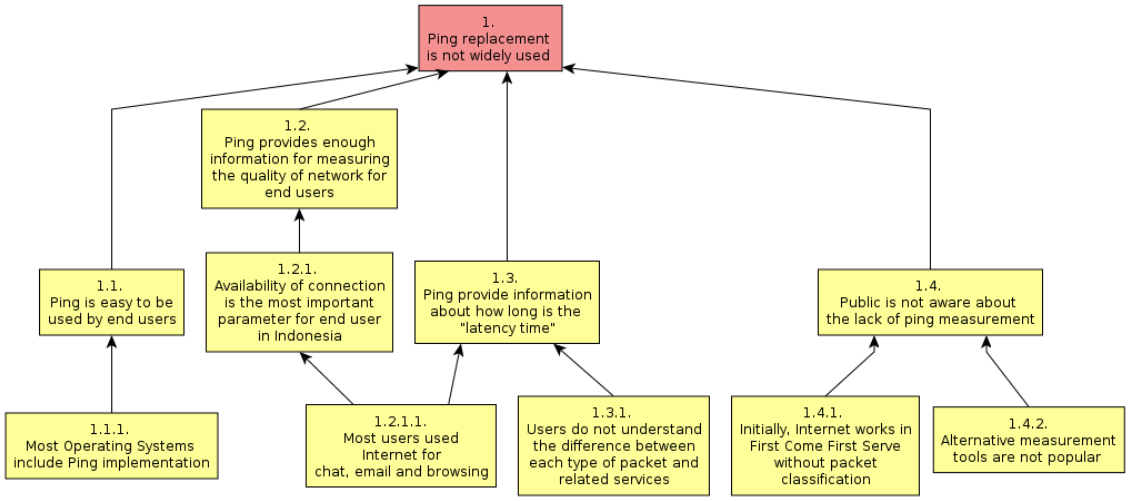


Figure 3.11: LWBG : Ping acceptance

to the overall load on network. Although RFC 1122 prescribes that any host must accept an echo-request and issue an echo-reply in return, this is supposedly a security risk. Thus, hosts that no longer follow this standard are frequent on the public Internet. Many ISPs change the ICMP packet priority to provide the "*illusion*" that their network connection is fast.

This limitation does not change how user perceive the use of PING as network measurement. Users are not aware the change of routing priorities in routers. It shows a large semantic gap between the specification of what will be measured and the type of measurement that is actually available. Each application present different type of measurement and different measurement interface to users. Users understand and accept the measurement method based on their knowledge and some other factors. To understand this phenomenon I derive a LWBG shown in Fig. 3.11.

Description of LWBG : Ping acceptance (See Fig. 3.11)

1. [*Ping replacement is not widely used*]. The limitation of ping has been known. However, people still used it to compare the services provided by a server in Internet. Many online gamers use it to measure which servers are fast enough from their locations.

- 1.1. [*Ping is easy to be used by end users*].
- 1.2. [*Ping provide enough information for measuring the QoS for end users*].
- 1.3. [*Ping provide enough information about the latency time*].
- 1.4. [*Public is not aware about the lack of ping measurement*].

1.1. [*Ping is easy to be used by end users*]. Ping is easy to use, and it is available in most operating system.

- 1.1.1. [*Most operating systems include Ping implementation*].

1.2 [*Ping provide enough information for measuring the QoS for end users*]. Ping provide information such as round trip time in milliseconds.

- 1.2.1. [*Availability is the most important parameter for end users*].

1.2.1. [*Availability is the most important parameter for end users*]. For most users in Indonesia, availability of connection is still the most important parameter. It is due to the bad quality of network services in various place of Indonesia.

- 1.2.1.1. [*Most users used Internet for chat, email, and browsing*].

1.2.1.1. [*Most users used Internet for chat, email, and browsing*]. Users has not used the application such as streaming, or VoIP. The most favorite application is chat. For chat application, availability connection is the most important parameter.

1.3. [*Ping provide enough information about the latency time*]. Ping measures the round trip time (rtt).

- 1.2.1.1. [*Most users used Internet for chat, email, and browsing*].
- 1.3.1. [*Users do not understand the difference between each type of packet and related services*].

1.3.1. [*Users do not understand the difference between each type of packet and related services*]. For end users, they do not care about the detail of packet type, such as ICMP, TCP or others, They just know about the name of program.

1.4. [*Public is not aware about the lack of ping measurement*]. The problem of ping due to the FCFS discipline is not known widely by people. Furthermore, there are many routers which still employs FCFS.

- 1.4.1. [*Initially Internet works with FCFS*].
- 1.4.2. [*Alternative measurement tools are not popular.*

1.4.1. [*Initially Internet works with FCFS.* The initial design of Internet forwards the packet between node with the First Come First Serve manner. Only after there is extra demand for the classification of service, the new router employs the non FCFS discipline in managing the packet that should be forward.

1.4.2. [*Alternative measurement tools are not popular.* Beside ping there are various simple measurement, such as tcpping, or hping. However, those programs are not as popular as ping.

Other measurement in Internet, which have also been accepted by public widely is the **Alexa** rank [`http://www.alexa.com`]. Alexa rank is known as a measurement for comparison of the access number of web sites or popularity of a web site.

Description of LWBG : Alexa acceptance (See Fig. 3.12)

1. [*Deficiency of Alexa measurement method is not considered by public*]. Alexa methods is far from perfect. Amazon's Alexa traffic reporting service has little credibility left among people who follow traffic trends. For example in August 2008, Alexa said that YouTube passed Google itself in total page views. They were wrong, but their data continues to perpetuate this alternate reality.

- 1.1. [*Many users use it as popularity measurement*].

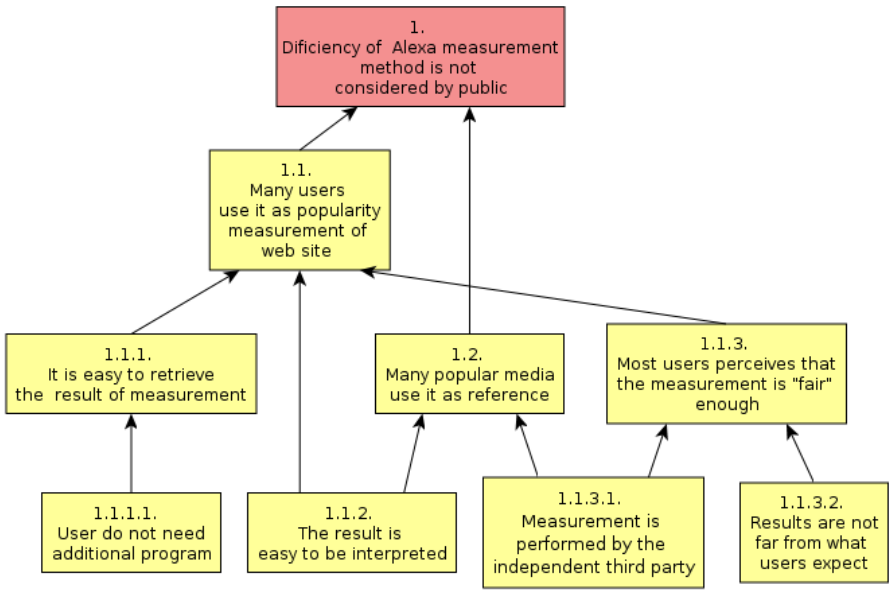


Figure 3.12: LWBG : Alexa acceptance

- 1.2. [*Many popular media use it as reference*].

1.1. [*Many users use it as popularity measurement*]. Many companies, which related to the advertising in web use Alexa measurement as reference. The perform valuation of the web site based on the Alexa measurement

- 1.1.1. [*It is easy to retrieve the result of measurement*]
- 1.1.2. [*The result is easy to be interpreted*]
- 1.1.3. [*Most users perceives that the measurement is fair enough*].

1.1.1. [*It is easy to retrieve the result of measurement*]. User can view the result of measurement and comparison only by using the browser.

- 1.1.1.1. [*User do not need additional program*]

1.1.1.1. [*User do not need additional program*]. User only need browser, and most computers now has browser. It means users do not need to install any software.

1.2. [*Many popular media use it as reference*]. Many media in reporting the popularity of a web site, using the Alexa rank as their reference.

- 1.1.2. [*The result is easy to be interpreted*]
- 1.1.3.1. [*Measurement is performed by the independent third party*]

1.1.2. [*The result is easy to be interpreted*]

1.1.3. [*Most users perceives that the measurement is fair enough*]. User still perceives that Alexa is fair, even though Alexa measurement is performed by using the plug-in in Internet Explorer, It means users who use Firefox, or other browsers, cannot participate in the data collections. However, users are not aware with this problem.

- 1.1.3.1. [*Measurement is performed by the independent third party*]
- 1.1.3.2 [*Results are not far from what users expect*]

1.1.3.1. [*Measurement is performed by the independent third party*]. Alexa is an independent company with business only providing the measurement.

1.1.3.2 [*Results are not far from what users expect*]. The web site that is popular is also has a high rank in Alexa measurement, web site which is not so popular has low rank in Alexa measurement.

The two example of measurements, shows that the acceptance of measurement methods is important in establishing the measurement of services.

3.6 QoS in Web Science

The technical oriented QoS such as network in QoS viewed the computer system as purely technical system. However, the web itself has evolved into a socio-technical artifact. As people daily's life work have become increasingly relying on World Wide Web. As proposed by Zhuge and Shi [Hai Zhuge, 2008], as web ecology, web may evolve into an artificial ecosystem, that harmoniously evolves with society, economy, culture, sciences and technologies. Web ecology attempts to study the harmonious

development of the web, society, economy and the nature. as an entire environment. It concerns the architecture and function for the environment, the method and technology for developing the environment as well as the intrinsic relationships and rules in the environment, Thus interconnection environment is called EcoWeb. The web is a mirror to human society.

This research which combines computer science with other approach now is known as Web Science discipline [Tim Berners-Lee, 2006], [James Hendler, 2008]. Although, it is still a provocative direction, and still being discussed to be established as separate discipline [Shneiderman, 2007]. This new discipline is defines as the "*science of decentralized information system*". The web as technology is socially embedded. Therefore, the web science as a new discipline attempt to broaden the research agenda to address such social issues as trust, reputation, privacy, governance, copyright and network communication standards. The web science is inter-discipline in nature. Parallel with understanding the user requirement, a new discipline call Service Science also emerge.

In web science, the social nature of Web technologies is considered. Therefore, the web science must address user need and requirement analysis through question like : What do people and communities want from the Web ? this perspectives encourage the research to understand to a deep understanding of the information and services users want. Web also has some negative aspects such a security breaches, identity theft, privacy violation and the social disruptive of globalization. It also yields a risk because it provides opportunities for those who broke laws, spread hate, and promote or coordinate terrorism.

Web science also has a commitment to universal usability. It also address user who speak multiple languages, as well as users from diverse cultures, novice/experts, young/old, low-literacy users, and user with disabilities. Understanding the complex, cross-disciplinary dynamics driving development on the Web- the main aim of Web science. Web science need a new methodologies for gathering evidence and finding ways to anticipate how human behavior will affect development of system that is evolving at an amazing rate.

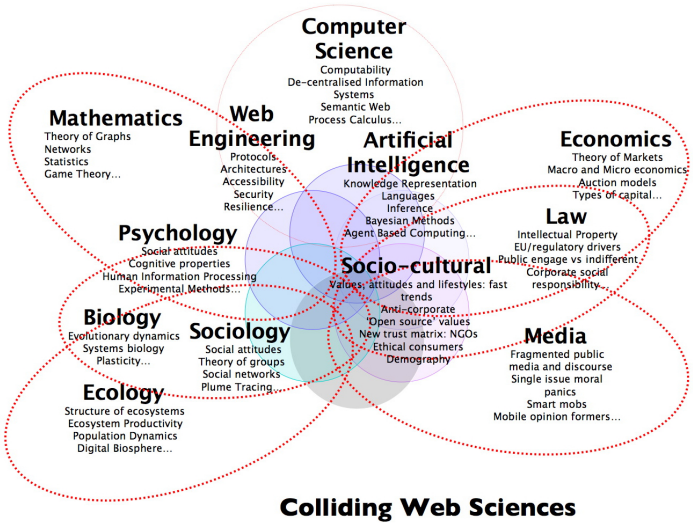


Figure 3.13: Web science discipline (Web Science) [Wendy Hall, 2008]

In Indonesia the Web also affects how the government communicate with their citizen, and how these population communicate. as well as how a government decisions are taken. I choose this approach due to the fact that computer and its application cannot separate with the human role. Thus, the social aspect now plays more important role in developing a system as well in evaluating the system.

Web Science is relative different with conventional computer science works, as shown in Tab. 3.7.

Besides the web science, web engineering is also established as a new discipline [Athula Ginige, 2001]. Web engineering is not a clone of software engineering, another both involve programming and software development. It encompass many software engineering principles, it incorporates many new approaches, methodologies, techniques and guideline to meet the unique requirement of Web/based system. It is believed that the web/based system development is different with traditional software development. The web development is mixture between print publishing and software development, between marketing and computing between internal communication and external relations, and between art and technology. Web engineering is also multi-discipline.

Table 3.7: Computer science vs Web science [Shneiderman, 2007]

Computer Science	**Web Science**
Metric	
Moore's Law	Page views
Order (n) algorithm analysis	Unique visitors/month
Gigabytes	Number of song or videos
Topics	
Computer networks	Social networks
Packet switching	Voice over IP, music sharing
Information	Relationship
Programming languages	Wikis, blog, tagging
Database, operating systems, compilers	E-commerce, E-learning, E-government, medical informatics, financial analysis
3D graphics, rendering algorithm.s, computational	Creating and sharing video, animation, video, animation, music, photos, maps
Focus	
Technology	Applications
Computers	Users
Supercomputers	Mobile devices
Proficient programmers	Universal usability

3.7 Summary

In this Chapter some basic terminologies are described. Those terminologies are service, quality and Quality of Service (QoS). A service is defined as meaningful set of capabilities provided by an existing or intended set of system to all who utilize it: subscribers, end users, network providers, and service providers – each seeing a different perspective of service. Quality is the totality of features and characteristics of a product or a service that bears on its ability to satisfy the given need. *Q*uality of Service (QoS) is a set of qualities related to the collective behavior of one or more objects.

It is also described in level model of Quality of Services. Those levels are : QoS in network infrastructure, QoS in network level, Software quality as QoS, Usability as QoS, Culturability, Acceptability and Actability. Each level has their own technologies as well as different parameters. This level is defined with respect to design approach used in each level.

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Chapter 4

Localization in Distro

I do not understand the menu, and I do not want to take English course, I only want to use computers. I only want to send email to my son.

I often encounter statement as above during the computer introduction training to people in Indonesia. Due to lack of menu in Indonesia language users who cannot understand English, use the computer by memorizing the position of menus. Some users in Indonesia used the spreadsheet to type a letter, because they understands only how to use a spreadsheet program, and they know the function of menu in spreadsheet from the menu position (not from the meaning of the text in the menu). Thus, they write letters using a spreadsheet program, although there is a word processor program installed in the computer. The program has the same texts in the menu, but they still cannot use it, because the menu position are different [Wiryana, 2001].

This chapter addresses the localization effort as part of effort to create sustainable system due to different culture between users and designers. The localization process itself is not free from the culture and users influence. In this Chapter, is also demonstrated and investigated, how the localization method is adjusted in order to satisfy the local need. The adjustment is performed by using LWBA as tool to investigate the problem. The improvement of the existing localization method is performed according to the findings in LWBA.

4.1 Languages in User Interface

The first attempt to suit the computer system, such as software to the local need is by performing the internationalization/localization. Internationalization and localization are means of adapting computer software to different languages and regional differences. Focal points of internationalization and localization efforts include:

- Language
  - Alphabets/scripts; most recent systems use the Unicode standard to solve many of the character encoding problems, as well as different systems of numerals. The writing direction which is e.g. left to right in German, right to left in Persian, Hebrew and Arabic have to be taken into account. Text processing differences, such as the concept of capitalization which exists in some scripts and not in others, different text sorting rules, etc
  - Spelling variants for different countries where the same language is spoken, e.g. localization (en-US, en-CA) vs. localization (en-GB, en-AU)
  - Input device such as enablement of keyboard shortcuts on any keyboard layout
  - Graphical representations of text (printed materials, on-line images containing text)
- Culture
  - Images and colors: issues of comprehensibility and cultural appropriateness
  - Names and titles
  - Government assigned numbers (such as the Social Security number in the US, National Insurance number in the UK, Isikukood in Estonia) and passports
  - Telephone numbers, addresses and international postal codes
  - Currency (symbols, positions of currency markers)

  - Weights and measures system as well as Paper sizes

- Writing Conventions

  - Date/time format, including use of different calendars system.
  - Time zones (UTC in internationalized environments)
  - Formatting of numbers (decimal points, positioning of separators, character used as separator)

- Any other aspect of the product or service that is subject to regulatory compliance

The Localization Industry Standard Association (LISA) [`http://www.lisa.org`] defines internationalization as follows:

Definition 6. *Internationalization is the process of generalizing a product so that it can handle multiple languages and cultural conventions without the need for the re-design. Internationalization takes place at level of program design and document development.*

Using this definition, internationalization is the process of designing a software application so that it can be adapted to various languages and regions without engineering changes.

Definition 7. *Localization involves taking a product and making it linguistically and culturally appropriate to the target locale (country/region and language) where it will used and sold*

Localization is the process of adapting software for a specific region or language by adding locale-specific components and translating text. Subjects unique to localization include:

- Language translation
- National varieties of languages

- Special support for certain languages such as East Asian languages
- Local customs
- Local content
- Symbols
- Order of sorting
- Aesthetics
- Cultural values and social context

The distinction between internationalization and localization is subtle but important. Internationalization is the adaptation of products for potential use virtually everywhere, while localization is the addition of special features for use in a specific locale. Internationalization is done once per product, while localization is done once for each combination of product and locale. The processes are complementary, and must be combined to lead to the objective of a system that works globally.

The components of Graphical User Interface (GUI) which relates to the localization process are:

$$GUI = \{M, T, H, B\} \tag{4.1}$$

GUI is the GUI systems, M is the menus of the software, T is the metaphor used by the system such as icons, directions, etc. H s the online help and B is the manual books. Each components is collection of those components :

$$M = \{m_1, m_2, \cdots, m_k\} \tag{4.2}$$

$$T = \{t_1, t_2, \cdots, t_l\} \tag{4.3}$$

$$H = \{h_1, h_2, \cdots, h_l\} \tag{4.4}$$

$$B = \{b_1, b_2, \cdots, b_t\} \tag{4.5}$$

Those components will depends on the users and its culture. Therefore, the basic steps to fulfill the user need is the localization. The localization process of GUI is :

$$L : GUI_{L1} \rightarrow GUI_{L2} \tag{4.6}$$

$GUI_{L1}$is the GUI accepted in original culture of designer, and GUI_{L2} is GUI accepted by user in other culture. One work of the localization is the translation. The problem there is not one to one map between $M_1 \rightarrow M_2$, that guarantee the same map $T_1 \rightarrow T_2$.

Definition 8. *Translation is only one of the activities in location; in addition to translation, a localization project include many other tasks such as project management, software engineering, testing and desktop publishing.*

Basically the localizations efforts attempts to translate the software from the language used by the designer to the user's languages. A good localization will try to fulfill some criteria such as :

- A good translation
- A consistent translation
- A consistent translation and other GUI components, for example the acceleration key.

Most people would not necessarily care that the software they are using might have been developed in a small town in India. Instead, people expects software to give them the impression as if it was developed in their native tongue and culture-Japanese, French, Arabic, or German. Thus software localization is geared toward adapting software not only to the language but also to the culture of the target market. Translation is only part of the job.

Localization requires a vast amount of translation-including all of a product's text, menus, dialog boxes, buttons, wizards, on-line Help, printed documentation, packaging, and CD labels. Multimedia files need to be translated, too, and if the product contains videos, the spoken text needs to be carefully re-synchronized as well. However, again, beyond merely translating the language, localization also needs to adapt the product to the particular locale in which it will be used. Currency, address, number, and date formats need to be changed; the sort order possibly needs to be adjusted; and for many Asian languages the fonts and the font size have to be changed, too. Arabic and Hebrew require right-to-left (RTL) layout of not only the text, but of the whole user interface (UI), including buttons, menus, and dialog boxes.

As a result, if the software will be localized into certain Asian languages, or into Arabic or Hebrew, it must be designed to support culture-aware features right from the start. The final localized version of the original software product should look and feel as if it had been designed in the user's home country. "Localizability," divided localizability into two categories: software localizability and content localizability.

Due to their length, the terms are frequently abbreviated to the acronyms i18n (where 18 stands for the number of letters between the i and the n in internationalization, a usage coined at DEC in the 1970s or 80s) and L10n respectively. The capital L on L10n helps to distinguish it from the lowercase i in i18n. Some companies, like Microsoft and IBM, use the term globalization for the combination of internationalization and localization. Globalization can also be abbreviated to g11n [IBM, 2000].

Definition 9. *Globalization addresses the business issues associated with taking a product global. In the globalization of high-tech products this involve integrating localization throughout a company, after proper internationalization and product design, as well as marketing, sales, and support in the world market*

Localization is a basic effort in accommodating users who has different culture than the original developer. However, only translating the GUI into the user language

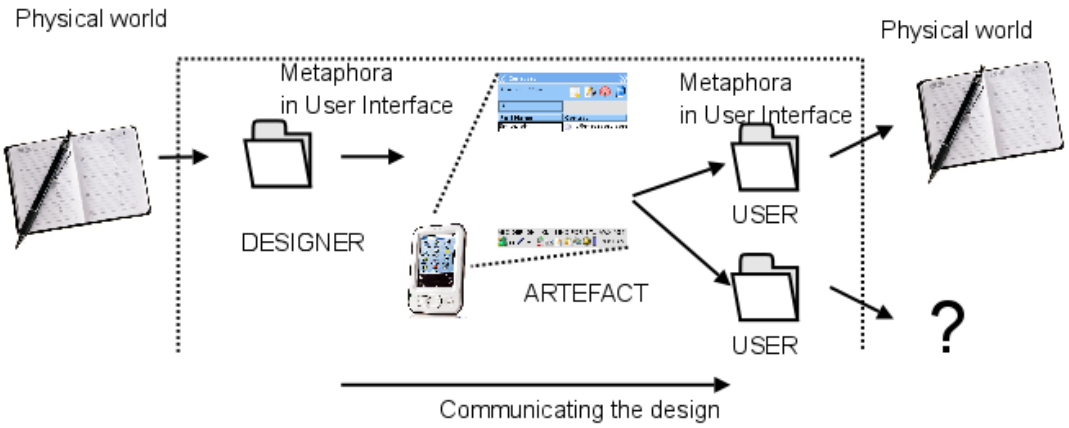


Figure 4.1: Mapping to unknown object

sometimes is not enough. Understanding the user context is an important aspect in customizing or designing a system. As shown in Fig. 4.1, an icon or menu for "`Address book`" cannot be translated easily into Indonesian as "`Buku alamat`". For particular users they do not know the real object such as `Address Book`, because they never see, experience or have and use that real object.

Language is used to describe and report the reality. However, language is not only content but also provide a context and way to re-contextualize content [Renzl, 2007]. Translating user interface components into other language without considering context does not solve the metaphor problem. User interface has to be redesigned to bring the concept of real object such as `Address Book` to an understandable object for users. User preferences for software are also influenced by the culture. The availability of source code enables local developers to perform more than translating the menu to accommodate this culture preference.

A lack of GUI in local language, can also bring the system into insecure state. One example is the phishing attack which happened in Indonesia for the KlikBCA.com [`http://www.klikbca.com`], an on-line banking from BCA Bank in Indonesia [I Made Wiryana, 2
Many Indonesia users whenever receives SSL dialog for confirmation of the certificate as shown in Fig 4.2, cannot understand the meaning of this dialog. Reading in English for users who are not fluent in English is very time consuming. Most users just want to carry on transactions as quick as possible. Thus, they tend to choose `Yes`.

Figure 4.2: SSL Warning cannot be understood

They do not realize that this decision brings them to the rogue web site, that collects the user name and password.

4.2 Localization in Indonesia

The Indonesia language is a normative form of the Malay language, an Austronesian (or Malayo-Polynesian) language which has been used as the lingua franca in the Indonesian archipelago for centuries and was elevated to the status as an official language of the Republic of Indonesia by the Indonesian Declaration of Independence in 1945, drawing inspiration from the *Sumpah Pemuda* (Youth's Oath) event in 1928. Indonesia language is used by approximately 200 million people. It is used by some people in East Timor, Netherlands, Philippine, Brunei Darussalam, Singapore, Southern Thailand, Saudi Arabia, Malaysia and Suriname.

Basically, the Indonesian language is relatively simple because there are no case of gender or definite article, no conjugation, no future or past tense, and no even a verb *"to be"*. On the other hand, this simplicity could also bring complexity to speaker because lack of strict rules make difficult to write Indonesia text correctly [Merdekawaty,]. Furthermore, Indonesian language is very contextual which means that the preference of words shall be accustomed with the purpose of articles as well as the audience. Indonesia language has minimal two different style in accordance

with its purpose. First is the official Indonesia language, second is the non-official Indonesia language.

Over the years, the Indonesian vocabularies are also influenced and expanded by several languages such as Dutch, Portuguese, Hindi or Sanskrit, Arabic, English and Javanese, and other local languages in Indonesia, mostly through trade contacts and international media. The use of computer also influences the adoption of many English computer terminologies into Indonesian languages.

The localization effort in Indonesia firstly was performed by Dali. S. Naga, in 1984. This project translated the BASIC command into Indonesia, and it was known as KILANG [Naga, 1984]. However, this project did not take the usability into their translation consideration. Microsoft Indonesia also tried to localize the MS DOS, but it had not been released to public [Mantoro, 2003].

Localization to Indonesia language also inherits the difficulties of translation the text to Indonesian [Quinn, 2003]. Some reasons which makes the translation is difficult are :

- **The meaning of words are very contextua**l. For example there are 24 Indonesian pronouns that correspond to "you" . The context is also depends on the relation of speakers, as well as the honoric level.

- **Indonesia language does not have plural form**. However, there are various numeral classifier, word that is used when count somethings. It indicate what semantic category the object belongs to.

- **Grammar of Indonesia language is not strict**. There is no differentiation between past, present and future. There is lack of formalization in the Indonesia language grammatical

- **The influence of local language and culture.** It produces different meanings of a same word in Indonesia language [Heider, 1991].

- **There is not "enough" vocabulary especially for the computer terminologies**. There is an on-going effort performed by *Pusat Pengembangan*

Bahasa Indonesia, to translate the scientific and engineering terminologies into Indonesia terminologies. However, it was found that many translated words are not known by public.

- **Research in computer linguistic area of Indonesian language is still underdeveloped** [Nazief,].

Since 1996 GNU/Linux was getting more attention in Indonesia. more people want to try and to install this operating system, as an alternative operating system. However, there are still exists many problems for disseminating the Linux distribution for users in Indonesia. One of the biggest obstacles is the language. Most of Linux documentations or user interface are not not written in Indonesia, There are many Indonesian developers who are working in translating the Linux HOW-TO document and the other related documents to Indonesia language. Based on my observation, users in Indonesia start to install and use software directly without reading any documentation. They read the manuals or documentations after facing a problem. Thus, the translation of the installation and administration of the Linux Distribution will provide a big assistance for the new users. Most translation effort of OSS in Indonesia has objectives :

- To provide a FOSS system which has an installation or administration in Indonesia language, including the help system.
- To promote FOSS to the public in Indonesia through the Indonesia distribution.

4.3 Indonesian localization in SuSE

As shown in Fig 4.3, I started the localization effort, in 1997 I formed a group of lecturers and students in Gunadarma University Jakarta-Indonesia. This group was formed to translate the SuSE Linux distribution. SuSE 5.3 was chosen because is the most complete distribution and has complete documentations. The final product would be a big help for the user in Indonesia. SuSE also had a system management

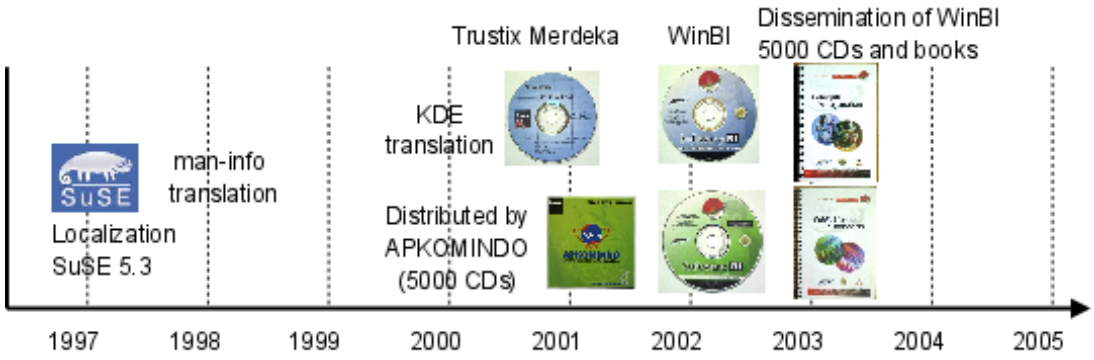


Figure 4.3: Time-line of localization experiment

program called YaST. In this work I and my team also translated the installation and the YaST program, but not the GUI or other programs. Getting the source file and submitting the result of translation was not a big problems for a open source based products.

The works of SuSE translation still follows the translation cycle of proprietary product as shown in Fig. 4.4. The translation results were submitted to the software developers, In this works I acted as the editor and performing the consistency check of the localization works and also distribute the work to other translator. The translators received text files contains the original English text that were translated into Indonesian language. After 3 months of part time work the translation are finished, The files were submitted to the SuSE developers.s Then, the SuSE developer will compile and package to the final SuSE 5.3 distribution. As the translators, I received the final product (SuSE distribution as release version) before the release date.

In this life-cycle, I can only evaluate the translation after the packaging process. However, I and the translator team were not able to correct the translation at this point, Thus, the correction can be applied only for the next version of distribution. Sometimes in the next version, the texts will be changed or the distribution of text in each file also changed. Keeping the consistency between the translation works is difficult in this development method.

During this first attempt, I found that the project management model for translation is an area which has not been explored thoroughly. This project was the first

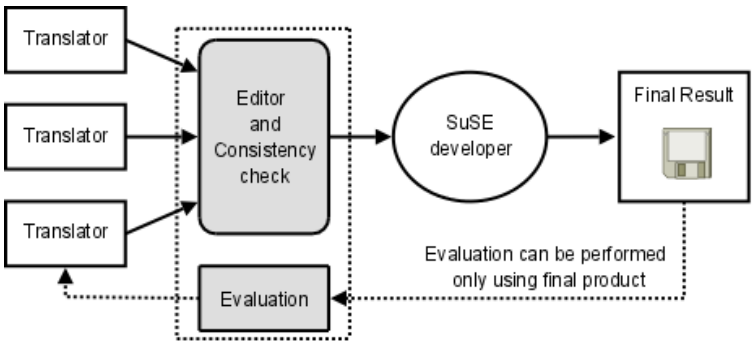


Figure 4.4: Translation process in SuSE

project for us which had to be coordinated and managed via Internet. In this localization proses, there were also some unsatisfying results, such as users understand differently the translated text. To understand the problem of the translation process, I derive the LWBG of the problems appear in this translation work. This LWBG is shown in Fig. 4.8.

Description of LWBG : Problem in SuSE's translation process (See Fig. 4.8)

1. [*User interprets terminologies with different context*]. One of problems in translating program to other language is how to capture the same meaning from user point of view.

- 1.1. [*Indonesia language is very contextual*].
- 1.2. [*Translator cannot know the exact context of texts*].

1.1. [*Indonesia language is very contextual*]. A meaning of word in Indonesian depends really on the context of the usage. The same words have different meaning in different context.

1.2. [*Translator cannot know the exact context of texts*].

- 1.2.1◆ [*Translators cannot test as final products*]. The context can be easily understand, if translator can see in which parts of menu/system the texts are used.

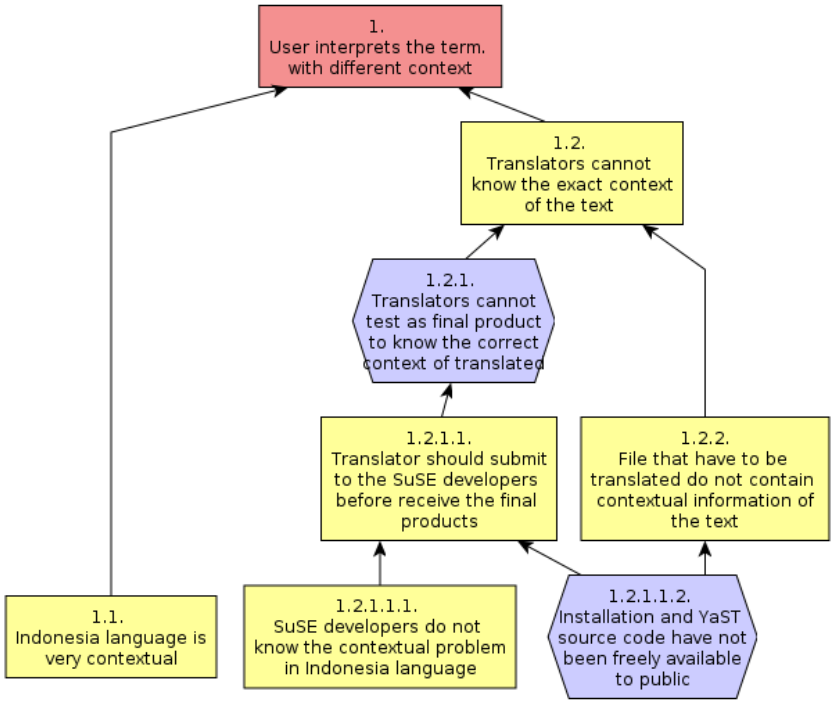


Figure 4.5: LWBG : Problem in translation process of SuSE

- 1.2.2 [*Translators have to submit to the SuSE developers before receiving final products*].

1.2.1 ◆ [*Translators cannot test as final products*].

- 1.2.1.1 [*Translators have to submit to the SuSE developers before receiving final products*].

1.2.1.1 [*Translators have to submit to the SuSE developers before receiving final products*].

- 1.2.1.1.1 [*SuSE developers do not know the contextual problem in Indonesia language*].
- 1.2.1.1.2. ◆ [*Installation and YaST source code had not been freely available to public*].

1.2.1.1.1 [*SuSE developers do not know the contextual problem in Indonesia language*]. SuSE developers do not know the Indonesia's user or computer usage

in Indonesia. As one of most populous country in the worlds, Indonesia is still unknown country for many software developers.

1.2.1.1.2.◆ [*Installation and YaST source code had not been freely available to public*]. In 2000, the YaST was still proprietary software, the source code are not freely available. Not the YaST is Open Source software, and people can look and change the software easily,.

1.2.2. [*File that have to be translated do not contain contextual information of the text*].

- 1.2.1.1.2.◆ [*Installation and YaST source code had not been freely available to public*].

Improvement as suggested by LWBA: Therefore, to improve the localization process, some factors can be modified :

- 1.2.1◆ [*Translators cannot test as final products*]. In the localization process, testing the translated text as the final product can help to understand the context of the text. If the translator can evaluate it earlier, translators can correct it.
- 1.2.1.1.2.◆ [*Installation and YaST source code had not been freely available to public*]. The availability of source code of software enables local developers as translators to test the system as the final product.

4.4 User acceptance in translation

As shown in Fig. 4.6, translation process in GUI is more than translating the text from the original language to language of users. It involves also understanding the user perception of the metaphor of translated text. Each user group has their own perceptions. For example, translating "`window`" to "*jendela*" is not always a good idea. For most users the terminology “jendela” refers to the “real window” and it never

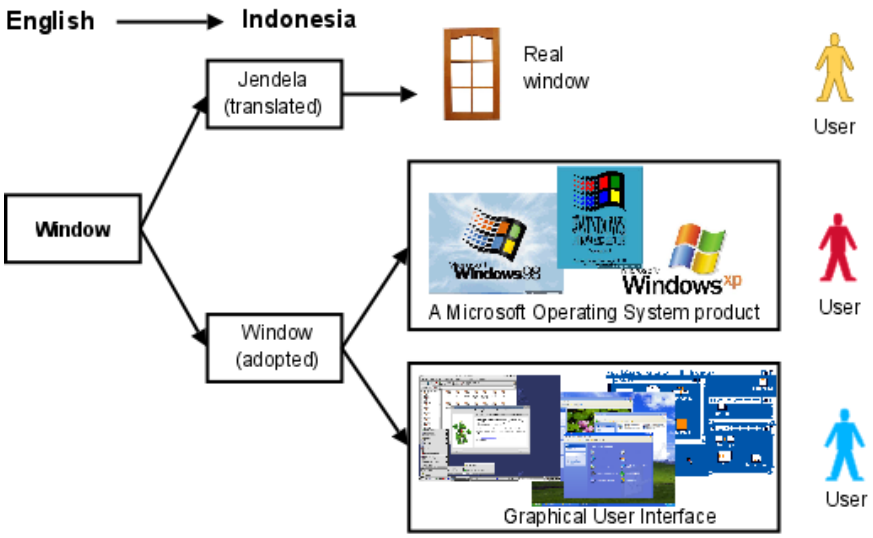


Figure 4.6: Problem in translating an unknown metaphor

refers to the same metaphor as “window” in GUI. Users understand faster and easier with "window" rather than "*jendela*". Different group of users also perceive the term “window” differently. This term have two meanings for those different groups. First, they use “window” for all Microsoft Operating system products, such as Windows XP, Windows NT etc. The other use the “window” term as the terminology to refer the “desktop environment”. The background knowledge of users determine how they perceive the translated metaphor and text.

Therefore, the first step in performing the translating is defining the target users. The type of users determine the strategy of the terminology selection, as well as the narration style of the sentences. Computers users in Indonesia now have very various background. As shown in Fig. 4.7, how and where they use computers also different with the country where the softwares are developed.

The type of target users determines how translated terminology will be chosen from the original terminology. For users who have been familiar with the English, adapted terminologies such as : diskette, *konfigurasi* (configuration), boot, etc, are more suitable. The used terminologies also provide a smooth transition from their background knowledge. To understand the problem of different interpretation of the text, I draw LWBG as shown in Fig. 4.8. This analysis identify the important factors

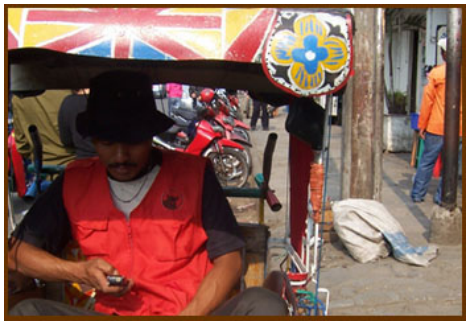


Figure 4.7: Users in Indonesia

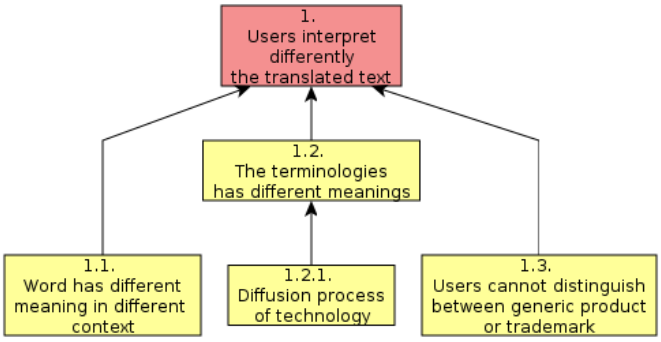


Figure 4.8: LWBG : Problem of same metaphor different meanings

in performing the localization.

Description of LWBG : Problem of same metaphors has different meaning (See Fig. 4.8)

1. [*Users interpret differently the translated texts*]. During the translation sometimes translators use a translated terminology, but users interpreted it differently. For example, "window" which is translated into "jendela", users do not understand the translated term.

- 1.1. [*Word has different meaning in different context*].
- 1.2. [*The terminologies have different meanings*].
- 1.3. [*Users cannot distinguish between generic product name or trademark*].

1.1. [*Word has different meaning in different context*]. For example window, it can be Window as part of a metaphor in Windowing system or Window as physical.

1.3. [*Users cannot distinguish between generic product name or trademark*]. Users often cannot distinguished between a generic name such as "tooth paste" or a trademark, "ODOL". In Indonesia people know "ODOL" is tooth paste. Or "Infocus" is the overhead projector.

1.2. [*The terminologies have different meanings*].

- 1.2.1. [*Diffusion process of technology*].

1.2.1. [*Diffusion process of technology*]. How users know a technology determines which terminology that is preferred by users. If the products has been exist for a long time in a particular group. They prefer the original terminology not the translated or adopted, e.g. in Germany people still prefer to use "*Tastatur*" not keyboard, but in Indonesia they prefer "*Keyboard*" than *"papan ketik"*.

To understand how users accept the translated version, I made a simple usability evaluation during my road show in various city in Indonesia in 1999 [KOMPAS, 1999]. In each public lecture, I evaluated about 5-10 users, they were exposed with the SuSE with Indonesia language, After that I interviewed them and found about their impressions of translated version. I also asked the public through various computer mailing lists in Indonesia such as pau-mikro, itcenter, mikrodata.

In many cases adapted terminologies are not the correct from linguistic point of view, but it is better from the usability point of view. System can be more usable for user, because they can understand and use the software. In translating the menus, the usability play more important role than the correctness of the translation from linguistic point of view. Many translation efforts in Indonesia are useless due to the "*awkwardness*" of the translation. Translators tend to use the "new" terminology which are correct from the Indonesia linguistic point of view, but are very "*strange*" for normal users.

Example 10. *Mouse is a device which requires a device driver.*

Many text translators try to translate this English sentence into a correct Indonesian text as in Example 11.

Example 11. : *Tetikus suatu perangkat yang membutuhkan sebuah penggerak perangkat.*

However, during the evaluation with users, most users did not understand the translated version. Because they were more familiar with "*mouse*" and "*device driver*" rather than "*tetikus*" and "*penggerak perangkat*". They tend to read the English version again, because for them, it is easier to understand than Indonesian version.

Hence, it is important for translators to keep balance between the familiarity of a terminology and correctness of a terminology from the linguistics point of view. To tackle this problem sometimes a new term is used but with a more familiar term in the bracket. For example : *mount*, *load*. These words are translated as : *mengaitkan* (mount), *memuatkan* (load). However, it can be used only for the on-line help, not for the menus. As the consequences, I assumed, that they have been familiar with the English or adapted terminologies such as : diskette, *konfigurasi* (configuration), boot, etc. I want to provide a smooth transition from the users who have only MS-Windows background. It is important since most of this typical users do not have any idea about these following terminologies, *mount*, *file device*, *boot manager* etc. During the translation, many standard Indonesian computer terminologies cannot be used.

For example : *mount*, *load*

These words are translated as :

mengaitkan (mount), *memuatkan* (load)

Description of LWBG: Why do not use standard term (See Fig. 4.9):

1. [*Users do not accept the standard translated terminologies*]. Many users in Indonesia do not accept the standard translated terminologies issued by Pusat Bahasa Indonesia, a government bodies which defined the standard language of Indonesian language.

Table 4.1: Different strategies in translating

Strategy	**Example**	**Comments**
Original terminology is used and not being translated	modem, mouse	In some cases, the English terminologies are widely used by Indonesian user,
Original terminology is adapted	device → divais	Some English terminologies are adapted directly, only how they are written is different
Original terminology is translated	file → berkas	Some terminologies are possible to be translated into Indonesian language. Furthermore the translated terminologies are popular enough for user.
Introducing new terminology	mount → kaitkan	"mount" is unknown concepts for MS Windows users. It is difficult for them to understand.
Cannot be translated easily	default → default	It is very difficult to translate default into one word in Indonesia. Most users prefer the original

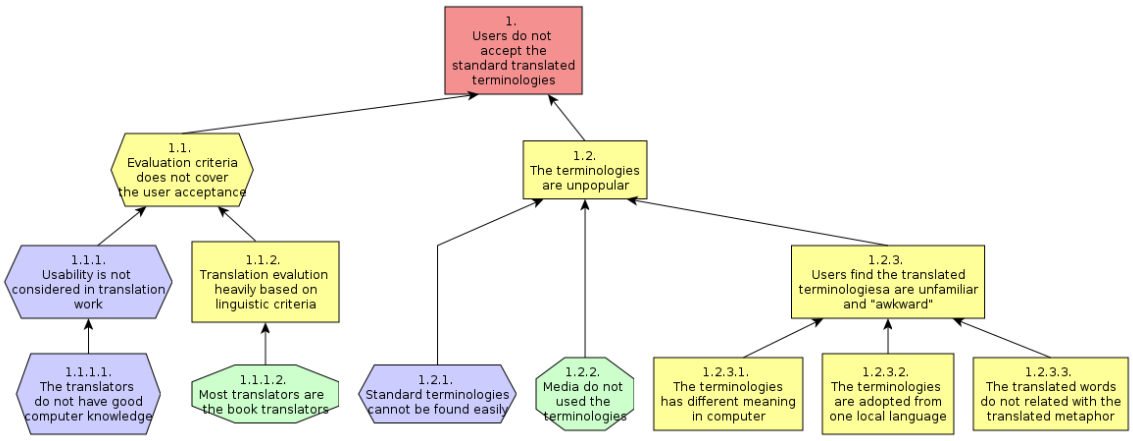


Figure 4.9: LWBG : why do not use standard term

- 1.1. [*Evaluation criteria do not cover the user acceptance*]. The terminologies are developed without considering the user acceptance, the decision purely based on linguistic point of view, or from the linguistic expert point of view.
- 1.2. [*The terminologies are unpopular*]. Some standard terminologies are "*unknown*" for users. Thus, for users there is no different between understanding the Indonesian terminologies and the English terminologies.

1.1. [*Evaluation criteria do not cover the user acceptance*]. User acceptance has not been used for evaluating the translation of softwares.

- 1.1.1. ◆ [*Usability is not considered in translation work*].
- 1.1.2. [*Translation evaluation is heavily based on linguistic criteria*].

1.1.1. ◆ [*Usability is not considered in translation work*]. Usability in Indonesia is still considered in the user interface, web design. The make use of usability concept in translation work is still new.

- 1.1.1.1. ◆ [*The translators do not have good computer knowledge*].

1.1.1.1. ◆ [*The translators do not have good computer knowledge*].

1.1.2. [*Translation evaluation heavily based on linguistic criteria*].

- 1.1.2.1. [*Most translators are book translators*].

1.1.2.1. ● [*Most translators are book translators*]. Many translators have background as the book translators, as book translator they do not need to consider the consistency or the length of translated text.

1.2. [*The terminologies are unpopular*]. People only choose the popular terminology, if mouse is more popular than *tikus,* they will prefer mouse.

- 1.2.1. ◆ [*Standard terminologies cannot be found easily*].

- 1.2.2. ● [*Media do not used the terminologies*].
- 1.2.3. [*User finds translated terminologies are awkward*].

1.2.1. ◆ [*Standard terminologies cannot be found easily*]. The standard terminologies formerly are not freely available to the public. Public has to buy book, and there is no on-line dictionary for this terminologies.

1.2.2. [*Media do not use the terminologies*]. Media in Indonesia still use the English terminologies, such as keyboard rather than *papan ketik*. The translated terminologies are not popular in media.

1.2.3. [*User finds translated terminologies are awkward*]. Many Indonesian users (as in my evaluation sessions), cannot accept the translated terminologies, because they found the terminology does not sound well.

- 1.2.3.1. [*The terminologies has different meaning in computer*].
- 1.2.3.2. [*The terminologies are adopted from one local language*].
- 1.2.3.3. [*The translated words do not relate with the translated metaphor*].

1.2.3.1. [*The terminologies has different meaning in computer*]. Some terminologies cannot be translated into Indonesia language, because it has different meaning, for example: *tongkat kesenangan* (joystick).

1.2.3.2. [*The terminologies are adopted from one local language*]. Many standard terminologies are adopted from local language, for example *mengunduh* (download), *senarai* (scanner). For the people in Indonesia who are not from those ethnic group, the terminology is not popular or understandable.

1.2.3.3. [*The translated words do not relate with the translated metaphor*].

Improvement as suggested by LWBA: From those LWBG, to improve translation works, some considerations should be taken into accounts:

- 1.1.1.◆ [*Usability is not considered in translation work*]. To evaluate which translated terminologies are used, I decide to employ a usability evaluation with real users, the acceptance of users play more important role.
- 1.2.1.◆ [*Standard terminologies cannot be found easily*]. To achieved this goal, the translated terminologies should be freely available in Internet and public can download and get it easily
- 1.1.1.1.◆ [*The translators do not have good computer knowledge*]. To solve this problem, the translators should familiar with the computer technology and understand the usability evaluation. Computer knowledge background is important for the translators. In Open Source projects, most of them are program developers.

4.5 Problems in Open Source localization

I also involved in the translation of man pages, and KDE. I acted as the coordinator for Indonesia localization in KDE. Both translation efforts follow the life cycle of localization in Open Source program as shown in Fig. 4.10. Usually, the translation of Open Source program is performed by volunteers and most of them also able to compile the translation text into the final program. Therefore, each translator can evaluate the result of translation directly. Translators submit their work directly to the submission system. In this life-cycle model the consistency is very hard to be maintained. Every translators can use his/her own terminologies, for language such as Indonesia which just in the beginning of localization effort, this situation just produces a very bad translated text. To understand the problem I derive the LWBG as depicted in Fig. 4.11.

The Indonesia localization effort of KDE was very slow, to accelerate it I and several developers from Trustix Asia formed a group on April 1999 to focus on the

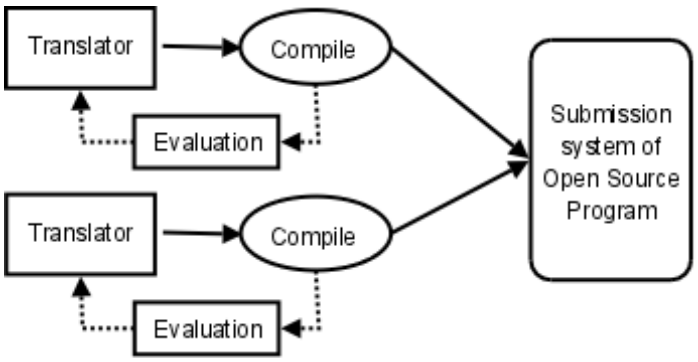


Figure 4.10: Localization process of Open Source Software

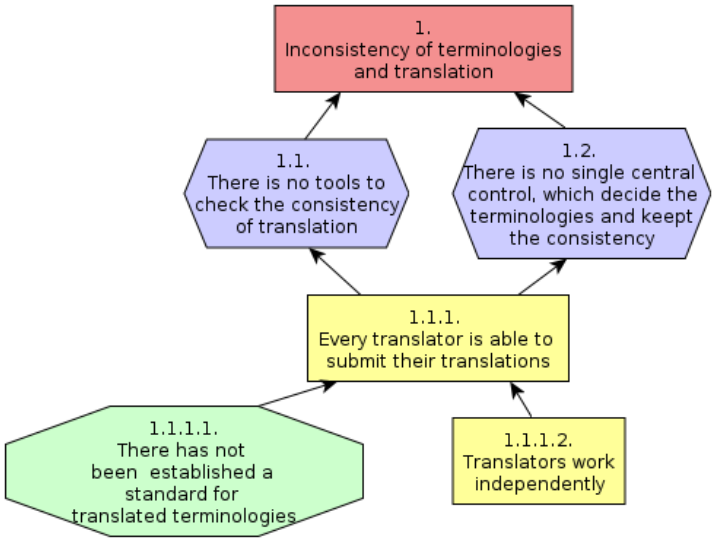


Figure 4.11: LWBG : Problem in open source localization problem

KDE localization. I already coordinated the Indonesia localization in KDE during that time. Learning from the inconsistency of translated terminologies as well as the experience in localization of SuSE as well as the localization of various man-page, I changed the translation mechanism, into Fig. 4.12. It is not the same as the *"standard"* localization procedures. However, for Indonesia this change could be more practical and could accelerate the work.

Description of LWBG : Problem in Open Source localization problem (See Fig. 4.11)

1. [*Inconsistency of terminologies and translation*]. Some similar texts in Open Source software are translated differently by different people or by different groups. For example, some groups decide to use standard terminologies, some groups use adopted terminologies.

- 1.1. ◆ [*There is no tools to check the consistency of translation*]. The submission system does not check the consistency, because only collect the translated text.
- 1.2. ◆ [*There is no single central control, which decide the terminologies and keep consistency*].

1.1. ◆ [*There is no tools to check the consistency of translation*].

- 1.1.1. [*Every translator is able to submit their translations*].

1.2. ◆ [*There is no single central control, which decide the terminologies and keep consistency*]. In the Open Source project, the central repository of translated text only collect the text. Without performing the consistency check.

1.1.1. [*Every translator is able to submit their translations*]. In Open Source model, every body who want to join the translation, after finishing their work, they can submit their work to the CVS.

- 1.1.1.1. ● [*There has not been established a standard for translated terminologies*].
- 1.1.1.2. [*Translators work independently*].

1.1.1.1. ● [*There has not been established a standard for translated terminologies*]. In Indonesian the localization is still news, therefore it has not been well established the standard terminologies that can be referred by translators.

1.1.1.2. [*Translators work independently*]. Every body can joins the translation efforts in Open Source software. Among the translators sometimes do not know each other or contact each other.

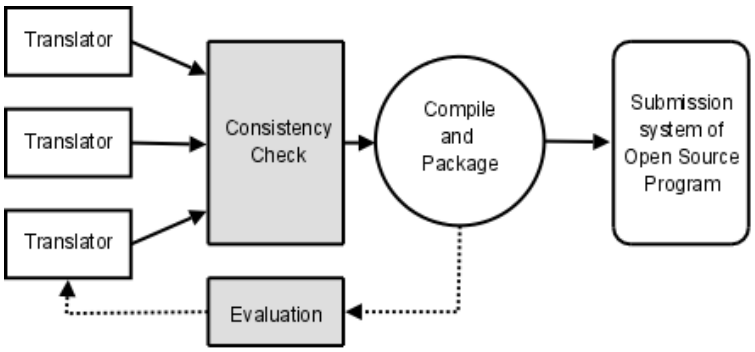


Figure 4.12: The development cycle of localization in Trustix Merdeka

Improvement as suggested by LWBA: This improvement is based on the node that can be improved to prevent the top node in LWBG,. Those nodes are :

- 1.1. ◆ [*There is no tools to check the consistency of translation*]. To prevent this node, a tool to check the consistency of translation should be developed and employed.

- 1.2. ◆ [*There is no single central control, which decide the terminologies and keep consistency*]. A single control that can perform cross check among various translated file can produce a more consistent translation.

Furthermore, to produce better Indonesian localization in the future, this following aspects should be considered:

- 1.1.1.1. ● [*There has not been established a standard for translated terminologies*]. A well established translated terminologies has to be developed and also disseminated to public.

This development cycle yields a better result, because I can evaluate the pre-release product, and do the correction. In this development cycle, I could evaluate the translation in the GUI, therefore some translation problem in GUI can be identified such as :

- The length of translated menu

- The accelerated key

- The consistency of translation

The first distro developed in Indonesia was Trustix Merdeka [eBizz Asia, 2003]. This distro was developed by Indonesian developer who is working with Trustix, a Linux company in Norway. I worked as adviser for the Trustix Merdeka development. To distribute this Distro, APKOMINDO about 5000 CDs to the public as a part of educating public about Intellectual Property Right in Computer. However , the Indonesia language in this distro only in the installation program, and the menus. The on-line help had not been translated.

4.6 Distro localization as service packaging

Distro (distribution) is a collection of kernel, libraries, application and utilities that make the installation and uses of Linux easier for the normal users. Distro plays important role in introducing Open Source widely, because it makes users can easier to install and used the new system. Customizing distro or remastering distro usually is performed due to the specific requirements of the users, such as the localizations of menu and installation process. Since the Internet connection in Indonesia has not been in high capacity, Linux distribution also plays role as knowledge delivery media. Thus, the availability the system in one media (CD-DVD) is very useful for users. Thus distro in Indonesia has to include the documentation in Indonesian.

According to Computer Literacy Survey in 2001 from Agency for Assessment and Application of Technology (BPPT - Badan Pengkajian dan Penerapan Teknologi), Indonesia users still need the GUI which is written in Indonesia language. President of Indonesia, Abdurahman Wahid issued Decree of President (Inpres) No. 02/2001, about the use of Indonesia language for computer program. To implement this Inpres the Indonesia government through BPPT launched an initiative called Software RI under P2LBI Project. The Ministry of Research and Technology had requested to the Microsoft Indonesia to perform the localization initiative. At that time Microsoft Indonesia refused to do it, due to time and cost consideration [eBizz Asia, 2001]. Therefore, government decided to do the localization based on the Open Source Software.

For this initiative, Trustix Asia, Gajah Mada University and Gunadarma University as the representative of Open Source community performed the works.

4.6.1 Scope of works

WinBI development was about three months and it is listed in Tab. 4.2 and there were 30 translators and 3 developers who were involved in the development. Most of them are students and staffs of Gunadarma University. The works was started by using Trustix Merdeka as the starting point, because the Trustix Merdeka has already many components which has been translated into Indonesian. Before starting the translation project, the Trustix Merdeka was evaluated. The distro development was performed by different groups of persons such as translators for PO and DocBook files, programmers, graphic designer, and evaluators.

The developers were grouped into following groups :

- Software developers (3 persons)
- PO translators (7 persons). Translator receive the PO files as the input and translate them into the final PO files..
- On-line and document translators (9 persons). The on-line translator received the DocBook files.
- Graphic designer (1 person).
- Evaluation coordinator (1 persons).
- I was responsible as Technical coordinator (1) and there was a person as project coordinator (1).

The localization of the entire distro is different with the localization of one program. Translation for a complete distro is more complex than translating a program. In this translation process, some components have to be translated such as :

Table 4.2: Milestones of WinBI project

	Translator GUI	**Translator Document**	**Programmer**	**Evaluator**
2001-08	Recruitment	Recruitment	Preparing tools for translation works	Recruitment
2001-09-03	Training for the translators	Training for the translators	Installing the collaboration tools	Defining the evaluation methods
2001-09-10	Consistency check, create menu trees, dictionary	Translate the documents and on-line help	Evaluate the previous OSS works that can be used	Testing the available works from other OSS
2001-09-17	Translate	Translate the documents and on-line help	GUI design and prototype building	Evaluate the prototype
2001-09-23	Translate	Translate the documents and on-line help	Developing the installation script	Evaluate the prototype
2001-10-01	Testing translation	Convert to appropriate format	Integrate the GUI for installation and the installer script	Evaluate the translation
2001-10-08	Consistency check	Consistency check	Build the binary package	Evaluate the installer
2001-10-15	Correction	Correction	Integrate and build the binary package	Evaluate the on-line Help
2001-10-22	Final evaluation	Final evaluation	Final testing and packaging	Acceptance test
2001-10-29	Release and introducing	Release and introducing	Deliver as ISO	Acceptance test with real users

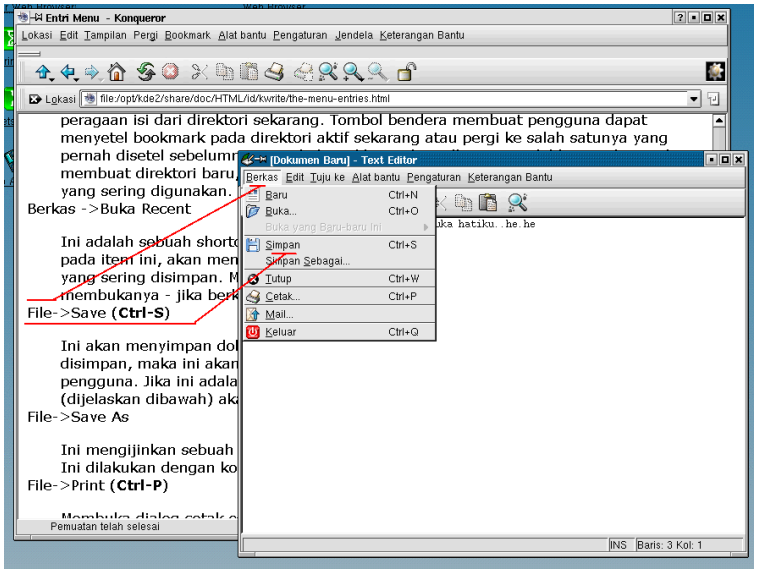


Figure 4.13: Consistency between GUI components

- **Graphical User interface components**, such as menu, buttons, title of windows. Some terminologies should be translated consistently. This problems is shown in Fig. 4.13

- **Warning message**, such as error and warning messages should be translated according to context otherwise user cannot understand it.

- **On-line help text**. The terminologies in this text should be consistent with the translated item in the GUI components. It also has different file formats.

- **Documentation**. The manual books, or tutorial books have to be consistent with the program and translated GUI components. It has also different file formats.

4.6.2 Development process

To handle the complexity of distro localization, I defined the development flow as as shown by Fig. 4.14. The time limitation of this work is the big consideration in deciding the workflow.

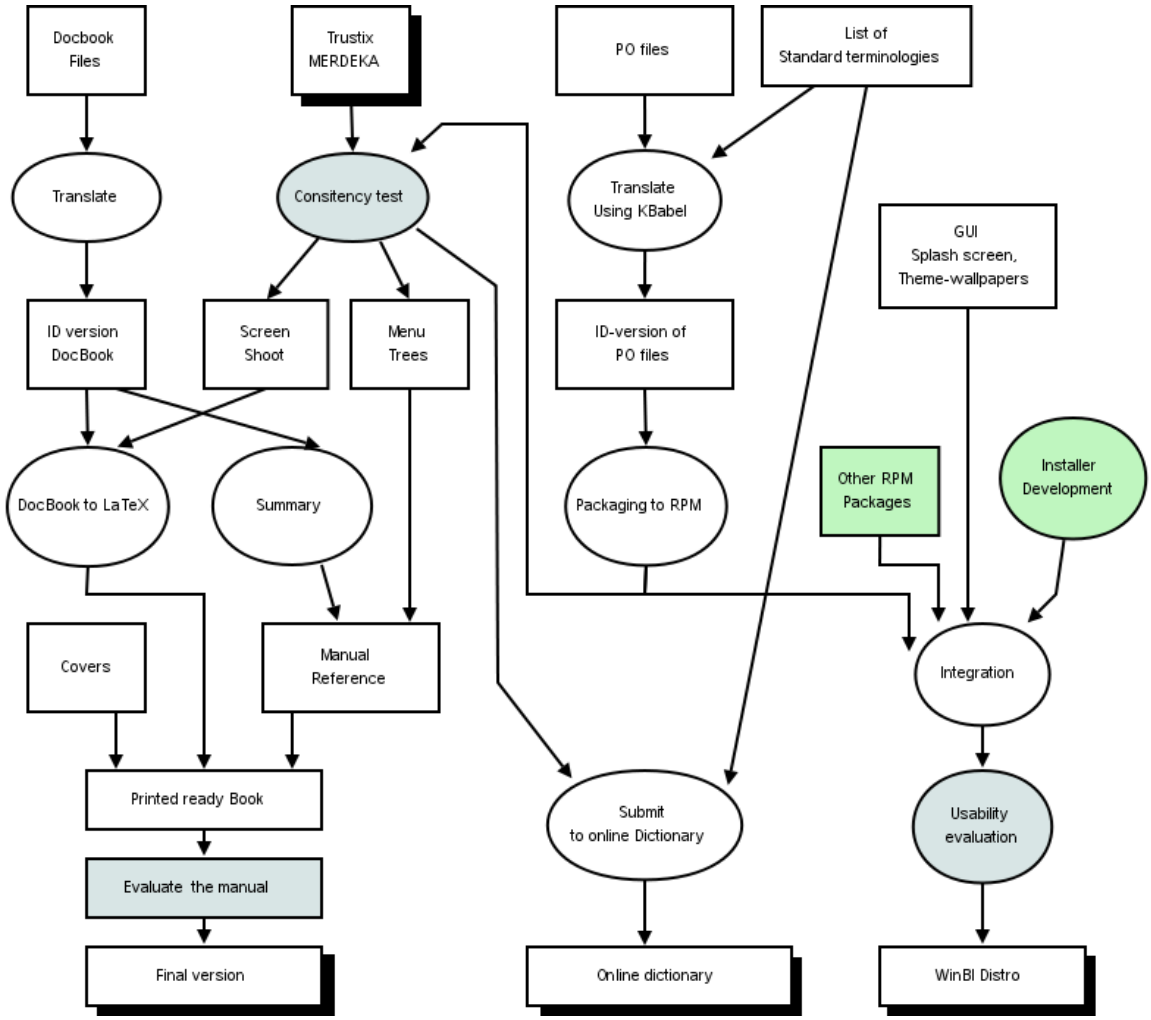


Figure 4.14: Process flow of translation

- I grouped the PO translators into two groups. The first PO translator team, translated the PO files which had not been translated in Trustix Merdeka. The second team evaluated the translated PO files in Trustix Merdeka and build the phrase table in order to check the consistency of translation. This table were used in the translation process. To edit the PO files we used **KBabel** [`kbabel.kde.org/`].

- There was no DocBook files which had been translated in this step, thus translators can start to translate it. DocBook is an open format, it is easy for the students who had not been familiar with it to understand the format and built the tools that can make the translation faster. The English terminologies were not translated, because translator have to wait the final version of translation from the GUI Component translation.

- In the installer program, there are some PO files for menu and on-line help of installer. These files were translated by the translator team and DocBook. Graphic designer creates the icons, pictures which are used during the installation process as well as design the layout and the cover for manual books. LaTeX was chosen as format to prepare the publication in order to keep the consistency between document and make the workflow of document production faster. The programmer developed the installation program by modifying an available installation program. Paper based prototype were employed to evaluated the installation steps.

- After finishing translation process, consistency check were performed for all PO files. Each phrase were collected and stored into database. By comparing with the guideline of Decree of President 02/2001, and the other translated terminologies, the translation was evaluated. Using the integrated table, the change a phrase will change the other GUI components that use this phrase. The length of text is also considered, due to the size of GUI.

- After deciding the suitable translated terminologies, the whole PO files are

checked again, and the "*search-replace*" are performed in on-line Help documents, because the English terminologies had not been translated. This process was performed for all PO files and all DocBook files. This was the second cycle of translation process.

- After that screen-shots were taken and they were used in the documents and on-line Helps. To make the checking process easier we built the menu trees automatically using script which used **GraphViz** [`http://www.graphviz.org`]. This menu trees assist developers, whenever they wanted to refine the translation works.

- After finishing all translated, the result were packaged into RPM package, because the WinBI using RPM as the package manager. The installer and the init script would be integrated into the distro and the ISO image was generated. After the ISO image is ready, The usability evaluation was performed according to the testing form. The focus is on the translation aspects of GUI.

- For the on-line help, the **DocBook** using **db2Latex** were converted and than processed into the printed ready format by applying the class that had been prepared. By using this workflow, and used the same source files, the printed book, on-line help, and the menu can be kept consistent. To produce the on-line help in the web, the DocBook files were translated directly to HTML.

In performing translation some consideration are taken into account, such as:

- **Usable translation**. The translation is not only correct according to grammar and guidance for Indonesia language. It is better to avoid the use of a new terminology which is very "awkward" for typical users.

- **Consistent translation**. The files that should be translated are spread in hundreds of files. For example, "`File`" or "`Find`" should be translated into the same word for all files or program components. It should be avoided the use of different translated terminologies for a same word.

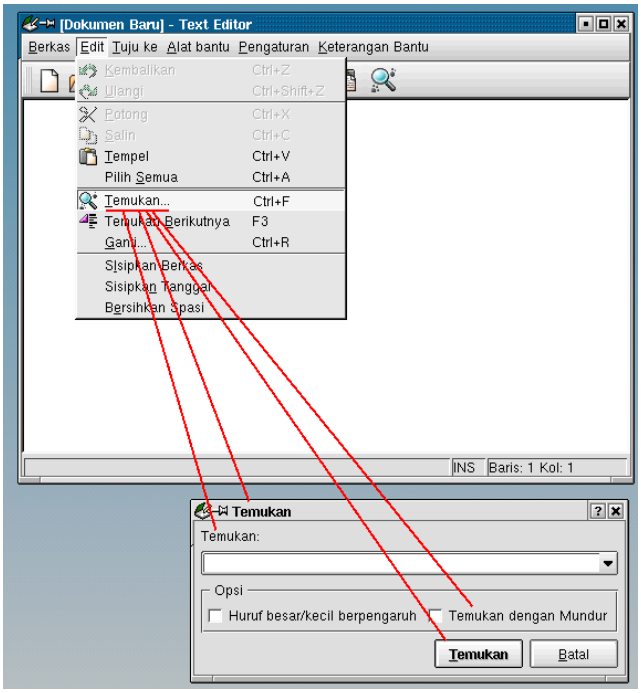


Figure 4.15: Consistency problem between different softwares

- **Consistency between the menu in the program, on-line help and manual as well as consistency among programs in the distro.** As shown in Fig. 4.13, some explanations in on-line help refer to a GUI component. For example "`Push the Cancel button`", should be translated to "`Tekan tombol Batalkan`". Some GUI components in a programs also refers to other GUI components in other programs. In a distro there are more than 100 programs and about 1000 files.

- **Size of translated text with the GUI components**. In many cases, the translated text in Indonesia are longer than the English version. Therefore, sometimes the source code of programs should be changed. For example "`Help`" will be translated as "`Bantuan`" or "`Keterangan bantu`". Calculating the length of text can be avoid this problem. Availability the source code of programs is a big help.

- **The accelerator keys**. For example in the English version "`New`" has accelerator key `Ctrl-N`, the Indonesian version is "*`Baru`*", However if we keep the

Figure 4.16: Installation of WinBI in Indonesian

accelerator key as `Ctrl-N` (there is no relation with "*Baru*", then we have to change into `Ctrl+B`). Furthermore, it should be checked whether there is a clash of accelerator key.

Results of this projects was not only the WinBI, but the PO files which can be used for other translation project or other Distro. It also submitted to the KDE as Indonesia localization. The translated phrase collection are also available for public in a form of parallel corpus.

4.7 Evaluation

Most localization evaluation methods used in Western world based on the premise that participants will find it easy to articulate their feelings, thought and they will claim if the system is not working as they expect. However, this assumptions cannot always be used. For example in Indonesia, it is difficult to expect use say that "*this is not good because of xxx*". The same phenomenon also appears in India [Chavan, 2005]. Each culture has different effect in the usability testing, for example a structure interviews also has different effect for different culture background of users [Ravikiran Vatrapu, 2005].

Most of Asian culture largely try to accept the state of given situation (in Indonesia this emotion is known as "*nerimo*"). Therefore, users try to work around the problem

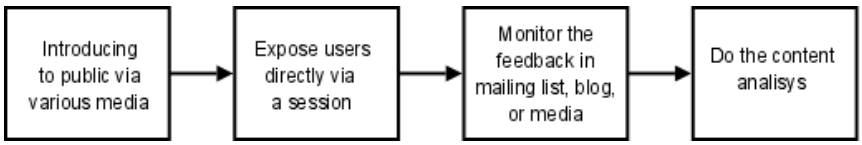


Figure 4.17: Acceptability evaluation developed in this work

that they encounter rather than complaining about it. Stating a negative opinion about things in uncomfortable for most people. Indonesians do not like to complain directly in face-to-face meeting. Therefore, to learn about the acceptability I used different strategy to measure the Quality of the distro. It is shown in Fig. 4.17. The measurement is performed in this following phases :

1. **Introducing the public via various media**. Since the target is public, I used various mass media, Internet as well as conventional media such as magazine, newspapers. In my research I view users as the object which is influenced by media.

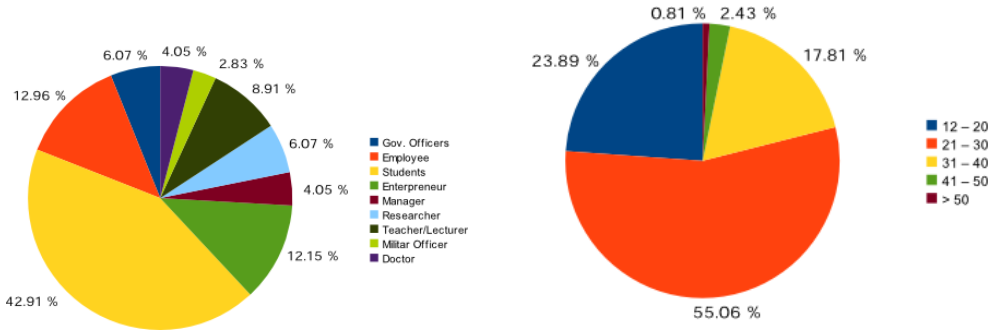
2. **Expose users directly via a session**. To expose as many as users directly to the system being developed, I used the public lectures, demonstrations, etc. The distribution through media such as CD-ROM was also used.

3. After exposing users, I **monitors the feedback from users**. Rather than relying on direct complain, I experienced that it will be more efficient to monitor the mailing list, blog or media.

4. After collecting the feedback, I can do **the content analysis**, to understand how the user perceive the system.

To employ an indirect method to evaluate the results of localization, distro is assumed as a service package mechanism. The QoS of this service are :

$$QoS_{distro} = \{L_{terminologies} \oplus C_{terminologies} \oplus C_{text} \oplus A_{terminologies} \oplus S_I\} \qquad (4.7)$$



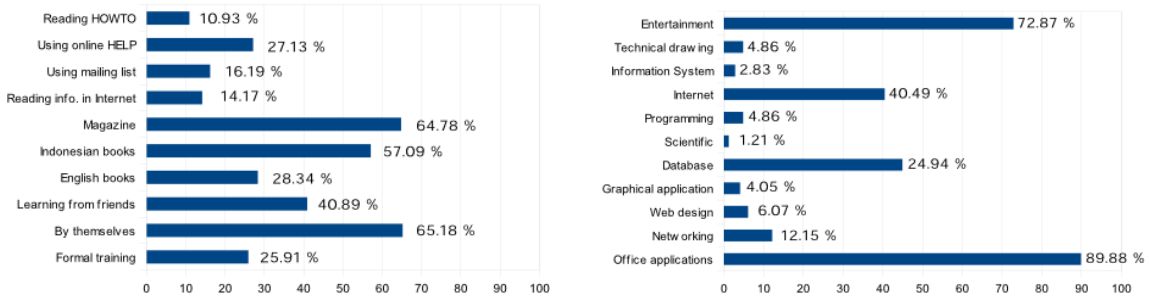
(a) Users background (b) Age of users

Figure 4.18: Background of users

where QoS_{distro} is the quality of distro, as a package service,$L_{terminologies}$ is the linguistic correctness of terminologies, $C_{terminologies}$is the consistency of terminologies, C_{text} is the consistency of translated text, $A_{terminologies}$ is how users accept the translated terminologies and S_I the availability of supporting information in those distro. The S_i factors is very local dependent. For example in a country such as Indonesia, where the Internet connection has not been very fast, users cannot rely on the Internet to gather information about how to use the system. Thus, the availability of S_I of a distro plays important role in a country like Indonesia.

How good the $C_{terminologies}$, and C_{text} can be evaluated automatically using a script. The script will parsed all PO files, sort and display the terminologies. However, there is a difficulty in employing an automated tools to evaluated the consistency. It is due to the nature of Indonesia language, which is very contextual. Thus, I had to perform the walk-through evaluation to check the consistency.

To understand the $A_{terminologies}$, the evaluation were performed using usability evaluation and interview. During the road show to several cities (Jakarta, Semarang, Tulung Agung, Yogyakarta, Surabaya, and Bali). I collected 247 respondents and also from the 112 person in mailing list and on-line interview. The background of the respondents are shown in Fig. 4.18. The sample users were still dominated by students. However, it is interesting, because most student has been familiar with the English versions of terminologies, and can read English, but they still expected the Indonesian version of GUI.



(a) How users get information (b) How users use computer

Figure 4.19: Background of knowledge

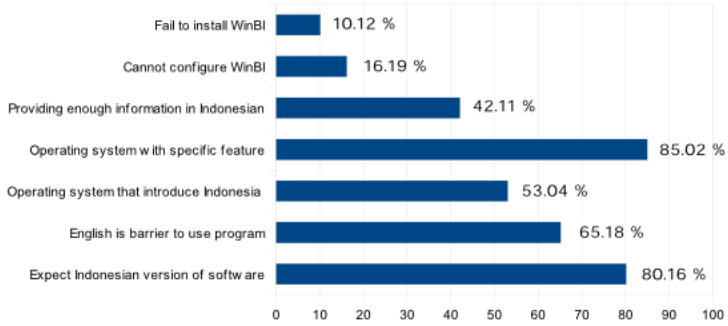


Figure 4.20: Respond of translation works

How users get the information that supporting the use of system is shown in Fig. 4.19a. Most of them still requires the information in Indonesia language. Most users use computer for the Office Application and Entertainment, as shown in Fig. 4.19b.

During the evaluation the users have to do some tasks using the translated GUI. Those tasks are defined based the usage of computer applications, such as the office application. I did not expect the user to give their critiques or impression. I just wanted to expose the user with the final results. The feedback, critique are received from the various mailing list and the media. I tried to track how the media report the results of the WinBI distro. After introducing and expose the user to the final results as shown in Fig. 4.20.

However, the a localized software is not always viewed as a positive quality by users, because of several reasons such as :

- Many people consider that the translated version cannot be understood. Most of the who are familiar with the English terminologies still prefer to use English

Figure 4.21: Localization in mobile devices

version [Haryanto, 2002]. This behavior is very different with the user attitude in Germany or Scandinavia countries. In both countries the use of special characters also contribute to acceptance of the localized version. Moreover, in Germany users already familiar with their own terminologies for many computer terminologies, such as *Drucker*, *Bildschirm*, etc.

- Many people argue that providing the Indonesia language in GUI will not encourage public to learn English. English proficiency is perceive as important skill.

- The accessibility, i.e. providing access to all users even the minority ones has not been considered as a quality of software in Indonesia

Therefore, localization should be combined with effective dissemination strategy to reduce the negative perception of the localization works. As shown in Fig.4.3, WinBI chooses the Internet and popular media to distribute the results to public. The combination between Internet, and CD-ROM and exposed in popular magazine shows a good strategy to disseminate the localization works. Nowadays, people start to accept the GUI in Indonesia. Devices which are used by public widely, such as cell phone, now is supplied with Indonesia language as the Language Option in their GUI, for example shown in Fig. 4.21. This pictures are taken from the NOKIA N70.

4.8 Summary

Software should be designed and customized according to the user and the context. Localization is the first steps to this direction. The software development itself is also influenced by users and its cultural factors. Even for a simple work such as software localization, the system development method has to be suited to match with local requirements.

By identifying from beginning this problem, the development process can produce better results. In this Chapter it has been shown, how to find the problem in existing system development by using the LWBA. Those system development for localizations are :

- Localization of proprietary product which based on Open Source Software, SuSE
- Localization of Open Source Software.
- Localization that fulfill the condition of Indonesia language, Linux distro called WinBI

It has also been addressed the adjustment of development methods by using LWBA. It has also been demonstrated how indirect evaluation method should be performed for the users in Indonesia which do not prefer to complain directly.

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Chapter 5

Air Putih in Tsunami Relief Action

This chapter provides the background motivation of a new system development method. The development method itself evolves and practices successfully in the relief action in Aceh. The LWBA is used to analyze the success factor of the development method as well as identifying problems of the existing system development method. Based on results of LWBA, the new system development method is formulated. This Chapter also demonstrates how Internet can be exploited as tool to perform the ethnography type study for understanding the development process, as well as be used as the analytical tool for qualitative study.

The Asian tsunami disaster on 26th December 2004 in Aceh (Nanggroe Aceh Darussalam, NAD), North Sumatra and other affected parts of the Indian Ocean which were devastated hit by this disaster. The tsunami left more than 150,000 dead in Aceh and destroyed much of the province's essential infrastructure such as roads, power plants, and telephone lines. This natural disaster led to one of the biggest humanitarian relief operations in history. Hundreds of organizations trying to provide relief and rescue for the thousands of victims. However, the efforts faced a coordination and communication problem, since the communication infrastructure did not exist after the Tsunami. The communication is required in order to established a well-coordinated teamwork among the organization which involved in relief actions [Spiegel, 2005].

Before the Tsunami struck Aceh, Air Putih was only a small IT group which was started from an online chat group. Air Putih and also the The Indonesian Information

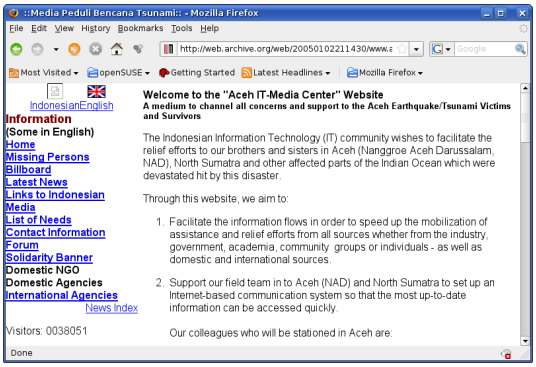

Figure 5.1: The first version of Aceh Media Center [`http://www.webarchive.org`]

Technology (IT) community understood that the total lack of communications on the ground was a huge problem. Through helping the Tsunami victim, and minimizing further loss of life, the group became the first IT group that contemplated to assist according to its field of expertise. Along with an alliance of computer enthusiasts, they were fighting to apply the powers of the Internet to help coordinate the world's largest humanitarian operation since World War II. Coordinated and supported by the Indonesian Information Technology Federation, an association which includes nine industry groups, they had formed the Aceh Media Center (AMC), an organization devoted to applying information technology to solving the humanitarian disaster of the province.

They provided the wireless Internet infrastructure across Aceh. The work of Air Putih has been invaluable for many International organization during the relief action, PMI (Indonesian Red Cross), Medicos del Mundo (MDM), World Food Program and many other organizations can have Internet access. The USNS Mercy, a hospital ship providing critical care to survivors also considered the wireless infrastructure provided by Air Putih is very important to their work [ESA, 2005].

5.1 Tsunami relief action

To solve the communication and coordination problem during the relief effort, the Internet Service Provider Association of Indonesia (APJII - Asosiasi Penyedia Jasa

Figure 5.2: The Air Putih actions during Tsunami relief [Putih, 2005]

Internet Indonesia) and the Wireless LAN Association (both members of the Indonesia Information Technology Federation, IITF) together with other volunteers from IITF and the IT community swiftly acted by setting up hot-spots, called Aceh Media Centers (AMC), The AMC Mission aimed to deliver a reliable communication system to the relief workers, journalists and officials involved in the tsunami relief efforts in Banda Aceh and northern Sumatra .

To understand how the time limitation in performing the actions, I performed interviews with the Air Putih members (via chat and email) as well as from the Air Putih documentations. I describe their actions in chronologically order :

- After the Tsunami on 27th Dec 2004, a day after the disaster, donated computers and communication equipment began to pile up, including computers, wireless devices, cables, and the Very Small Aperture Terminal (VSAT).

- Two members of the Air Putih community flew to Banda Aceh with 13 boxes of wireless equipment, cables, antennas, the VSAT, and a collapsible tower. The first objective was to assist the data gathering of the field. Air Putih realized that distribution and coordination were the biggest hurdles in the beginning. Some people need rice but they got blankets; some people need water but they received rice.

- More Air Putih members joined in the next few days. Two members scouted the city, still scattered with corpses, for sites to set up a wireless broadcasting device. They spotted a tower at top of an Internet cafe and persuaded the owner to let them to use his equipment

- On 1 January 2005, the AMC had reestablished Internet connectivity in Banda Aceh - even before the state telecom company PT Telekomunikasi Indonesia Tbk starting their recovery action [McCawley, 2005]. The AMC has set up free Internet sites at Banda Aceh's main post office and the governor's residence, which serves as the headquarters for government operations. The team has also set up an outdoor Internet tent as shown in Fig. 5.2. Journalists could use this facility for free between 8 am to 8 pm. The center is open to local people as well as for NGOs working in the areas. The AMC Mission was to achieve "*wireless freedom*" for all the victims, relief workers, journalists and others involved in the operation using fixed wireless equipment.

- Air Putih members had to improvise with local materials, grabbing nearby pipes and using long wooden poles to hook up radio towers. They battle regular blackouts and, above all, say they need more bandwidth, which would allow them to transmit more data. The Calang Internet center is the Air Putih 5th Internet center in Aceh. Three others are in Banda Aceh, while another one is in Gunung Sitoli, Nias Island. In Banda Aceh, the media centers are located at: their own field office, Jl. Teuku Umar 31, Seutui; Jesuit Refugee Service field office at Jl. Elang, Lr. Merpati No. 43, Ateuk Pahlawan; and at University of Syah Kuala. Each center equipped with 5 computer terminals. With these two hot-spots they were able to service all the relief organizations

- The "*wireless freedom*" concept was also brought to Meulaboh, which was in the direct path of the tsunami. They also went to isolated areas as the island of Simeuleu. Air Putih also collaborated with other IT volunteers from different countries, such as Earl Campbell, a ham radio specialist from New Mexico, Peggy Townsend, an Internet specialist from Michigan, and Jeremy Parr of the

Bahamas are providing backup. The team of volunteers used a portable VSAT unit to provide the bandwidth from a satellite feed [Smartbridges, 2005].

- Air Putih also provided the Aceh Media Center web site [`http://www.mediacenter.or.id`], which served more than 100,000 hits in less than a month of operations. The detail access of the AMC web site is shown in Tab. 5.1. The site includes frequent news updates and has also a database of missing persons .

The vital importance of their communications link became clear when on March 28, 2005 , there was a major aftershock measuring 8.7 on the Richter scale. Fears of another tsunami quickly surfaced and the people in the town did not know if they should evacuate to higher ground. With radio mass destroyed, there were no warnings. Using the Internet system, they can monitor and prepare the evacuation [Smartbridges, 2005].

The main tasks of Air Putih during the relief actions are :

- Facilitate the information flows in order to speed up the mobilization of assistance and relief efforts from all sources – industry, government, academia, community groups or individuals – both domestic and international.

- Support the field team in Aceh and North Sumatra to set up an Internet-based communication system so that the most up-to-date information can be accessed quickly.

- Provide back-up assistance for the distribution of all goods and services to the victims and survivors.

The activities of Air Putih are not only ICT related, but also as normal volunteer who help the victims and survivors. These activities requires volunteers who are capable in both activities. The Air Putih community has about 40 members and some advisers. After the Tsunami relief action they formed officially as Air Putih Foundation with more formal activity as Information and Communication Technology Response Team. I joined them to be one of the Air Putih advisers.

Table 5.1: Access to AMC web sites [Putih, 2005]

Month	**Total hit**
2004-12	No data
2005-01	904.343 (2 weeks data)
2005-02	No data
2005-03	No data
2005-04	323.307
2005-05	323.307
2005-06	362.710
2005-07	270.698
2005-08	206.385
2005-09	283.179
2005-10	284.244
2005-11	218.176
2005-12	121.814 (2 weeks)

After Tsunami relief, Air Putih Foundation continues to build the Internet infrastructure in Aceh with various activities. The Internet infrastructure build by Air Putih is shown in Fig. 5.3. Air Putih Foundation has completed the installation two BTS (base transmitter station) in Banda Aceh, as part of its effort to create new high speed Pre-WIMAX internet wireless connection. The 5,8 GHZ wireless equipment has been provided by Intel Corp. The project has started since early June, after received permission from Rehabilitation and Reconstruction Agency for Aceh and Nias (BRR) to continue the project as a special case. Previously, the project hampered by telecommunication regulatory that forbid the use of 5,8 GHZ wireless technology. Current wireless Internet connection that already setup by Air Putih since early days of tsunami is still using the classic 4,3 GHZ.

The Aceh Media Center (AMC) website is also evolving to the Media Center and covers not only Aceh but the whole area of Indonesia. Some new features are provided such as the map application, real time warning system and also mobile access. It is shown in Fig. 5.4.

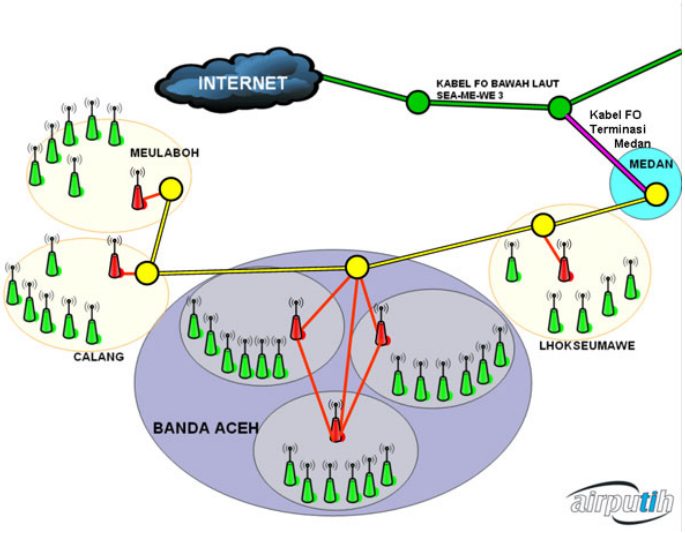

Figure 5.3: Internet infrastructure built during Tsunami relief [Putih, 2005]

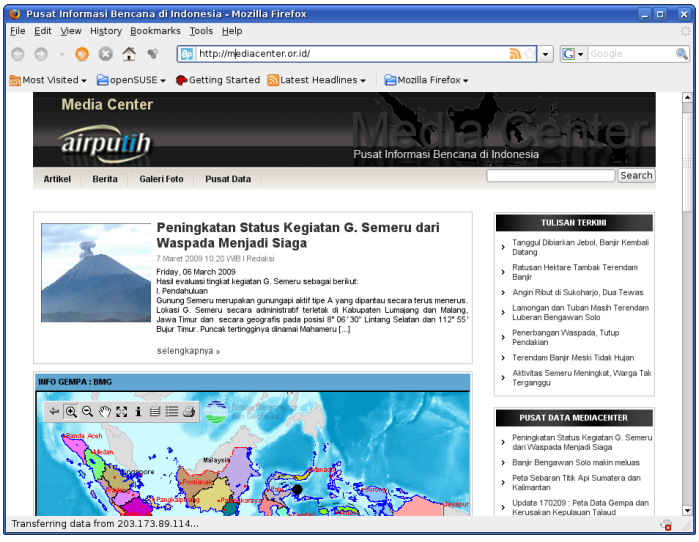

Figure 5.4: Current web site of Media Center [`http://www.mediacenter.or.id`]

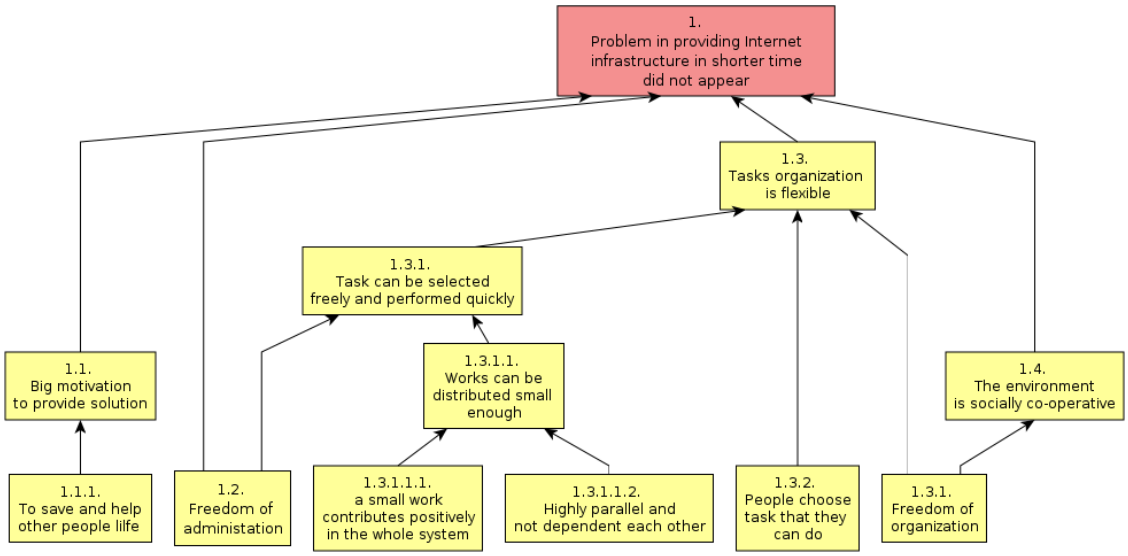

Figure 5.5: LWBG of the Air Putih success

5.2 The success factors

As far as my knowledge, Air Putih is the first form of this type of project and it has been very successful to solve the problem. The success of Air Putih in providing the Internet infrastructure in Aceh after Tsunami, has shown that in a particular situation, with an appropriate approach the task can be performed efficiently. Unfortunately, there is no further study in this area, many studies about the relief action are more on the satisfaction of Indonesian people during relief. Many reports in media [TIME, 2005], [Desiree Bliss, 2007] neglects the needs of Information infrastructure during the Tsunami relief. This Chapter is my attempt to investigate how the Air Putih works in solving the Internet Infrastructure in Aceh successfully. To understanding the success factors, I derive the LWBG as shown in Fig. 5.5.

Description of LWBG: Why Air Putih success (See Fig. 5.5)

1. [*The big obstacle for providing Internet infrastructure in short time did not appear*]. During a natural disaster, it always predicted that establishing an Internet infrastructure cannot be performed in a shorter time [Spiegel, 2005]. In the developing countries that situation is worse, due to the unavailability of equip-

ment and human resource. However, these predicted problems did not appear in Aceh during relief action after the Tsunami. The Internet infrastructure was built in very short time. Some causal factors of this success are :

- 1.1. [*Big motivation to provide solution*]. Motivation is the non technical factor that cannot be neglected in the emergency situation. A big motivation will encourage the people to find any possible solution as well as to do the collaboration. They tend to think out of the box to provide alternative an unusual solution.
- 1.2. [*Freedom of administration*]. By minimizing the administration and bureaucracy Air Putih can operate very flexible and faster.
- 1.3. [*Tasks organization is flexible*]. The structure of the organization itself is very flexible. Thus, the assignment of who should be responsible to perform which task is very flexible. It can reduce the organization time which requires by "normal" organization.
- 1.4. [*The environment is socially co-operative*].

1.2. [*Freedom of administration*]. Many activities do not need a complex administration or paper works. Each time there are volunteers they can choose the work and start to work.

1.1. [*Big motivation to provide solution*].

- 1.1.1 [*To save and help other people life*].

1.1.1 [*To save and help other people life*]. Volunteers in the relief action are driven by the intention to save other people life, to provide help to other people. There are also some people who are working as professional in the help organization, such as WHO, THW, etc.

1.3. [*Tasks organization is flexible*]. The tasks during the relief actions were determined in a flexible way.

- 1.3.1. [*Tasks can be selected freely and performed quickly*].
- 1.3.2. [*People choose task that they can do*].
- 1.4.1. [*Freedom of organization*]. Since the beginning of Air Putih activities, I have been involving with them.

1.3.2. [*People choose task that they can do*]. In Air Putih, the volunteers are not bounded officially, they can choose the works based on their own interest and their times.

1.3.1. [*Tasks can be selected freely and performed quickly*].

- 1.2. [*Freedom of administration*].
- 1.3.1.1. [*Works can be distributed small enough*].

1.3.1.1. [*Works can be distributed small enough*]. Tasks are divided into a small and do-able work.

- 1.3.1.1.1. [*A small work contributes positively in the whole system*].
- 1.3.1.1.2. [*Highly parallel and not dependent each other*].

1.3.1.1.1. [*A small work contributes positively in the whole system*]. Since before the Tsunami there was not many telecommunication and Internet infrastructure in Aceh, a small contribution provides significant results.

1.3.1.1.2. [*Highly parallel and not dependent each other*]. Many works were very simple and do not need complex coordinations with other parties. To finish the works, they also did not need to wait other works.

1.4. [*The environment is socially co-operative*]. Before the Tsunami, the political situation in Aceh war in a conflict situation. However, during the relief actions, some parties were willing to co-operative to do the relief actions.

- 1.4.1. [*Freedom of organization*]. Since everybody voluntarily joined Air Putih, they are ready to co-operative each other in performing activities. Other organizations and persons which interacts with Air Putih also establish the works in voluntarily basis. Person can establish the collaboration without considering their official organizations or groups. The attachment to the official organization were not strong.

1.4.1. [*Freedom of organization*]. The Air Putih organization is very flexible, every body can join, and involve in activities. They can choose what they can contribute. There is no registration, no complex paper-works.

The node in this LWBG show the characteristic of the projects that can be handle using the same approach as Air Putih in Aceh. The main success factors of Air Putih are (as terminal node) :

- 1.1.1 [*To save and help other people life*].
- 1.2. [*Freedom of administration*].
- 1.3.1.1.1. [*A small work contributes positively in the whole system*]
- 1.3.1.1.2. [*Highly parallel and not dependent each other*].
- 1.3.2. [*People choose task that they can do*]
- 1.2. [*Freedom of administration*]

This characteristics has many similarities with the Open Source Development model. It is shown that using LWBA, I can identify the characteristics that contribute to the success of Air Putih work during the Tsunami relief action.

5.3 Project model

As an Emergency Response Team, most activities of Air Putih Foundation can be classified as unplanned activities and should be delivered as quick response of emergency situation [Nations, 1991]. Being well known in Indonesia as the Information

and Communication Technology Emergency Response Team, Air Putih foundation has involved many time to handle this type of activities after natural disasters such as earthquakes, tsunami etc. The information system now plays important role in the relief actions as mandated by the UN General Assembly o in 1997 Resolutions 51/194 [Naidoo, 2007]. Basically, the information system during the relief action has following tasks :

- Disaster communication systems for relief purposes
- Communication needs of disaster management
- Tactical communications (among relief workers on disaster site with province & state administrations)
- Strategic communications (among affected area with country and the outside world)

The main characteristics of the project handled during Tsunami relief are :

- The program is a response of an emergency situation. Mostly without being appointed officially by any official organization. Most initiative comes from Air Putih Foundation.
- The projects should be performed in very limited time. The implementation has to be proceed as soon as possible without waiting the requirements from the clients (practically there is no party as client in this project). Therefore, the requirement analysis and the design phase has to be performed as quick as possible
- There are various groups of users with their own characters as well as expected services. Also their own culture (organization culture, as well as national culture). The coordination and communication between the organization is not well defined and without any official contract.

- A good design is difficult to be implemented due to various limitation such as, time, budget as well as the knowledge of other parties. Therefore, an acceptable design is preferred rather than the best design. Some adjustments should be taken in implementing the design. However, these adjustments have to be tracked.

- The developers or parties involved in the project not all in the same location. Thus, Internet plays important role as communication tools in development process. Moreover, many developers do not known each other before the project.

During the Tsunami relief action and post-Tsunami some ICT related projects were also performed by Air Putih Foundation. Those projects are :

- **Sistem Informasi Gempa** (SIGAP), a mapping application to inform public about the earthquake. Public can access more detail information regarding earthquake, and Tsunami information [Harapan, 2007].

- **Sistem Informasi Puskesma**s (SIMPUS), is a information system to manage the public health in Aceh. This information system initially developed by GTZ and Malteser International [Gutsmiedl, 2008].

Even for a long term projects (2 years) such as the Open Source Migration project [Sudane, 2008] a '*conventiona*l' project model cannot be employed. It is not due to the laziness, but to the very specific type of works. Due to these characteristics, it was very difficult to employ an existing development method. To investigate why the available methods cannot be employed I draw LWBG as shown in Fig. 5.6.

Description of LWBG : Need a new development method (See Fig. 5.6)

1. [*Available system development methods cannot be used*]. Many available or known development models such as waterfall, SDLC cannot be used in this type of projects.

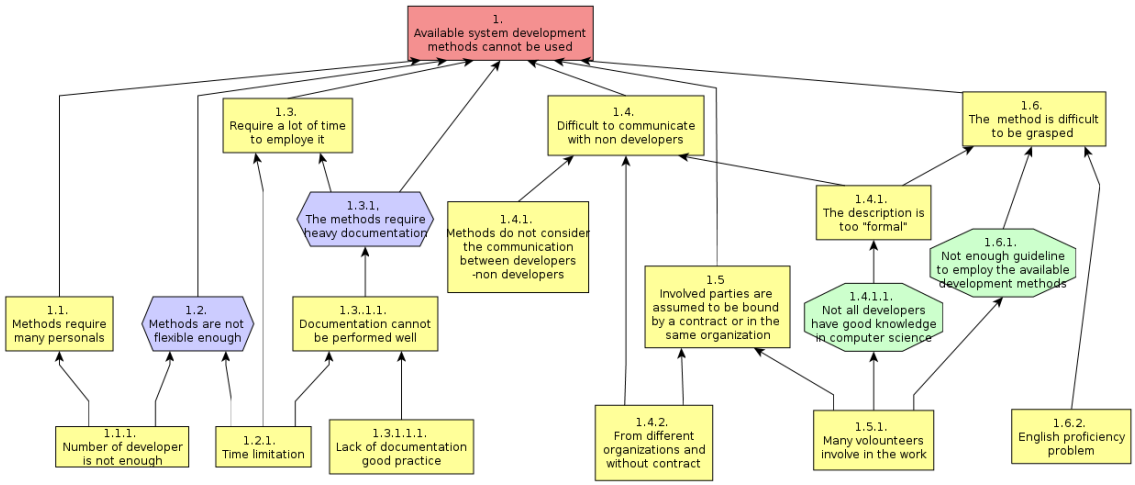

Figure 5.6: LWBG: Need a new development method

- 1.1. [*Method requires many personals*]. In an emergency situation, number of volunteers or persons who involve in the project is always limited. Thus, the development should use as small as possible number of people.
- 1.2. ◆ [*Methods are not flexible enough*]. In the emergency situation, flexibility play an important role.
- 1.3. [*Require a lot of time to employ it*].
- 1.4. [*Difficult to communicate with non developers*]. Developers have to communicate with various persons. Many method require special notation, such as different type of notations. In many cases, developers have to communicate with non developers who involve in the process.
- 1.5. [*Involve parties are assumed to be bound by a contract or in the same organization*].
- 1.6. [*The method is difficult to be grasped*].

1.1. [*Method requires many personals*]. Many development methods require many personals to implement. In the emergency situation it is the big obstacle. Many development model separate each phase into different groups of people. It means that the development process requires many groups of people.

- 1.1.1 [*Number of developer is not enough*]. In the tsunami area the number of volunteers is always limited. They are also need for other non ICT related jobs.

1.2.◆ [*Methods are not flexible enough*]. Many development methods are very strict about the phase and the structure of the teams. In the emergency situation the role of participants are not clearly defined.

- 1.2.1. [*Time limitation*].

1.3. [*Require a lot of time to employ it*]. Many development methods requires a lot of time to employ them, because each phase can only be proceed after the previous phase is finished.

- 1.3.1.◆ [*The methods require heavy documentation*]

1.4. [*Difficult to communicate with non developers*]. Many development methods use notation that cannot be understood by non developers easily, for example public, or stakeholders. Furthermore, many development methods have various model of diagrams. It produce the complexity for people to understand it.

- 1.4.1. [*Methods do not consider the communication between developer-non developers*]

- 1.4.2. [*From different organizations and without contract*].

1.5. [*Involved parties are assumed to be bounded by a contract or in the same organization*]. In works such as relief action, the participant of relief action are not bounded by a contract. Furthermore, some of them do not belong to any official organization.

- 1.5.1. [*Many volunteers involve in the work*]

1.6. [*The method is difficult to be grasped*]. Many development methods and the notations are too complicated for casual developers. In relief action, the availability of human resource is very limited.

- 1.6.1.● [*Not enough guideline to employ the available development methods*]
- 1.6.2. [*English proficiency problem*].

1.1.1 [*Number of developer is not enough*]. In the emergency situation, there is always lack of people.

1.2.1. [*Time limitation*]. In emergency situation, the intention is to provide the solution as fast as possible.

1.3.1.◆ [*The methods require heavy documentation*]. Many methods assumes that the developers always has enough time to perform the detail documentation.

- 1.3.1.1. [*Documentation cannot be performed well*]

1.3.1.1. [*Documentation cannot be performed well*]. Many works during the relief actions were not well documented. Such as, how the server was installed and configured.

- 1.3.1.1.1. [*Lack of documentation of good practice*].

1.3.1.1.1. [*Lack of documentation of good practice*]. Some participants in the relief action do not have good practice in documenting their works.

1.4.1. [*Methods do not consider the communication between developer-non developers*]. Most development methods only concerns the communication among the developers, or from customer to developers. The communication between developer to non developers has not been considered as an important factor in formalizing the development method.

- 1.4.1.1.● [*Many developers do not have good knowledge in computer science*].

1.4.2. [*From different organizations and without contract*]. Many organization which active and involve in the relief action are voluntary, most of them do not have an official contract between them. Trust is established by having the same goal to save the people life.

1.4.1.1. ● [*Many developers do not have good knowledge in computer science*]. The volunteer have various background, their knowledge about computer is limited, but they want to joint the relief action.

1.5.1. [*Many volunteers involve in the work*]. During the relief many volunteers joint the action. Some of them are professionally working for the organizations, some of them belong to an organization, and some of them do not belong to any organization. *"Voluntary"* have different meaning between people Indonesia and several Western countries.

1.6.1. [*Not enough guideline to employ the available development methods*]. In the emergency situations, for developers who are not familiar with particular development method get the guideline or practical knowledge about the methods is always big problem. Therefore, they just prefer not to do it, if they do not know it.

1.6.2. [*English proficiency problem*]. For some of the volunteers, English is always still language, they can communicate orally but cannot write the documentation in English well.

Improvement as suggested by LWBA: From the analysis in LWBG as shown in Fig. 5.6 that Air Putih has employed some form of a novel system development model that has following main characteristics :

- 1.2. ◆ [*Methods are not flexible enough*]. The flexibility of method is an important requirement, due to the nature of projects. Thus it yields the method which can be classified into Agile method rather than Heavyweight methods. It will described further in Chap. 9.

- 1.3.1. ◆ [*The methods require heavy documentation*]. Air Putih decided to choose a mechanism that do not rely on the heavy documentation. The documentation is should help the works, but not as an extra load.

This development model is not designed or invented, but evolve during various Air Putih activities. In this work, I only try to capture the interaction and how the work and formalize it into the proposed system development method. To capture this development model, I did interview using Internet such as email, chat as well as involving actively in the Air Putih activities. Since the beginning of Air Putih activities, I have been involving with them very closely. This is the "action participatory part" of my research. During this part I also contribute in the evolution of those development process.

The phase of development in Air Putih can be captured and shown in Fig. 5.7. The significant different of the development model compare to conventional model are :

- The human resource such as graphic designer, programmer etc cannot be selected freely, but depends on which developer are available or willing to work in this project. Therefore, there is always the learning process in the development process. The learning process is performed by the technical coordinator or designer to bring the programmer or graphic designer understand or can implement the designed system.

- The resources such as hardware or network cannot be requested freely. Most of the time members of Air Putih only depends on resources that are available.

- In this type or project, various organizations involve, each organization has their own cultures and their constraints. Understanding them will be a big assistance in defining the system. In the design, the organization is assumed that cannot be changed in short time.

The development is performed in following orders:

- The development model starts by understanding and defining users. Each group of users has their own expected services is derived as well as the risk of each services. In an emergency situation it is impossible to provide all expected services from all users, because there are many constraints.

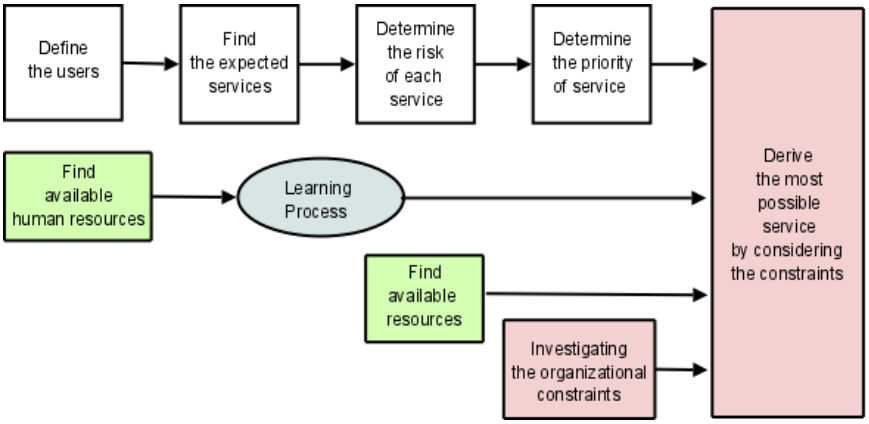

Figure 5.7: Development phase in emergency situation

- Finding the human resources which support the projects. In the emergency situation, acquiring the human resource is not as easy as in the corporate setting. In emergency situation, the human resources are always limited. Therefore, in the development model the learning process is embedded in the development model.

- Finding the other resources such as physical and electrical resources.

- One important thing before developing the solution is to investigate the organizational constrains.

- From users groups, expected services, available human resources, technical resources as well as organizational constraints, system is specified and developed.

Flexibility of development methods as well as the components use for the implementation of system plays important role in this type of project. Therefore, Air Putih decided to use COTS (Commercial Off The Shelf). This decision based on the socio-technic considerations [Douglas Kunda, 1999]. However, COTS is more in the term of **Component-Off-The Shelf**, since the decision to employ more Open Source Software in the projects. The recent Open Software Source (OSS) has change the COTS market [Maurizio Morisio, 2002]. Therefore, finding the COTS OSS is more suitable for the projects that is similar with Air Putih activities.

5.4 Summary

In this Chapter, it has been demonstrated that in a particular situation developers employ a development method without they define it before hand. The development method evolves due to the flexibility of the method in order to achieve the goal. Basically the development method is performed to ensure the sustainability of system. The Air Putih work during the tsunami relief action, is a special type of work that requires special system development method.

I also addresses how to extract the successful but unknown method, I interviewed and involved actively with Air Putih and communicate with Internet. It also shown that Internet can be used as research tool. Furthermore, the LWBA is used to extract the result of this ethnography study and to understand the nature of projects, as well as to derive the good practices and the system development method of Air Putih. LWBA is also used to identify problems of existing development methods and to formalize the new system development methods based on the experience in Air Putih works. This new development model has many similarities with Agile method and Open Source Development method.

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Chapter 6

Early Warning Information System

In this chapter I focus on how the implementation phase in the proposed system development method is performed. I also demonstrate, how to use LWBA to perform the requirement elicitation and analysis. In this example, the requirement is triggered by an incident. Furthermore, I also describe, how LWBA can be used to refine the implementation and as well as ability to track the decision during the implementation phase. I also elaborate how LWBA can be used to correct the sustainability problem of design.

Learning from the impact of absence the Tsunami Early Warning System, the effort to build the Early Warning System (EWS) in Indonesia is initiated. GITEWS (German Indonesian Tsunami Early Warning System) project was initiated by German government to develop a tsunami early warning system for Indonesia [C. Falck, 2009]. This Tsunami early warning system is integral part of multi-hazard Early Warning System for the registration of other natural catastrophes including earthquakes and volcanic eruptions. The system integrates terrestrial seismologic and geodetic monitoring arrays with marine and satellite-based observation platform. GITEWS initiative is coordinated by Helmholtz Association of German Research Center, and represented by the GeoForschungZentrum Potsdam with the project partners.

The GITEWS system consists of various component such as the sensor network, simulation modeling and Decision Support System (DSS). The GITEWS still focuses on the measurement, detection and risk modeling of the Tsunami. For delivering the notifications and services, the GITEWS has planned the Service Oriented Architec-

ture (SOA). Unfortunately, it still be planned to be finished on 2010 [GITEWS, 2009].

The Early Warning System is managed by BMG (*Badan Meteorologi dan Geofisika* - Indonesian Meteorological and Geophysical Agency), BMG is the Indonesian non department government for meteorology. The system itself will be used by scientists and government officers at warning center. There is no information delivery to the public directly from the GITEWS systems. According to the Disaster Management Bill, the Vice President of Indonesia has appointed following institutions [Loewe, 2008] to handle the disaster management :

- Early Warning System (Meteorology and Geophysics Agency - BMG)
- Public education and preparedness (Indonesian Institute of Sciences - LIPI)
- Communication and information (Ministry of Communication and Information - KOMINFO)
- Emergency response (National Coordinating Agency for Disaster Response and Displaced People - BAKORNAS)

6.1 Early warning incident

In the current Early Warning System, the dissemination the alert to the public had not been taken into serious consideration by developers. The end users had not been taken into account of the design of Early Warning System. Ignorance of the end users interaction programming can kill people [Thimbleby, 2008], and it has been demonstrated by this early warning incident .

BMG has developed the Tsunami alert warning using SMS, it has been available on mid August 2006. BMG collaborates with Telkomsel (a cellular provider in Indonesia). This collaboration enables BMG to broadcast warnings to government officers, military/police officers via Short Message Service (SMS). The advisory from BMG is sent according to the potentially of Tsunami [Loewe, 2008]:

- Earthquake magnitude > 5 Richter: warning is sent to via SMS to BMG staffs

- Earthquake magnitude > 6 Richter: warning is sent to the officers in related agencies

- Earthquake magnitude > 7 Richter: BMG informs to Ministers of Science and Technology, Communication and Information, Transportation, Internal Affairs and the Office of the President.

Although, the early warning system produces a warning, but if the dissemination to public failed, the whole system cannot performed the function as being designed. Due to delay or absence of delivery warning to the public, some incidents has occurred. As reported by many news papers , since the public was not informed about the Tsunami warning even though the government officer received the warning [Lewis, 2006], However, a SMS messages has limitation, it is only 150 characters. The government officers did not release the warning to the public because they were not sure about the tsunami possibility [Aglion, 2006] and they did not want to threaten people [Edmonton, 2006]. The false early warning system can create panic in public, and they run without coordination as happened in Aceh [Raihan, 2007]. Moreover, even if the government had tried to contact local authorities by telephone, or radio. The warning still could not be delivered to the public, since there is no system to delivered this warning to public [CBC, 2006]. There was no evacuation action was performed before the Tsunami in Java, and there were more than 340 victims [Deutsch, 2006].

After this incident, Indonesia government via Ministry of Communication and Information decided to deploy the dissemination system to the public. Developing a reliable, practical Early Warning Information System (EWIS) is a must, and cannot wait until the dissemination system of GITEWS installed in 2010. According to the Indonesia's constitution Geophysical and Meteorological Institution (*Badan Meteorologi dan Geofisika* - ***BMG***) owns the legal standing to deliver all related information and early warning messages to related government institutions and media wide, domestically and widely[Loewe, 2008]. Air Putih foundation has been already known has experiences during relief action in Aceh, as well as in providing the warning system for Tsunami via satellite [Nurhayati, 2007]. The Indonesia government

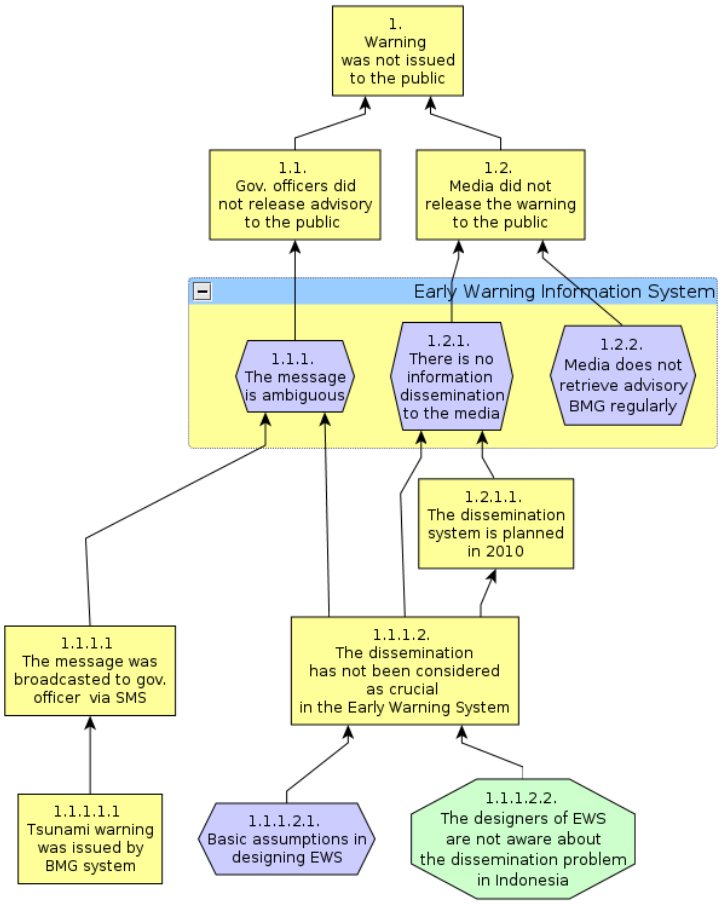


Figure 6.1: LWBG : Problem of existing Early Warning System

requested Air Putih foundation to develop the Early Warning Information System (EWIS) as fast as possible [Putih, 2007a].

As one of advisers in Air Putih Foundation, I participated to design the EWIS. First, I has to identify the current problem in designing the EWIS, thus I draw the LWBG of the incident due to the absence of a good Early Warning Information System. This LWBG is used to investigate the root causal of this incident it is shown in Fig 6.1. The non technical aspects such as organizations and regulation are also investigated. This LWBG leaded to the design specification of EWIS.

Description of LWBG : Problem of existing Early Warning System (See Fig. 6.1)

1. [*Warning was not issued to the public*]. As reported by several media, the warning was not conveyed to the public [Lewis, 2006], [Aglion, 2006], [Deutsch, 2006].

- 1.1. [*Gov officers did not release advisory to the public*]. Public in Indonesia knew the warning from the local authority, police department as well as other government bodies. But they did not release any warning.
- 1.2. [*Media did not release the warning to the public*]. There is no media, that reported the warning.

1.1. [*Gov. officers did not release advisory to the public*]. To prevent the panic in public, government officers decided not to release the warning to public [Edmonton, 2006].

- 1.1.1. ◆ [*The message is ambiguous*]

1.1.1. ◆ [*The message is ambiguous*]. The SMS message does not explain clearly the potential of Tsunami of the earthquake. The BMG message did not state it clearly.

- 1.1.1.1. [*The message was broadcasted to gov.officer via SMS*].
- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]

1.1.1.1. [*The message was broadcasted to gov. officer via SMS*]. The existing early warning dissemination system from BMG delivered the message to the government officers via SMS.

- 1.1.1.1.1. [*Tsunami warning was issued by BMG system*]

1.1.1.1.1. [*Tsunami warning was issued by BMG system*]. In this incident, the warning has been sent by the BMG.

1.2. [*Media did not release the warning to the public*]. The early warning system of BMG only broadcasts SMS to the police and government officers, but not

directly to the TV or radio [Loewe, 2008]. In an emergency situation the public should be informed as soon as possible. As shown by Fig. 6.2, a survey in the people in Tsunami area, Nias, public still expect the Tsunami warning are received from the local government, and media (TV, radio, news paper).

- 1.2.1.◆ [*There is no information dissemination to the media*]
- 1.2.2.◆ [*Media does not retrieve advisory BMG regularly*]

1.2.2.◆ [*Media does not retrieve advisory BMG regularly*]. Media cannot retrieve the final advisory from BMG, they can only access the warning system in Internet but from other international resources.

1.2.1.◆ [*There is no information dissemination to the media*]. The existing early warning system did not deliver the warning to the media, they only send SMS to government officers.

- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]
- 1.2.1.1. [*The dissemination system is planned in 2010*]

1.2.1.1. [*The dissemination system is planned in 2010*]. The dissemination of early warning information to the public is not considered important. The GITEWS plans the project will be installed on 2010 [GITEWS, 2009].

- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]

1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]. The main problem of the Early Warning System design such as GITEWS is the absence of Early Warning dissemination process to the public. The GITEWS focuses only on the detection, modeling and decision support

- 1.1.1.2.1.◆ [*Basic assumptions in designing EWS*]
- 1.1.1.2.2.● [*The designers of EWS are not aware about the dissemination problem in Indonesia*]

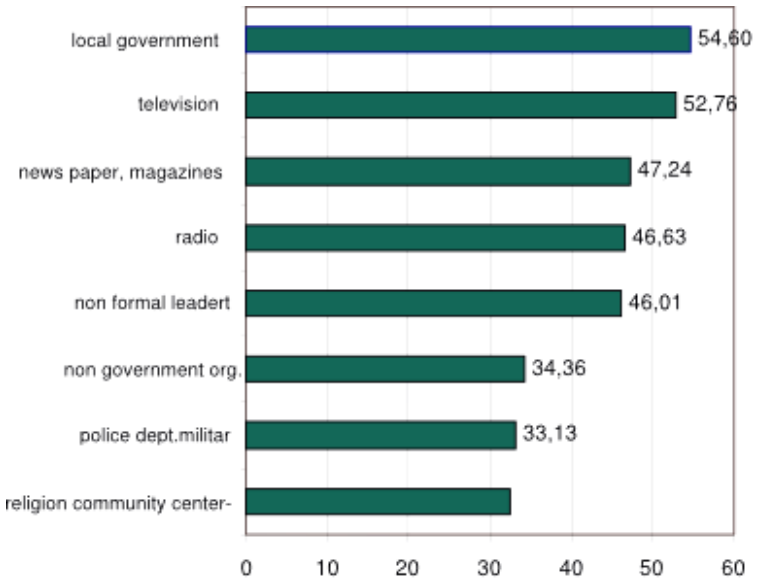


Figure 6.2: How public expect the warning information[Nugroho, 2007]

- 1.1.1.◆ [*The message is ambiguous*]

1.1.1.2.2.● [*The designers of EWS are not aware about the dissemination problem in Indonesia*]. The designers of GITEWS assumed that the dissemination to the public is not a significant problem. However, the Indonesia situation is very different with the situation of the designer of GITEWS (in Germany). In Indonesia the dissemination and capacity building of the public should be put in the first priority before design can be implemented. This node show how the sustainability Case-1 appears in this incident.

Improvement suggested by LWBA: From the LWBG shown in Fig. 6.1, in order to prevent the same incident as stated as the top node 1. [*Warning was not issued to the public*], EWIS should has following characteristics as countermeasures that prevent this node to appear.

- 1.1.1.◆ [*The message is ambiguous*]. The message format should be unambiguous. The recipient can interpret them correctly, the message is also robust to the error during delivery.

- 1.2.2.◆ [*Media does not retrieve advisory BMG regularly*]. Rather than expecting the initiative from the media, BMG should be more active in pushing the warning to media.

- 1.2.1.◆ [*There is no information dissemination to the media*]. The dissemination system should deliver the warning directly to the media such as television and radio.

However to ensure the sustainable system, There organizational change is should be notified during the development :

- 1.1.1.2.2.● [*The designers of EWS are not aware about the dissemination problem in Indonesia*]. It is the learning part of the proposed development method. In this proposed approach, it is identified that the learning process should be included as the condition in developing the system.

The use of SMS for delivering the warning has a problem due to the length of message (150 characters). As demonstrated by the Early Warning Incidents during the Pangandaran Tsunami. The government officers could not decide actions that should be taken, due to the lack of information. The warning is only 150 characters without any suggesting action. In designing a better early warning dissemination system, the misinterpretation the short message was taken into account. To understand this misinterpretation incident, I executed analysis as shown in Fig. 6.3, this analysis was used also to inform to the stakeholder about the needs of the annotation system for warning message. Communication to the stakeholders is important in the development process.

Description of LWBG : Why requires an annotation. See Fig. 6.3.

1. [*Misinterpretation of message*]. As shown by incident, the government officers misinterpreted the warning. They assumed that there would be no Tsunami.

- 1.1. [*Each group of users have their own preference of interpretation*]

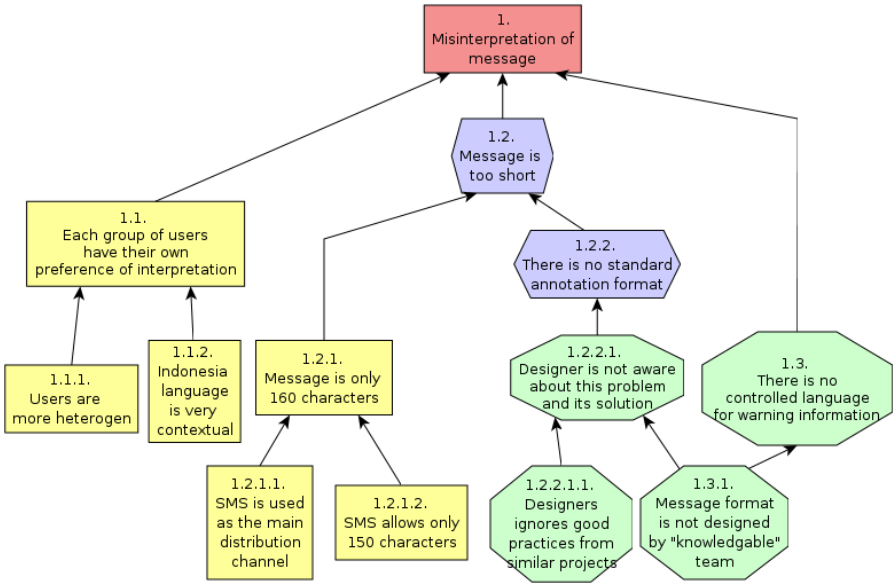


Figure 6.3: LWBG: Why requires an annotation

- 1.2. ◆ [*Message is too short*]
- 1.3. ● [*There is no controlled language for warning information*]

1.1. [*Each group of users have their own preference of interpretation*]. Since the same message was sent to different people, without any guidance to interpret it, users can interpret it differently.

- 1.1.1. [*Users are more heterogen*]
- 1.1.2. [*Indonesia language is very contextual*]

1.1.1. [*Users are more heterogen*]. The warning is sent to various people, from the Ministry, local government and police/military officers. The local government officers have also different knowledge and education background. It influences how they interpret the warning.

1.1.2. [*Indonesia language is very contextual*]. As described in Chap. 4. Indonesia language is very contextual, the meaning of words depends on the context and the speaker.

1.2. ◆ [*Message is too short*]. The length of message limits more detail information, such as actions that should be taken, etc. The recipient has to understand it.

- 1.2.1. [*Message is only 160 characters*]
- 1.2.2. ◆ [*There is no standard annotation format*]

1.2.1. [*Message is only 160 characters*]. BMG decided to use MS to send the warning. The limitation of message length of SMS determine the Lent of warning.

- 1.2.1.1 [*SMS is used as the main distribution channel*]
- 1.2.1.2. [*SMS allow only 160 characters*]

1.2.1.1 [*SMS is used as the main distribution channel*]. SMS is selected as the distribution channel, because it is very economics and can reach public widely.

1.2.1.2. [*SMS allow only 160 characters*]. One SMS message can contain at most 140 bytes (1120 bits) of data. Thus, one SMS message can contain up to: 160 characters for 7-bit character encoding. 7-bit character encoding is used for Indonesia language.

1.2.2. ◆ [*There is no standard annotation format*]. BMG has not developed the standard annotation for delivering the early warning information to various stakeholders.

- 1.2.2.1. ● [*Designer is not aware about this problem and its solution*]

1.2.2.1. ● [*Designer is not aware about this problem and its solution*]. The designer of early warning system has background in technical aspects, and just neglect the non technical aspects

- 1.2.2.1.1. ● [*Designers ignores good practices from similar projects*]
- 1.3.1. [*Message format is not designed by "knowledge" team*]

1.2.2.1.1. ● [*Designers ignores good practices from similar projects*]. Some other projects, actually has already developed the good practice for disseminating the warning to public [RIzalid Boer, 2006].

1.3. ● [*There is no controlled language for warning information*]. Until the design of EWIS, none of the BMG persons who is aware about the controlled language, or any standard message content to deliver the message.

- 1.3.1. ● [*Message format is not designed by "knowledgeable" team*]

1.3.1. [*Message format is not designed by "knowledgeable" team*]. The message format is designed without considering several aspects such as integrity, non repudiation. It is still designed in ad hoc manner.

Improvement suggested by LWBA: To prevent the misinterpretation of short messages, the annotation mechanism should be used. This annotation mechanism is expected to prevent the misinterpretation by providing the countermeasure of following nodes :

- 1.2. ◆ [*Message is too short*]. The message should be long enough, for particular users. Other technology should be employed.
- 1.2.2. ◆ [*There is no standard annotation format*]. A standard annotation should be defined, before the annotation system can be developed.

However, some organizational learning should be taken into account such as:

- 1.2.2.1. ● [*Designer is not aware about this problem and its solution*]. The designer should start to consider other non technical aspect in designing system
- 1.2.2.1.1. ● [*Designers ignores good practices from similar projects*]. Information from the similar projects should be collected and used if possible.
- 1.3. ● [*There is no controlled language for warning information*]. A controlled language should be defined, however it requires a long process, but it should be started.

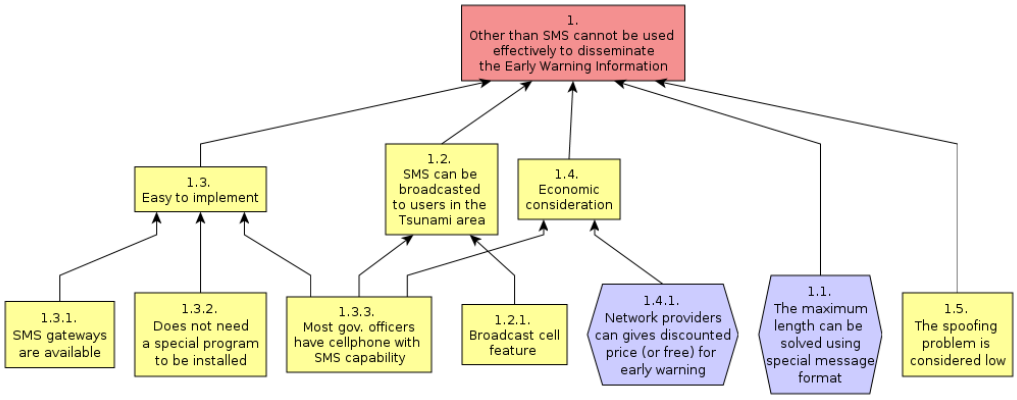


Figure 6.4: LWBG: Using SMS

- 1.3.1.● [*Message format is not designed by "knowledge" team*]. For a better message format, people from various discipline should involve in designing the message format.

BMG still decided to use SMS for delivering the warning to government officers, police/military officers, because it was still the best available option. To investigate this decision I draw the LWBG as in Fig. 6.4.

Description of LWBG : Using SMS. See Fig. 6.4

1. [*Other than SMS cannot be used effectively to disseminate the Early Warning Information*]. Due to the geographic situation, and the limited access of Internet, in Indonesia Short Message Service (SMS) is still the best method to deliver the short information. It can be sent immediately, and can reach many users easily. Moreover, many people in Indonesia from different background has been familiar with this technology. One major advantage of SMS is that it is supported by 100% GSM mobile phones.

- 1.1.◆ [*The maximum length can be solved using special message format*]
- 1.2. [*SMS can be broadcasted to users in the Tsunami area*]
- 1.3. [*Easy to Implement*]

- 1.4. [*Economic consideration*]
- 1.5. [*The spoofing problem is considered low*]. The providers can install the countermeasure for the SMS spoofing [Openmind,]

1.1. ◆ [*The maximum length can be solved using special message format*]. To solve this problem, the extension of SMS called concatenated SMS (long SMS) can be used. In this mechanism, the long message will be broke down into smaller parts, and they are sent each of them as single SMS. When messages arrive at the destination, the mobile phone will combine into long message.

1.2. [*SMS can be broadcasted to users in the Tsunami area*]

1.5. [*The spoofing problem is considered low*]. The BMG considers that SMS spoofing in Indonesia is still low.

- 1.2.1. [*Broadcast cell feature*]
- 1.3.3. [*Most gov. officers have cellphone with SMS capability*]

1.5. [*The spoofing problem is considered low*]. SMS Spoofing occurs when a fraudster manipulates address information in order to impersonate a user that has roamed onto a foreign network and is submitting messages to the home network. Frequently, these messages are addressed to destinations outside the home network – with the home SMSC essentially being "hijacked" to send messages into other networks [William Enck, 2005].

1.2.1. [*Broadcast cell feature*]. As defined in Short Message Service Cell Broadcast (SMS-CB) [GSM 03.41]. using this capability it is possible to broadcast the public information to all mobile users in a specified geographical area [3GPP, 2003].

1.3. [*Easy to Implement*]. Due to the time limitation, the complexity of implementation, should be taken into account.

- 1.3.1. [*SMS gateways are available*]

- 1.3.2. [*Does not need special program to be installed*]
- 1.3.3. [*Most gov. officers have cellphone with SMS capability*]

1.3.1. [*SMS gateways are available*]. During the system development, there were already many SMS gateways already available in Indonesia. SMS is the most popular mobile service in Indonesia.

1.3.2. [*Does not need special program to be installed*]

1.3.3. [*Most gov. officers have cellphone with SMS capability*]

1.4. [*Economic consideration*]. Cost consideration is very important in a developing countries to ensure the sustainability of the system.

- 1.3.3. [*Most gov. officers have cellphone with SMS capability*]
- 1.4.1.◆ [*Network providers gives discounted price (or free) for early warning*].

1.4.1.◆ [*Network providers gives discounted price (or free) for early warning*]. The SMS is a good candidate, since it does not consume much bandwidth, and many providers want to provide it for free for the public.

Improvement suggested by LWBA: To use SMS efficiently as the delivery mechanism in the EWIS, some factors should be considers in the operation of the system:

- 1.4.1.◆ [*Network providers gives discounted price (or free) for early warning*]. A special co-operation between various cell-phone providers had to be established. In this project, the cell phone providers had provided this services for free, because it is important for public safety.
- 1.1.◆ [*The maximum length can be solved using special message format*]. The concatenated SMS can be used to solve this problem.

6.2 Background of project

Basically, this system distributes the early warning information received from the BMG to various media, The EWIS distributes the warning to:

- **To TV/Radio and other media online**, In each TV/radio station there is a client installed that display warnings. In TV station the warning is converted automatically to TARGA format, and then it is mixed directly to the video signal. The warnings are broadcasted directly in televisions as running text. In the radio station, the announcers announce the warning. In various location, the sirens automatically sound if there is a possibility of Tsunami.

- **To registered users, such as government officers via SMS**. By collaborating with cellular providers, the warnings are broadcasted to the government officer, military/police officers as well as other registered users. The BMG maintains the database of registered users.

- **To public in Tsunami area, using cell broadcast SMS.** The system sends SMS to the BTS of cellular operator in the Tsunami area according to the information from BMG. A Cell broadcast is sent to all cell phone in that area.

- **To public using Internet**. The client program is also provided for public. Using this client program, public can monitor in real time the warning. The client program is available for MS Windows and Linux platform.

The project was finished in about 2 months, from the requirement phase until the deployment as shown in Tab. 6.1. During the development, there was only 1 developers (Sahir) who developed the system as well as client program. There were also other 2 persons (Imron and Agus) for supporting the deployment process, such as server and client installation as well as the short training to users. All developers communicated and collaborated using Internet. During this project, as designer, I had no direct face-to-face meeting with developers. We only communicated via e-mail, and messenger. Since I was located in Bielefeld, Germany, I could not involve in the final

Date	Milestone
2006-07-31	Starting the project
2006-08-03	First meeting between developers and parties involved in projects
2006-08-04	Information about network configuration was received, it was fixed
2006-08-09	The design had been finished, requested hardware
2006-08-14	The equipment arrived and was available for developer
2006-08-22	The 1st prototype was shown to the users, to gather feed back
2008-08-24	Server was installed as well as all clients in various locations
2008-09-11	Deployed the system to server and client
2008-09-22	The first on-air. The warning message was displayed on television

Table 6.1: Milestones of project

decision meeting for the implementation. My involvement was only to identify the main problems and providing the initial design.

Air Putih Foundation has experience in handling the Emergency Response team, developers have been familiar with the domain of emergency situation. However, some constraints in this project had to be identified before the development of system, such as

- The regulation regarding early warning dissemination.
- Minimal number of meeting and coordination with BMG. Therefore, to develop with many iterations was very difficult
- Minimal information and documentation, about the system in BMG as well as the warning message format.

LWBA is very useful for finding the constraint and to explore the countermeasure that prevent the incident.

6.3 Development process

6.3.1 User identification

To understand the user expectations, I grouped the user as shown in Tab. 6.2.

Users	Type of expected information	Goal	Risk
Regional BMG	Detail information	To answer the question from the media/public	The delay and not complete information
Police/military officers	Short information via SMS, With more detail the information about impact and risk	To prepare the evacuation and coordination with other government agencies. They should receive the information before the public.	Too detail information which is not necessary. Information without the action information.
Media	Short	This information will be disseminated to public. The information should be short but informative.	A false or corrupted message
Public	Detail and short	Public an access the Tsunami warning from Internet.	An attack in web site.

Table 6.2: Users identification

6.3.2 Information flow

The early warning information which is distributed in TV/radio is as classified as informative message, not a coordinative or command. However, an inappropriate information produces a bad impact to the public, such as panic. Thus, the broadcasted information is depends on the audience who receives the information. The users and messages that their expected is shown in Fig. 6.5

Since there are various users, in developing the early warning information system

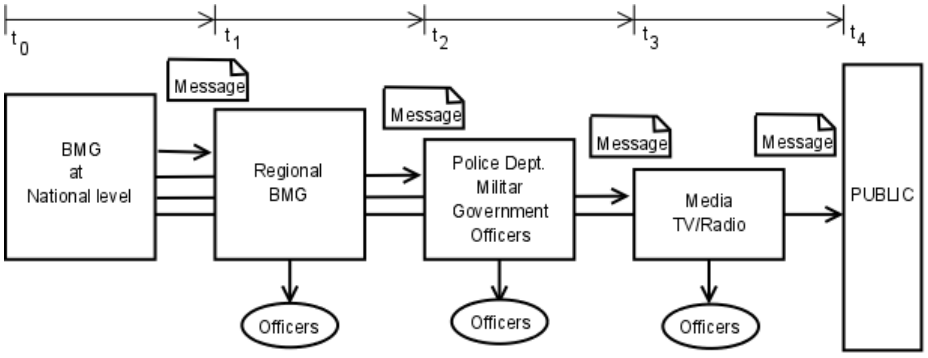


Figure 6.5: Users and messages

some considerations should be taken into account :

- Each group of users have different expected information. The detail, the narration style, and content. For example, the public does not need the detail latitude and longitude. For them, location information is preferred to be The city and distance from known city" rather than only "latitude and longitude.
- Not all message are distributed to the public. It will be better if the notification has some levels. Each group of users receives the message which in their level.
- An information about the action that should be taken after receiving the message, should also be informed.

Timing to deliver the warning is very important in managing disaster. Late in delivering the warning on the order a few minutes can increase the number of injuries and causalities. Japan only needs a few minutes to disseminate the warning to community [RIzalid Boer, 2006].

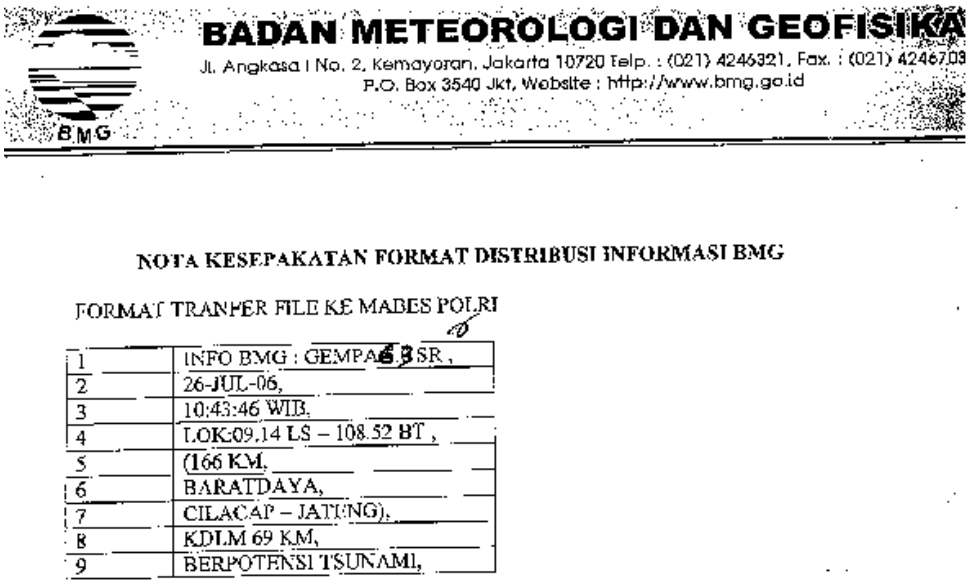
6.3.3 Message format

BMG provided information about the message format that they used to deliver the Tsunami advisory. This format based on a government regulation. These message as shown in Fig. 6.6 is broadcasted to the police department. Basically the BMG use two message format in their tsunami warning bulletin:

1. The message format for deliver the information about the earthquake that is **potential to produce a Tsunami**. As shown in Tab. 6.3
2. The message format for deliver the information about the earthquake that is **not potential to produce a Tsunami.** As shown in Tab. 6.4

Message format 1

This first message message is used to inform about the earthquake that can produce a tsunami. It is shown in Tab. 6.3. This message is sent in one SMS message, in



BADAN METEOROLOGI DAN GEOFISIKA

Jl. Angkasa I No. 2, Kemayoran, Jakarta 10720 Telp. : (021) 4246321, Fax. : (021) 4246703
P.O. Box 3540 Jkt, Website : http://www.bmg.go.id

NOTA KESEPAKATAN FORMAT DISTRIBUSI INFORMASI BMG

FORMAT TRANFER FILE KE MABES POLRI

1	INFO BMG : GEMPA6.3SR,
2	26-JUL-06,
3	10:43:46 WIB,
4	LOK:09.14 LS – 108.52 BT,
5	(166 KM,
6	BARATDAYA,
7	CILACAP – JATENG),
8	KDLM 69 KM,
9	BERPOTENSI TSUNAMI,

Figure 6.6: Message format used by BMG

Table 6.3: Message format of advisory from BMG

Line	Example	Description
1	`INFO BMG : GEMPA6.3SR`	Identification of Bulletin, Richter scale
2	`26-JUL-06`	Date
3	`10:43:46 WIB`	Time in GMT+7
4	`LOK:09.14 LS - 108.52BT`	Location in Longitude - Latitude
5	`(166KM,`	Location relative to known city
6	`BARATDAYA,`	
7	`CILACAP-JATENG),`	
8	`KDLM 69 KM,`	The depth of epicentrum
9	`BERPOTENSI TSUNAMI`	Tsunami possibility

following format :

```
INFO BMG : GEMPA6.3SR, 26-JUL-06, 10:43:46, LOK:09.14 LS - 108.52BT,
(166KM,  BARATDAYA, CILACAP-JATENG), KDLM 69 KM,  BERPOTENSI TSUNAMI,
```

Message format 2

This format as shown in Fig. 6.4 is used only to inform about the earthquake but without possibility of Tsunami. This message format will be sent in one SMS message in following format :

Table 6.4: Message format of advisory from BMG

Line	Example	Description
1	`INFO BMG : GEMPA6.3SR`	Identification of bulletin, Richter scale
2	`26-JUL-06`	Date
3	`10:43:46 WIB`	Time in GMT+7
4	`LOK:09.14 LS - 108.52BT`	Location in Longitude - Latitude
5	`(166KM,`	Location relative to known city
6	`BARATDAYA,`	
7	`CILACAP-JATENG,`	
8	`KDLM 69 KM,`	The depth of epicentrum
9		This field is blank if there is no possibility of Tsunami

```
INFO BMG : GEMPA6.3SR, 26-JUL-06, 10:43:46, LOK:09.14 LS - 108.52BT,
(166KM, BARATDAYA, CILACAP-JATENG), KDLM 69 KM,
```

Those two message formats are used by BMG to inform the earthquake advisories to the government officers via the Short Message System (SMS), that should be less than 150 characters. The government officers who receive the alert have to decide, whether the information can be forwarded to public or not. The problem with this dissemination system is the recipient cannot easily understand and there is not enough background information. The failure of understanding this message has a big effect such as the public was not informed, and the evacuation was not performed. To understand the problem of message format, I derive the LWBG as depicted in Fig. 6.7.

Description of LWBG : Problem of existing message (See Fig. 6.7).

1. [*Message is ambiguous*]. The first thing that I identify, is the message format. The message format is ambiguous. People who receives the message cannot understand exactly, the meaning, and the actions that expected to be taken.

- 1.1. [R*ecipient cannot distinguished between corrupted message or blank entry*]
- 1.2. [*Public cannot understand easily the "time"*]
- 1.3. [*Recipient doesn't know the action should be done*]

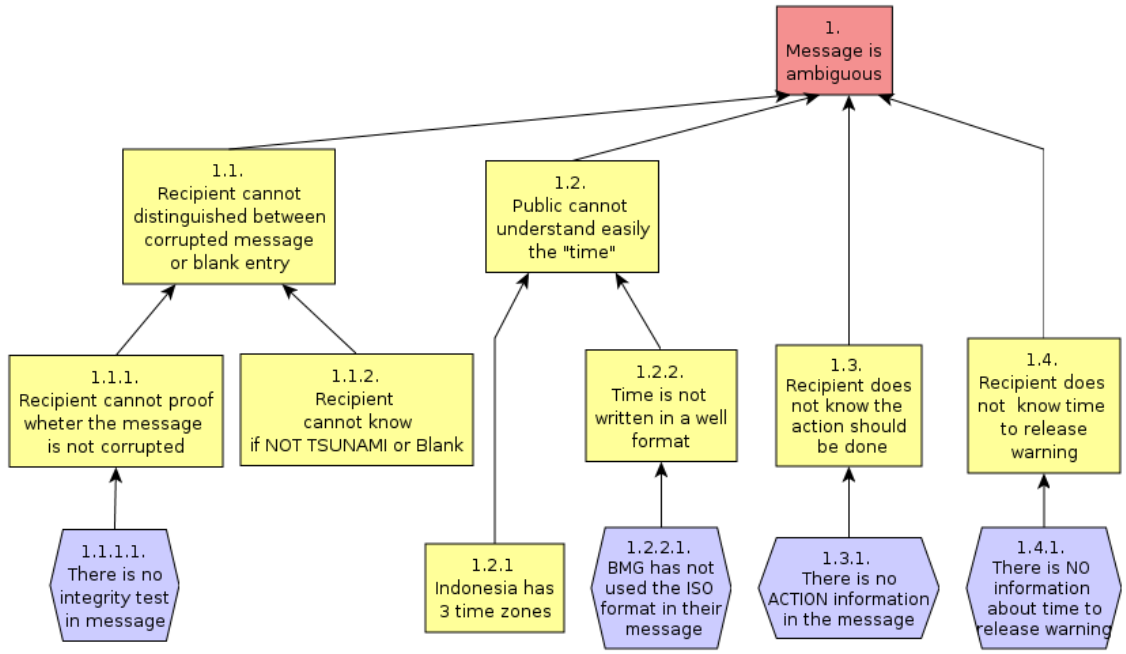


Figure 6.7: LWBG: Problem of existing message

- 1.4. [*Recipient doesn't know time to release warning*]

1.1. [*Recipient cannot distinguished between corrupted message or blank entry*]. In the current message format, if the earthquake does produce the Tsunami, the field will be BLANK. Thus, user cannot distinguish whether is blank (non Tsunami) or the message has been corrupted along the transfer.

- 1.1.1. [*Recipient cannot proof whether the message is corrupted*]
- 1.1.2. [*Recipient cannot know if NOT TSUNAMI or Blank*]

1.1.2. [*Recipient cannot know if NOT TSUNAMI or Blank*]. There is no mechanism to distinguish between NOT TSUNAMI or BLANK.

1.1.1. [*Recipient cannot proof whether the message is corrupted*]. There is no mechanism for user to check, whether the message is corrupted, Because the message is not added with additional information for this purposes.

- 1.1.1.1. ◆ [*There us no integrity test in message*]

1.1.1.1.◆ [*There is no integrity test in message*]. User cannot perform the integrity test for the received message.

1.2. [*Public cannot understand easily the "time"*]. Public who receives the message cannot understand the time signature of the message. For example the message state that "*08:00 there is an earthquake*".

- 1.2.1. [*Indonesia has 3 time zones*]. This node contribute to the confusion of the time signature
- 1.2.2. [*Time is not written in a well format*]. By implementing non standard time format, the problem is getting bigger. A notation such as 08/04/02 has at least six different interpretations around the world. All-numeric dates and time are not unambiguous and depend very much on local custom. Using a well format can avoid this problem.

1.2.1. [*Indonesia has 3 time zones*]. Indonesia has 3 timezones (GMT+7, GMT+8, GMT+9). Advisory message which only write the time in format 08:00 am, is not sufficient, Because people from other time zone will interpret it differently.

1.2.2. [*Time is not written in a well format*]

- 1.2.2.1.◆ [*BMG has not used the ISO format in their message*][ISO, 2004]

1.2.2.1.◆ [*BMG has not used the ISO format in their message*] ISO 8601 is an international standard for date and time representations issued by the International Organization for Standardization (ISO). The signature feature of ISO 8601 date and time representations is the ordering of date and time values from the most to the least significant or, in plain terms, from the largest (the year) to the smallest (the second). This format is not used by BMG in the warnings.

1.3. [*Recipient doesn't know the action should be done*]. For some warnings, as shown by the incidents, government officers, cannot easily to determine the action.

- 1.3.1.◆ [*There is no ACTION Information in the message*]

1.3.1.◆ [*There is no ACTION Information in the message*]. It will be better if in the message there is information about the ACTION, such as contact the BMG, evacuations etc.

1.4. [*Recipient doesn't know time to release warning*]. Recipients has to decide by themselves, when they have to release warnings to public

- 1.4.1.◆ [*There is NO information about time to release warning*]

1.4.1.◆ [*There is NO information about time to release warning*]

Improvement suggested by LWBA: The message format from BMG for Tsunami bulletin, still has problems which cause the receiver cannot make a decision promptly. Thus, to analyze what is the cause of the failure, I draw LWBG as shown in Fig. 6.7. The node that can be prevented by employing countermeasure mechanism are:

- 1.2.2.1.◆ [*BMG has not used the ISO format in their message*]. The time information in message is ambiguous. The tsunami bulletin from BMG does not employ the standard time notation. Indonesia has 3 time zones (GMT +7, GMT +8, GMT+9), but the message does not provide with information of the time zone. However, the use of "*WIB*" is more common for the Indonesia users rather than GMT+7. But for the non Indonesia users, this abbreviation is not known and can produce a confusion. The date also is not written in standard format. Perhaps it is easier for Indonesian but for other system can produce misunderstanding.

- 1.3.1.◆ [*There is no ACTION Information in the message*]. There is no information about response and action that should be performed by the receiver. BMG itself in other early warning for the land and forest fire management in Central Kalimantan has employed classification of message such as NORMAL, SIAGA 3, SIAGA and SIAGA 1 [RIzalid Boer, 2006]. This classification also has been good documented and used for the fire management. The message does not describe the suggested action.

- 1.4.1.◆ [*There is NO information about time to release warning*]. To avoid the panic situation in public without the evacuation preparation. The time to release the warning should be also determined.

- 1.1.1.1.◆ [*There us no integrity test in message*], The tsunami bulletin from BMG describes if there will be `TSUNAMI` or `BLANK`. It is not a good choice, because if user receive `BLANK`, users cannot decided if it there is no TSUNAMI or the data has not been sent. It will be better if there is no BLANK entry, i.e `[BERPOTENSI|TAK POTENSI]`

After finding the nodes that can be modified, the improvement of existing system can be proceed.

6.3.4 Suggested message format

In designing the EWIS, I decided that EWIS system should fulfill these following criteria :

- **Auditable**. It means it can be tracked, who enter the data, and to whom the messages are sent. Which TV, Radio station that cannot receive and cannot display the warning.

- **Integrity**. The receiver can proof if the message has not been corrupted in the delivery process.

- **Non repudiation**. The receiver of message can distinguished, whether the message comes from the authorized source or not.

- **Synchronous**. In displaying the warning message to the public, all TV/Radio have to do it at the same time.

After analyzing by using LWBA of the problem in the existing message format, I decided to encapsulate warnings in following message format:

```
<Journal>
    <ID></ID>
    <Date></Date>
    <TimeStamp></TimeStamp>
    <Author><Author>
    <Level></Level>
    <Status></Status>
    <Distribute></Distribute>
    <Message></Message>
    <TimeToRelease></TimeToRelease>
    <Signature></Signature>
</Journal>
```

The description of the messages are :

- `<ID>` the message id. This id is unique for each message.
- `<Date>` the date of message. The date should be written in ISO standard [`http://www.cl.cam.ac.uk/~mgk25/iso-time.html`], year-month-date
- `<TimeStamp>` for the message. The time should be written also in ISO format. hour:minute:second+GMT. Thus, instead of 01:00:00 WIB, time should be written as 01:00:00+07:00
- `<Author>`, the name of person or person ID who is responsible with the release of the information.
- `<Level>` level of the warning. BMG and related government officer have to define this field first. for example it can be one of `[EVAKUASI|WASPADA|INFORMASI]`. `EVAKUASI`, if the information will have impact to the evacuation preparation, `WASPADA` if the receiver should be more attention and follow more detail information. `INFORMASI`, the danger level is low, it is only an information. I choose different level of warning because I was not aware of the standard that Fire and Forest Warning System [RIzalid Boer, 2006].

- `<Status>` the status of distribution level of the information. The status can be one of `[APARAT|MEDIA|PUBLIK]`. `APARAT` is for the government officers, `MEDIA` is only for the mass media, `PUBLIK`. it means that the information may be distributed to public.

- `<Message>` the early warning message from BMG itself

- `<TimeToRelease>` time to release the warning to the public. In particular situation to avoid the panic situation, it will be better, if the related government bodies has coordinated each other such as the evacuation preparation before releasing the warning to the public.

- `<Signature>` digital signature made by Author. The receiver can proof if the message comes from the original Author.

6.3.5 Recipient perception

Each group of audience need a different type of information. For example the BMG regional office will understand, if they receive information in following message

```
INFO BMG : GEMPA6.3SR, 26-JUL-06, 10:43:46, LOK:09.14 LS - 108.52BT,
(166KM, BARATDAYA, KDLM 69 KM, BERPOTENSI TSUNAMI,
```

However, this message will not be understood by the public, if being broadcasted to the public in Television. Therefore, this message should be translated in other narration style before can be displayed as running text in television. This message should be expanded into :

```
INFO BMG : Gempa berkekuatan 6.3 Skala Richter, pada tanggal
26 Juli 2006 jam... di sekitar kota ... Gempa ini berpotensi untuk
menimbulkan Tsunami. Masyarakat harap waspada dan melakukan persiapan
pengungsian.
```

Therefore, I suggested annotation system as shown in Fig. 6.8. However, the annotation mechanism has to be defined officially in some aspects, such as:

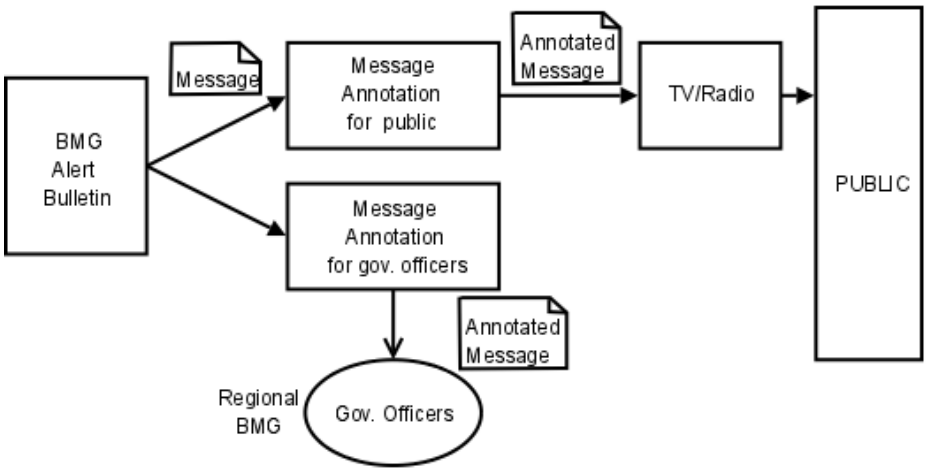


Figure 6.8: Annotation procedure

- Texts that should be added to the original text. For example if the message should appear on television or RSS reader
- Person who is allow to edit or annotate the message.

However, the decision is in the BMG hand not in the developers, as designer I could only suggest the mechanism.

6.4 Implementation

The implementation of this project was performed in very short time. Therefore, the collaboration between involved parties are important rather than the best design from one party point of view.

6.4.1 Network architecture

In the design of network, I can only provide the system requirement, the telecommunication providers determine the final deployment. Basically in designing the network structure of the early warning information system the main considerations are :

- **To avoid the bottleneck in one link**. The link between BMG to the Internet is a dedicated link, however it was only 64 KBps. Formerly, BMG wanted to

keep all system in their server. But I identified, that the problem is the reliability of the connection. Hence, I suggested in my design to put the mirror in other place and BMG servers only acts to generate the alert. The distribution of message and management of EWIS is performed by other server.

- **To avoid the single point of failure**. To fulfill this consideration, the server mirroring facility in Indonesia Internet Exchange (IIX) should be considered. In the case of the link between BMG and TELKOM is not working.

Basically the message in EWIS propagates in following steps:

- Early Warning (EW) server in national BMG receives the early warning information from early warning system such as GITEWS and Japan. This information will be processed and send as the BMG bulletin to the EWIS server..
- After that, the message is sent to server in the Internet connected directly to Indonesia Internet eXchange (IIX). Therefore, requests do not go through the 64 KBps connection
- From the server in the Internet, the information is broadcasted to various client which are connected using various type of connections. In broadcasting to the client the protocol should be as efficient as possible to avoid the bottleneck in sending the message.

Public communications facilities are failure prone during natural disasters, much effort was taken to establish a network of satellite links providing a separate communication infrastructure independent. This system is supported by Telkom and CSM, a satellite link provider company for the telecommunication infrastructure. The entire networks is isolated using Virtual Private Network (VPN) provided by TELKOM to protect against the Internet and unauthorized access. To send the message effectively via SMS the collaboration with mobile providers were established.

There are 6 radio stations which have the EWIS client installed in their stations. Those radio stations are: Radio Sarinah, Smart FM, Delta FM, Sonora, Trijaya,

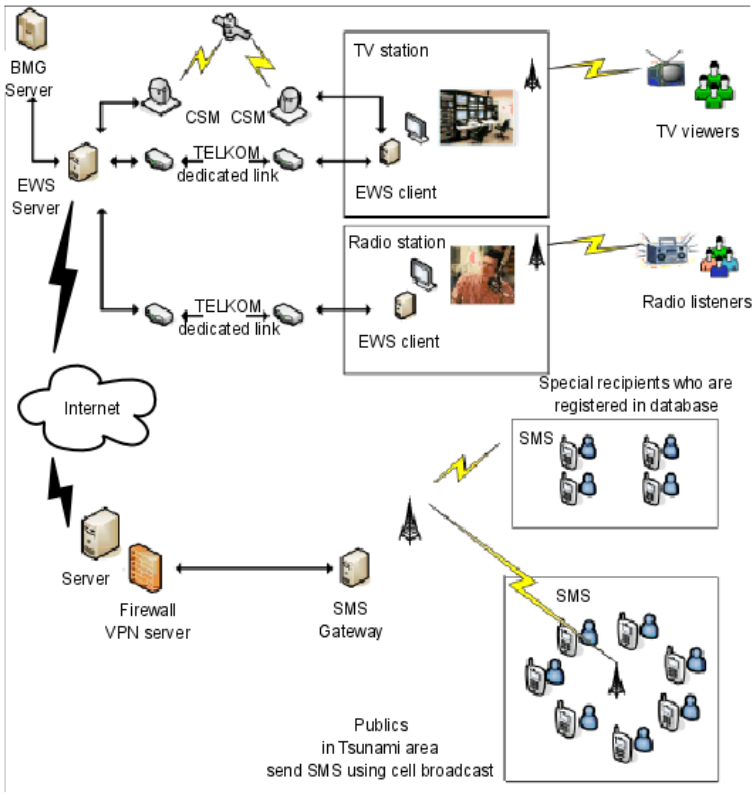


Figure 6.9: Network structure of EWIS [Putih, 2007b]

Prambors. There are also 11 TV stations which are connected directly to EWIS system. Those TV stations are : TVRI, AnTV, Global TV, Indosiar, Lativi, Metro TV, RCTI, SCTV, TPI, TransTV and TV7

6.4.2 Software components

To implement the EWIS, I decided to use a ready made Open Source Software as the components of the EWIS. OSS is different with the conventional COTS (commercial off the shelf), because developers or users can change the software at level deeper than the component level. Customization is possible in using of OSS. To implement EWIS in my design, I suggested following software as the components.

- Jabber client and server. The jabber is choose as the protocol due to the bandwidth consumption and the simple broadcast mechanism.

- Apache web server. To serve the request from the Internet as well as for con-

trolling the whole system and Postfix as Mail server.

- SMS Gateway, To send the SMS message. This gateway is provided by telecommunication provider via a software interface.

- Some tailor made software, that performs time stamp generator, digital signature system, parsing the message, notification system, converter to TARGA system for displaying warning to television. The converter utilizes the Imagemagick program.

- FTP/SFTP server and client

- Log system

The implementation of EWIS has following workflow:

- BMG own a private key and public key, that are used to sign each advisory.

- Every time an advisory from BMG comes, it will be parsed and add some information such as `TimeStamp` and `Signature` (using the key from BMG).

- Using a special jabber client the message in XML format is sent and broadcasted to all connected client.

- After receiving message the client parses and process depends on the type of client. Each type of client annotates the message regarding the defined narration style and additional information for each group of users. For the TV station, the message is supplied to character generator and mix directly to the video system. However the warning is displayed only at the time in field `TimeToRelease`. Each client should be synchronized with time server.

- After displaying or distributing via SMS, the client sends notification to the server. Thus, the server can monitor which client has distributed the information, and which client which cannot distribute the information.

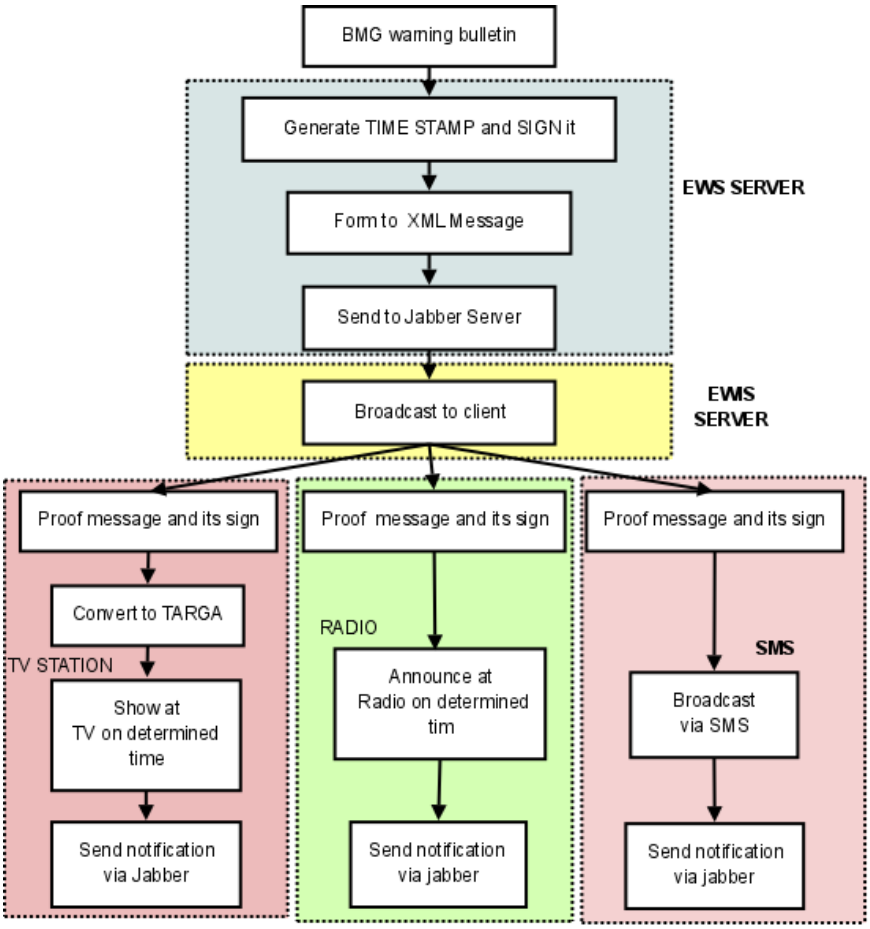


Figure 6.10: Data flow of suggested design

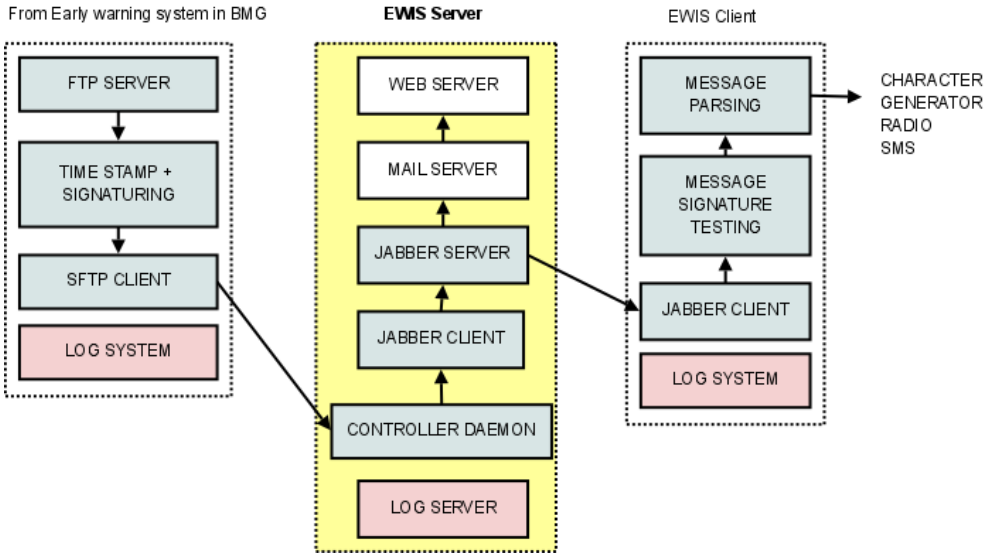
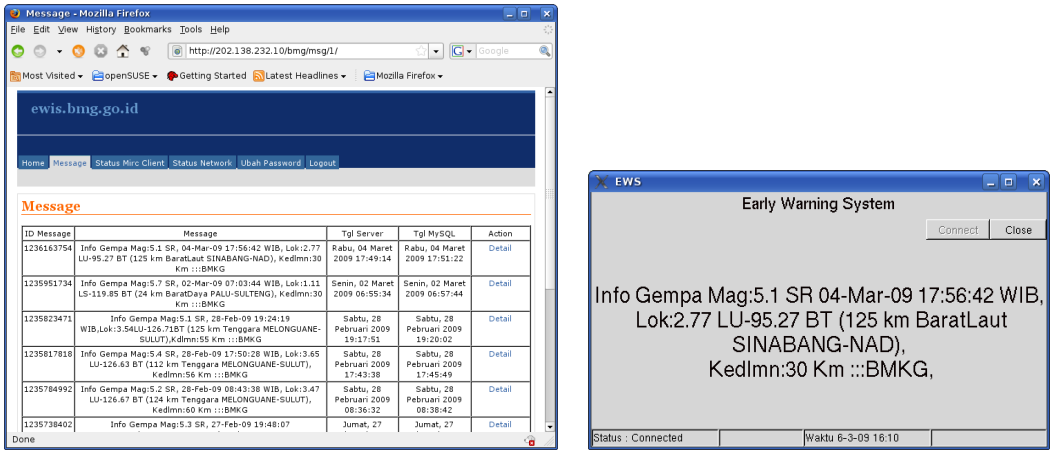


Figure 6.11: Software components of suggested design



(a) Server side of EWIS in BMG (b) EWIS Client program

Figure 6.12: Server applications

6.4.3 The real implementation

The design of EWIS is implemented and the system can be monitored via [`http://202.138.232.10/bmg/`] as shown in Fig. 6.12a. The EWIS also provides client program as shown in Fig. 6.12b. Public can download freely the client program and access to the warning instantly via Internet. The RSS feeds is also provided. The warning message is distributed directly to the TV/Radio and via SMS using various SMS gateways from telecommunication providers.

In real project, which performed in very short time, with many limitations, an ideal design cannot be implemented completely. Some changes as well as compromises had to be performed. Basically, the change of design, is an effort to keep the sustainability of design. The adjustment in the final implementation are :

- The warning message from the EWS in BMG is sent via ftp to the EWIS server, rather than via sftp as in the initial design.
- Instead of jabber, developers decided to use the IRC (Internet Relay Chat).
- Instead of employing the digital signature mechanism. They used only MD5 to be used as integrity control of the message.
- The suggested message format cannot be used because the government has not issued a new regulation regarding the new message format. Therefore the

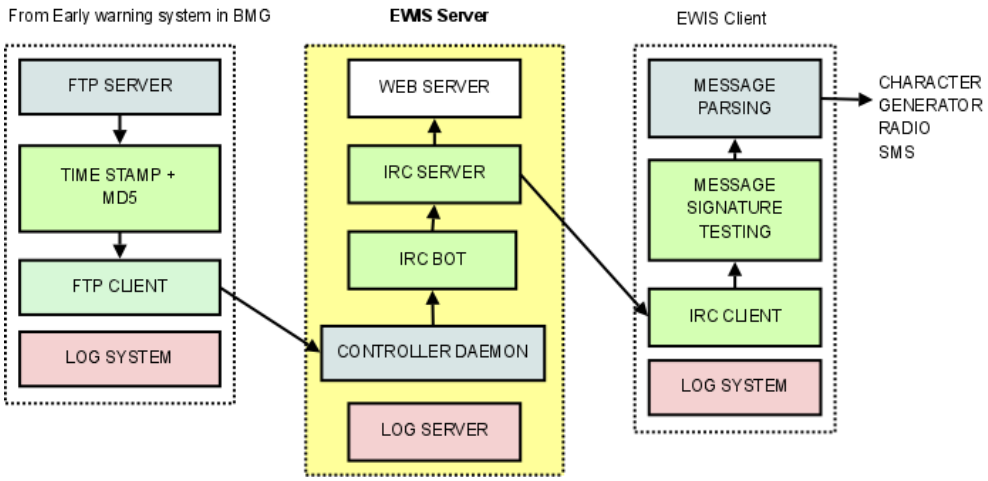


Figure 6.13: Software components in real implementation

system should use the old format but add some additional entry to correct some problems.

- The time notation is still a non ISO format but it is more understandable to public in Indonesia.
- The annotation mechanism is not applied.

The software components of real implementation is depicted in Fig. 6.13. The implemented messages format are :

```
[timestamp_unixtime] [md5] message.
```

An example of the message are

```
1157326754 24c5f7225e78d867d1eadf1b88a9782a Info BMG:
Gempa 6.1 SR, 04-Sep-06, 06:18:09 WIB,Lok:6.72LS-131.99BT,
(146 km, BaratDaya, Tual-Maluku ),Kdlmn:33 Km (tidak
berpotensi TSUNAMI),
```

In the implementation phase of this proposed development method, tracking the change of implementation is very important to ensure the sustainability of the design in the future. If the incident occurs due to this change, the aspects that should be changed can be easily identified by evaluating the LWBG. The first decision to use IRC is explored in the LWBG as shown in Fig. 6.14.

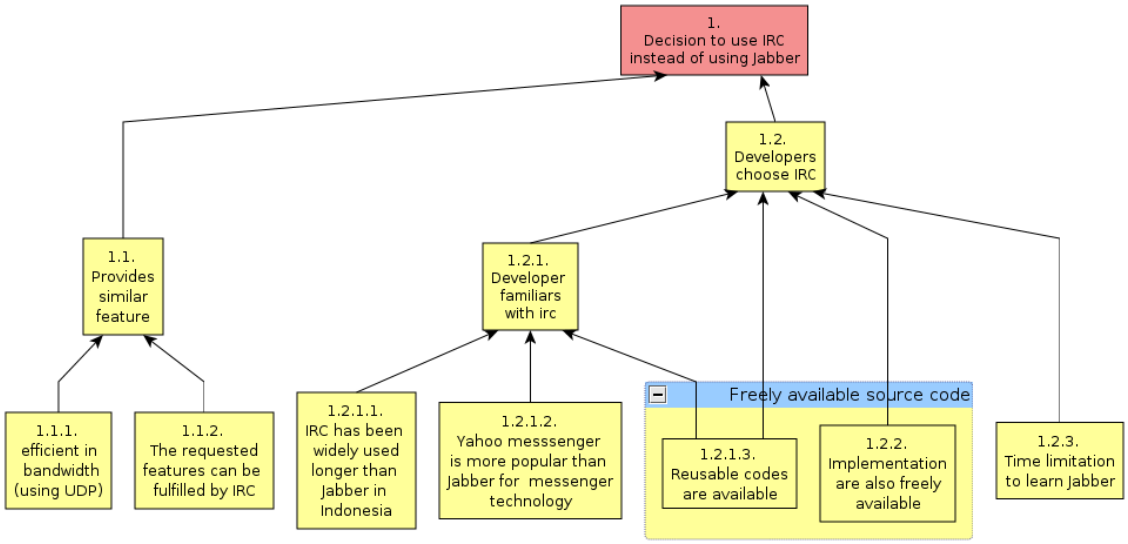


Figure 6.14: Use of IRC instead of jabber

Description of LWBG : Decision to use IRC (See Fig. 6.14)

1. [*Decision to use irc instead of jabber*]. In the implementation, developer decided to use IRC rather than jabber.

- 1.1. [*Provides similar features*]
- 1.2. [*Developers choose mirc*]

1.1. [*Provides similar features*]. In this applications, not all jabber features will be used, the most important features is broadcasting of message.

- 1.1.1. [*Efficient in bandwidth*]
- 1.1.2. [*The requested features can be fulfilled by IRC*]

1.2. [*Developers choose mirc*]. Although, jabber has been suggested, the developer still decided to use IRC.

- 1.2.1. [*Developers are familiar with irc*]
- 1.2.1.3 [*Reusable codes are available*]

- 1.2.2. [*Implementation are also freely available*]
- 1.2.3. [*Time limitation to learn jabber*]

1.2.1.3 [*Reusable codes are available*]. Many freely available source codes that ready to used are available for the IRC server and clients. It reduces time to develop applications.

1.2.2. [*Implementation are also freely available*]. Developer can download and start to use it.

1.2.3. [*Time limitation to learn jabber*]. Since jabber technology is new for developer, he did not have enough time to explore and implement in an important project.

1.2.1. [*Developers are familiar with irc*]. IRC is already used longer in Indonesia, therefore, many developers are already familiar with this technology.

- 1.2.1.1 [*IRC has been widely used longer than jabber in Indonesia*].
- 1.2.1.2 [*Yahoo messenger is more popular than jabber for messenger technology*].
- 1.2.1.3 [*Reusable codes are available*]

1.2.1.1 [*IRC has been widely used longer than jabber in Indonesia*]. Jabber is still not popular in Indonesia

1.2.1.2 [*Yahoo messenger is more popular than jabber for messenger technology*]. Yahoo messenger is the most popular messenger services in Indonesia.

From this analysis, it seems that change to IRC did not has a big risk in the system performance. Because the most important features is still fulfilled by IRC. Other adjustment during the implementation phase is the decision not to use the digital signature mechanism of message. To track and analyze the risk of this decision I derive the LWBG as shown in Fig. 6.15.

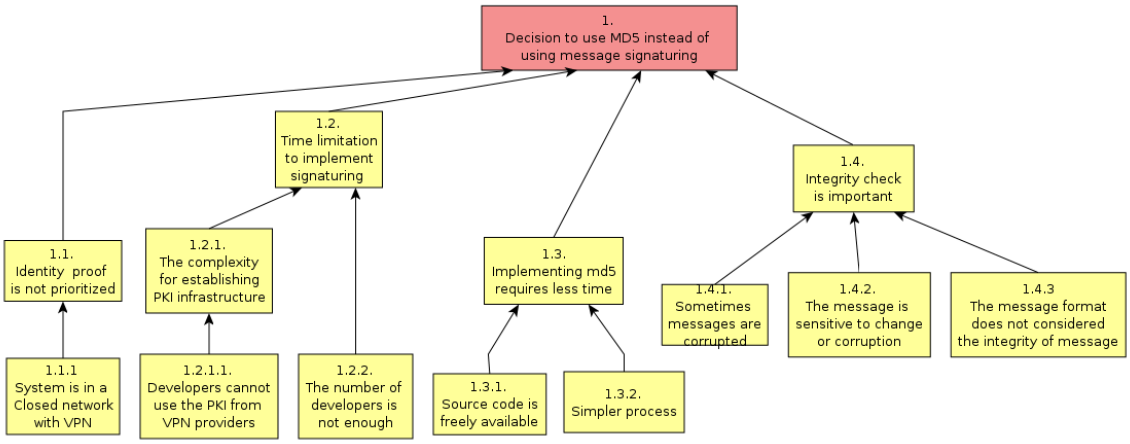


Figure 6.15: LWBG: Why use MD5

Description : LWBG : Why use MD5. See Fig. 6.15.

1. [*Decision to use MD5 instead of message signaturing*]. In the real implementation, developer and BMG decided to use only message digest MD5, instead of digital signaturing of message with public and private key.

- 1.1. [*Identity proof is not prioritized*]
- 1.2. [*Time limitation to implement signaturing*]
- 1.3. [*Implementing MD5 requires less time*]
- 1.4. [*Integrity check is important*]

1.1. [*Identity proof is not prioritized*]. BMG decided, since the source of advisory is only BMG, the identity proof is not necessary.

- 1.1.1. [*System is in closed network with VPN*]

1.1.1. [*System is in closed network with VPN*]. The system of advisory is a closed network, only the dissemination from the EWIS server to public used the Internet with special client program

1.2. [*Time limitation to implement signaturing*]. Only 1 month, was not enough for developer to implement the digital signaturing mechanism, furthermore the key management had to be solved as well.

- 1.2.1. [*The complexity for establishing PKI Infrastructure*]
- 1.2.2. [*The numbers of developers is not enough*]

1.2.2. [*The numbers of developers is not enough*]. There was only 1 developer, that practically worked part time in this project.

1.2.1. [*The complexity for establishing PKI Infrastructure*]. Establishing the Public Key Infrastructure is complex. Especially, if the legal aspect or the organization aspect had not been prepared

- 1.2.1.1 [*Developers cannot use the PKI from VPN providers*]

1.2.1.1 [*Developers cannot use the PKI from VPN providers*]. The VPN provider did not provide the services for PKI. Developer cannot use their PKI infrastructure.

1.3. [*Implementing MD5 requires less time*]. MD5 is simple to implement.

- 1.3.1. [*Source code is freely available*]
- 1.3.2. [*Simpler process*]

1.3.1. [*Source code is freely available*]. Many free implementations of MD5 are available such as from GNU.

1.3.2. [*Simpler process*]. Message digest is simpler than signaturing.

1.4. [*Integrity check is important*]. The integrity check is important for testing, whether the message is corrupt during the transmission

- 1.4.1. [*Sometimes messages are corrupted*]
- 1.4.2. [*The message is sensitive to change or corruption*]

- 1.4.3. [*The message format does not considered the integrity of message*]

1.4.1. [*Sometimes messages are corrupted*].

1.4.2. [*The message is sensitive to change or corruption*].

1.4.3. [*The message format does not considered the integrity of message*]. The existing message format is very sensitive to the corruption. It can change the Latitude, Longitude, as well as the Tsunami information.

However, in the implementation it could not be implemented, and other decision is chosen. As the top node is the failure of design decision to be implemented is use 1. [*Decision to use MD5 instead of message signature*] in Fig. 6.15. This deflection of design decision appears due to :

- 1.1. [*Identity proof is not prioritized*].
- 1.2. [*Time limitation to implement signaturing*].
- 1.3. [*Implementing MD5 requires less time*].
- 1.4. [*Integrity check is important*]

These above four nodes are considered does not conflict with the objective of developed system. The terminal nodes of this LWBG are:

- 1.1.1. [*System is in closed network with VPN*]
- 1.2.1.1 [*Developers cannot use the PKI from VPN providers*]
- 1.2.2. [*The numbers of developers is not enough*]
- 1.3.1. [*Source code is freely available*]
- 1.3.2. [*Simpler process*]
- 1.4.1. [*Sometimes messages are corrupted*]
- 1.4.2. [*The message is sensitive to change or corruption*]

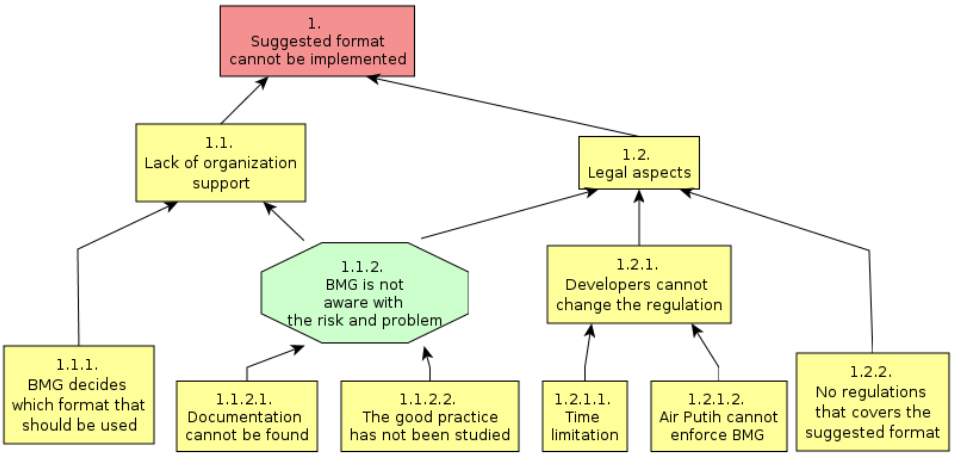


Figure 6.16: LWBG : Suggested format cannot be implemented

- 1.4.3. [*The message format does not considered the integrity of message*]

From those terminal nodes, only the node 1.2.1.1 [*Developers cannot use the PKI from VPN providers*] which is negative with the development of the good system. However, this constraints is cannot be lifted easily. Thus, the decision to use MD5 instead of digital signature is still acceptable.

The suggested format cannot be fully implemented in the real implementation, but some adjustment was performed. To consider the problem in suggested message format acceptance, I draw LWBG as shown in Fig. 6.16.

Description of LWBG : Suggested format cannot be implemented. See Fig. 6.16.

1. [*Suggested format cannot be implemented*]. The BMG did not accept the suggested format, and developer did not carry on to implement it.

- 1.1. [*Lack of organization support*]
- 1.2. [*Legal aspects*]

1.1. [*Lack of organization support*]. BMG do not have human resource which has capability in analyzing the messages. The message is designed in ad hoc manner without risk consideration.

- 1.1.1. [*BMG decides which format that should be used*]
- 1.1.2. [*BMG is not aware with the risk and problem*]

1.1.1. [*BMG decides which format that should be used*]. BMG is the government organization which owns responsibility to determine which format that can be used to deliver the warning to public.

1.1.2. [*BMG is not aware with the risk and problem*]. From the meeting with the BMG representatives, it seems that there is no awareness of the risk of the message format.

- 1.1.2.1. [*Documentation cannot be found*]
- 1.1.2.2. [*The good practice has not been studied*]

1.1.2.1. [*Documentation cannot be found*]. During the development, BMG did not supply enough documentation about the message format.

1.1.2.2. [*The good practice has not been studied*]. Actually, there are many studies regarding the early warning information system, as well as the standard and good practice[RIzalid Boer, 2006]. However it seems that BMG ignored this information.

1.2. [*Legal aspects*]. The warning information is officially released by government to public. Therefore, the legal aspects such as regulation, organization that is responsible to issue the problem

- 1.1.2. [*BMG is not aware with the risk and problem*]
- 1.2.1. [*Developer cannot change the regulation*]
- 1.2.2. [*No regulations that covers the suggested format*]

1.2.2. [*No regulations that covers the suggested format*]. The suggested format has not been covered by any government regulation. The messages that are delivered to the public should base on government regulations.

1.2.1. [*Developer cannot change the regulation*]. The change of regulation, even for a simple thing such as the message format, requires a complex bureaucracy. Developers do not have power to change the regulation, they can only provide the suggestion.

- 1.2.1.1. [*Time limitation*]
- 1.2.1.2. [*Air Putih cannot enforce BMG*]

1.2.1.1. [*Time limitation*]. The time that was available to develop and install this system was only 1 month. It was also time for training the users, installation and the testing.

1.2.1.2. [*Air Putih cannot enforce BMG*]. As stated in the regulation, BMG has the official decision about the implementation of the EWIS. Air Putih foundation only provides the assistance in developing the system.

6.5 Evaluation

Although, the project was performed in very short time (1 month) and used very small resources but it provide a very good result. Until now, there are about 31 Tsunami warning delivered to the public. There is no complain from the users due to the absence of Tsunami warning as before. How good the system performance can be evaluated by considering the number of warning delivered to the public.

$$QoS_{EWIS} = f\left(\left(\sum W_{delivered} - \sum W_{undelivered}\right) - \sum FW\right) \quad (6.1)$$

QoS_{EWIS} is the quality of the EWIS in delivering the services, this value will be determined by the $\sum W_{delivered}$, the number of message delivered to public and $\sum W_{undelivered}$, the number of warning message that cannot be delivered to public. The EWIS is not expected to deliver the false alarm, thus $\sum FW$, the number of false alarm should be minimized.

Table 6.5: Warning delivered by the EWIS

	Message type						
Year	0	1	**2**	3	4	5	10
2006	0	134	**5**	0	0	0	10
2007	9	182	**16**	659	11	0	12
2008	0	0	**7**	445	7	3	0
2009	0	0	**1**	112	1	0	0

To show the performance of the EWIS, the data gathered during the operation of EWIS is shown in Tab. 6.5. The warning are delivered to the public by the system. Each delivery has the error code 0 - 10 with the meaning as follow :

- **Code 0** - Non Tsunami/ earthquake related information
- **Code 1** - Earthquake without Tsunami possibility
- **Code 2** - Tsunami warning
- **Code 3** - Earthquake info without Tsunami related information
- **Code 4** - Cancellation or end of Tsunami
- **Code 5** - Correction of earthquake warning
- **Code 10** - Testing

The code 6 - 9 are still reserved for the future usage. The earthquake information is dominant the warning delivered to the public. There also some Tsunami warning delivered to the public 5 warning in 2006, 16 warnings in 2007, 7 warning in 2008 and 1 warning in 2009. Beside the direct data, I also monitored the blogsphere, mailing-list, as well as the media. After launching of the EWIS, there is no same incident regarding undelivered Tsunami warning. Public is notified directly after there is advisories from the BMG.

6.6 Summary

Ignoring end users and community in disaster management may result that large scale heavy science based sensors, analysis cannot effectively implemented at the local level and cannot be sustainable. And it produces only "*bigger toys for bigger boys*" [Gurstein, 2005]. It can also put people life in danger.

In this Chapter, I have demonstrated how the requirement is derived from an incident, i.e. Early Warning Incident in Indonesia. Based on this incident, the requirement and the design specification are derived by employing LWBA that is notated in LWBG. The requirement which based on incident, is basically the demonstration of proposed method to solve the Sustainability problem Case-1.

The use of Component of The Shelf system which can be customized freely provides a significant benefit in the implementation. It is shown in Fig. 6.14 and Fig. 6.15 the freely available source code play important role in the decision and in success of this class of Project.

In the real project, not all design can be implemented, some adjustment and compromises should be made. I called this the Service Refinement phase. To perform the refinement and to track the change as well as to consider the risk of change, I employ the LWBG to investigate the limitation and risks. In this investigation, I consider the non technical and technical aspects. The LWBA as extension of WBA is a suitable method to identify the non technical aspects, such as regulation, and organization. Using the LWBA, I can also identify the learning process that should be embedded in the development process.

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Chapter 7

President Web Site

In this chapter I address how the evaluation and the sustainability problems are solved in the proposed development methods. The LWBA is used to finding the strength and the weakness from the developed system as well as to finding the sustainability problem. In this chapter the sustainability problem Case-1 and Case-2 as defined in Chap. 1 are solved using the LWBA as tool to identify the problem and to define the solutions. Moreover, the LWBA is also used to find the non technical aspects that should be considered in ensuring the sustainability of system. The detail implementations of the system are not be explained further, only method to reach decision as well as considerations in implementation phase are addressed in this Chapter.

7.1 Public Information System in Indonesia

The impact of Information and Communications Technology (ICT) on development has been recognized as a multi-dimensional, multi-stakeholder and pervasive process. Electronic government (eGov) involves the electronic delivery of services that reduces the cost of internal operations of a government as well as its interactions with communities and citizens. World Bank defines eGovernment as the use of information technologies by government agencies that have ability to transform relationship with citizens, business, and other arms of government [Bank, 2003]. Government information system are public information system which should be analyzed from several perspectives as regards users, usages, data contents, and technical, organizational, and legal

aspects [Sundgren, 2005]. E-government is a comprehensive concept that involves any aspect of government-to-consumer, government-to-business, and government-to-government interaction that can be enhanced through the use of information and communications technologies. The corresponding objectives of eGovernment are:

- Interconnect public administrations (Interchange of Data between Administrations) in order to improve efficiency;
- The creation of an integrated services (once information as address, civil status etc is available in one of the administration, it should not be asked again by another) that allows citizens and private companies to communicate in a simple and modern way with public authorities, while respecting confidential information and the private life.
- The creation of an Internet server accessible to everyone for the purpose of the on-line management of as many acts and forms as possible; it may also be used by citizens as an interactive forum.

It should lead to a fundamental change in the administrative structures and means of providing services to the citizens and companies. Key stakeholders in eGov include individual citizens, businesses, civil society organizations, government departments, ministries, government-owned corporations, parliament and elected parliamentary representatives, civil servants and other officials, judiciary and other levels of government. Some examples of eGov are facilitating transactions with citizens and other public, facilitating information provision and dissemination, facilitating online interaction with businesses, management and control of administrative functions, building community awareness and participation etc.

Effective implementation of e-government applications necessitates identifying and forecasting potential challenges in the international and domestic environment. Some of these challenges and threats are examined below:

- **Digital Divide**. Many citizens and businesses may not be able to access e-government related services because they are not connected to information and

communication networks and also linguistic barriers

- **Lack of an integrated and compatible technology platform**. E-government will not happen if support systems are incompatible and are not integrated.
- **Concerns about Privacy and Security**. Citizens may be hesitant to use e-government channels because there is no data privacy and security guarantee.
- **Uncertainty about Legal Status of Electronic Records**. Despite an increase in encryption and electronic signatures there are certain challenging issues surrounding the legal status of electronic records.
- **Financial and Human Resource Constraints**. Inadequate financing for e-government initiatives and also high training and retraining costs for government employees.
- **Inconsistencies between Electronic and Physical Records Management**. Storing information on electronic media such as compact disks, floppies and web pages poses several challenges.
- **Lack of Inter-agency Cooperation and Participation**. Resistance to e-government and the extensive integration that this envisions may cause some agencies not to actively participate and coordinate in the deployment of e-government applications.
- **Incompatible Development Agendas across Levels of Government**. Many times, development agendas at different government bodies are incompatible. This is a crucial issue for countries like Indonesia where infrastructure development programs are often delayed leading to diversion of financial and human capital.

Many Asian governments hope that Internet and its consequent knowledge economy can lead them to leap frog into equality with the developed West [David T. Hill, 2002]. The Internet has been developing in Indonesia with its own unique practice and characteristics [Lim, 2003]. The Indonesia context has its own social, cultural, political

and economic context where the seed of Internet grow. For public in Indonesia, the Internet offers a social participation outside the state surveillance. Internet is also played important role in the political movement in Indonesia. During the Suharto regime, it by passed the government controlled television and radio station, and dissidents shared information about protest by email, and used chat groups to exchange information.

In Indonesia the term of e-Government was officially introduced to public through the Presidential Instruction No 06/2001, about the Information and Communication Technology (ICT) Development and Applicability in Indonesia, in which states that government of Indonesia has to use ICT to support good governance [M. Salahuddin, 2005]. It also stated an efforts to make the use of ICT optimal were really need to endeavor public and to unify the nation. The national ICT council was also formed via the Presidential Decree No 20/2006. This council has the duty to do national coordination on ICT area, which covers government agencies in local and central area, state-owned company, local-state-owned company, ICT communities, entrepreneur, professional institutes and general public [Donny BU, 2006]. In adopting ICT, Indonesia as a developing country needs a breakthrough strategy which can effectively accelerate the use of ICT. It is believed that ICT has a big potential to improve the quality of life and accelerate the development. However, to reach this goal Indonesia government should be more active and has a good commitment to build the political awareness, developing a good competitive business environment, as well as preparing the readiness of public in adopting the ICT.

Internet has change how the state informs the public. The state can no longer use the style of the past (banning and censoring), instead it must be more in the open communication. The web site of President of Republic of Indonesia attempts to deliver the information about President's activities as a form of Public Information System, which is part of eGovernment services. Public information system, is an information system which is available for public use. The public information system is defined a system designed for use by the general public, rather than specialist in particular field or organization.

Public information system are analyzed from several perspectives as regards user and usages, data contents, technical, organizational, and legal aspects ([Sundgren, 2005]). The Public Information System can be in following forms :

- Information systems making public data and other utility data available to the public, e.g. official statistics, map, directories
- Information system supporting individual actors, companies who need to perform a certain task, which is initiated and controlled by a citizen
- Information system supporting social processing involving both citizens, public authorities, and others
- Information systems supporting business task for public authorities and institutions
- News, media, and system for informing the general public

7.2 Simple web site as critical system

World Wide Web (WWW) is the largest hypertext system, a form of distributed repository of information. WWW has enjoyed the success because of [Instone, 1996]:

- The URL provides geographic universality and a single conceptual space.
- It has relatively simple user interface, namely hypertext.
- There is plenty of content. It leverages existing documents on the Internet. It is relatively easy to become an author.
- The protocol is communicationally light and easy to implement. The standards make it fairly interoperable and it is very cross-platform. It is built upon free software.
- It is open on many fronts. It provides immediate gratification, access and retraction

Table 7.1: Characteristics of simple and advanced Web based system [Athula Ginige, 2001]

Simple Web-based system	**Advanced Web-based system**
Simple Web pages primarily presenting textual information	Complex web pages
Information content does not change - fairly static	Information is dynamic-changes with time and users's needs
Simple navigation	Difficult to navigate and find information
Stand-alone system	Integrated with database and other planning, scheduling, and tracking systems
High performance is not major requirement	Requires high performance and continuous availability
Developed by a single individual or by a small team	Requires a large development team with expertise in diverse areas
Used for information dissemination in non-core application	Deployed in mission-critical application

- The Internet and corporate intranets are mature enough to handle it.

Due to its serendipitous nature, browsing behavior is very difficult to quantify. The multitude of potential users for any web site, or service, ensure that, no matter what level of detail is chosen, there will be some users who will believe there is too much detail and some who believe there is too little detail. It can be concluded that there is no single structure or set of services will ever be appropriate for all users at all time. it must be desirable to increase the effectiveness of its use wherever possible. Basically a Web page can be considered as :

- User Interface
- Publication
- Service Interface
- Information interface

The Web based system can be classified into two major groups as shown in Tab. 7.1.

7.3 Background of project

On November 2005, President of Republic of Indonesia, Dr. H. Soesilo Bambang Yudhoyono decided to develop the official web site of President. It is the first web site of President of Republic of Indonesia. A small developers team was formed to define the requirements and develop the system. The first prototype with the actual hardware should be demonstrated in front of President of Republic of Indonesia and his staffs at the end of December 2005. There was only 1 month to design, prepare, hardware acquisition and deploy the system. On 14th of February 2006 the web site was officially launched. The milestones of this project is listed in Tab. 7.2. The system survived from the big hit as well as attacks on the first week after launching.

Performance, reliability and security of system are the main considerations in developing this system. Security is a big consideration for this web site, because this web site publishes the official documents of President of Republic of Indonesia. An attack which changes the content will result big impact to the public. Sustainability of system is also the main consideration. There is also specific security requirement, for example the content providers of the web site should be able to access the back end system securely everywhere such as in Internet Cafe. Thus, the isolation and integration control is a requirement to protect from tempering.

The open standard approach is selected for developing contents. The page design is not only targeted to only a particular popular browser such as Internet Explorer. Different type of clients such as text based browser or mobile browser also are considered. The web site should content many type of file, has the facility to audio and video streaming, and support the notification via short messaging system (SMS). The document format used in the developed system has to be free from being locked into a single vendor.

The web site of President of Republic of Indonesia is designed with main non technical considerations as follow:

- Public gets benefit from this project. Government can provide better services using cheaper solution. Public can get better services from government.

- Cost effective (with very tight budget comparing with other similar government projects). The office of President of Republic of Indonesia intends to show a role model in providing a public information system in efficient way.
- The project is executing without breaking the "regulation", for example the domain problem should be solved by following the regulations.
- A good role model for other government projects. It will assist the government body to provide a good services to the public and decreasing the cost for providing such services.
- A good learning process as well as can be used as source of many academic researches in Information and Communication Technology. Result of this project can be applied as foundation for future research which involves the user and culture aspects of ICT in Indonesia.
- No sponsorship from vendors. In calculating the budget, The sponsorship from vendor for the short time should be minimized. Therefore, the standard price of software license is used for the consideration, as well as the cost of communication services.

7.4 Development process

The development in this project has several focuses:

- Focus on communication between users, stake holder, visitors, and developers. Agile method [Cockburn, 2002] still focus on the communication between developers
- Focus on threat and risk including the non technical ones. The considered threat is also the semantic threats [Schneier, 2000].

Based on the ethnography studies during the development of system as defined in previous Chapter, instead of trying to enforce a development model from the text

Table 7.2: Milestones of President web site development

Month	Activity	Comments
2005-10-4th week	Requirement analysis	The presidents staff collaborated with the developer closely
2005-11-1st week	Design and organizations	
2005-11-2nd week	Prototype development	
2005-11-3rd week	Server and supporting hardware installation and configuration	The server and storage system was installed in data center of Telkom Tbk.
2005-11-2nd week	Installation of networking infrastructure in President office	
2005-12-3rd week	Prototype demonstration	In a closed meeting between the stakeholders, consultants, developers. The prototype was demonstrated using the real servers.
2006-01	Users trainings, and prototype refinement	The president staffs were trained to use the content management system
2006-02-14	President web site launching	The launching was officially in President palace and covered by media

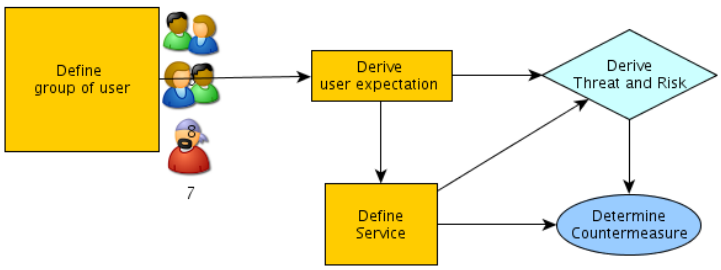


Figure 7.1: Development process

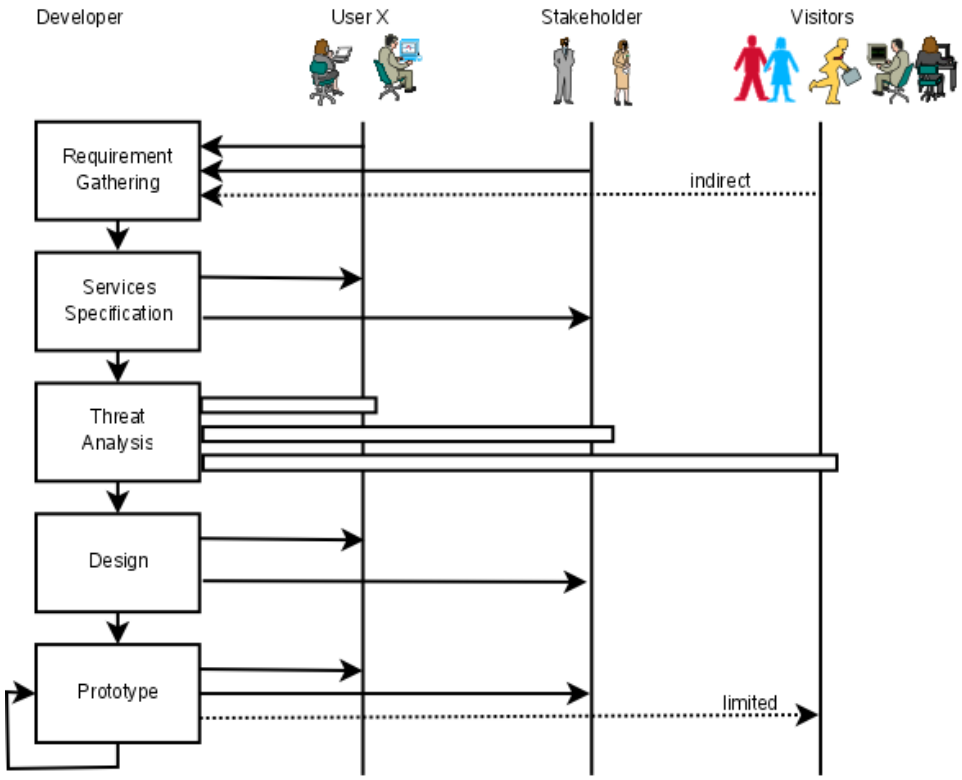


Figure 7.2: Path of communications

books, I tried to capture, how interactions between users, developers, and stakeholders. In this development model, I do not separate the influence of different groups of user with the design. Many development model only considers users as small parts of the design. Most of them, put the user in the passive situation.

Basically the design of President web site follow the participatory approach by considering end users as the main actors. It is shown in Fig. 7.1. The fist steps is the user groups definition. For each user groups we derive the user expectations. Every groups users expect different function or information delivered by the web site. Groups in this method, is the attacker, the person or system which has intention to violate the security policy. After this steps, the services can be defined based on most expected services. Each groups of users also different threat in the system. Understanding this threat can be used to consider the countermeasures that can be employed.

Each phase has different communication path with the users which is shown in Figure 7.2. The detail of development steps are :

1. Defining the users groups and stakeholders.

2. Developers gather the functional and non functional as well as technical and non technical requirements by sitting closely with the users and stakeholders. I and my team employed participatory design and as result I listed requirements and customizations that I need according to local needs. I employed the prototype based design during the requirement phase. The expected results from visitors is gathered indirectly using mailing list and blogsphere.

3. Service definitions. I defined services provided by developed system, based on the users groups. These services are also search engines, podcast, streaming services etc. This definition was informed to the users as well as stakeholders

4. Threat analysis. For each services, and each user groups, I defined the possible threats. After that, necessary countermeasure were applied.

5. I designed the implementation of the system and and solved the conflict of the requirements.

6. Develop prototype. Using web page as prototype, I received input from users very fast. The system were developed into the final application based on this prototype. Therefore it was not one-throw prototype.

7. Testing and refine the prototype. The test was performed directly with the users, and also stakeholders.

8. The implementation of system itself was performed in following weekly cycle :

   (a) On the first day of cycle, a to do list was given to developers, as well as the job for networking providers

   (b) During the week, developers performed their jobs and informed the result daily.

(c) At the end of the week evaluation was performed, list the jobs that have been done. Moreover, I wrote a new to do list, or made a adjustments in design/architecture

(d) The change architecture or design were informed in Internet site for developer and network provider. Every change should be followed by a root causal analysis namely LWBA.

(e) In this development, the developer were not in the same place. Hence, Internet was used as the communication medium and collaboration tool.

7.4.1 Define the user groups and stakeholders

Every system has a purpose or mission. Most human-made systems are designed to fulfill and achieve the owner organization's role, missions and objectives. The success of the system is determined by HOW WELL the system is specified, designed, developed, integrated, verified, validated, operated and supported. Before starting the development, defining the user-groups and understanding who the stakeholders are, is very important in ensuring the development process. However, in many development methodologies and approaches user are still viewed as anonymous object that is going to use the system [Isomaki, 2005].

In a system basically there are three type of users [Wasson, 2006]:

- **End user**. Individuals or organizations that receive benefits directly from the results of system, product or services. I refine the definition of this user group, by defining the sub-group, such as the visitor who are Indonesian, and non Indonesian. Because it determines users interest of the system. Users who visit the system and influence the system judgment

- **Stake holder**. An individual or organization that has a vested interest in the outcome produced by a system in performing its assigned mission. In this developed system, they are President, other government agencies.

- **System user**. An individual or organization that employs a system, product

Table 7.3: Users and stakeholders

Users	Expectations	Threat
Presidents staffs	To submit the news as fast as possible	Error in submitting the data, cannot login to the Content Management System (CMS)
Media	To receive the latest detail information of the President activities, such as speech, press releases, photos	Bad acceptance
Public	To receive the latest information	Cannot submit the critique, cannot get the latest information
Researchers	To use president web site as information resource for research	Retrieve false information
Attacker	To attack the system (DoS, defacement), using system to spread a misinformation	Defacement, denial of services

or services or their by-product for purpose of accomplishing a mission-oriented or task. In the developed system they are staffs of Office of President.

In this works, I define other group of users (many development model do not classify this group as user) :

- **Attackers**. By considering the attacker as part of users, I tried to understand their expectations, and it assisted to deploy the countermeasures.

From each user groups, I investigated the main threat. Threat in this works as shown in Tab. 7.3 are not only regarding the syntactic attack but also semantic attack [Schneier, 2000].

7.4.2 Requirement elicitation and analysis

In establishing the requirement elicitation I employed the Lightweight Because Analysis (LWBA). Use of LWBA for example based requirement elicitation is shown in Fig. 7.3.

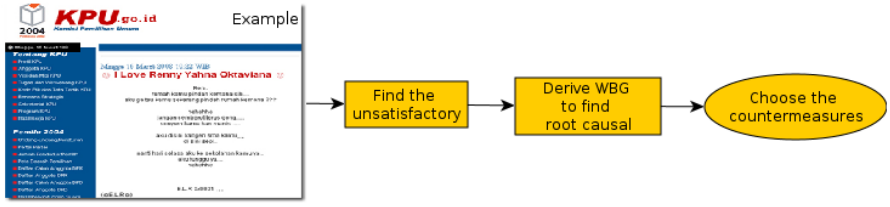


Figure 7.3: Example based requirement elicitation

1. First, I gathered examples that describe the user requests. These examples can be gathered by comparing with the high profile web sites or high profile cases in Indonesia. For example in this development Detik.com [`www.detik.com`], KPU [`http://www.kpu.go.id`], or other similar web sites.

2. From examples, I collected unsatisfactory statements from the stakeholders. In this project, I and my team had only limited time for meeting with the stakeholders. Therefore, the requirement statements are very general. The statements was in a form

$$System_{Designed} \succ System_{example} \tag{7.1}$$

Where the operator $\succ$ denotes the particular *attribute* of *System* is better than compared system.

The requirement statements from stakeholders are follow :

- **R1**: The President web site should be faster than DETIK.COM [`http://www.detik.com`]

$$(System_{designed}) \succ_{faster} (System_{detik.com}) \tag{7.2}$$

- **R2**: The web site should be more secure than KPU [`http://www.kpu.go.id`]

$$(System_{designed}) \succ_{secure} (System_{kpu.go.id}) \tag{7.3}$$

- **R3**: The site should be more *modern* and has *more features* than other government sites

$$(System_{designed}) \succ_{attractive} (System_{govs.web\,sites}) \tag{7.4}$$

- **R4**: The site should be more open to accept the visitors contribution

$$(System_{designed}) \succ_{open} (System_{govs.web\,sites}) \tag{7.5}$$

- **R5**: The site should be efficient in budget

$$(System_{designed}) \succ_{efficient} (System_{govs.web\,sitesdetik.com}) \tag{7.6}$$

- **R6**: Sustainability of system, if the developer team is changed to the new group. The new team should be able to continue and takes over the project

$$(System_{designed}) \succ_{sustain} (System_{govs.web\,sites}) \tag{7.7}$$

3. From each **R**, I derive the LWBG (Lightweight Why Because Graph) to investigate the constraints, that can be handle by implementing the system as countermeasure of those nodes, and which constraints that require longer time to change it. LWBG describes the causal factor of deficiencies which are chosen as requirements. The top node is in the form :

$$\sim attribute\,(System_{example}) \tag{7.8}$$

where *attribute* is the attribute used to compare $System_{developed}$ with $System_{example}$

7.4.2.1 R1. Faster than detik.com

DETIK.COM [`http://www.detik.com`] is the most popular online news in Indonesia. Although, the page design of detik.com is always criticized by the page designers community in Indonesia, but the popularity of DETIK.COM makes many users still used it as reference. One big critique about DETIK.COM is the speed for retrieving the

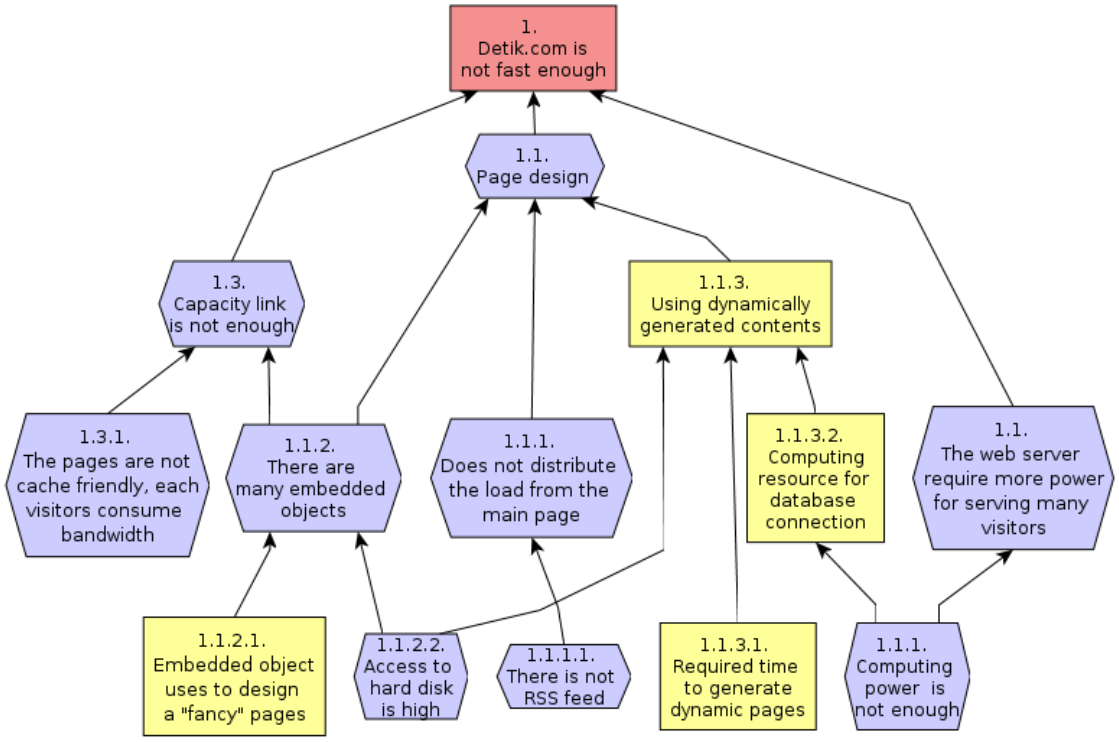


Figure 7.4: LWBG : DETIK.com is not fast (R1)

pages. Therefore, stakeholders of President web site did not want the developed website is slower than DETIK.COM. This preposition is used as the basic of requirement, the top node in Fig. 7.4.

Description of LWBG : Detik.com is not fast enough (R1). See Fig. 7.4

1. [*Detik.com is not fast enough*]. Detik.com [`http://www.detik.com`] is the most popular online news site in Indonesia. However, many visitors complains that the loading time of this site is very slow. Therefore, the president staffs emphasize that the President web sites should be faster than Detik.com.

- 1.1.◆ [*Page design*]. A good web design will contribute to the speed of loading, since there are not many embedded objects, as well as the page is very small.
- 1.2.◆ [*The web-server require more power for serving many visitors*].
- 1.3.◆ [*Capacity link is not enough*]

1.1. ◆ [*Page design*]. The bad page design can make the retrieve time of a web page is long.

- 1.1.1. ◆ [*Does not distribute the load from the main page*]
- 1.1.2. ◆ [*There are many embedded objects*]
- 1.1.3. [*Using dynamically generated contents*]

1.1.1. ◆ [*Does not distribute the load from the main page*]. The detik.com does not distribute the page to several web servers, such as for images, for embedded object, or for the text. All objects are put in the same server

- 1.1.1.1. ◆ [*There is no RSS feed*]

1.1.1.1. ◆ [*There is no RSS feed*]. Detik.com decided not to have RSS, therefore visitors have to retrieve the whole main pages only to check the latest news.

1.1.2. [*There are many embedded objects*]. In the page of web sites, contains of many embedded objects, each object requires time to be retrieved.

- 1.1.2.1. [*Embedded object uses to design a "fancy" pages*]
- 1.1.2.2. ◆ [*Access to hard-disk is high*]

1.1.2.1. [*Embedded object uses to design a "fancy" pages*]. Embedded object, such as java applet, flash are used to create a fancy web sites. A fancy web site is important for country like Indonesia, users in Indonesia tend to evaluate firstly based on the appearance than the functionality.

1.1.2.2. ◆ [*Access to hard-disk is high*]. The high access to hard disk, decrease the speed to provide services. Time to access hard disk is now the bottleneck of system.

1.1.3. [*Using dynamically generated contents*]. At that time, DETIK.COM relied on the dynamic page generation. Each page is generated on the fly.

- 1.1.2.2.◆ [*Access to hard-disk is high*]
- 1.1.3.1. [*Required time to generate dynamic pages*]
- 1.1.3.2. [*Computing resource for database connection*]

1.1.3.2. [*Computing resource for database connection*]. Each connection to database require more computing resource, i.e. memory.

- 1.2.1.◆ [*Computing power is not enough*]

1.2.1.◆ [*Computing power is not enough*]. The computing power of server is not enough to serve the load

1.2.◆ [*The web-server require more power for serving many visitors*].

- 1.2.1.◆ [*Computing power is not enough*]

1.2.1.◆ [*Computing power is not enough*]. The server of DETIK.COM is not big enough to handle the load.

7.4.2.2 R2 - More secure than KPU.COM

The defacement of KPU [`http://tnp.kpu.go.id`] is very famous in Indonesia due to the importance of KPU web site. KPU web site was used to deliver the result of vote in the election in Indonesia. In 2004, an attacker had defaced the web site via SQL injection, and changed the web site as well as the name of political parties [Post, 2004]. The stakeholders wanted to avoid the same incidents in the president web site.

Description of LWBG: The defacement of KPU web site (R2). See Fig. 7.5

1. [*Defacement on KPUs' web site*]. This case was very popular. because has been covered in media and the attacker had been caught. In this defacement, the main web site of KPU (Indonesia election commission) was changed. The parties names were changed.

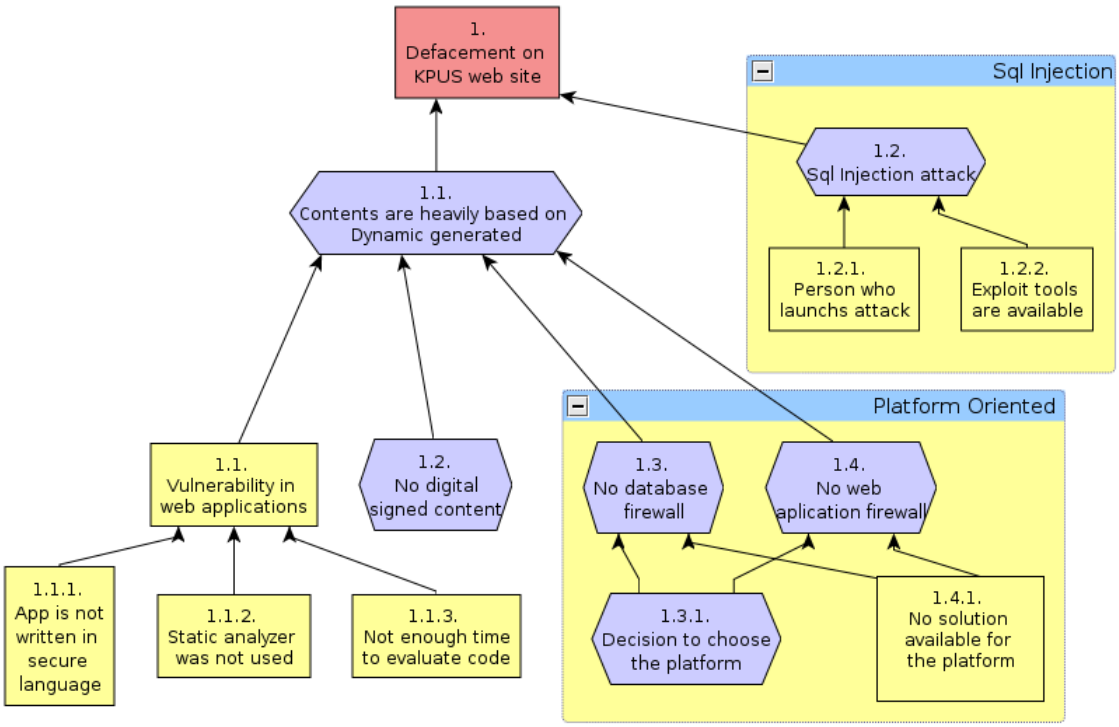


Figure 7.5: LWBG : The defacement of KPU web site (R2)

- 1.1.◆ [*Content are heavily based on Dynamic generated*].
- 1.2.◆ [*SQL Injection attack*]
- 1.3.◆ [*No database firewall*]
- 1.4.◆ [*No web application firewall*]

1.1.◆ [*Content are heavily based on Dynamic generated*]. The page was designed around the dynamically generated pages. From the database the web application

- 1.1.1. [*Vulnerability in web applications*]
- 1.1.2.◆ [*No digital signed content*]

1.1.2.◆ [*No digital signed content*]

1.1.1. [*Vulnerability in web applications*]. There was vulnerability in web application that allow the attacker took advantage of it.

- 1.1.1.1. [*App. is not written in secure language*]
- 1.1.1.2. [*Static analyzer was not used*]
- 1.1.1.3. [*Not enough time to evaluate code*]

1.1.1.1. [*App. is not written in secure language*]. The web application is written in ASP on MS Windows.

1.1.1.2. [*Static analyzer was not used*]. Static analyzer, which can be used to find vulnerabilities in the web application code was never applied in the web application. Therefore, a simple vulnerability was still not detected.

1.1.1.3. [*Not enough time to evaluate code*]. Developers only have short time to develop the web application, because they has to concentrate to do other tasks, such as coordinate the deployment of the computers all over Indonesia.

1.2.◆ [*SQL Injection attack*]. Attacker used SQL injection to change the web page.

- 1.2.1. [*Person who launches attack*]
- 1.2.2. [*Exploit tools are available*]

1.2.1. [*Person who launches attack*]. Somebody launch the attacks, as high profiles web sites, many attackers keep attack the site.

1.2.2. [*Exploit tools are available*]. SQL injection does not require a sophisticated tools, only the normal browser can be used to launch this attack.

1.3.◆ [*No database firewall*]. The database is connected directly to the web application without being controlled by database firewall, such as GreenSQL. The SQL injection can be launched without being filtered.

- 1.3.1.◆ [*Decision to choose the platform*]

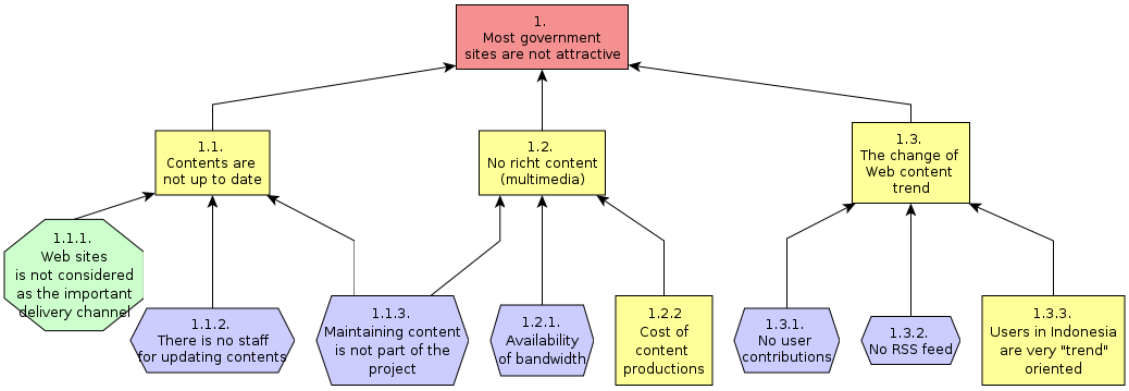


Figure 7.6: LWBG : Government sites are not attractive (R3)

- 1.4.1. [*No solution available for the platform*]

1.3.1.◆ [*Decision to choose the platform*]. The KPU has chosen a particular platform, based on MS Windows Server.

1.4.1. [*No solution available for the platform*]. In those platform, some countermeasure for security was not available, or requires extra license cost.

1.4.◆ [*No web application firewall*]. There is no web application installed in KPU system, the content management system is exposed directly to the Internet.

- 1.3.1.◆ [*Decision to choose the platform*]
- 1.4.1. [*No solution available for the platform*]

7.4.2.3 R3 - More attractive than other government sites.

In various mailing list, media, and blogsphere, users in Indonesia very often expressed their unsatisfactory with the government web sites. They found that the government web sites, are not good maintained and are not attractive to visitors. The stakeholders want that the web site have to be attractive enough to attract many visitors regularly. To investigate the problems in government web sites, I derive the LWBG as depicted in Fig. 7.6.

Description of LWBG: Government sites are not attractive (R3). See Fig. 7.6.

1. [*Most of government sites are not attractive*]. Users in Indonesia still find that many government web sites are not attractive. They do not want to visit and check the information regularly, since they found that there is not many information in the web sites. Many government web sites are not up to date.

- 1.1. [*Contents are not up to date*].
- 1.2. [*No rich content (multimedia)*]
- 1.3. [*The change of Web content trend*]

1.1. [*Contents are not up to date*]

- 1.1.1.● [*Web sites are not considered as the important delivery channel*]
- 1.1.2.◆ [*There is no staff for updating contents*]
- 1.1.3.◆ [*Maintaining content is not part of the project*]

1.1.1.● [*Web sites are not considered as the important delivery channel*]

1.1.2.◆ [*There is no staff for updating contents*]

1.1.3.◆ [*Maintaining content is not part of the project*]

1.2. [*No rich content (multimedia)*]

- 1.2.1.◆ [*Availability of bandwidth*]
- 1.2.2. [*Cost of content productions*]

1.2.1.◆ *Availability of bandwidth*]

1.2.2. [*Cost of content productions*]

1.3. [*The change of Web content trend*]

- 1.3.1.◆ [*No user contributions*]
- 1.3.2.◆ [*No RSS feed*]
- 1.3.3. [*Users in Indonesia are very "trend" oriented*]

1.3.1.◆ [*No user contributions*]

1.3.2.◆ [*No RSS feed*]

1.3.3. [*Users in Indonesia are very "trend" oriented*]

7.4.2.4 R4 - more open than other government sites

As shown in Fig 7.7 we try to understand, why the popularity of government sites is low among the people. One of the problem is, the government sites still neglect the public input, there is no real feedback in the websites due to the input from public. From the LWBG we found that, many government web sites, never displays the comment from visitors. Therefore, the communication is performed only one direction. In the President web site we provide the form for supplying the visitor comments, and we display them.

Description of LWBG : Government sites are not open (R4). See Fig. 7.7.

1. [*Public perceives that gov. sites are not open enough for public*]. Public in Indonesia still perceives that most government web sites is still closed to the public contributions.

- 1.1.● [*Used only for disseminating gov.information*]
- 1.2. [*One way communication narration style*]
- 1.3.● [*Gov. bodies do not consider two way communication is important*]

1.1.● [*Used only for disseminating gov.information*]. Most government web sites only distributing information in one direction, from government bodies to public. Government bodies has not had any interest to accept the input from the public directly.

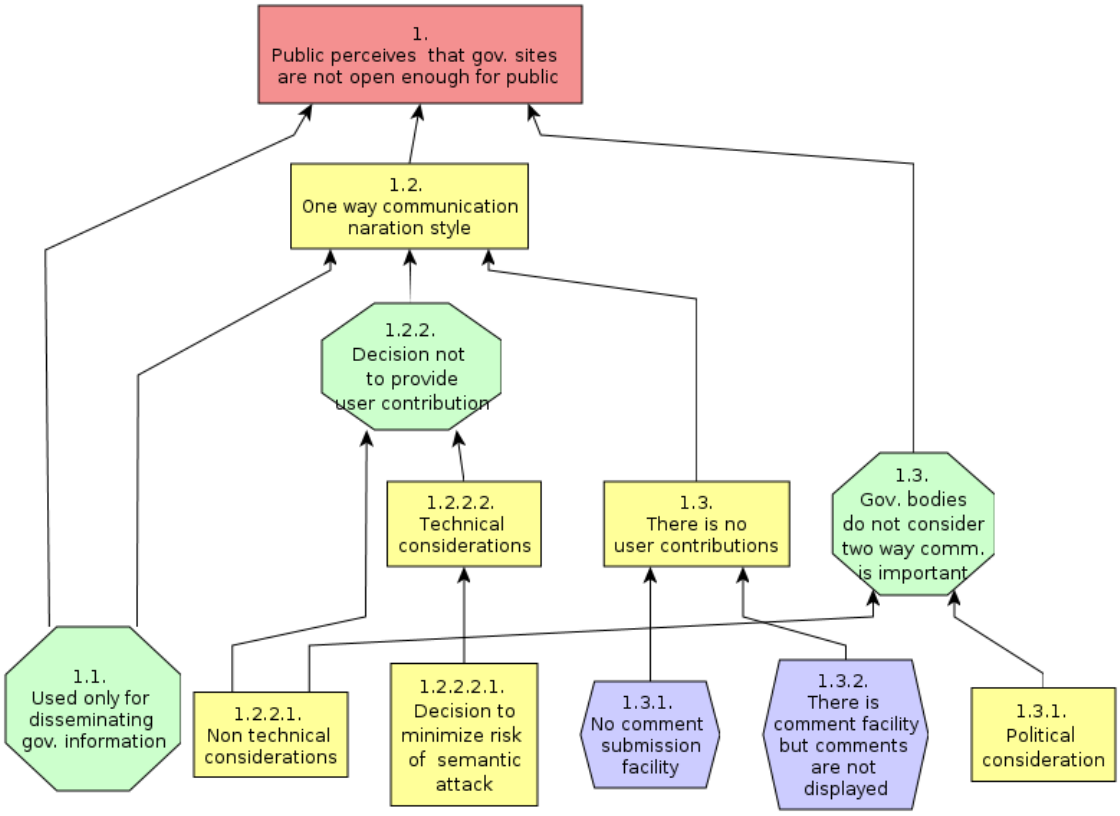


Figure 7.7: LWBG : Government sites are not open (R4)

1.2. [*One way communication narration style*]. The text in the government web site, has narration style still in one direction. It also due to the Power Distance Index of Indonesia.

- 1.1.● [*Used only for disseminating gov.information*]
- 1.2.1. [*There is no user contributions*]
- 1.2.2.● [*Decision not to provide user contribution*]

1.2.1. [*There is no user contributions*]. Most government does not have facility to enable user contribution contents.

- 1.2.1.1.◆ [*No comment submission facility*]
- 1.2.1.2.◆ [*There is comment facility but comments are not displayed*]

1.2.1.1.◆ [*No comment submission facility*]. Not many government web sites, has comment submission.

1.2.1.2.◆ [*There is comment facility but comments are not displayed*]. There is also web sites with comment submission, but public never know whether the comment is accepted or not.

1.2.2.● [*Decision not to provide user contribution*]. There still big trend, the government web site

- 1.2.2.1. [*Non technical consideration*]
- 1.2.2.2. [*Technical consideration*]

1.2.2.1. [*Non technical consideration*]. Many users in Indonesia still like to abuse the comment facility, such as use it to launch attack, or write the bad words.

1.2.2.2. [*Technical consideration*]. The users comments has to be maintained carefully, otherwise it opens vulnerabilities

- 1.2.2.2.1. [*Decision to minimize risk of semantic attack*]

1.2.2.2.1. [*Decision to minimize risk of semantic attack*]. Using the user comment, attackers can write the semantic attack, such as false information etc. Many government bodies, want to avoid the dissemination of misleading information.

1.3. ● [*Gov. bodies do not consider two way communication is important*]. Many government officers or government bodies in Indonesia are still not aware the importance of direct input from the public. They prefers the information from the same government officers.

- 1.2.2.1. [*Non technical consideration*]
- 1.3.1. [*Political consideration*]

1.3.1. [*Political consideration*]. Many government officers are still "*old school*" government officers. They just want to play safe.

7.4.2.5 R5 - more efficient in budget than other government sites

The eGov project as well as web site project in Indonesia are known to be not efficient in budget. There are several corruption cases of the government web sites [Febrianti, 2005]. In this president web site, stakeholders did not want to have the same problem. The project should be executed as efficient as possible without neglecting the main goal. Thus, firstly I perform the LWBA, which is shown in the Fig. 7.8.

Description of LWBG : Government web sites are expensive (R5). See Fig. 7.8

1. [*Government web sites are expensive*]. Government web sites are known not efficient in budget, many corruption case related to the government web sites has been brought to the court.

- 1.1. [*Cost of networking*]

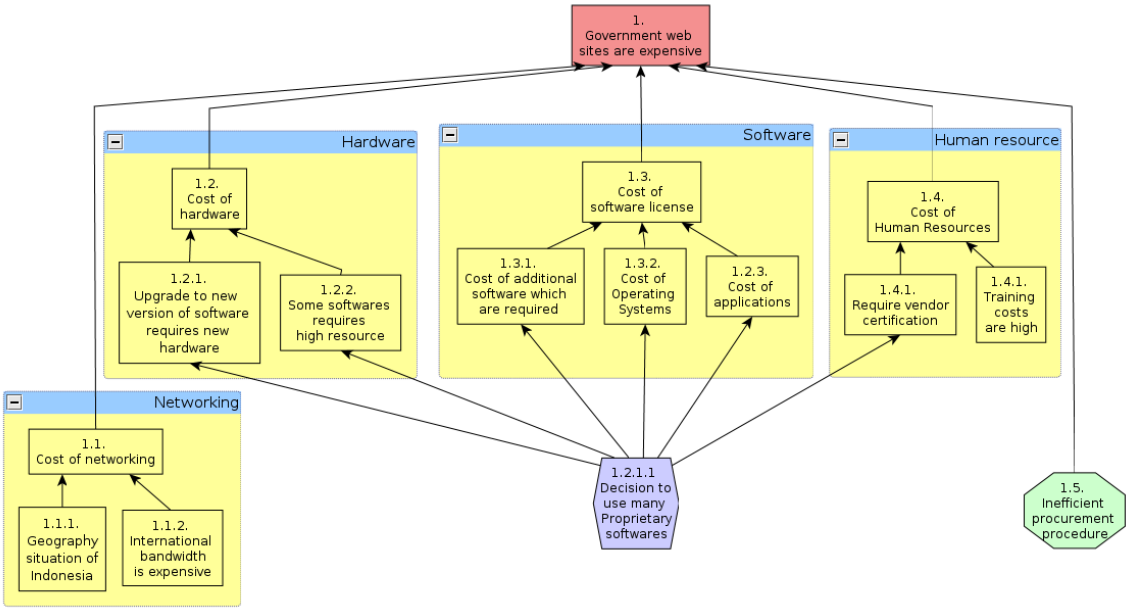


Figure 7.8: LWBG : Government web sites are expensive (R5)

- 1.2. [*Cost of hardware*]
- 1.3. [*Cost of Software License*]
- 1.4. [*Cost of Human Resources*]
- 1.5. ● [*Inefficient procurement procedure*]

1.5. ● [*Inefficient procurement procedure*]. The procurement procedure of IT project in Indonesia is known very inefficient.

1.1. [*Cost of networking*]. Indonesia still has the high cost of Internet connection [Donny BU, 2006]

- 1.1.1. [*Geography situation of Indonesia*]
- 1.1.2. [*International bandwidth is expensive*]

1.1.1. [*Geography situation of Indonesia*]. Indonesia is archipelago, connecting the whole islands require a big investment. It yields high cost for the network provider to cover the whole Indonesia. Government just lately starts the Ring Palapa, a project that connects Indonesia via the fiber optic connections

1.1.2. [*International bandwidth is expensive*]. The biggest part of total Internet cost in Indonesia is still the international connection.

1.2. [*Cost of hardware*]

- 1.2.1. [*Upgrade to new version of software requires new hardware*]
- 1.2.2. [*Some software requires high resource*]

1.3. [*Cost of Software License*]. Propriety solution always has higher license cost, the Open Source solution has zero cost of license.

- 1.3.1. [*Cost of additional software which are required*]
- 1.3.2. [*Cost of Operating Systems*]
- 1.3.3. [*Cost of applications*]

1.4. [*Cost of Human Resources*]. Cost of human resource cannot be neglected, as well as the cost to train them and get the certification from vendor (mostly for proprietary software).

- 1.4.1. [*Require vendor certification*]
- 1.4.2. [*Training costs are high*]

1.4.2. [*Training costs are high*]. Professional training cost from vendor is still expensive in Indonesia.

1.2.1. [*Upgrade to new version of software requires new hardware*]. Some software, whenever users upgrade to new version, the software require more computing power of hardware. It means extra cost for users.

- 1.2.1.1. ◆ [*Decision to use many proprietary software*]

1.2.2. [*Some software requires high resource*]. Some software for the same function requires higher computing resources.

- 1.2.1.1.◆ [*Decision to use many proprietary software*]

1.3.1. [*Cost of additional software which are required*]. Some additional software such as virtualization, firewall, integrity control, anti virus, IDS are required for a secure solution.

- 1.2.1.1.◆ [*Decision to use many proprietary software*]

1.3.2. [*Cost of Operating Systems*]. Some proprietary operating systems require expensive license cost.

- 1.2.1.1.◆ [*Decision to use many proprietary software*]

1.3.3. [*Cost of applications*]. Application software also requires extra cost of license, or cost to develop.

- 1.2.1.1.◆ [*Decision to use many proprietary software*]

1.4.1. [*Require vendor certification*]. For a particular level of knowledge, the proprietary solution require the people has to take the special certification.

- 1.2.1.1.◆ [*Decision to use many proprietary software*]

1.2.1.1.◆ [*Decision to use many proprietary software*]. Government bodies may choose the solution that they prefer. There is no regulation that determine the government bodies to choose particular software. The decision to use proprietary software, has consequence in the total cost.

7.4.2.6 R6 - more sustain than other government sites.

Many IT government projects in Indonesia cannot sustains. A good system that functions in the other countries are just copied and implemented in Indonesia. However, that system cannot sustain in Indonesia, because the environment in Indonesia is very different with the country where the system is designed (Case-1). Furthermore, many IT government project cannot sustain after the project is ended (Case-2). The next

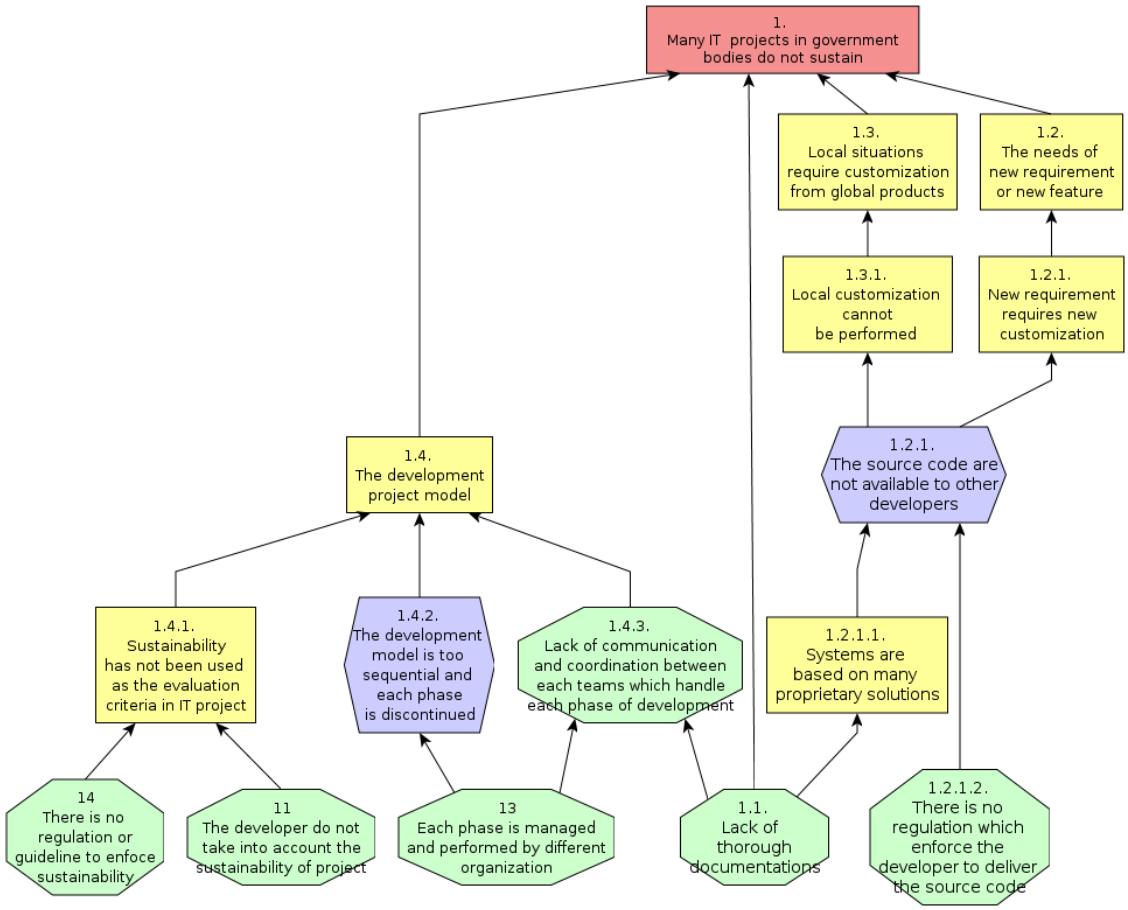


Figure 7.9: LWBG : Government projects do not sustain (R6)

group which continues the work just replaces the old system and re-develop the same system again.

For example, In late 1990, Indonesia government Nusantara-21, high level ICT framework to connect the archipelago, this plan was discarded in 1998 during the economic crisis [M. Salahuddin, 2005]. In 2002, The National IS Framework (SISFONAS) developed a framework to define system, application/software, regulative and human/capacity requirements. However, until now SISFONAS has not been implemented [M. Salahuddin, 2005]. In the president web site, stakeholders wanted to avoid this situations. The WBA of this situation is depicted in Fig. 7.9

Description of LWBG: Government projects do not sustain (R6). See Fig. 7.9.

1. [*Many IT projects in government bodies do not sustain*]. Many government sites has bad reputations, such as, every time new project, the old project is abandoned, there is no sustainability consideration between projects.

- 1.1.● [*Lack of thorough documentations*]
- 1.2. [*The needs of new requirement or new feature*]
- 1.3. [*Local situations require customization from global products*]
- 1.4. [*The development project model*]

1.1.● [*Lack of thorough documentations*]

1.2. [*The needs of new requirement or new feature*]

- 1.2.1. [*New requirement requires new customization*]

1.2.1. [*New requirement requires new customization*]

- 1.2.1.1.◆ [*The source code are not available to other developers*]

1.3. [*Local situations require customization from global products*]

- 1.3.1. [*Local customization cannot be performed*]

1.3.1. [*Local customization cannot be performed*]

- 1.2.1.1.◆ [*The source code are not available to other developers*]

1.2.1.1.◆ [*The source code are not available to other developers*]

- 1.2.1.1.1. [*Systems base on many proprietary solutions*]
- 1.2.1.1.2.● [*There is no regulation which enforce the developer to deliver the source code*]

1.2.1.1.2.● [*There is no regulation which enforce the developer to deliver the source code*]

1.2.1.1.1. [*Systems are based on many proprietary solutions*]

- 1.1.● [*Lack of thorough documentations*]

1.1.● [*Lack of thorough documentations*]. Freely documentations of a developed projects is very difficult to find. Therefore, company, or groups which continue a project, in the proposal can only 'guess' the previous projects. It is difficult to find the strength or weakness from the previous projects.

1.4. [*The development project model*]. There is no well established and defined the development standard for the IT project in Indonesia.

- 1.4.1. [*Sustainability has not been used as the evaluation criteria in IT project*]
- 1.4.2.◆ [*The development model is too sequential and each phase is discontinued*]
- 1.4.3.● [*Lack of communication and coordination between each teams which handle each phase of development*]

1.4.1. [*Sustainability has not been used as the evaluation criteria in IT project*]. In the IT project decisions, the criteria is only regarding the budget, and the proposed solution from the technical point of view.

- 1.4.1.1.● [*There is no regulation or guideline to enforce sustainability*]
- 1.4.1.2.● [*The developer do not take into account the sustainability of project*]

1.4.1.1.● [*There is no regulation or guideline to enforce sustainability*]. The regulation of IT projects in Indonesia has not been well established. The regulation is only cover the procurement process but without ensuring the sustainability of system.

1.4.1.2.● [*The developer do not take into account the sustainability of project*]. Developers are still not aware or interested in sustaining the system. For them, finishing the projects, is more important. The future of the project, is not their consideration.

1.4.2. [*The development model is too sequential and each phase is discontinued*], For example the people who writes the master plan, to develop the infrastructure development are performed separately.

- 1.4.2.1. ● [*Each phase is managed and performed by different organization*]

1.4.2.1. ● [*Each phase is managed and performed by different organization*]. Each organization never contacts each other.

1.4.3. ● [*Lack of communication and coordination between each teams which handle each phase of development*]. Documentations is generally big problem in Indonesia. The documentation culture has not been well established.

- 1.4.2.1. ● [*Each phase is managed and performed by different organization*]
- 1.1. ● [*Lack of thorough documentations*]

7.4.3 Service specification and organizational strategy

After gathering the requirement, the next step is defining services. The definition is in informal way, since I had to describe and establish agreement with the stakeholders. Services, S, can be derived from the LWBG: $LWBG_R$

$$LWBG_R = \{N_0, N_1, ...N_n, M_0, M_1, ..., M_m, P_0, P_1, ..., P_k\}$$

Where $LWBG_R$, is the LWBG of the Requirement (R), N is the node as causal factor, M is the node of causal factor that can be changed and under developer control, P is the node that can be changed but require longer time because it is not under developer control. The Service Specification (S) for each Requirement can be derived by providing the countermeasure of M

$$S = \{\sim M_1, ..., \sim M_n\} \tag{7.9}$$

For the President Web site, following is the Service Specification is the list of countermeasure of following nodes

S1 : To provide faster web site than DETIK.COM

- 1.1.◆ [*Page design*]. The web page should be designed as small as possible in order to reduce the required bandwidth.
- 1.2.◆ [*The web-server require more power for serving many visitors*]. Capacity of web server should be enough to handle the load.
- 1.2.1.◆ [*Computing power is not enough*]. The processor, RAM should be enough.
- 1.3.◆ [*Capacity link is not enough*]. The capacity link of Internet should be enough. The cost should be cover the Internet cost.
- 1.1.2.◆ [*There are many embedded objects*]. The embedded object in the page design should be minimized.
- 1.1.1.◆ [*Does not distribute the load from the main page*]. The files should be distributed in different server.
- 1.1.2.2.◆ [*Access to hard-disk is high*]. The software design should minimizes the hard disk access.
- 1.1.1.1.◆ [*There is no RSS feed*]. The RSS feed should be provided in the developed system.

S2 : To provide web site that is more secure than KPU

- 1.1.◆ [*Content are heavily based on Dynamic generated*]. The dynamic page should be minimized.
- 1.2.◆ [*SQL Injection attack*]. The countermeasure for the SQL injection should be considered.
- 1.3.◆ [*No database firewall*]. Database firewall is used.
- 1.4.◆ [*No web application firewall*]. Web application is used.

- 1.3.1.◆ [*Decision to choose the platform*]. The platform that is selected, should provide all software components require to provide secure solution

S3 : To provide web site which is better than other Government web site

- 1.2.1.◆ [*Availability of bandwidth*]. The bandwidth should be enough, the budget to cover bandwidth should be considered for the operational cost.

- 1.1.2.◆ [*There is no staff for updating contents*]. A team that updates the contents should be formed.

- 1.1.3.◆ [*Maintaining content is not part of the project*]. The maintenance cost should be considered as important part of the total budget.

- 1.3.1.◆ [*No user contributions*]. The user contribution facilities should be provided.

- 1.3.2.◆ [*No RSS feed*]. The RSS feed should be provided in the developed system.

S4: To provide government web site that is more open

- 1.2.1.1.◆ [*No comment submission facility*]. User comment facility should be provided.

- 1.2.1.2.◆ [*There is comment facility but comments are not displayed*]. The comment should also be displayed to public.

S5: To provide a web site project that is more efficient in budget

- 1.2.1.1.◆ [*Decision to use many proprietary software*]. The use of proprietary software should be minimized, if possible the use of Open Source software is preferred

S6: To make more sustainable project

- 1.2.1.1. ◆ [*The source code are not available to other developers*]. The source code should be available to developers that will continue the project.

- 1.4.2. ◆ [*The development model is too sequential and each phase is discontinued*]. The development should be not to sequential without coordination from each phase.

Furthermore, the requirement elicitation and analysis also provides the organizational strategy to provide a better system. It can be derived from the same LWBG. Organizational Policy (OP) for each Requirement can be derived by providing the countermeasure of P

$$OP = \{\sim P_1, ..., \sim P_k\} \tag{7.10}$$

From the President Web site, I can derive some organizational strategy :

OP3: To provide web site which is better than other Government web site

- 1.1.1. ● [*Web sites are not considered as the important delivery channel*]. The government bodies should start to deliver more information to public via Internet.

OP4: To provide government web site that is more open

- 1.1. ● [*Used only for disseminating gov.information*]. The government bodies should use the web site also for other purposes, such as gathering the input from public, corruption reporting system, as well as transaction system.

- 1.2.2. ● [*Decision not to provide user contribution*]. The government bodies, should start to provide the user contribution contents, such as news, report, or only the users comment. User comment should be displayed in the web site.

- 1.3. ● [*Gov. bodies do not consider two way communication is important*]. Government officers should more consider the importance of two way communication between public and government bodies.

OP5: To provide a web site project that is more efficient in budget

- 1.5. ● [*Inefficient procurement procedure*]. The procurement procedure in Indonesia should be more efficient, but accountable.

OP6: To make more sustainable project

- 1.2.1.1.2. ● [*There is no regulation which enforce the developer to deliver the source code*]. Developers should deliver the source code in government projects.
- 1.4.1.1. ● [*There is no regulation or guideline to enforce sustainability*]. Sustainability should be considered in the procurement evaluation.
- 1.4.1.2. ● [*The developer do not take into account the sustainability of project*]. Develops should be prepared with the sustainability of system
- 1.1. ● [*Lack of thorough documentations*]. Documentation should be easily accessed and it should be detail enough in describing the project.
- 1.4.3. ● [*Lack of communication and coordination between each teams which handle each phase of development*]. Each developer groups which are responsible in each phase has to communicate each other.
- 1.4.2.1. ● [*Each phase is managed and performed by different organization*]

This requirement elicitation and services specification can lead developers to put some services which are relatively new in Indonesia, especially in government sites. For example the RSS-feed, at the time when the site was developed, there was no government web sites which provides this services. Even the big news web site such as DETIK.COM did not provide it. President web sites, is the first government sites which provides the RSS-feed. The LWBA can be used not only to derived the service

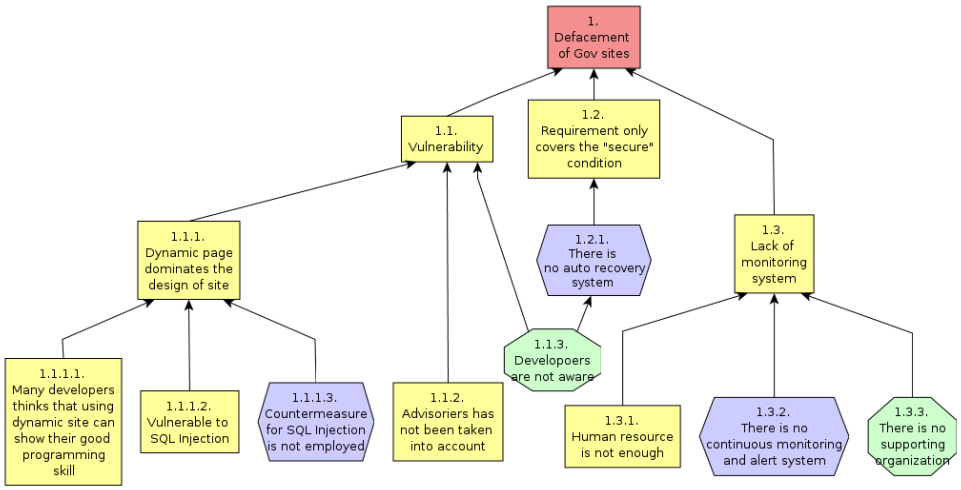


Figure 7.10: LWBG : Defacement of Government web sites (R2)

specification, but also to define the organizational strategy in order to provide a better service.

7.4.4 Threat analysis

This phase tries to predict the threat and risk from each available services from each group of users. Each group of users has different tendency to do attack. Design the system based on the user requirement as well as the trade off between the services and the threat. One biggest threat is the defacement. Many government web site in Indonesia are target of the defacement. Thus, to avoid this threat I derive the LWBG of the incident as shown in Fig. 7.10

Description of LWBG : Defacement of Government Web Sites. See Fig. 7.10.

1. [*Defacement of Gov. Sites*]. There are many defacement of government web sites in Indonesia, such as in Depkominfo, BPS .

- 1.1. [*Vulnerability of web applications*]
- 1.2. [*Requirement only covers the secure condition*]

- 1.3. [*Lack of monitoring system*]

1.1. [*Vulnerability of web applications*]. Some defacement are performed by exploiting the known vulnerabilities in web applications.

- 1.1.1. [*Dynamic page dominate the design of site*]
- 1.1.2. [*Advisories not been take into account*]
- 1.1.3.● [*Developer are not aware*]

1.1.2. [*Advisories not been take into account*]. Many of those vulnerabilities are already known, and the patch already available. Unfortunately no action has been taken to patch the system.

1.1.3.● [*Developer are not aware*]. Developers of web application do not aware the vulnerability in the web applications.

1.1.1. [*Dynamic page dominate the design of site*]. Most government web site use the dynamic page, without considering how often the information is updated.

- 1.1.1.1. [*Many developers thinks that using dynamic site can show their good programming skill*]
- 1.1.1.2. [*Vulnerable to SQL injection*]
- 1.1.1.3.◆ [*Countermeasure for SQL Injection is not employed*]

1.1.1.1. [*Many developers thinks that using dynamic site can show their good programming skill*], Some developers without considering the users or the function of the web site, want to use the content management system that employs the dynamic generate page. They believe, it shows their ability in writing the software.

1.1.1.2. [*Vulnerable to SQL injection*], A dynamic generated page that used database engine, normally has possibility to be vulnerable to SQL injection.

1.1.1.3. ◆ [*Countermeasure for SQL Injection is not employed*]. Many web application developers are not aware with the countermeasure of SQL injection, such as web-application firewall, or database firewall, or the static analyzer for the web application code.

1.2. [*Requirement only covers the secure condition*]. The requirement in the design phase only cover the good conditions, what the system should provide during the insecure condition is never covered.

- 1.2.1. ◆ [*There is no auto recovery system*]

1.2.1. ◆ [*There is no auto recovery system*]. An auto-recovery system will recover the whole system as quick as possible to the secure condition. By applying this mechanism, every time there is a defacement, system can recover itself very fast.

- 1.1.3. ● [*Developers are not aware*]

1.3. [*Lack of monitoring system*]. Most government web sites do not employ the monitoring system.

- 1.3.1. [*Human resource is not enough*]
- 1.3.2. ◆ [*There is no continuous monitoring and alert system*]
- 1.3.3. ● [*There is no supporting organization*]

1.3.1. [*Human resource is not enough*]. Mostly government web site concentrate only for the development, not for the maintenance and operation. Therefore, during operation there is not enough human resource available who perform the continuous monitoring task.

1.3.2. ◆ [*There is no continuous monitoring and alert system*]. In Indonesia, until now there is no monitoring and alert services which provided by government bodies, or companies.

1.3.3.● [*There is no supporting organization*]. Indonesia has not had an active Computer Emergency Response Team. Indonesia just started an computer security related bodies, called ID-SIRTI (Indonesian Security Incident Response Team on Internet Infrastructure which monitors the Internet traffic [Donny BU, 2006].

Improvement derived from LWBG: From the incident analysis, to prevent the same attack, from the LWBG can be derived the countermeasure. The countermeasures that should be employed in the president web site to avoid the same problems:

- 1.1.1.3.◆ [*Countermeasure for SQL Injection is not employed*]. In president web site, the countermeasure for the SQL injection has to be applied, the web application firewall, database firewall, as well as the intruder detection system.

- 1.3.2.◆ [*There is no continuous monitoring and alert system*]. An continuous monitoring and alert system is installed. This monitoring system will evaluate if the web page is the original one. The monitoring system was installed in RVS Arbeitsgruppe Bielefeld, it also monitor the international connection.

- 1.2.1.◆ [*There is no auto recovery system*]. Whenever there is the defacement, the president web site has been equipped with the software that will recover the whole web pages, and the defacement page will be replaced with the original one.

To prevent the situation, some organizational change as well as learning should be performed. Based on LWBG some pre-cautions that should be taken into account :

- 1.1.3.● [*Developers are not aware*]. Web application developers should be trained to understand the security problem of web application. This learning phase had also performed informally during the president web site development.

- 1.3.3.● [*There is no supporting organization*]. The supporting organization for the security of the government web sites should be formed.

7.4.5 Prototyping strategy

Getting feedback from users as early as possible is very important in this participatory development model. Therefore, I decided to use the prototype which evolves to be the final product. The prototyping was done in the web page and the results are discussed before being shown to the stake holder. Since the developers were not stay in the same room, the discussion were carried on using the Internet. During this process, the prototype were annotated with the comment by using the graphic editor. This prototype were also shown for the discussion with the stake holder. Mostly the stake holder will have comment in appearance of the web sites. The prototype is depicted in Fig. 7.11. Appearance is very important for Indonesia users, especially for the official web sites. Some cultural maker should be taken into consideration.

The prototype is not one-throw prototype, or only paper based prototype. I used the web page as the prototype. After obtaining the agreement with the stakeholder, the prototype is refined until the final services.

7.4.6 Conflict resolution in implementation

The service specification for the whole systems is a combination between the Services Specification derived from each Requirement :

$$\mathbb{S} = \{S_1 \oplus S_2 \cdots \oplus S_m\} \tag{7.11}$$

However, sometimes there are conflicts between component of service specifications. In a conflict, the goal of system should be used to judge which specification that should be taken and which specification that should be dropped. In this section, I will describe how to solve the conflict in the implementation by using LWBA. I will focus on two main conflicts in the decision during implementation of President website:

- **CR1: Open Source Software vs Proprietary solutions**. After the technical characteristics being defined we request to the proprietary vendor to submit

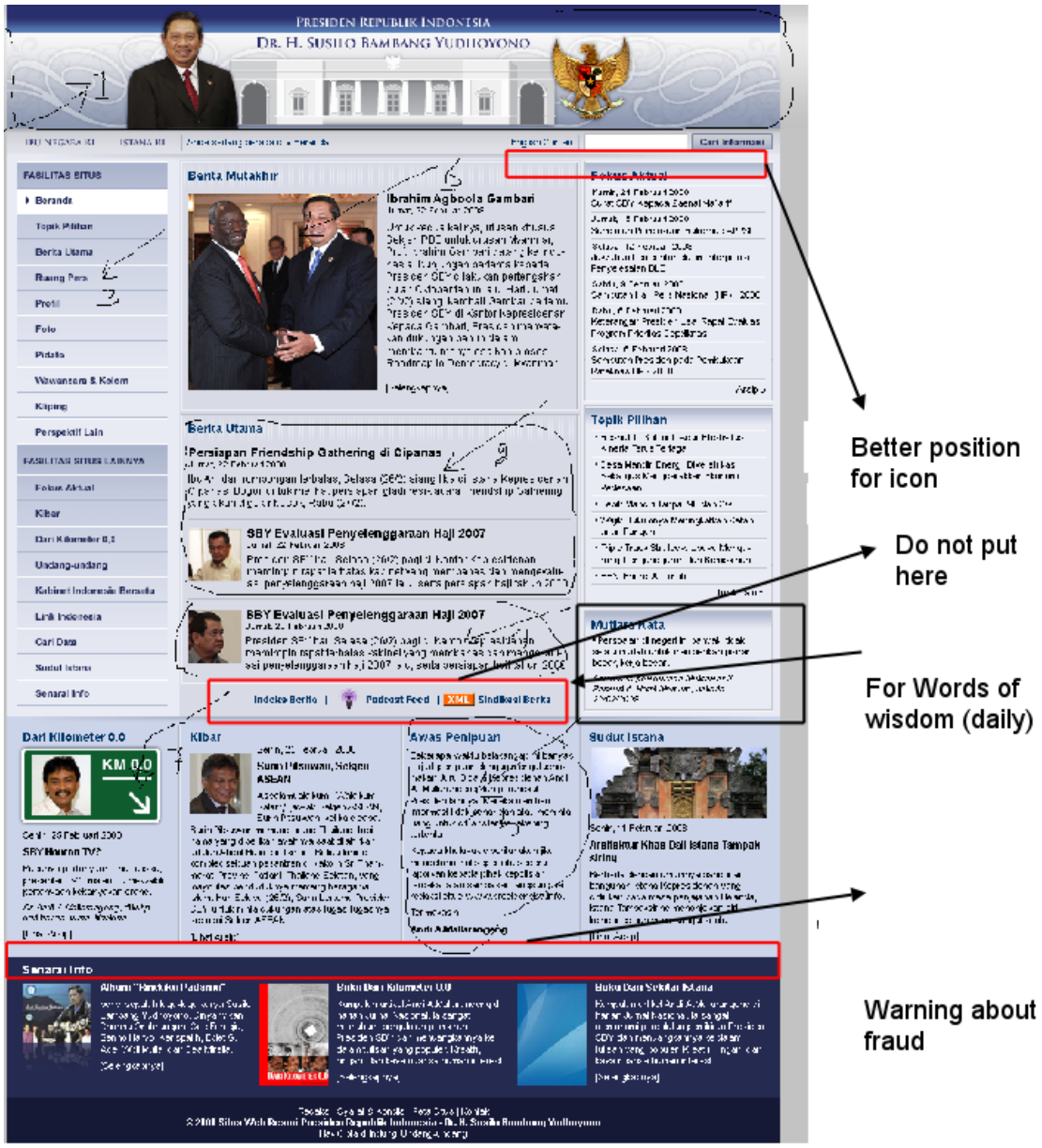


Figure 7.11: Prototype and comments

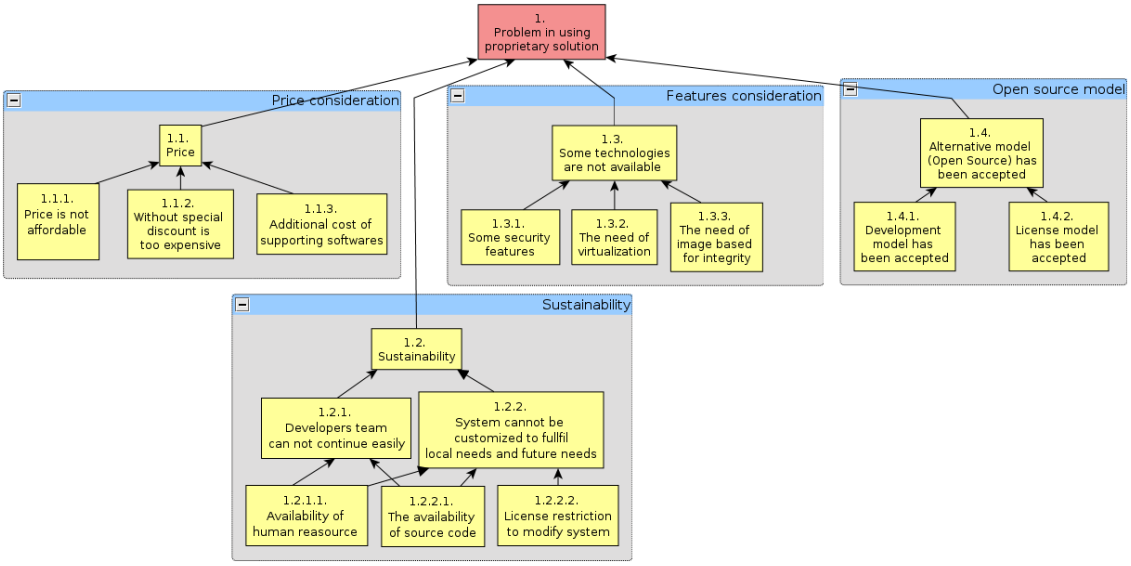


Figure 7.12: LWBG : Maximize use of OSS

their budget and possible solutions using the proprietary operating system. At the same time, the same solution but using the open source solution was also developed by developer team. Most of the developers are familiar with proprietary and open source solutions.

- **CR2: Dynamic generated web contents vs static web pages**. In the web site development, web application developers tend employ dynamic generated web contents without considering the frequency update of information. However, this strategy also has some weaknesses.

The LWBA is used to analyze the decision that taken in the implementations. This LWBA is used to track the decision made during this phase. In the development a high profile web site such the president web site, the question about using Open Source or proprietary is not only technical, but also non technical. To make decision, I derive the LWBG with the top node is the problem that frequently exists in current software implementation in government agencies. This LWBG is shown in Fig. 7.12.

Description of LWBG : Use of OSS. See Fig. 7.12.

1. [*Problem in using proprietary solution*]. Many government projects in Indonesia, uses the proprietary software solutions,

- 1.1. [*Price*]
- 1.2. [*Sustainability*]
- 1.3. [*Some technologies are not available*]
- 1.4. [*Alternative model (OSS) has been accepted*]

1.1. [*Price*]. The price of proprietary software license is still too high for the Indonesia users.

- 1.1.1. [*Price is not affordable.*]
- 1.1.2. [*Without special discount, it is too expensive.*]
- 1.1.3. [*Additional cost of supporting software*]

1.1.1. [*Price is not affordable*]. Comparing with the currency in Indonesia, the software license is very expensive.

1.1.2. [*Without special discount, it is too expensive*]. Many campuses or government bodies can afford to buy the software license, by accepting the special discount from the vendor. Without the special discount or price arrangement, the price is just to expensive for Indonesia standard.

1.1.3. [*Additional cost of supporting software*]. Users has to buy additional software such as firewall, anti virus, or additional software that has not bundled in the computer.

1.2. [*Sustainability*] Some project which based on the proprietary software cannot sustain.

- 1.2.1. [*Developer team cannot continue easily*]

- 1.2.2. [*System cannot be customized to fulfill local needs and future needs*]

1.2.1. [*Developer team cannot continue easily*]. If a project is continued by a new group of developer, they cannot continue or maintain the project. Or if there is a new request in the future, this request also is hard to be fulfilled

- 1.2.1.1. [*Availability of human resource*]
- 1.2.2.1. [*The availability of source code*]

1.2.1.1. [*Availability of human resource*] Finding enough developers who understand a particular technology sometime is difficult. The good developer is scarce.

1.2.2.1. [*The availability of source code*] Without the source code, it is very difficult for other group of developers to understand the system, modify the system.

1.2.2. [*System cannot be customized to fulfill local needs and future needs*] The Sustainability Case-1 sometimes is difficult to tackle, because the system is designed in different situation. After using the system, and there is a new requirement, for example due to new technology trend, the modification also cannot be performed. Many solutions in Indonesia cannot sustain because this both case of sustainability.

- 1.2.1.1. [*Availability of human resource*]
- 1.2.2.1. [*The availability of source code*]
- 1.2.2.2. [*License restriction to modify system*]

1.2.2.2. [*License restriction to modify system*]. Most proprietary software has very restricted license, Users or developer without special permission are not allowed to change the code.

1.3. [*Some technologies are not available*]. In particular proprietary software, some technologies have not been available

- 1.3.1. [*Some security features*]
- 1.3.2. [*The need of virtualization*]
- 1.3.3. [*The need of image based for integrity*]

1.3.1. [*Some security features*] In the developed system, I require the integrity control, intruder detection and prevention, good log mechanism and in some platform it has not been available. It should be acquired separately.

1.3.2. [*The need of virtualization*]. Virtualization is required in the developed system, because the security features, as well as the feature to perform the live migration in order to provide better reliability of system.

1.3.3. [*The need of image based for integrity*]. To protect the integrity of system (for auto recovery features), the system requires the image based system.

1.4. [*Alternative model (OSS) has been accepted*]. Open Source Solution now used in Indonesia in many projects. Indonesia government has also launched an initiative called Indonesia, Go Open Source ! (IGOS). It shows the acceptance of OSS model in the government bodies.

- 1.4.1. [*Development model has been accepted*]
- 1.4.2. [*License model has been accepted*]

1.4.1. [*Development model has been accepted*]. Open Source development method is already accepted in Indonesia.

1.4.2. [*License model has been accepted*]. Open Source license is already accepted in Indonesia.

The cost of software as well as the piracy rate are still a big problem that has to be encountered by government and public in adopting the ICT for daily operation. However, many institutions developing their IT system without considering the software cost. The use of proprietary and closed software do not only make the cost very

high but also create some hidden cost and hidden problems, such as the hardware upgrade, file format, the software piracy, and in some specific cases, the fact that the program code cannot be read leaves doubts regarding the reliability, particularly in terms of confidentiality.

The use of proprietary and closed software do not only make the cost very high but also :

- Software upgrades or releases make old hardware obsolete;
- The generalization of a proprietary format makes the use of competing software difficult or impossible. Older versions of the software cannot process documents from newer versions.
- Users cannot be sure that the range of products with which they have become familiar will continue to be available in the future;
- In some specific cases, the fact that the program code cannot be read leaves doubts regarding the reliability, particularly in terms of confidentiality.

As shown in Fig. 7.12, by choosing Open Source a very economic implementation can be achieved. The initial cost of the system is 56.000.000 IDR. It is also the system development cost, software license, hardware cost and communication. The monthly cost is about 24.000.000 IDR, including the servers and network rent, content maintenance and system development and maintenance [Donny BU, 2006].

Open Source is chosen, not only due to the cost, but also to other consideration, such as shown in Fig. 7.12. For example the security features and reliability. At that time, there is no proprietary solution which were able to satisfy our needs such as, live migration, full isolation of system, and the other security requirements. By exploiting Open Source software, developers who are already familiar with the software can customize directly the source code, and suited the system to the specific need. This model of development cannot be done in proprietary solution without paying a high cost of license.

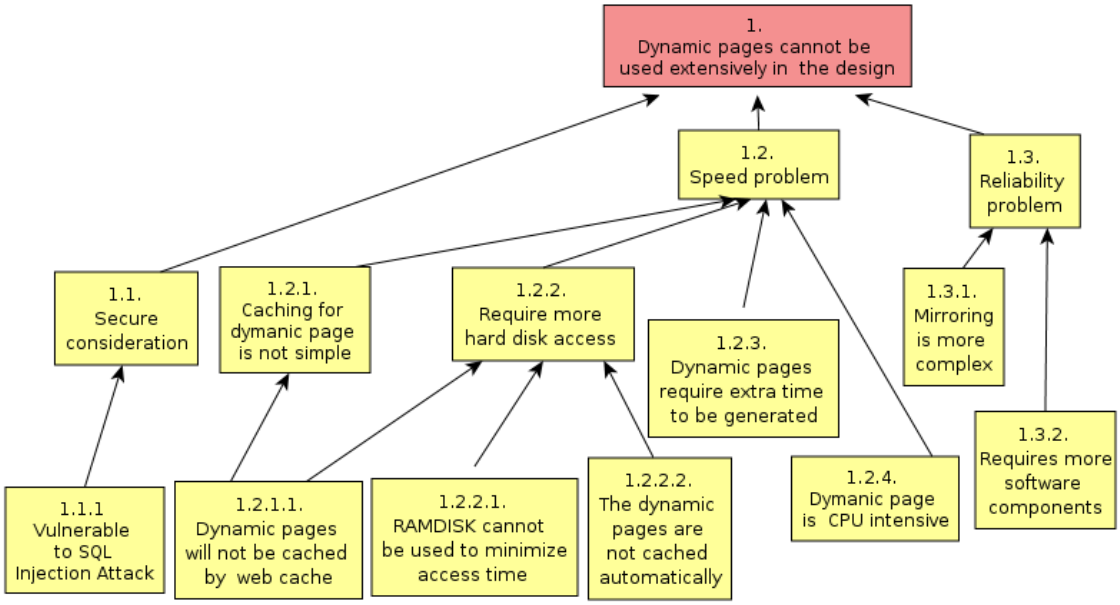


Figure 7.13: LWBG of Dynamic pages should be minimized

In designing the web page, there is always the dynamic page. Most web application developers want to design that the web site uses dynamic pages that without considering how often the pages will be updated. To solve this conflict between the developers, I use the LWBA as the tools for conflict resolution in the implementation phase as shown in Fig. 7.13

Description of LWBG : Dynamic page should be minimized. See Fig. 7.13.

1. [*Dynamic pages cannot be used extensively in the design*]. Developers suggested to use the dynamic pages in the web design. Many Content Management System, basically operates in this mechanism.

- 1.1. [*Security consideration*]
- 1.2. [*Speed problem*]
- 1.3. [*Reliability problem*]

1.1. [*Security consideration*]. Security is one of the main criteria in this design, therefore, any decision should consider this criteria.

- 1.1.1. [*Vulnerable to SQL Injection Attack*]

1.1.1. [*Vulnerable to SQL Injection Attack*]. A dynamic web page is open possibility to an SQL injection attack, the KPU defacement, and many government web site defacement show this vulnerability.

1.2. [*Speed problem*]. Speed to deliver the pages to users is the main consideration as stated in the requirement (R1). Therefore, the implementation is judged based on the speed.

- 1.2.1. [*Caching for dynamic page is not simple*]
- 1.2.2. [*Require more hard disk access*]
- 1.2.3. [*Dynamic pages require more time to be generated*].
- 1.2.4. [*Dynamic page is CPU intensive*]

1.2.3. [*Dynamic pages require more time to be generated*].

1.2.4. [*Dynamic page is CPU intensive*]. The conversion from the database to the HTML page, requires some amount of processing power. The president web site minimizes the dynamic page generation.

1.2.1. [*Caching for dynamic page is not simple*]

- 1.2.1.1. [*Dynamic pages will not be cached by web cache*].

1.2.1.1. [*Dynamic pages will not be cached by web cache*].

1.2.2. [*Require more hard disk access*].

- 1.2.1.1. [*Dynamic pages will not be cached by web cache*].
- 1.2.2.1. [*RAM-DISK cannot be used to minimize access time*].
- 1.2.2.2. [*Dynamic pages are not cached automatically*].

1.2.2.1. [*RAM-DISK cannot be used to minimize access time*].

1.2.2.2. [*Dynamic pages are not cached automatically*].

1.3. [*Reliability problem*]. Reliability is the goal of this web site. More components lead to higher of failure probability. Thus, it reduce the reliability of system.

- 1.3.1. [*Mirroring is more complex*]
- 1.3.2. [*Requires more software components*]

1.3.1. [*Mirroring is more complex*]. A static page is very easy to replicate than dynamic pages.

1.3.2. [*Requires more software components*]. A static page only requires a web server without other software components such as PHP, Perl, java. It reduces the complexity of system, as well as the requirement of processing power.

7.5 Short description of implementation

The president web site was developed using many Open Source solutions. Several Linux distributions were used and many Open Source programs were utilized. The flexibility of Open Source and the choice make it easier to choose and benchmarking the solution. For example, for web server implementation, there are many choices such as Apache[`http://www.apache.org`], Lighttpd [`http://www.lighttpd.net`], Yaws[`http://yaws.hyper.org`] etc. For virtualization requirement there are many choice between OpenVZ [`http://www.openvz.org`] or Xen [`http://www.xensource.com`]. The flexibility of Open Source solution enabled developer to create a special system for log monitoring and management based on available Open Source solution such as Nagios [`http://www.nagios.org`], Argus [`http://www.qosient.com/argus/`], Awstats [`http://awstats.sourceforge.net/`], Snort [`http://www.snort.org`] etc.

In this works I do not describe in detail the structure of software and network architectures. I only focus on the method in deriving the requirement and method to

ensure the sustainability. The structure of system is briefly shown in Fig. 7.15. The system basically has following components:

- The web is served by a web cluster which serves the static pages. The dynamic pages are served by separate web server. This separation due to the security and performance consideration. Furthermore, there is also separate server that serve the search services and also as streaming server. The web server used the modified version of Lighttpd and Apache. The modification was performed due to some requirements.

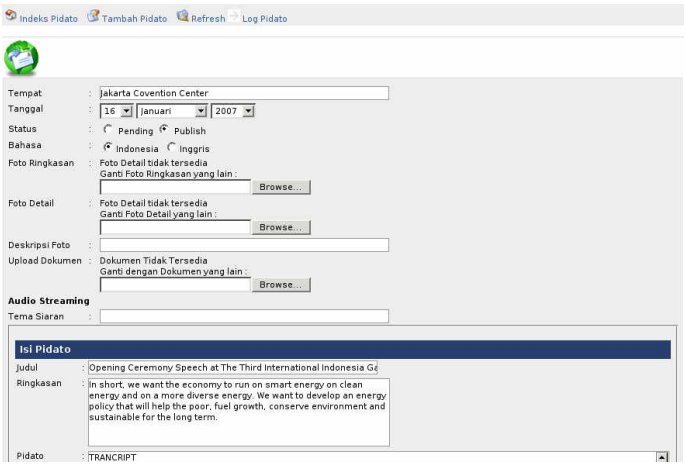
- The dominant static pages as shown in Fig. 7.14b are generated on demand from the dynamic contents in the Content Management System. As consequences, the content management system is not exposed directly to the Internet. A queue mechanism for content submission system is used for user comment facility.

- To reach the security goal some strategy are implemented such as : layering structuring for accessing the system, VPN and Firewall as basic requirement, integrity control, prevention of attack of the dynamic sites such as Cross Site Scripting (XSS) and SQL Injection, continuous monitoring and alert.

- Each server is executed in the container of virtual machine in the virtualization environment. This virtualization also enable to perform the live migration and disaster recovery. At the time, proprietary solution cannot satisfy the requirement for virtualization as well as live migration.

- The firewall, load-balancer, Intruder Detection System (IDS) and Intruder Prevention System (IPS) are configured in fail-over configuration. It is managed and configured by the Telkom Tbk.

- The content management system used by users (staffs of Office of President) was developed from scratch by the developer team. It is not based on any Content Management System (CMS). It was developed during this project. The CMS as shown in Fig. 7.14a is also designed to accept the submission and maintenance by using mobile devices.



(a) Content Management System

(b) President web site

Figure 7.14: President web site

- Some tailor made softwares to perform conversion from dynamic page to static page, the queue mechanism for user comment submission, log managements etc.

7.6 Strategy for evaluation system

To measure how good the system, I implement various measurement :

- **Direct measurement**. This measurement is important for developers P_{D1}, stakeholders P_{S1} as well as media P_M.

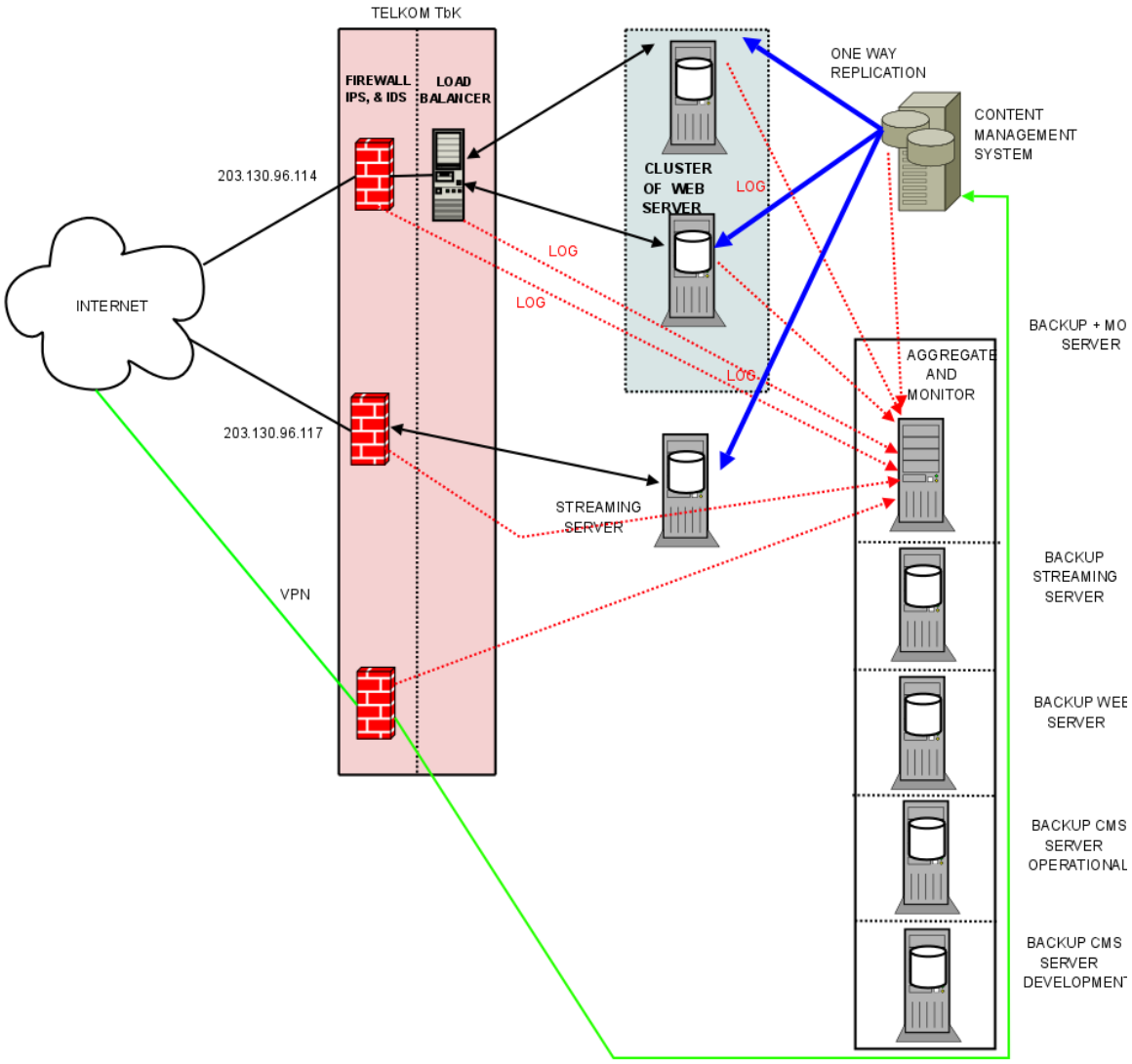


Figure 7.15: Structure of President web site

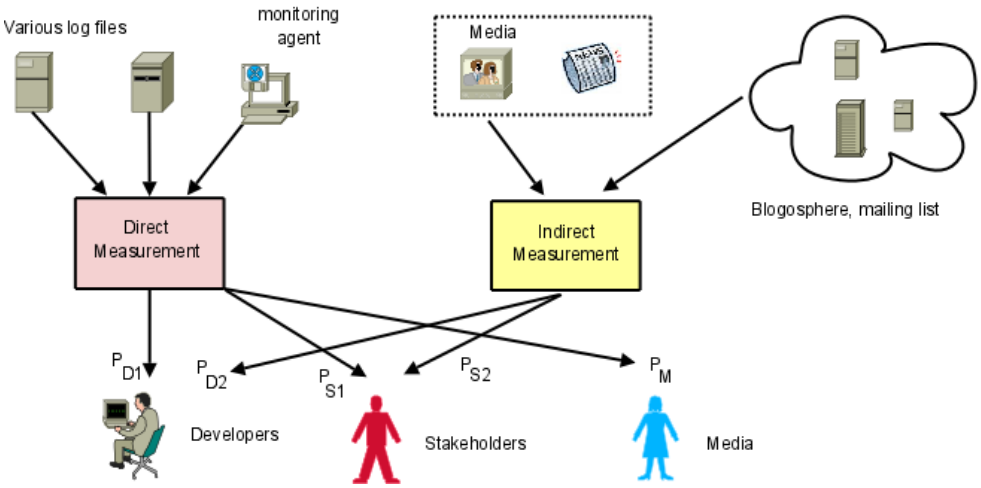


Figure 7.16: Measurement strategy

- **Indirect measurement**. This measurement is only important for stakeholders P_{S2}, and developers P_{D2} require it as the feedback from public.

7.6.1 Direct measurement

Direct measurement is performed directly using the log files from various programs used by the system. The direct measurement is used in several phase of development. During the design phase, the evaluation was performed to measure how good the system from the operator and stakeholder point of view. User groups which are outside of the team cannot be used as tester due to the confidentiality of project. During implementation phase, measurements were performed to test the functionality, as well as to simulate the predicted load of the system.

The direct measurement is used to improve the system, or to test the design assumptions. For example, for the designing of web pages, I decide to choose the standard format which is not tied with particular browsers or particular operating systems. From the log file I found some interesting results. After operating the website 1 years some interesting results in comparing the used of open source and proprietary software can be demonstrated in this paper. We only presents two data sets which are related with the spread of the Open Source usage in Indonesia. Since

Table 7.4: Browser statistic of visitors

Month	Browser agent (%)					
	IE	Gecko	Opera	Safari	Konqueror	Others
2006-02	65.626	19.882	7.068	0.427	0.152	6.845
2006-03	64.449	17.135	7.774	0.315	0.244	10.083
2006-04	63.528	16.434	7.435	0.411	0.188	12.004
2006-05	64.931	17.612	6.517	0.426	0.212	10.302
2006-06	62.266	17.706	7.172	0.509	0.220	12.128
2006-07	61.561	17.803	7.230	0.474	0.194	12.739
2006-08	62.299	19.025	7.244	0.572	0.147	10.713
2006-09	61.559	19.602	6.710	0.595	0.163	11.371
2006-10	61.237	19.761	6.162	0.772	0.144	11.925
2006-11	60.627	20.793	6.574	0.793	0.279	10.934
2006-12	57.820	20.301	6.522	0.689	0.304	14.365
2007-01	58.303	20.992	6.613	0.602	0.270	13.220
2007-02	56.307	22.746	7.178	0.712	0.337	12.720
2007-03	52.002	29.281	6.817	0.543	0.281	11.078

most of the visitors come from the Indonesia [Wiryana, 2007], the data can represent the user in Indonesia.

- **Browser used by visitors**. As shown in Table 7.4 the IE users are about 65% of visitors. Many users in Indonesia only used browser which is included in their operating system, to download other browser via Internet is still big problem. However the number of users who used IE is decreasing. On the other hand, the open source browser such as Gecko based (Firefox, Galeon etc), Konqueror is going up. Although users have to do extra works to download or install the open source browser, but they expect the benefit for doing it, such as security. It shows the increasing the acceptance of open source as alternative solution. Therefore, it can be concluded that there is a positive trend in the use of Open Source browser in Indonesia.

- **Operating systems used by the visitors.** It is still dominated by MS Windows, and follows by Linux and others as shown in Table 7.5. The percentage of users who use Linux as desktop operating system is small compared to MS Windows. However, it cannot be neglected and increasing from time to time.

Table 7.5: Operating Systems

Month	Operating System (%)					
	MS Windows	Linux	Mac	Free/Net BSD	SunOS	Others
2006-02	89.888	2.241	0.758	0.015	0.007	7.090
2006-03	87.203	2.254	0.699	0.010	0.003	9.831
2006-04	84.702	2.348	0.814	0.007	0.004	12.125
2006-05	84.947	3.535	0.832	0.037	0.007	10.643
2006-06	84.935	2.468	0.900	0.007	0.002	12.228
2006-07	84.588	1.618	0.947	0.017	0.014	12.816
2006-08	86.342	1.730	0.982	0.029	0.011	10.906
2006-09	85.489	1.591	1.046	0.031	0.005	11.839
2006-10	84.590	1.467	1.229	0.044	0.022	12.647
2006-11	85.699	1.615	1.446	0.002	0.000	11.237
2006-12	82.299	1.725	1.238	0.007	0.002	14.728
2007-01	83.386	1.828	1.022	0.004	0.000	13.759
2007-02	82.920	2.422	1.337	0.013	0.005	13.304
2007-03	84.182	2.549	1.085	0.020	0.000	11.534

The other operating system such as BSD and SunOS are mainly used for the proxy server in many corporate networks or Internet cafes in Indonesia. Some operating system which cannot identified are also mostly Linux-based system as well.

7.6.2 Indirect measurement

This measurement is performed to know the impact of web sites to the public, also the impression from the public. To do this indirect measurement I chose several sources :

- Mail from users or contact form. The users comment show how visitors is still interested in the president web site. The statistics of the users comment is shown in Tab. 7.6.
- Blogsphere and mailing list.
- Media online or media conventional such as news papers and magazines.
- Sites that links to the president web site.

Table 7.6: Comments from users

Month	Submitted	Published	% Published
2006-02	2056	780	37.94
2006-03	1073	282	26.28
2006-04	462	205	44.37
2006-05	497	328	66.00
2006-06	351	167	47.58
2006-07	290	160	55.17
2006-08	434	230	53
2006-09	330	167	50.61
2006-10	282	128	45.39
2006-11	286	116	40.56
2006-12	286	121	42.31
2007-01	437	162	37.07
2007-02	201	66	32.84
2007-03	516	164	31.78
2007-04	453	244	53.86
2007-05	464	247	53.23
2007-06	371	184	49.60
2007-07	372	165	44.35
2007-08	462	201	43.51
2007-09	395	163	41.27
2007-10	362	174	48.07
2007-11	476	188	39.50
2007-12	527	142	26.94
2008-01	466	189	40.56
2008-02	396	141	35.61
2008-03	525	151	28.76
2008-04	731	152	20.79
2008-05	1156	242	20.93
2008-06	751	223	29.69
2008-07	519	141	27.17
2008-08	560	174	31.07

To evaluate the results of the indirect measurement, I use LWBG to understand problems and to perform the improvement. The real example of this indirect measurement is the preposition: "*Bad acceptance of presidensby.info*". After launching the site, there were many critiques in mailing lists, media, as well as in the user comment submitted in the system. This critique regarding the make use of "`presidensby.info`" as domain rather than "`presidenri.go.id`". To investigate this problem, I perform the LWBA with LWBG as shown in Fig. 7.17.

Description of LWBG of Domain Usage Critique. See Fig. 7.17.

1. [*Bad acceptance presidensby.info domain*]. There were many critique regarding the use of this domain. The critique were found in mailing list, open letter, blogsphere, and also in media. It shows the bad acceptance of this domain selection.

- 1.1. [*Decision to use presidensby.info*]
- 1.2. [*Many critiques about the use of presidensby.info domain*]

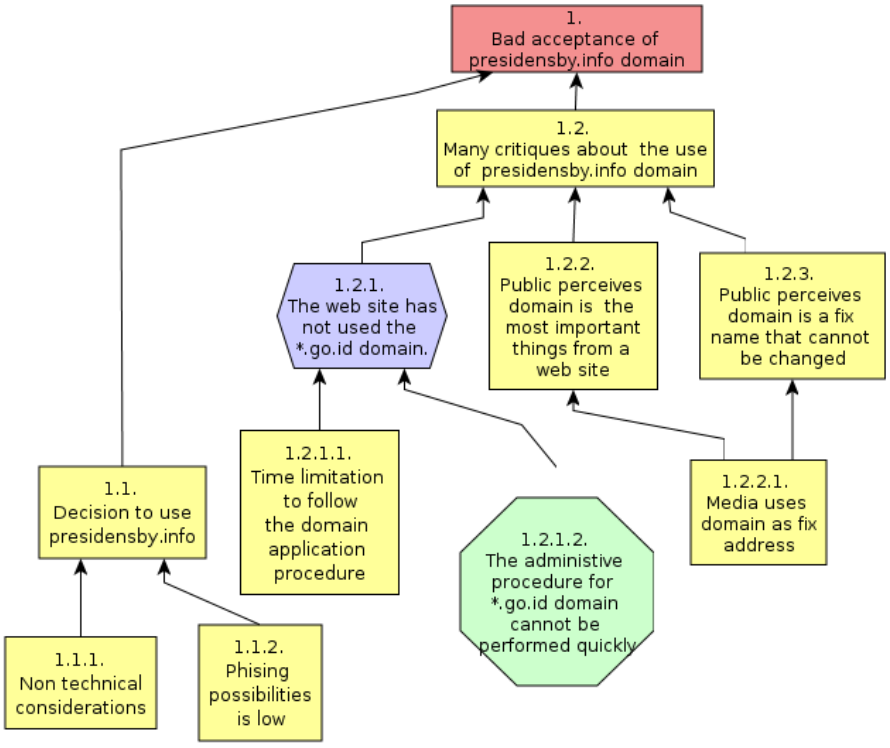


Figure 7.17: LWBG: Domain usage critique

1.1. [*Decision to use presidensby.info*]. During the meeting with the president's staff. The decision was taken to choose this domain.

- 1.1.1. [*Non technical considerations*]
- 1.1.2. [*Phising possibilities is low*]

1.1.1. [*Non technical considerations*].

1.1.2. [*Phising possibilities is low*] The presidensby.info domain is considered to have phising possibility low .

1.2. [*Many critiques about the use of presidensby.info domain*]. In various mailing lists, media, blogsphere, there were many critique regarding the use of presidensby.info domain. An open letter is also circulated that criticize this selection of domain.

- 1.2.1. [*The web site has not used the *go.id domain*]

- 1.2.2. [*Public perceives domain is the most important things from a web site*]
- 1.2.3. [*Public perceives domain is a fix name that cannot be changed*]

1.2.1. [*The web site has not used the *go.id domain*]. The president web site, was launched using `presidensby.info` domain.

- 1.2.1.1. [*Time limitation to follow the domain application procedure*]
- 1.2.1.2. [*The administrative procedure for *.go.id domain cannot be performed quickly*]

1.2.1.1. [*Time limitation to follow the domain application procedure*]. There is not enough time to apply the presiden.go.id domain.

1.2.1.2. ● [*The administrative procedure for *.go.id domain cannot be performed quickly*]. The application process of go.id domain was complex and required longer time than available time before the launching.

1.2.2. [*Public perceives domain is the most important aspect from a web site*]

- 1.2.2.1. [*Media uses domain as fix address*]

1.2.2.1. [*Media uses domain as fix address*]. Media use domain, as the name of web site, such as DETIK.COM rather than Detik news, or Presidensby.info rather than Presiden web site.

1.2.3. [*Public perceives domain is a fix name that cannot be changed*]. Many users in Indonesia still has perception that the domain is something that cannot be changed. It is fix and attached into a particular content of a web site.

- 1.2.2.1. [*Media uses domain as fix address*]

7.7 Incidents during operation

During the operation some incident exists which require some improvement of the system. I used the LWBG to analyze the various incident and performed the change of the system or the organization with other parties. The incidents can be grouped into :

- System failure
- Security problem
- Performance problem

7.7.1 System failure

The first system failure that I experience during the operation of President web site is due to the Distributed Denial of Service (DDoS) attack. The next day after the launching of President web site, there was the massive DDoS to the IP number of President web site. This attack caused the IP number of President web sites was blocked. This situation occurred longer than 1 hour, because I did not receive the notification. To understand the problem, and to install the countermeasure to avoid the same problem, I derive the LWBG as shown in Fig. 7.18.

Description of LWBG : DDoS Attack. See Fig. 7.18.

1. [*Website cannot be accessed from outside of Indonesia for longer than 1 hour*]. In the first day after launching. President web site cannot be accessed from outside of Indonesia about 1 hour.

- 1.1. [*Website cannot be accessed from outside of Indonesia*]
- 1.2. [*There is no immediate notification to network provider*]]

1.1. [*Website cannot be accessed from outside of Indonesia*]. From the monitoring system in RVS, I received alert that the web site cannot be accessed from outside of Indonesia

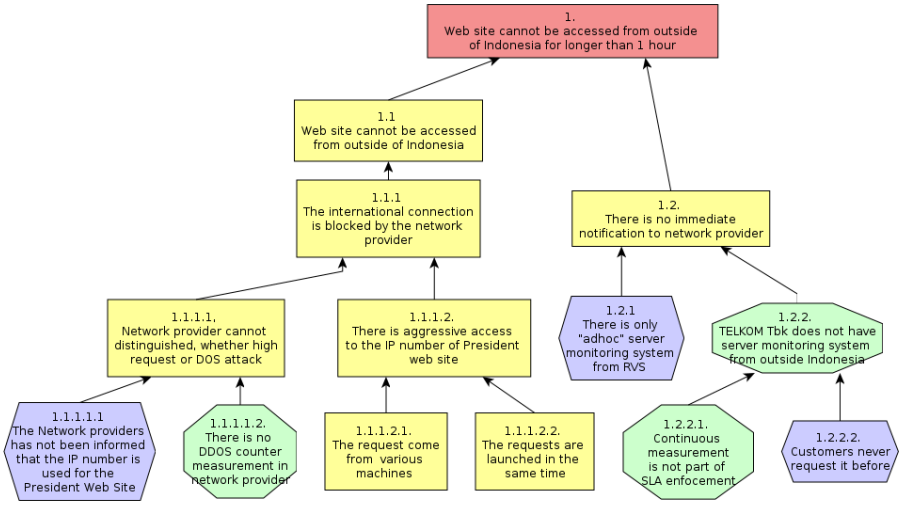


Figure 7.18: LWBG : DDoS Attack

- 1.1.1. [*The international connection is blocked by the network provider*]

1.1.1. [*The international connection is blocked by the network provider*]. Using the `tcptraceroute`, it could be identified that the international connection from Telkom Tbk was blocked.

- 1.1.1.1. [*Network provider cannot distinguished, whether high request or DOS attack*]
- 1.1.1.2. [*There is aggressive access to the IP number of President website*]

1.1.1.1. [*Network provider cannot distinguished, whether high request or DOS attack*]. The upstream provider could not identify whether the high request is DoS or just normal request. The router has not been equipped with the countermeasure for DoS.

- 1.1.1.1.1. ◆ [*The Network providers has not been informed that IP number is used for the President Web Site*]
- 1.1.1.1.2. ● [*There is no DDoS counter measurement in network provider*]

1.1.1.1.1. ◆ [*The Network providers has not been informed that IP number is used for the President Web Site*]. As the maintainer team of President web site did

not inform to the upstream provider. Usually the network provider (Telkom TbK), that should inform to the upstream, because the president web site is not bound by any contract with the upstream provider.

1.1.1.1.2. ● [*There is no DDOS counter measurement in network provider*]

1.1.1.2. [*There is aggressive access to the IP number of President website*]. Upstream provider identified that there is high access to the particular IP number (President web site's IP number).

- 1.1.1.2.1. [*The request come from various machines*]
- 1.1.1.2.2. [*The request are launched in the same time*]

1.1.1.2.1. [*The request come from various machines*]. The same request comes from many machines in the same time, It is similar with the DDoS (Distributed Denial of Service)

1.1.1.2.2. [*The request are launched in the same time*]

1.2. [*There is no immediate notification to network provider*]. The Telkom TbK does not provide the real time notification for the malfunction or problem. Therefore, as the maintainer I did not receive any alert.

- 1.2.1. ◆ [*There is only "adhoc" server monitoring system from RVS*]
- 1.2.2. ● [*TELKOM Tbk does not have server monitoring system from outside Indonesia*]

1.2.1. ◆ [*There is only "adhoc" server monitoring system from RVS*]. For the maintenance of President Web site, I developed and installed a simple monitoring system in RVS network facility. This monitoring system, regularly check the connection to the president web site. I used it as evidence for complaining to network provider.

1.2.2. ● [*TELKOM Tbk does not have server monitoring system from outside Indonesia*]. There was no system monitoring facility offered by Telkom Tbk. The system monitoring is available only for the internal of Telkom Tbk, not for the customers.

- 1.2.2.1. ● [*Continuous measurement is not part of SLA enforcement*]
- *1.2.2.2.* ◆ [*Customer never request it before*]

1.2.2.1. ● [*Continuous measurement is not part of SLA enforcement*]. In the contract with Telkom TbK, the continuous measurement is not covered.

1.2.2.2. ◆ [*Customer never request it before*]. Not many customers in Indonesia are aware with the continuous monitoring.

Improvement suggested by LWBG : After analyzing using LWBA, I suggested following actions to be taken :

- 1.2.1. ◆ [*There is only "adhoc" server monitoring system from RVS*]. As countermeasure, now I decided to install more server monitoring as well as subscribe to the server monitoring services. Unfortunately the server monitoring services do not have monitor agent from IIX, therefore additional monitoring agent in IIX has to be installed.
- *1.2.2.2.* ◆ [*Customer never request it before*]. As countermeasure, now officially the web site team asked to the Telkom Tbk, to provide the server measurement.
- 1.1.1.1.1. ◆ [*The Network providers has not been informed that IP number is used for the President Web Site*]. After the incident, the first countermeasure that was performed, is to contact the upstream provider and informed them that the IP number of President web site has a big access.

Some actions that should be performed by other parties were also suggested, such as :

- 1.1.1.1.2. [*There is no DDOS countermeasure in network provider*]. I suggested to the Telkom TbK, and upstream provider to install the DDoS countermeasure.

- 1.2.2.1. [*Continuous measurement is not part of SLA enforcement*]. I suggested to Telkom TbK, to provide the monitoring and measurement facility to the customers, and it should also be covered in the contract and SLA.

- 1.2.2. [*TELKOM Tbk does not have server monitoring system from outside Indonesia*]. I suggested to Telkom TbK, to have server monitoring outside Indonesia that can monitor the International connection.

7.7.2 Security problems

During 3 years operation of President web site, there is only one significant security problem. This attack did not exist in President web sites, but in the DNS service provider which is used by the President Web site. However, since this attack produced a perception to the public as the President web site has been defaced . After the incident, I had to deliver the explanation to the stakeholder about the cause of this incident. To analyze this incident I draw the LWBG as shown in Fig. 7.19. The LWBG is invaluable explanation tool, not only for developers but also for the non developers. Using this graphical representation of LWBG, stakeholder could understand the problem.

Description of LWBG : Presidensby.info redirection incident

1. [*Public thinks that there is defacement of President Web site*]. As being reported by media as well as many posting in blogsphere, there is the perception that the attacker has successfully got the access and change the president web site..

- 1.1. [*Public see the appearance of www.presidensby.info is not the original one*].

- 1.2. [*Public is not aware the existence of the official site : www.presidenri.go.id*].

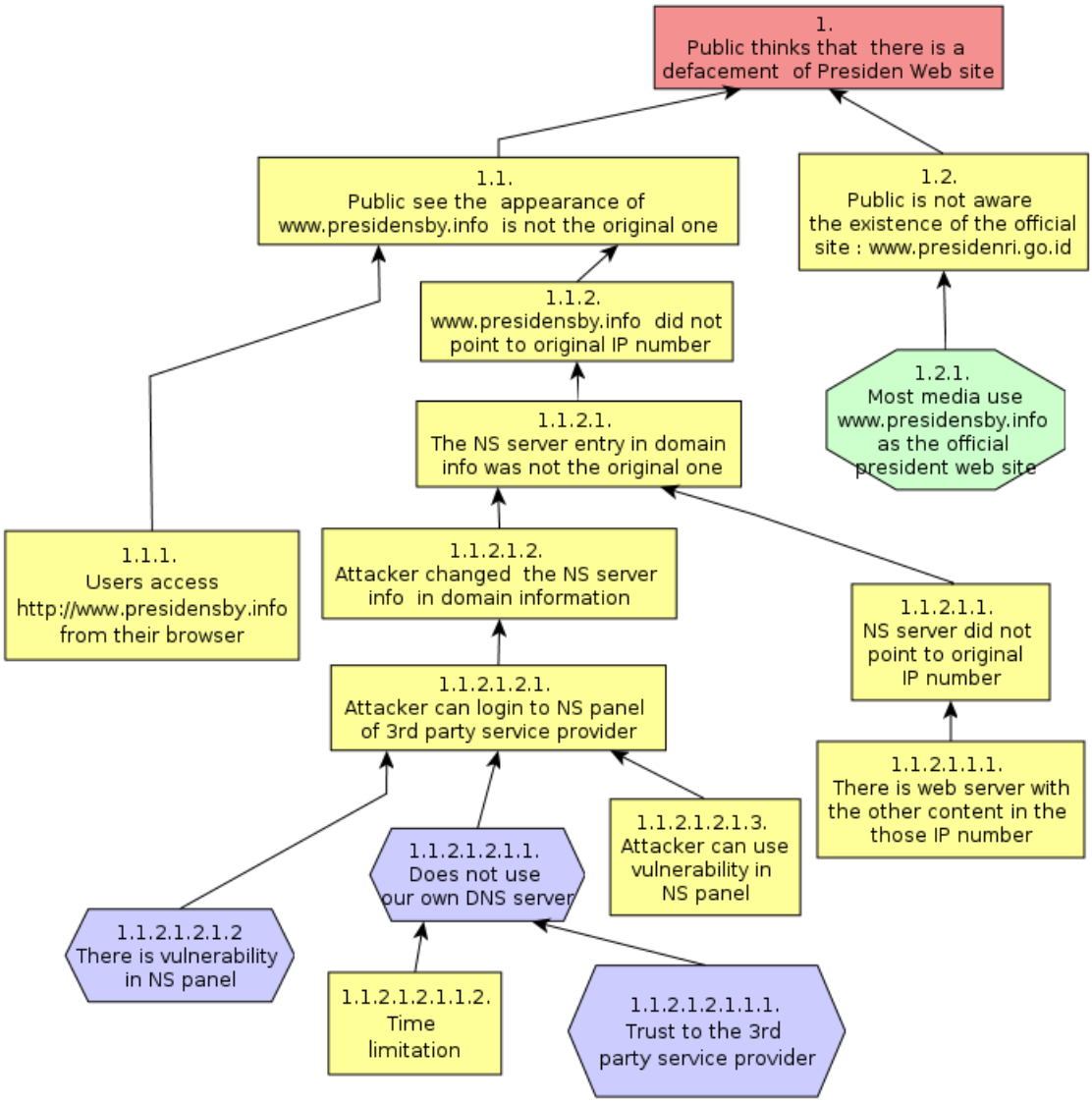


Figure 7.19: LWBG : Presidensby.info redirection incident

1.1. [*Public see the appearance of www.presidensby.info is not the original one*]. Public see the president web site was changed to other appearance. This appearance has a political message.

- 1.1.1. [*User access http://www.presidensby.info from their browser*]
- 1.1.2. [*www.presidensby.info did not point to original IP number*] Instead of pointing to `203.130.196.114` , the query to presidensby.info pointed to `67.19.72.205`

1.1.1. [*User access http://www.presidensby.info from their browser*]. Users access the president web site using domain http://www.presidensby.info, there is also other domain http://www.presidenri.go.id, but most users still use the previous one.

1.1.2. [*www.presidensby.info did not point to original IP number*]. By query using DNS query tools, the host www.presidensby.info did not show the original and correct IP number. By accessing using the IP number the original web site has not been changed.

- 1.1.2.1. [*The NS server entry in domain info was not the original one*]

1.1.2.1. [*The NS server entry in domain info was not the original one*]. Checking the detail of the domain name, it show that the information had been changed and point to the `afraid.org`

- 1.1.2.1.1 [*NS Server did not point to original IP number*]
- 1.1.2.1.2. [*Attacker change the NS server info in domain information*]

1.1.2.1.1 [*NS Server did not point to original IP number*]. The information in NS shows that it point to the other IP number : `67.19.72.205`

- 1.1.2.1.1.1. [*There is web server with the other content in those IP number*]

1.1.2.1.1.1. [*There is web server with the other content in those IP numbe*r]. In the machine with IP number `67.19.72.205`, there is a web server which is actively serves the pages

1.1.2.1.2. [*Attacker changes the NS server info in domain information*]. Attacker changed the domain information successfully.

- 1.1.2.1.2.1. [*Attacker can login to NS panel of 3rd party service provider*]

1.1.2.1.2.1. [*Attacker can login to NS panel of 3rd party service provider*]. Attacker can login to NS panel of 3rd party service provider.

- 1.1.2.1.2.1.1.◆ [*Does not use our own DNS server*]
- 1.1.2.1.2.1.2.◆ [*There is vulnerability in NS panel*]
- 1.1.2.1.2.1.3. [*Attacker can use vulnerability in NS panel*]

1.1.2.1.2.1.2.◆ [*There is vulnerability in NS panel*]. From the log file received as evidence from the 3rd party service provider, it shows that there is vulnerability in the PHP application of the NS panel.

1.1.2.1.2.1.3. [*Attacker can use vulnerability in NS panel*]. Attacker can successfully exploit this vulnerability

1.1.2.1.2.1.1.◆ [*Does not use our own DNS server*]. Presidensby.info does not our own DNS server

- 1.1.2.1.2.1.1.1. [*Time limitation*]
- 1.1.2.1.2.1.1.2.◆ [*Trust to the 3rd party service provider*]

1.1.2.1.2.1.1.1. [*Time limitation*]. The short time for development and the other constraints made developers do not want to deploy maintain DNS system by themselves.

1.1.2.1.2.1.1.2. ◆ [*Trust to the 3rd party service provider*]. The 3rd party service providers is trusted, and already serve many critical web sites.

1.2. [*Public is not aware the existence of the official site : www.presidenri.go.id*]. Public still does not know that the domain presidenri.go.id with the same contents has been active for a long time. Some of them still think that two web site with different web addresses are maintain by different groups, i.e. not the same web site but with more than one domain.

- 1.2.1. ● [*Most media use www.presidensby.info as the official president web site*]

1.2.1. ● [*Most media use www.presidensby.info as the official president web site*]. Most media in Indonesia, refer the official president web site as `www.presidensby.info` not `www.presidenri.go.id`

Improvement as suggested by LWBA: After the incident, the improvement is performed by considering the LWBG in Fig. 7.19 :

- 1.1.2.1.2.1.1. ◆ [*Does not use our own DNS server*]. After this incident, a dedicated DNS server is installed to serve the President web site.

- 1.1.2.1.2.1.2. ◆ [*There is vulnerability in NS panel*]. The provider has corrected the vulnerability.

- 1.1.2.1.2.1.1.2. ◆ [*Trust to the 3rd party service provider*]. We have to decrease our trust to the 3rd party. And star to use Telkom Tbk DNS infrastructure, because an incident occurred, from the legal point of view, the investigation can be easily. For example to acquire the log files etc.

A strategy to improve the situation but involve other organization or parties are :

- 1.2.1. ● [*Most media use www.presidensby.info as the official president web site*].

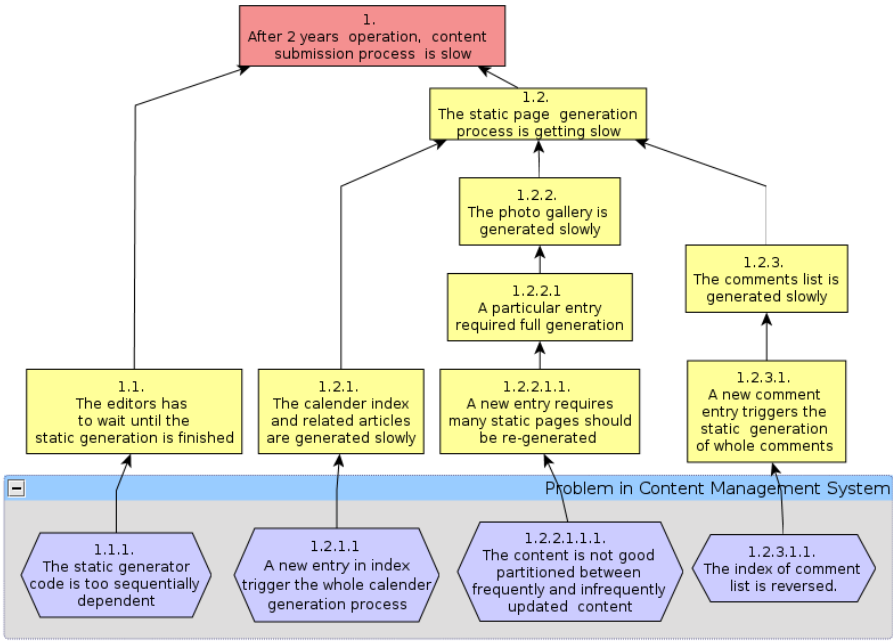


Figure 7.20: LWBG : Slow static page generation

7.7.3 Performance problem

After running the system more than 1 year. Users, i.e. staffs of presidensby.info expressed some dissatisfaction of the performance. This sustainability is due to design problem that appears after sometime of operation. It can be categorized as the Case-2 of Sustainability. The system environment has been changing, and it is different with the environment in initial operation of system.

Description of LWBG : Slow static page generation

1. [*After 2 years operation, content submission process is slow*]. The users (office of president's staff) who upload the contents, found that it was slow to submit a new content.

- 1.1. [*The editors have to wait static generation is finished*]
- 1.2. [*The static page generation process is getting slow*]

1.1. [*The editors have to wait static generation is finished*]. A new content will be successfully submitted after the static pages is generated.

- 1.1.1.◆ [*The static generator code is too sequentially dependent*]

1.1.1.◆ [*The static generator code is too sequentially dependent*]. The code to generate the static page from dynamic content is

1.2. [*The static page generation process is getting slow*]. Code that generates static pages requires 10 minutes for each new submission. It means there is something wrong, because initially it is very fast. The very short time for development made the code has not been checked for all possible input.

- 1.2.1. [*The calendar index and related articles are generated slowly*]
- 1.2.2. [*The photo gallery is generated slowly*]
- 1.2.3. [*The comments list generated slowly*]

1.2.1. [*The calendar index and related articles are generated slowly*]. The calender is generated slowly, every time there is a new entry in the calendar the submission is getting slow.

- 1.2.1.1.◆ [*A new entry in index trigger the whole calendar generation process*]

1.2.1.1.◆ [*A new entry in index trigger the whole calendar generation process*]. It is found that a new entry in index, triggers the static page generation for the entire pages of web site, from the beginning of the web site operation.

1.2.2. [*The photo gallery is generated slowly*]. The generation of photo gallery took about 10 minutes. It is too long and unacceptable.

- 1.2.2.1. [*A particular entry required full generation*]

1.2.2.1. [*A particular entry required full generation*]. The content management system (CMS) is designed to generate static page. However this generation has been designed to perform efficiently. Only related contents that should be generated. However, in the implementation, there is some problem that require the whole web site is generated. It takes about 15 minutes.

- 1.2.2.1.1. [*A new entry requires many static pages should be re-generated*]

1.2.2.1.1. [*A new entry requires many static pages should be re-generated*]. The full generation of static pages requires 10-15 minutes

- 1.2.2.1.1.1.◆ [*The content is not good partitioned between frequently and infrequently updated content*]

1.2.2.1.1.1.◆ [*The content is not good partitioned between frequently and infrequently updated content*].

1.2.3. [*The comments list generated slowly*] The table of content of user comments is always generated slowly.

- 1.2.3.1. [*A new comment triggers the static generation of whole comments*]

1.2.3.1. [*A new comment triggers the static generation of whole comments*]. In the current implementation, every time there is a new submitted comment, the whole comment section is generated to the static form. In the beginning of operation, the comments were minor, but after 2 years, it contributes to delay of static pages generations.

- 1.2.3.1.1.◆ [*The index comment list is reversed*]

1.2.3.1.1.◆ [*The index comment list is reversed*] The index in comment list is reversed, therefore the static generation had to be performed from the beginning.

Improvement as suggested by LWBG: From the LWBG as shown in Fig. 7.20, it can be identified that some improvements can be performed by performing the countermeasure of following nodes.:

- 1.1.1.◆ [*The static generator code is too sequentially dependent*]. The codes that generate static pages now is designed to be executed parallel. Jobs that can be distributed, will be distributed to other servers.

- 1.2.1.1. ◆ [*A new entry in index trigger the whole calendar generation process*]. The indexing mechanism of calender is redesigned, thus only the entry in current month, will be re-generated.

- 1.2.2.1.1.1. ◆ [*The content is not good partitioned between frequently and infrequently updated contents*]. The contents now is partitioned into several type, the most frequently updated and less frequent updated.

- 1.2.3.1.1. ◆ [*The index comment list is reversed*]. The code should be rewrite to perform the correct index generator for the comment pages.

7.7.4 Strategy for visualizing measurements

Some users have time limitation to follow the measurement results. Therefore, visualization of results play an important role to make the user accepted the performance of system. During the design, implementation as well as the operation, I have to show measurement results to the stakeholders. Due to the time limitation, using the long report and narration style is not appropriate. Therefore, various visualizations are used:

- 2 dimensional traffic visualization
- 3 dimensional traffic visualization
- Cloud of Words

The 2D visualization usually is used to display the time series data, for example as shown in Fig. 7.21, it shows the hit number of the server. The number of access always depends on the political issues, such as the visit of USA delegation, Iran resolution etc. However, the 2D visualization has some limitation to show the weekly pattern.

The 2D visualization is effective for example to understand more detail, temporal data. During the connection problem, it can be demonstrated when there is connection problem. For this purposes, the 2D visualization is preferred by users than 3D. Stakeholders and maintainers can understand that there is the connection failure in

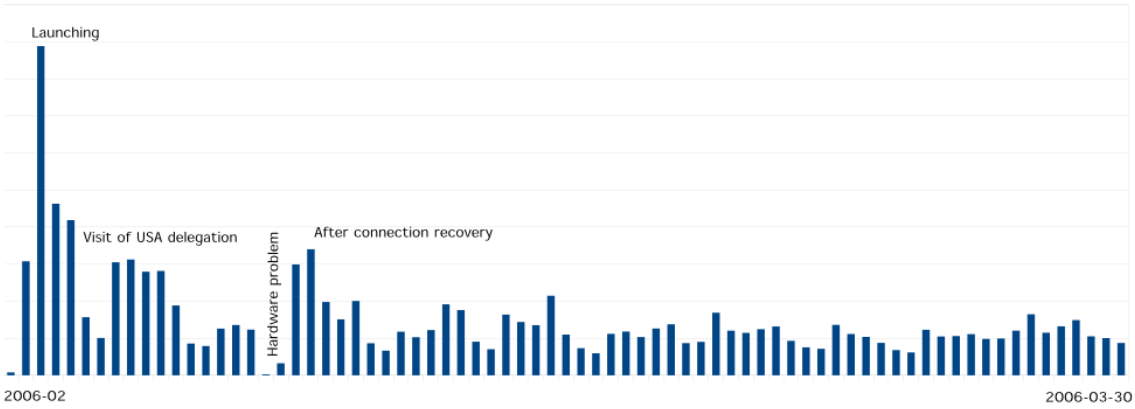


Figure 7.21: 2D Traffic visualization

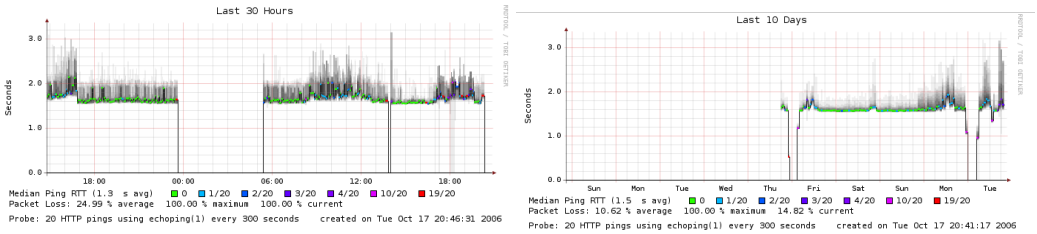


Figure 7.22: Visualization of connection failure

particular time (shown in Fig. 7.22 as the graphics approach to zero). These graphics are also good tools to communicate with the network providers which provides the Internet connection, i.e. Telkom Tbk. These graphics are taken from the monitoring system in RVS Arbeitsgruppe Bielefeld.

The 3D visualization of access data is also used to show the fast comparison between the access. The 3D visualization is good to show the weekly pattern and the high access. Fig. 7.23.

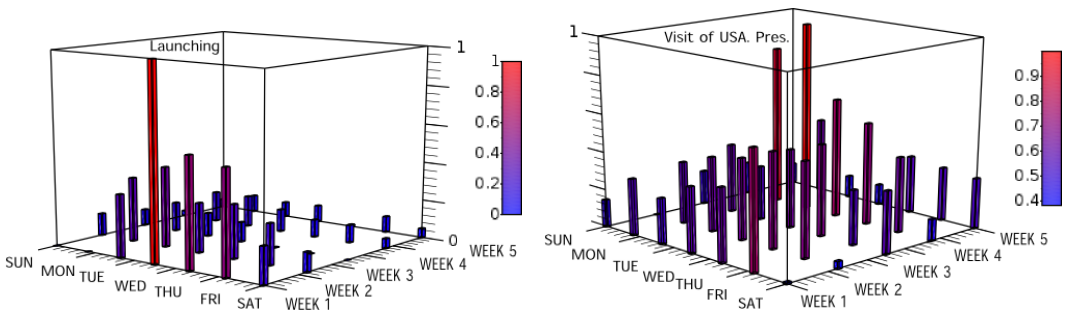


Figure 7.23: 3D traffic visualization of access

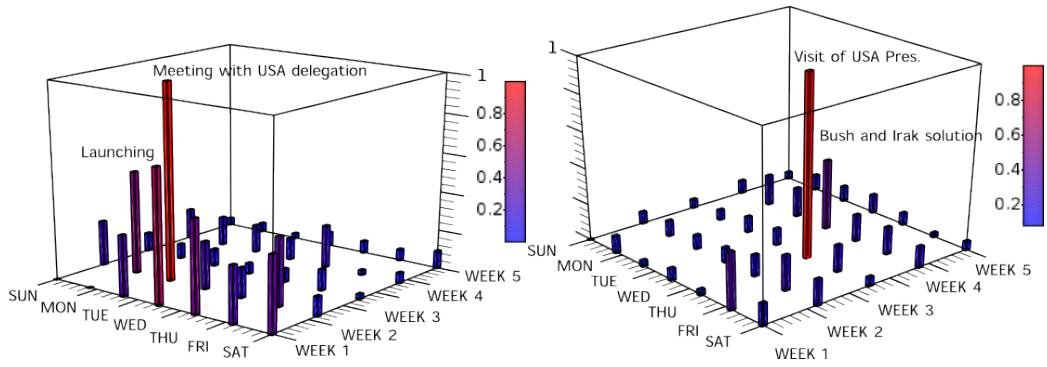


Figure 7.24: 3D Traffic visualization of attacks

Figure 7.25: Visualization using Cloud of Word

Using this 3D visualization as in Fig 7.24, the security attack that appears in the system can be presented better to the stakeholder in regular reports. High attacks correlates with an event in Indonesia, such as *"Meeting with USA delegation"*, *"Visit of USA president*", as well as "*the Bush and Iraq solution*". By using this 3D visualization the high attack can be shown clearly. For stakeholders, this type of visualization is more accepted rather than the 2D visualization.

However, for some type of data, stakeholders prefer other type of visualization. The cloud of words as shown in Fig 7.30a is used to display the source of security attack. The web sites receives security attack from various countries. In this visualization it is easy to show '*which country*' which is the source of security attack, i.e. Indonesia (ID). and the next is pk. This type of visualization is preferred to display this type of data.

7.8 Sustainability problem

Sustainability problem in this project appears in both cases. The Case-1 Sustainability, which is caused by discrepancy between the environment predicted by designer and the real environment, i.e. the mental model of users. Users has different views in

Figure 7.26: User comments

using of the system. An example of this sustainability problem, is the use of "`Contact Form`". Initially, this facility was designed to be use by visitors to contact the content team (person who is responsible in operating the web site). Although, a description and warning sign has been provided but visitors always keep sending the contact form as the message for President.

The Case-2 in this project, exists due to the change of user expectations. In the beginning, the video/audio contents is not expected. However, due to change of web trend, now users in Indonesia demand more video content in Web site president. Thus, the design cannot sustain, and some adjustment has to be taken. The both cases will be addressed in this section.

7.8.1 Different predicted environment

The Case-1 of sustainability as described in Chap. 2, is the discrepancy between the predicted environment and the real environment of the system. For example, the mental model of real users is different with the mental model being used by the designer. A real example is shown the problem in providing the user comment facility such as shown in Fig. 7.26.

What user perceives about this facility is different with what designer intended.

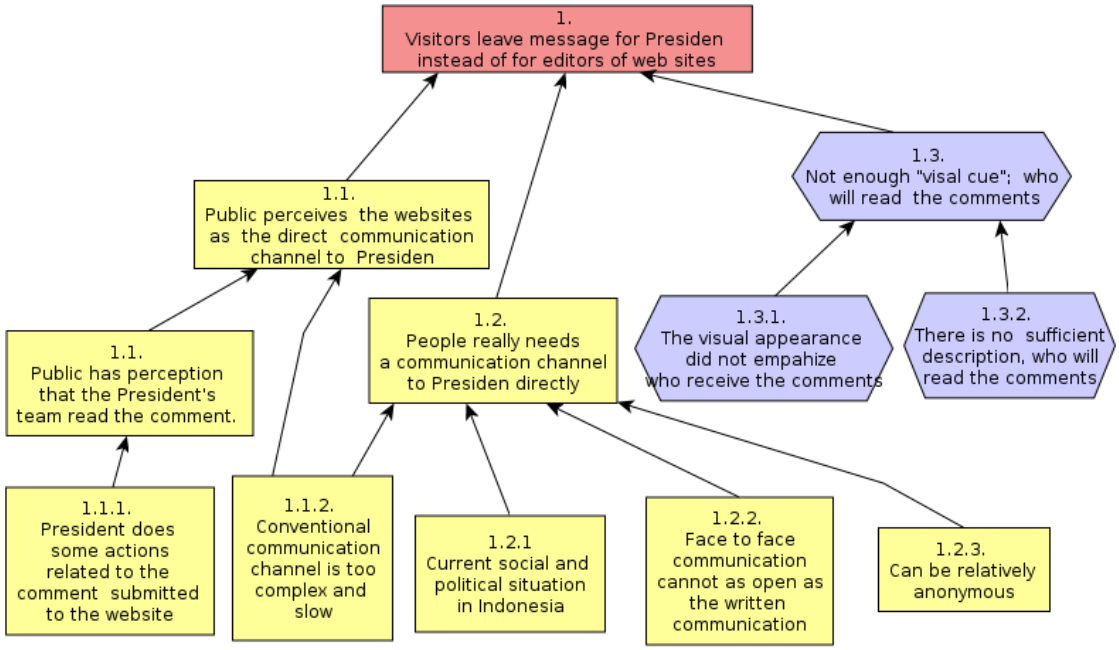


Figure 7.27: LWBG : User comments

Initially, this user comment facility is not designed to accept comment for President, but comments about the web site and the information in the web site. To understand the problems I derive the LWBG of this situation and shown in Fig. 7.27.

Description of LWBG : User comments

1. [*Visitors leave message for President instead of for editors of web sites*]. To provide more open government web site, the President web site provides a user comment facility. The comments are moderated due to security consideration, and the selected comment will be displayed. However, it is not filtered based on the political view.

- 1.1. [*Public perceives the websites as the direct communication channel to President.*]
- 1.2. [*People really needs a communication channel to President directly.*]
- 1.3.◆ [*Not enough visual cue who will read the comments*].

1.1. [*Public perceives the websites as the direct communication channel to President*]. From the users submissions, most submissions are written for the President of Republic of Indonesia. Users just neglect the description that has been provided in the web site.

- 1.1.1. [*Public has perception that the President's team read the comments*]
- 1.1.2. [*Conventional communication channel is too complex and slow.*]

1.1.2. [*Conventional communication channel is too complex and slow*]. Public in Indonesia find the bureaucracy in Indonesia cannot convey critiques and message directly to President in an efficient way. President had actually already provided with the special SMS number that can be used by public to send the critiques. However, the length of message in SMS is the big obstacle for using this SMS facility.

1.1.1. [*Public has perception that the President's team read the comments*]. Public finds that the President and his team read the comment submitted in the web sites.

- 1.1.1.1. [*President does some actions related to the comment submitted to the website*]

1.1.1.1. [*President does some actions related to the comment submitted to the website*]. President performs some action, that answers some comment submitted by users in the web site.

1.2. [*People really needs a communication channel to President directly*]. Public in Indonesia due to the history of government in Indonesia really wants direct access to president.

- 1.2.1. [*Current social and political situation in Indonesia*]
- 1.2.2. [*Face to face communication cannot as open as the written communication*]

- 1.2.3. [*Can be relatively anonymous*]

1.2.1. [*Current social and political situation in Indonesia*]. Public in Indonesia now want more direct communication with government officers. Formerly it is very difficult to be done, but not it changes,

1.2.2. [*Face to face communication cannot as open as the written communication*]. Due to the Indonesian culture, most Indonesian cannot have a direct and open communication in the face to face meeting, Therefore, a written communication can yield more direct and open message to be conveyed.

1.2.3. [*Can be relatively anonymous*]. Many people who want to submit the critique or to report the problem in government bodies, prefer to stay anonymous. For the public, Internet provide this anonymity in Indonesia [Lim, 2003].

1.3.◆ [*Not enough visual cue who will read the comments*]

- 1.3.1.◆ [*The visual appearances did not emphasize who receive the comments*]
- 1.3.2.◆ [*There is no sufficient description, who will read the comments*]

1.3.1.◆ [*The visual appearances did not emphasize who receive the comments*].

1.3.2.◆ [*There is no sufficient description, who will read the comments*]

The designed system cannot sustain, because what the designer design is different with what the user perception of this facility. The user feedback facility, as request by stakeholder, is designed for submitting user comment for the maintainer of President web site not for the President himself. However, as shown in top node 1. [*Visitors leave message for President instead of for editors of web sites*]. visitors still submit user comments for President.

Before I enforce a particular design decision to reflect the initial design decision, I investigated this problem by drawing the LWBG. From the LWBG, the users performs this action also shows different perception between users and designers, as shown in node 1.1. [*Public perceives the websites as the direct communication channel to President*]. This perception exists because of :

- 1.1.1. [*Public has perception that the President's team read the comments*]. 1.1.1.1. *President does some actions related to the comment submitted to the website.* It contributes the positive quality

- 1.1.2. [*Conventional communication channel is too complex and slow*]. Public find difficulty to send the comment to the government bodies. It is due to the inefficient work of bureaucracy in Indonesia. Therefore, most people do not prefer the written ways to convey message to the government officers.

This mismatch situation is also due to the situation as shown by node 1.2. [*People really needs a communication channel to President directly*]. This high demand of direct communication is not only due to 1.1.2. [*Conventional communication channel is too complex and slow*], but also caused by *:*

- 1.2.1. [*Current social and political situation in Indonesia*]. Public in Indonesia now wants more direct communication with government officers. Formerly it is very difficult to be done, but not it changes,

- 1.2.2. [*Face to face communication cannot as open as the written communication*]. Due to the Indonesian culture, most Indonesian cannot have a direct and open communication in the face to face meeting, Therefore, a written communication can yield more direct and open message to be conveyed.

- 1.2.3. [*Can be relatively anonymous*]. Many people who want to submit the critique or to report the problem in government bodies, prefer to stay anonymous. For the public, Internet provide this anonymity in Indonesia.

User can also has a unmatched perception duet to lack of visual cue of the web design. It makes user do not aware about to whom this comment will be submitted. It is shown in node 1.3.◆ [*Not enough visual cue who will read the comments*]. This lack of visual consequence

- 1.3.1.◆ [*The visual appearances did not emphasize whom receive the comments*].

- 1.3.2.◆ [*There is no sufficient description, who will read the comments*].

By considering the basic requirement, I did not stick with the initial design but decide to follow what the users think. The comment is received and published in the web site. Because the users perception yield positive acceptance of the web site a whole, and it make the system sustains for the future.

7.8.2 New demand of video content

The Case-2 of sustainability exists when there are new type of users, or users have the new requirements of systems. In other word, there is the change of environment in which the system should be able to respond it. The Case-2 of sustainability can appears because of :

- Unfulfilled requirements.
- Change of technology trend.
- Change of "users". More heterogen users normally generate more requirements.

To investigate, and analyze this phenomenon the change of environment which appears during the operation of President Web Site. After 3 years of the President web sites, I receive the new requirements of the system. In this works, I will focus in two new requirements :

- The demand of multimedia contents
- The new demand of search engine support

To solve this sustainability Case-2, I identify the requirement using the same approach such as in requirement elicitation analysis.

1. Find the unsatisfactory of service as the "top node"
2. Find the causal factor which produce this unsatisfactory.
3. Identify from the node that can be prevented by applying countermeasure.

Basically, the steps in performing the Sustainability, Case-2, is similar with Requirement Elicitation and Analysis.

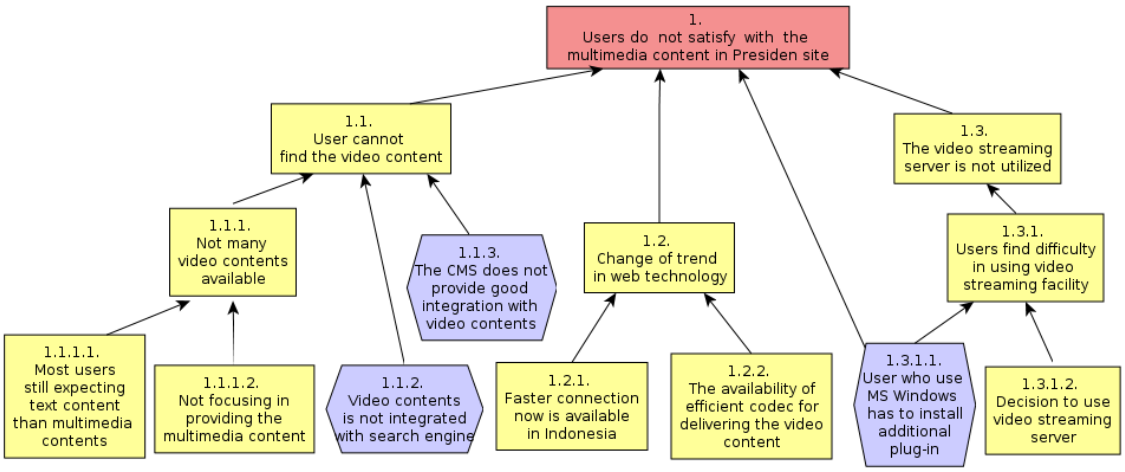


Figure 7.28: LWBG : The new requirement of video content

Description of LWBG : New requirement of video content

1. [*User do not satisfy with the multimedia content in President site*]. Users and stakeholders have requested more multimedia contest in the President web sites. They found the President Web site does not have many multimedia contents

- 1.1. [*User cannot find the video content*]
- 1.2. [*Change of trend in web technology*]]
- 1.3. [*The video streaming server is not utilized*]

1.1. [*User cannot find the video content*]. Users try to find the video content, but they could not find it.

- 1.1.1. [*Not many video contents available*]
- 1.1.2. [*Video contents is not integrated with search engine*]
- 1.1.3.◆ [*The CMS does not provide good integration with video contents*]

1.1.2.◆ [*Video contents is not integrated with search engine*]. The video content is still provided as the separate services, because at the design phase, I predicted there was not many demand for the video contents. Users cannot search the

video contents using the search engine, therefore they cannot find the video easily

1.1.3. [*The CMS does not provide good integration with video contents*]. The video content in Helix server was still not integrated with the main Content Management System. Because at the first year, the real demands of video content is still low.

1.1.1. [*Not many video contents available*] Due to the little demands of the video contents, the video content in President web sites has not been available

- 1.1.1.1. [*Most users are still expecting text content than multimedia contents*]
- 1.1.1.2. [*Not focusing in providing the multimedia content*]

1.1.1.1. [*Most users still expect text content than multimedia contents*]. Users who access the web site still need many textual data, such as the press release, or the photos.

1.1.1.2. [*Not focusing in providing the multimedia content*]. From the beginning of design, I did not focus on multimedia content, because the main goal, is to provide the information of President's activities as soon as possible, and also prevent the misquote

1.2. [*Change of trend in web technology*]

- 1.2.1. [*Faster connections now is available in Indonesia*]

1.2.1. [*Faster connections now is available in Indonesia*]. Now in Indonesia, many users access Internet using ADSL as well as the 3G connection via mobile devices. The availability of hot-spots in various places make users in Indonesia have better connections to the Internet. Thus, user now expect to access more video contents than 2 years ago.

1.2.2. [*The availability of efficient codec for delivering video content*]. Due to the popularity of the video sharing sites such as Youtube [`http://www.youtube.com`], Vimeo [`http://www.vimeo.com`], that uses Flash technology. Now it is possible for user with MS Windows to use the video streaming facility without installing extra plug-in.

- 1.2.2. [*The availability of efficient codec for delivering video content*]

1.3. [*The video streaming server is not utilized*]. From the log files, it can be evaluated that the video streaming server was not utilized by users.

- 1.3.1. [*Users have difficulty in using video streaming facility*]

1.3.1. [*Users have difficulty in using video streaming facility*], The video streaming server that was used require some complexity in user side to use it.

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]
- 1.3.1.2. [*Decision to use video streaming server*]

1.3.1.1.◆ [*User who use MS Windows has to install additional plug-in*].

1.3.1.2. [*Decision to use video streaming server*]

During the first 2 years operation, there was not many user demands for the multimedia contents such as audio and video streaming. Therefore the problem shown by node 1.1. [*User cannot find the video content*] was not significant to the Quality of Services. The users acceptance did not influence by this deficiency. This deficiency is caused by:

- 1.1.1. [*Not many video contents available*]. Due to the little demands of the video contents, the video content in President web sites has not been available
- 1.1.2. [*Video contents is not integrated with search engine*]. Users cannot search the video contents using the search engine, therefore they cannot find the video easily

- 1.1.3.◆ [*The CMS does not provide good integration with video contents*]. The video content in Helix server was still not integrated with the main Content Management System. Because at the first year, the real demands of video content is still low.

However, due to the new trend in the web usage in Indonesia as shown by node 1.2. [*Change of trend in web technology*], the situation change drastically. It is caused by :

- 1.2.1. [*Faster connections now is available in Indonesia*]. Now in Indonesia, many users access Internet using ADSL as well as the 3G connection via mobile devices. The availability of hot-spots in various places make users in Indonesia have better connections to the Internet. Thus, user now expect to access more video contents than 2 years ago.

- 1.2.2. [*The availability of efficient codec for delivering video content*]. Due to the popularity of the video sharing sites such as Youtube [`http://www.youtube.com`], Vimeo [`http://www.vimeo.com`], that uses Flash technology. Now it is possible for user with MS Windows to use the video streaming facility without installing extra plug-in.

Now, users in Indonesia show more demands to video contents. Initially the system provide video streaming via the Helix streaming server [`http://helix-server.helixcommunity.org/`] an open source streaming platform. However, to use this facility as shown by node 1.3. [*The video streaming server is not utilized*]. The utilization is low because 1.3.1. [*Users have difficulty in using video streaming facility*]

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]. After stopping support to real media coded, users who use MS Windows have to install

- 1.3.1.2. [*Decision to use video streaming server*]

Improvement from LWBA:

Therefore, after performing the LWBA, the video content will be provided using different implementation. The decision based on the countermeasures that can be provided by system in order to avoid the node 1. [*User do not satisfy with the multimedia content in President site*].

- 1.1.2.◆ [*Video contents is not integrated with search engine*]. The new video facility should be integrated with the search engine. It means if users search using the search engine can found the video content.

- 1.1.3.◆ [*The CMS does not provide good integration with video contents*]. The content team should be able to upload the video content easily via the Content Management System. The video content will be convert, tag, and integrated with the existing contents.

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]. In the new implementation, visitors do not require to install extra plug-in. Based on the log analysis in existing system, I notice that most visitors have MS Windows with the Flash plug-in. Thus, using this approach, visitors do not require to install extra plug-in.

7.8.3 New requirements

The President web site had provided the search facility. However, the use of search engine is still low. One factor is the static format strategy of president web site, makes user can easily use the other search engine services such as Google [`http://www.google.com`]. Therefore, I decide to extend the search facility using different approach, this search engine should cover the search mechanism which has not been used before. The search engine in President web site currently employs the Open Source applications which is non semantic search index. However, users criticize that it is difficult to find particular documents, To understand the search engine problem in Indonesia language, I draw LWBG as in Fig. 7.29

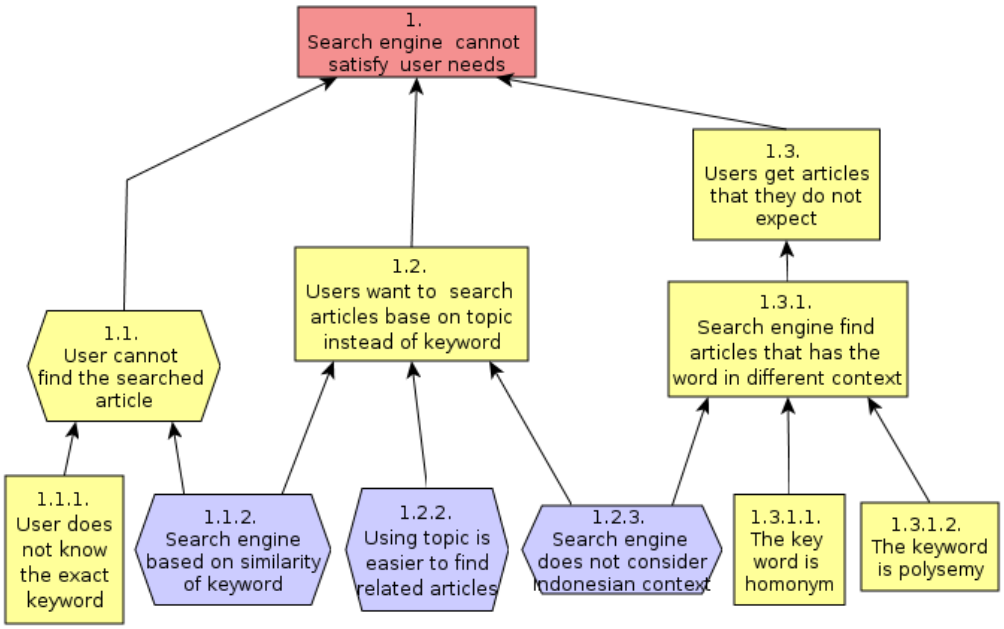


Figure 7.29: LWBG : Search engine problem

Description of LWBG: Search Engine problem

1. [*Search engine cannot satisfy users needs*]. Some users complains that they cannot use search engine well. The log from search engine (direct measurement) also shows that the usage is not very high. The comments from users in various mailing list (indirect measurement) also shown this problem.

- 1.1.◆ [*User cannot find the searched article.*]
- 1.2. [*Users want to search articles base on topic instead of keyword.*]
- 1.3.◆ [*Users get articles that they do not expect*]

1.1. [*User cannot find the searched article*]. Users criticize via mailing list, blogs, that they cannot find the documents that they want to search.

- 1.1.1. [*User does not know the exact keyword*]
- 1.2.1.◆ *Search engine based on similarity of keyword*]

1.1.1. [*User does not know the exact keyword*]. Sometimes users do not know the exact keyword that is used for searching.

1.2.1. [*Search engine based on similarity of keyword*]. The search application used in this web site, using similarity of keyword as the decision strategy.

1.2. [*Users want to search articles base on topic instead of keyword*]. Many users (based on the survey in mailing lists, and blogsphere), want to search the documents based on topics, or category. This change of method due to the popularity of Folksonomy, using Tag.

- 1.2.1.◆ [*Search engine based on similarity of keyword*]
- 1.2.2.◆ [*Using topic is easier to find related articles*]
- 1.2.3.◆ [*Search engine does not consider Indonesia context*]

1.2.2.◆ [*Using topic is easier to find related articles*]. Users asked the possibility to find articles based on the category or topics.

1.2.3.◆ [*Search engine does not consider Indonesia context*]. Most search engines is developed without considering the Indonesia language. Indonesia just also commences the research in computer linguistics [Nazief,].

1.3.◆ [*Users get articles that they do not expect*]. Users complain in the blogsphere and mailing lists, they could not find the articles that they want find.

- 1.3.1. [*Search engine find articles that has the word in different context*]

1.3.1. [*Search engine find articles that has the word in different context*]. Sometimes, search engine find an articles, and based on the search criteria used by the search engine. However, the articles is not the articles which users expect.

- 1.2.3.◆ [*Search engine does not consider Indonesia context*]
- 1.3.1.1. [*The key word is homonym*]

- 1.3.1.2. [*The keyword is polysemy*]

1.3.1.1. [*The key word is homonym*]. Homonym is one of a group of words that share the same spelling and the same pronunciation but have different meanings, usually as a result of the two words having different origins. Some words in Indonesian are homonym.

1.3.1.2. [*The keyword is polysemy*]. Polysemy is a word or phrase with multiple, related meanings. A word is judged to be polysemous if it has two senses of the word whose meanings are related. Indonesian has many polysemy.

Improvement from LWBG:

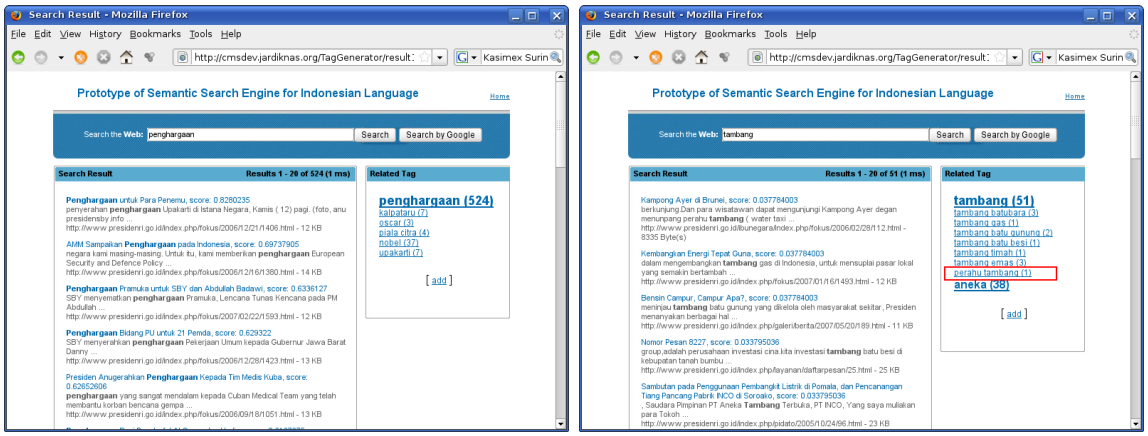
This semantic search engine has been implemented as a prototype as Master Thesis Project [Handayani, 2008]. The online prototype is shown as Fig. 7.30. This semantics search engine basically is an attempt to provide services based on the countermeasures from the following nodes :

- 1.2.1.◆ [*Search engine based on similarity of keyword*]. Search engine that should be enhanced with content analysis. Only using similarity measurement is not enough.

- 1.2.2.◆ [*Using topic is easier to find related articles*]. The topic map approach such as using Tag Cloud,

- 1.2.3.◆ [*Search engine does not consider Indonesia context*]. The content analysis should be developed by considering the Indonesian grammar as well as the contextual of text.

This identification of sustainability system by employing LWBG is a great contribution to define a better system.



(a) Tag Cloud for search result (b) Semantic problem

Figure 7.30: Prototype of semantic search engine

7.9 Summary

In this Chapter it has been shown, how to apply the proposed method to develop a critical web sites, which should fulfill the performance, security, reliability as well as the usability. The development is commenced by performing the requirement elicitation and analysis based on the bad examples. The requirements are derived by using LWBA. After identifying the requirements, the service specification as well as the organizational change and learning can also be specified. To solve the requirement conflicts the LWBA is also applied. It has been demonstrated how in the implementation decision LWBA is used to choose the type or platform and also the model of web applications. The president web site was developed by utilizing Open Source Software. This decision is taken based on the LWBG and contrast with the goal, i.e. efficient in budget, security and sustainability.

The sustainability of service analysis is an important to ensure the sustainability of system. It can be performed by using LWBA in both case, Case-1, and Case-2. In this Chapter, I also demonstrated the sustainability problem due to the different perception between designers and users (Case-1). The new requirement due to the change of technology trend is also described in this Chapter. This sustainability problem is categorized as Case-2. I also demonstrated how to identify the problems,

and how to adjust the developed system in order to ensure the sustainability by utilizing the LWBA. This chapter also addresses the evaluation methods, and the make use of LWBA to evaluate the non technical aspects from the system.

The development of President web site also demonstrated that participation of stakeholders should take place throughout the strategy and planning process in defining problems, setting vision, developing solution. Employing development methods which have their origin in the socio-technicals such as co-operative, collaborative, participatory or participative design, can accommodate better the user requirement. Equipped with better analytical tool such as LWBA, not only the technical improvement or decision that can be concluded, but also the non technical, such as organizational changing or learning actions.

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Chapter 8

Comparison

Evaluation systems is an important steps in the system development method. This chapter address how the evaluation of services provided by developed system is performed in proposed system development method. To perform the evaluation, the LWBG is used. Since I interest the quality the system in the broad level, to evaluate the developed model, I used the data from the media, mailing lists, direct personal correspondence, technical reports. Basically, there are three different strategies for evaluating the developed system :

1. **Type I. Comparison to similar system**. This comparison can be easily performed if there is similar projects, with more or less similar environment. To perform the comparison, as the top node of LWBG is the preposition of other similar systems ($S_{similar}$) performed inferior to the system being developed ($S_{developed}$) :

$$S_{similar} \prec S_{developed} \tag{8.1}$$

2. **Type II. Comparison to the situation during absence of system**. For example, particular services of the president web sites, and the early warning information system. Many users are aware the function of system during the absence of system such as during a malfunction, or maintenance schedule . Thus, I put the top node as the preposition of the comparison of situation with the presence of the system being developed ($S_{developed}$) and situation without the

Table 8.1: Various type of comparison

Project	Type I	Type II	Type III
WinBI	x	x	
Air Putih	x		x
Early Warning Information System		x	
President Web Site		x	

system being developed ($S_{absence}$). The comparison can be done in following form:

$$S_{absence} \prec S_{developed} \tag{8.2}$$

3. **Type III. Comparison with the expected unsatisfying situation**. This comparison is important to understand, why the proposed model provide a good results. To do this evaluation, I use the top node is a preposition in form of "*absence of predicted unsatisfying situation*". During the design, I predict the malfunction or unsatisfactory condition of the developed system. It can be derived from the requirements that should be fulfilled. Basically the unsatisfying condition ($UF_{predicted}$) is the requirement that cannot be fulfilled by the system. By using this as top node of LWBG, I can identify which factors that contribute to the success of the system.

$$S_{developed} \rightarrow UF_{predicted} \tag{8.3}$$

$$Top = \sim (UF_{predicted}) \tag{8.4}$$

In this work, I perform various type of comparison for each project. It is summarized in Tab. 8.1.

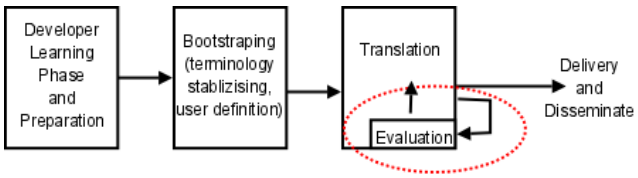

Figure 8.1: Development cycle of localization work

8.1 Localization

For this project, there are similar projects. that is also perform the localization for Indonesian. The localization is performed by Microsoft Indonesia, and translated the Windows XP. The object is not similar, however I can perform some comparison between the proposed method and the method used by Microsoft Indonesia.

8.1.1 Type I - comparison with MS models

As a comparison, in 2004 there was a collaboration project between Microsoft and Bandung Institute of Technology to translate MS Windows XP. It took about **1 year** to produce translation of Microsoft Windows XP menus. The final results is called the Indonesia language pack of Windows XP. This Windows XP translation had not produced online help or translation of other programs in MS Windows. It is only the translation of menu in MS Windows XP desktop. On the other hand, WinBI, also produces online Help of desktop system and various application programs localization from the Office application to the network application. The result from Microsoft Indonesia localization was less and require longer time [Magdalena, 2004].

The comparison between the Windows XP localization and WinBi is described in Tab. 8.2. There several factors that make the translation in WinBI is faster and more than Windows XP. Those factors are :

- Bootstrap process
- Evaluation process
- The availability of tools

Table 8.2: Comparison between localization of Windows XP and WinBI

	Windows XP	**WinBI**
Result	Localization of Windows XP menu	Localization of installation program, GUI, and various applications Localization of online help Manual books in Indonesia language CD-ROM and manual for developers who want to do the localization
Time	1 year	3 month
Final delivery	Language Interface Pack (*.msi)	Ready to installed distribution with manuals
Dissemination	Available in Internet for MS Windows XP license owner	Available in Internet, CD-ROM, disseminate via various magazine, Infolinux (5000), BPPT (5000)
Executor	Bandung Institute of Technology and Pusat Bahasa Indonesia	BPPT, Trustix Asia, Gadjah Mada University, Gunadarma University, Community
Other results	none	Collections of translated text as parallel corpus Various tools for translation works
Sustainability	Depends on Microsoft	The translations is absorbed in various Indonesian distro projects.

During the development of system, basically I started with a group of developers who most of them did not have any knowledge background in translation process. Therefore, in this development process a "bootstrap" process is required. This process basically the delivery the knowledge from the main developers to the developers and the translators. Providing a set of information about the tools, background knowledge to the translators will accelerate this process. In the development process I do not ignore the learning process. The learning process is about the format, technology or tools for the localization. Therefore, to sustain the translation work a guideline and books about this knowledge were prepared. The material is also made available in the Internet, it will assist other translation efforts and also to make sustainability can be achieve easier.

The different between the localization with the availability of source code and without the availability of source code is the process in performing the evaluation during the translation. As shown in Fig. 8.1, the localization team can performed the evaluation as soon as they finished their work. They do not have to submit to external developer and waiting for the results. Therefore, before delivering the final result, the cycle of `translation-evaluation` can be performed many times. In the proprietary approach without the availability of source code, the developer who performs the localization can only submit their works, without possibility to evaluate as final product.

Comparing time required by Microsoft localization project, WinBI project produced more results in shorter time. The translation Windows XP could not performed as fast as WinBI because translator team cannot compile the language packs, or performing the test by their own. Translators had to send the result to Microsoft before getting the final system Translators also cannot build the tools by themselves. Thus, they depends on the tools provided by Microsoft. Moreover, the translators might not use the translation results from various localization FOSS due to the license restriction.

The availability of source code and possibility to edit, compile the source code is a contributing factor in performing a better the translation work. The WinBI

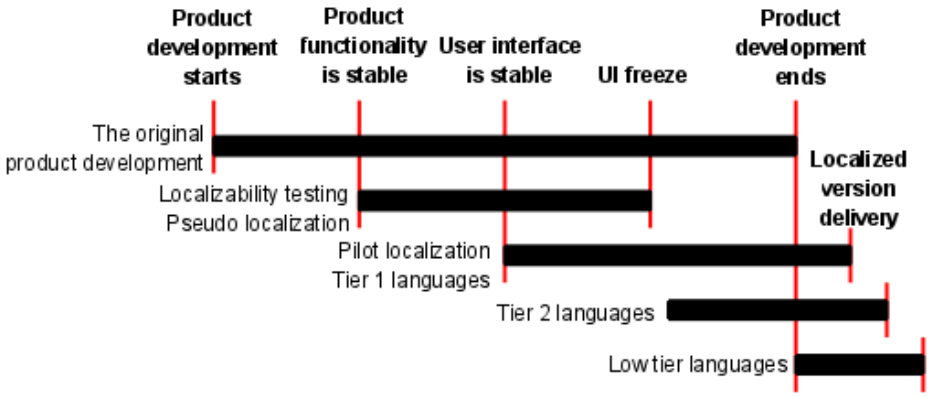

Figure 8.2: Localization phase by Microsoft

works was started by using Trustix Merdeka as the starting point, since the Trustix Merdeka has already many component which has been translated. The source code of Trustix Merdeka is freely available to public. It makes the "bootstrap" process in doing translation is faster than in MS Windows XP translation.

This significance different also due to the localization cycle. In the life cycle of proprietary products, the localization normally is performed by the "outsider" or contractor, not the core developer. The biggest problem is the delay between evaluation and translation itself. The translator cannot tested directly with the system, but they can only submit the result of translator to the developer and wait until developer produce the product it is shown in Fig 8.2

Furthermore, there is no also evidence how many users actually has been exposed with the result of Windows XP translation. Microsoft only provide the results as the downloadable files in their web sites. Most MS Windows XP sold in Indonesia still used the English version. To understand why the proposed method provides better result, I draw the LWBG as shown in Fig. 8.3

Description of LWBG : Proposed model is better than proprietary (See Fig.

1. [*The MS translation model cannot provide results as the proposed model*]. As described in Tab. 8.2

- 1.1. [*The translation in the final product has more errors*].

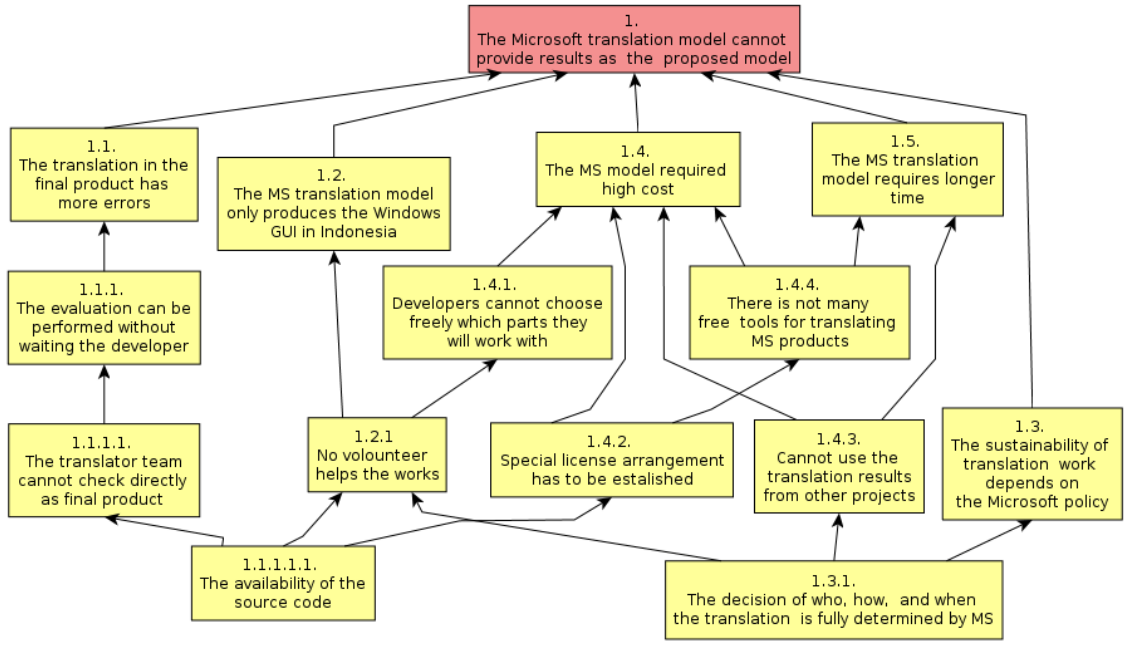

Figure 8.3: LWBG: the proposed model better than proprietary

- 1.2. [*The MS translation model only produces the Windows GUI in Indonesia*].
- 1.3. [*The sustainability of translation work depends on MS policy*].
- 1.4. [*The MS model requires high cost*].
- 1.5. [*The MS model requires longer time*].

1.1. [*The translation in the final product has more errors*]. Some terminologies used in the Windows XP are not popular. Many user criticizes it in the mailing list.

- 1.1.1 [*The evaluation can not be performed without waiting the developer*].

1.1.1 [*The evaluation can not be performed without waiting the developer*]. The translator team can only submitted the translation to MS developers.

- 1.1.1.1. [*The translator team cannot check directly the translation as final product*].

1.1.1.1. [*The translator team cannot check directly the translation as final product*]. The translator teams cannot compile the program as final products, because this is the proprietary program that has a license limitation.

- 1.1.1.1.1. [*The availability of source code*]

1.1.1.1.1. [*The availability of source code*]. There is no available source code for the translators.

1.2. [*The MS translation model only produces the Windows GUI in Indonesia*]. The Indonesia language pack of Windows XP only covers the menu and GUI, without the on-line help, or manual books.

- 1.2.1. [*No volunteer helps the works*]

1.3. [*The sustainability of translation work depends on MS policy*]. As the MS DOS Indonesian translation, the decision to release to public or to continue the translation works is dictated by Microsoft.

- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*].

1.3.1. [*Other developer teams cannot continue the work without getting permission from MS*]. In Open Source translation, every body have right to continue the translation or to fork the translation effort. In the MS Windows translation, only translators that has been established the permission can execute the translation work.

1.2.1. [*No Volunteer helps the works*]. Volunteers cannot joint freely to the translation efforts. Only translators contracted by Microsoft perform translation.

- 1.1.1.1.1. [*The availability of source code*]
- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]

1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]. In the proprietary software, vendor dictates who can continue the translation works. Sometimes, there is no business justification, the translation effort will be discontinued.

1.4. [*The MS model requires high cost*]. The cost of proprietary software, as well as the development tools

- 1.4.1. [*The developer cannot choose freely which part they will work with.*]
- 1.4.2. [*Special license arrangement has to be established*].
- 1.4.3. [*Cannot use the translation results from other projects*]
- 1.4.4. [*There is not many free tools for translating MS products*]

1.4.1. [*The proposed model, the developer take part what they want*]. The distribution of tasks is determined by the contract and the project manager.

- 1.2.1. [*Volunteers can help the works*]

1.4.2. [*Special license arrangement has to be established*]. To translate the proprietary software such as MS Windows, a special Non Disclosure Agreement usually is required.

- 1.1.1.1.1. [*The availability of source code*]

1.4.3. [*Cannot use the translation results from other projects*]. To avoid the complexity of license, the translation of MS Windows did not use the result of other translation work, such as from many Open Source software.

- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]

1.4.4. [*There is not many free tools for translating MS products*]. There is no many free tools, such as KBabel, or other translation tools.

- 1.4.2. [*There is no need to pay license*]

1.5. [*The MS model requires more time*]. WinBI was finished in 3 months, but MS translation project required longer than 1 year.

- 1.4.3. [*Cannot use the translation results from other projects*]
- 1.4.4. [*There is not many free tools for translating MS products*]

Beside faster, WinBi was also done with smaller budget. Cost consideration is a critical factor for developing countries. Countries may develop a specific customization to fulfill the local needs without asking the permission of a company.

8.1.2 Type III - Comparison with the situation without translation

To perform this comparison, a users who cannot understand English well was asked to use the software without the translation, and compare with used the WinBI. This comparison shows how is the impact of the WinBI to users. The LWBG of this comparison is shown in Fig. 8.7.

Description of LWBG: Absence of Translation

1. [*Some users in Indonesia have difficulty in using computers*]. Some users cannot use the computer, or some of them are just afraid to start to use it.

- 1.1.[*Programs do not provide user interface in Indonesia language*].
- 1.2. [*Online manuals are not written in Indonesia language*].
- 1.3. [*They cannot understand English well*].
- 1.4. [*Alternative solutions is not widely known*].

1.1. [*Programs do not provide user interface in Indonesia language*]. Users stated that the lack of Indonesian language in user interface is the big obstacle for them.

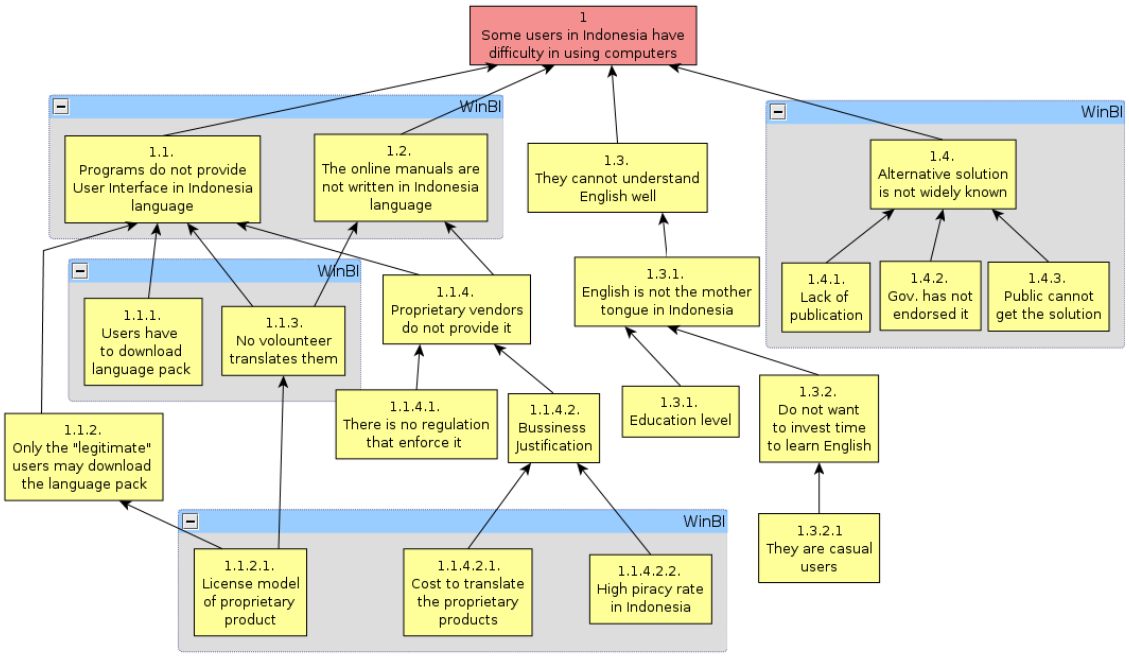

Figure 8.4: LWBG: Absence of WinBI

- 1.1.1. [*User have to download language pack*].
- 1.1.2. [*Only the legitimate users may download the language pack*].
- 1.1.3. [*No volunteer translate them*].
- 1.1.4. [*Proprietary vendors do not provide it*].

1.1.1. [*User have to download language pack*]. For Windows users has to download the Indonesia language pack.

1.1.2. [*Only the legitimate users may download the language pack*]. Only legitimate users (piracy version) who can download the language pack,

- 1.1.2.1. [*License model of proprietary products*]

1.1.2.1. [*License model of proprietary products*]. The proprietary restrict who may use and distribute software and the components.

1.1.3. [*No volunteer translate them*].

- 1.1.2.1. [*License model of proprietary products*]

1.1.4. [*Proprietary vendors do not provide it*].

- 1.1.4.1. [*There is no regulation to enforce it*].
- 1.1.4.2. [*Business justification*].

1.1.4.1. [*There is no regulation to enforce it*]. Until now, only Decree of President 02/2001, which suggest the use of Indonesian language in the software. However, the level is still as suggestion.

1.1.4.2. [*Business justification*].

- 1.1.4.2.1. [*Cost to translate the proprietary product*]
- 1.1.4.2.2. [*High piracy rate in Indonesia*].

1.1.4.2.1. [*Cost to translate the proprietary product*].

1.1.4.2.2. [*High piracy rate in Indonesia*]. Indonesia is still in the watch list of BSA, due to the high piracy rate.

1.2. [*Online manuals are not written in Indonesia language*]. The online manual of MS Windows is not available in Indonesian.

- 1.1.3. [*No volunteer translate them*].
- 1.1.4. [*Proprietary vendors do not provide it.*]

1.3. [*They cannot understand English well*].

- 1.3.1. [*Education level*].
- 1.3.2. [*Do not want to spend time to learn English*]

1.3.2. [*Do not want to spend time to learn English*]

- 1.3.2.1. [*They are casual users*].

1.3.2.1. [*They are casual users*].

1.4. [*Alternative solutions is not widely known*].

- 1.4.1. [*Lack of publication*]
- 1.4.2. [*Government has not endorsed it.*]
- 1.4.3. [*Public cannot get the solution.*]

1.4.1. [*Lack of publication*]

1.4.2. [*Government has not endorsed it*].

1.4.3. [*Public cannot get the solution.*]

8.2 Air Putih relief action

8.2.1 Type I - Comparison with relief action during Katrina.

After the Katrina disaster similar relief action was also performed. However, during the Katrina relief action, although the human resource and the facility is better than in Aceh, the Internet infrastructure recovery was very slow. To perform the evaluation I draw the LWBG as shown in Fig. 8.5.

Description of LWBG : Air Putih vs Katrina (See Fig. 8.5)

1. [*Internet recovery in Katrina is slow and more complex*]. The recovery of Internet infrastructure after the Katrina was slow. It was slower than in Aceh.

- 1.1. [*The network that should be recovered is more complex*].
- 1.2. [*The organization is more complex*].
- 1.3. [*The situation sometimes are not socially cooperative*].

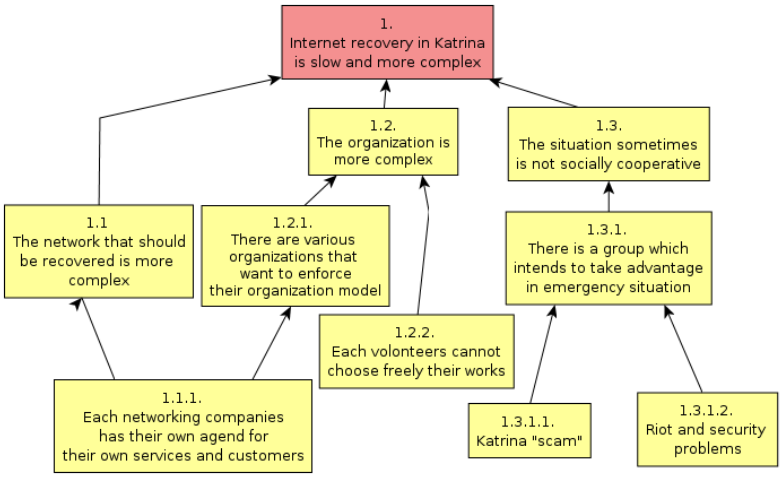

Figure 8.5: LWBG: Air Putih vs Katrina

1.1. [*The network that should be recovered is more complex*]. The previous network was more complex than in Aceh. In Aceh, before the Tsunami, there was not many network infrastructure.

- 1.1.1. [*Each networking companies has their won agenda for their own services and customers*].

1.1.1. [*Each networking companies has their own agenda for their own services and customer*]. There are many network company who own the network facility in the area. They want to recover their own services for their own customers.

1.2. [*The organization is more complex*]. Not only companies, there are also military, police, etc. This organization already has their well established organization and disaster management. However, sometimes they are not compatible each other.

- 1.2.1 [*There are various organizations that want to enforce their organization model.*]

- 1.2.2. [*Each volunteers cannot choose freely their works*].

1.2.1 [*There are various organizations that want to enforce their organization mode*]. Each organizations has had well established disaster management method. They cannot change it without going through complicated bureaucracy.

- 1.1.1. [*Each networking companies has their own agenda for their own services and customers*].

1.2.2. [*Each volunteers cannot choose freely their works*]. Volunteer has to join and manage by the group or organization. The decision of works, will be decided by the organization.

1.3. [*The situation sometimes are not socially cooperative*].

- 1.3.1. [*There is a group which intends to take advantage in emergency situation*].

1.3.1. [*There is a group which intends to take advantage in emergency situation*]. During Katrina relief action, there was crime groups, riot, as well as the other scams.

- 1.3.1.1. [*Katrina "scam"*].
- 1.3.1.2. [*Riot and security problems*].

1.3.1.1. [*Katrina "scam"*]. In Internet, there was a scam which take advantages of Katrina. This scam just pretend as Katrina victim, which requires the donation.

1.3.1.2. [*Riot and security problems*] There were many riots during post Katrina. They just tried to rob the supermarkets, shops, etc.

8.2.2 Type III. Comparison with the unexpected situation

After Tsunami in Aceh, many organizations and people already predicted that to build the Internet infrastructure in Aceh would take longer time and be difficult. To compare with this prediction, I draw LWBG as shown in Fig. 8.6.

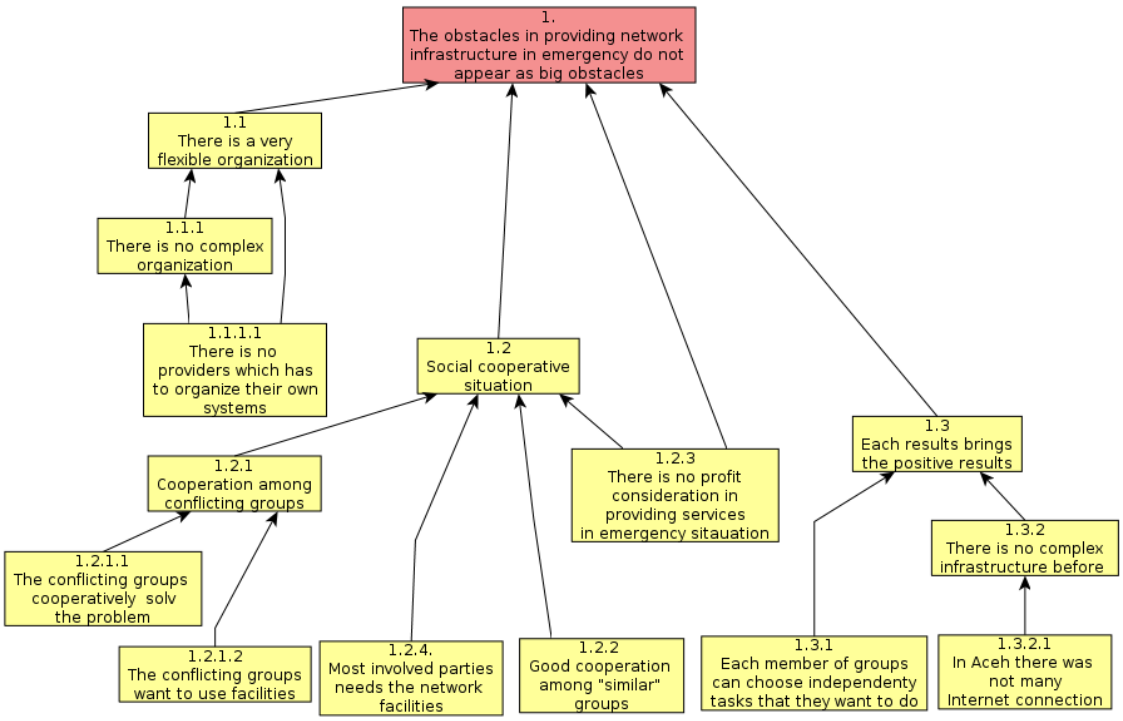

Figure 8.6: LWBG: the development model suitable for emergency situation

Description of LWBG: the development model is suitable for emergency situation 1. [*Obstacles in providing network infrastructure in emergency do not appear*]. It had been expected that, the Internet infrastructure in Aceh cannot be build in short time.

- 1.1. [*The organization is very flexible*].
- 1.2. [*Social cooperative situation*].
- 1.3. [*Each results brings positive results*].
- 1.2.3. [*There is no profit consideration in providing services in emergency situation*]

1.1. [*The organization is very flexible*]. The Air Putih organization is very flexible, there is no membership, every body may join. Even in Aceh Air Putih was not an organization, just a community.

- 1.1.1. [*There is no complex organization*]
- 1.1.1.1. [*There is no network provider which has to concentrate in recovering their own system*].

1.1.1. [*There is no complex organization*]. As the community there was no rigid organization structure.

- 1.1.1.1. [*There is no network provider which has to concentrate in recovering their own system*].

1.1.1.1. [*There is no network provider which has to concentrate in recovering their own system*]. Before Tsunami in Aceh, there was not many Internet services available.

1.2. [*Social cooperative situation*]. The situation post Tsunami in Aceh was cooperative.

- 1.2.1. [*Cooperation among conflicting groups*]
- 1.2.2. [*Good cooperation among similar groups*]
- 1.2.3. [*There is no profit consideration in providing services in emergency situation*]
- 1.2.4. [*Most involved parties needs to use networking facilities*]

1.2.1. [*Cooperation among conflicting groups*]. In Aceh there was the conflict groups. However, during post Tsunami, these groups did not continue their conflict, but collaboration each others

- 1.2.1.1. [*Conflicting groups cooperatively solve problems*]
- 1.2.1.2. [*Conflicting groups want to use facilities.*]

1.2.1.1. [*Conflicting groups cooperatively solve problems*].

1.2.1.2. [*Conflicting groups want to use facilities.*]

1.2.2. [*Good cooperation among similar groups*] Between similar groups, such as from IT community, religion groups established co-operation during relief action

1.2.3. [*There is no profit consideration in providing services in emergency situation*]

1.2.4. [*Most involved parties needs to use networking facilities*

1.3. [*Each results brings positive results*]. Even a small contribution provide a better situation.

- 1.3.1. [*Each member of groups can choose independently tasks that they want to do.*]
- 1.3.2. [*There is no complex network infrastructure before*].

1.3.1. [*Each member of groups can choose independently tasks that they want to do*] Each member chooses the task according their expertise and interest as well as their available time. For example, member who could not fly to Aceh, supports the activity from Jakarta or other cities, such as developing web site, finding donations etc.

1.3.2. [*There is no complex network infrastructure before*].

- 1.3.2.1. [*In Aceh there was not many Internet connection.*]

1.3.2.1. [*In Aceh there was not many Internet connection*].

8.3 Early Warning Information System (EWIS)

8.3.1 Type II - comparison with the situation without the EWIS

To perform this type of comparison, I compare with the situation without EWIS , i.e. incident of Early Warning. It is shown in Fig. 8.7

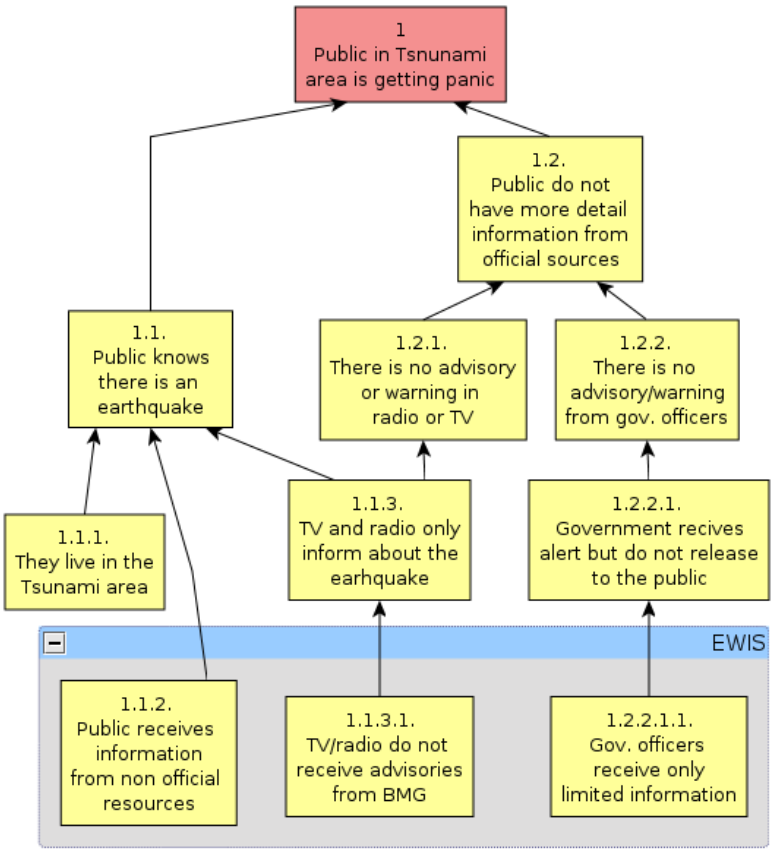

Figure 8.7: LWBG: Absence of EWIS

Description of LWBG: Absence of EWIS (See Fig. 8.7)

1. [*Public in Tsunami area is getting panic*]. Public in Tsunami area is getting panic, because there was no warning from the government officers.

- 1.1. [*Public knows that there is an earthquake*].
- 1.2. [*Public do not have more detail information from official resources*].

1.1. [*Public knows that there is an earthquake*]. In the area, public can feel the earthquake, but they do not know whether it is potential to be Tsunami.

- 1.1.1. [*They live in the Tsunami area*].
- 1.1.2. [*Public receives information from non official resources*].
- 1.1.3. [*TV/radio only inform about the earthquake*].

1.1.1. [*They live in the Tsunami area*]. They can feel it, because they are not far from the epicentrum.

1.1.2. [*Public receives information from non official resources*]. They also know from the friends, relatives, or other informal leaders.

1.1.3. [*TV/radio only inform about the earthquake*]. Many media, since they also live in the area, they also feel the earthquake and inform it.

- 1.1.3.1. [*TV/radio do not receive advisories from BMG*].

1.1.3.1. [*TV/radio do not receive advisories from BMG*] Advisory from BMG only delivered to government officers, police and military officers.

1.2. [*Public do not have more detail information from official resources*].

- 1.2.1. [*There is no advisory or warning in Radio or TV*].
- 1.2.2. [*There is no advisory or warning from government officers*]

.**1.2.1.** [*There is no advisory or warning in Radio or TV*]

- 1.1.3. [*TV/radio only inform about the earthquake*].

1.2.2. [*There is no advisory or warning from government officers*].

- 1.2.2.1. [*Gov. officers receive only limited information*].

1.2.2.1. [*Gov. officers receive only limited information*].

From the Fig. 8.7 the EWIS basically provide countermeasure of following nodes:

- 1.1.2. [*Public receives information from non official resources*]. By employing a countermeasure of this node, node 1.2. [*Public do not have more detail information from official resources*]. will be prevented to appear.
- 1.1.3.1. [*TV/radio do not receive advisories from BMG*]. By providing the advisory direct to the TV/radio, the successor nodes cannot be appear, i.e 1.1.3. [*TV/radio only inform about the earthquake*] and 1.2.1. [*There is no advisory or warning in Radio or TV*].
- 1.2.2.1. [*Gov. officers receive only limited information*]. There exist a system that provides 1.2.2. [*There is no advisory or warning from government officers*].

By employing the system that prevents those above node to appear, the top node 1. [*Public in Tsunami area is getting panic*]. can be avoided. Thus, the Early Warning Information System contributes to prevent the same incident.

8.4 President web site

8.4.1 Type I - Comparison with other government web sites

In Indonesia there are many government web sites, most of them are developed with developed method that do not taken into account the sustainability of system. The data in this evaluation was gathered from the mailing list, blogs, as well as the user comments. After that, the LWBA is performed with LWBG as shown in Fig. 8.8.

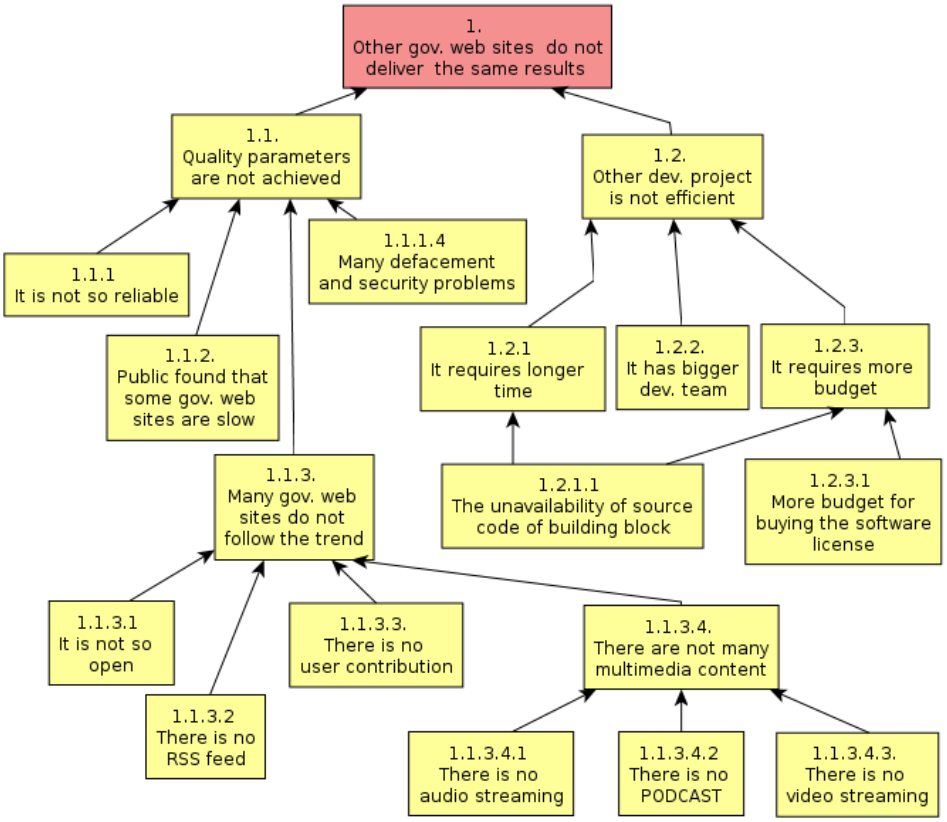

Figure 8.8: LWBG : President web site require less budget and quicker

Description of LWBG : President web site requires less budget and less time (See Fig. 8.8)

1. [*Other gov. web sites do not deliver the same results*].

- 1.1. [*Quality parameters are not achieved*].
- 1.2. [*Presidensby.info development is more efficient.*]

1.1. [*Quality parameters are not achieved*]

- 1.1.1. [*It is not so reliable*].
- 1.1.2. [*Public found that many gov.* web sites are slow].
- 1.1.3. [*Many gov. web sites do not follow the trend.*].
- 1.1.1.4. [*Many defacement and security problems*].

1.1.1. [*It is not so reliable*] Many government web sites some times are not available for a long time, for example due to the bandwidth availability or the web site maintenance.

1.1.2. [*Public found that many gov.* web sites are slow]. The speed of page loading is still dominant parameter for users in Indonesia to judge the web site. Many government web sites are slow.

1.1.1.4. [*Many defacement and security problems*]. There are many government web sites that are attacked and experienced the defacement. The President web site still survives against this type of attack.

1.1.3. [*Many gov. web sites do not follow the trend*] Many government web sites is design without considering the web technology trend.

- 1.1.3.1. [*It is not so open*].
- 1.1.3.2. [*There is no RSS feed*].

- 1.1.3.3. [*There is no user contribution*].
- 1.1.3.4. [*There are not many multimedia contents*].

1.1.3.1. [*It is not so open*] There are not many government web sites, which provide the user comments, display and have a team that read the user comments.

1.1.3.2. [*There is no RSS feed*].

1.1.3.3. [*There is no user contribution*].

1.1.3.4. [*There are not multimedia contents.*] No government web sites which has podcasting, audio or video streaming. The President web sites has already provided them since the launching.

- 1.1.3.4.1. [*There is no audio streaming*].
- 1.1.3.4.2. [*There is no PODCAST*].
- 1.1.3.4.3. [*There is no video streaming*].

1.1.3.4.1. [*There is no audio streaming*].

1.1.3.4.2. [*There is no PODCAST*].

1.1.3.4.3. [*There is no video streaming*].

1.2. [*Other dev. project is not efficient*]

- 1.2.1. [*It requires longer time*].
- 1.2.2. [*It has bigger development team*].
- 1.2.3. [*It requires more budget*].

1.2.2. [*It has bigger development team*]

1.2.1. [*It requires longer time*].

- 1.2.1.1 [*The unavailability of source code of building block*].

1.2.1. [*It requires longer time*].

- 1.2.1.1 [*The unavailability of source code of building block*].
- 1.2.3.1. [*More budget for buying software license*].

1.2.1.1 [*The unavailability of source code of building block*].

1.2.3.1. [*More budget for buying software license*].

8.4.2 Type II - comparison with the situation without the web site

To understand the impact of the developed system, it can be achieved by comparing with absence of the system. For example during the downtime of the system (failure, maintenance). This evaluation is shown in Fig. 8.9. The data of this evaluation is received from the journalists or users who uses the president web site as information resources, such as other news agency, news paper and magazines.

Description of LWBG: Journalist problem without the system (See Fig. 8.9)

1. [*Journalists have difficulty to report President activities*]. During the absence of the web site of president, journalists now find the difficulty without the president web site.

- 1.1. [*Journalists always have a tight deadline*].
- 1.2. [*They have to avoid misquote*].
- 1.3. [*Difficulty to write report quickly*].
- 1.4. [*Journalists are not in Jakarta*].

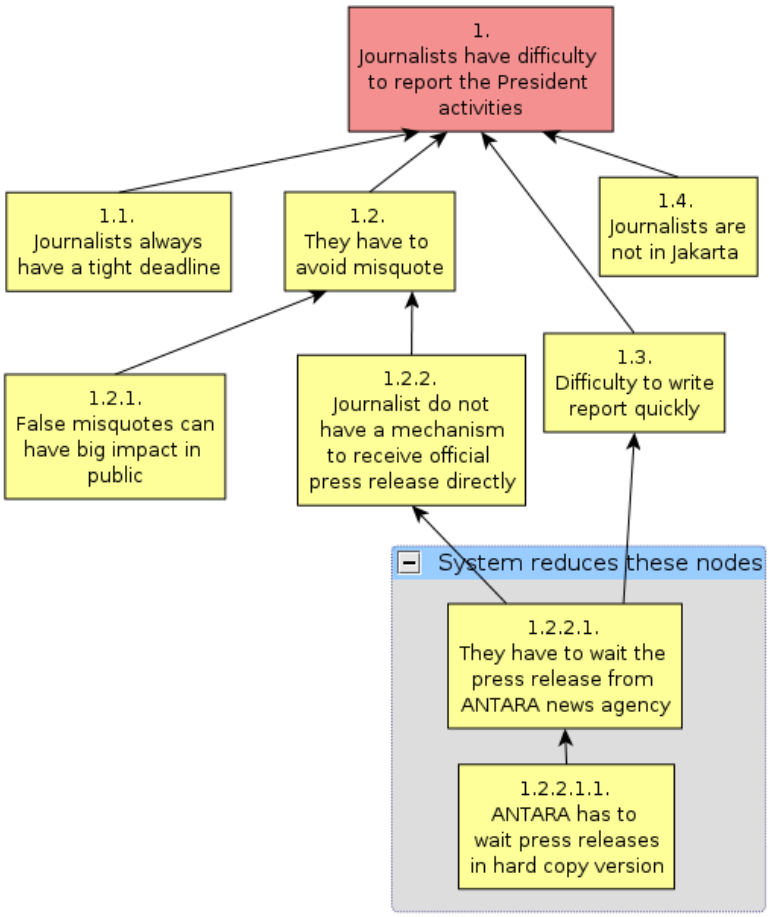

Figure 8.9: LWBG : Journalist problems without the system

1.2. [*They have to avoid misquote*]. Journalist has to work carefully, therefore they have to quote properly. A misquote can create a problem and sometimes they can be brought to the court.

- 1.2.1. [*False quote can have big impact to public*].
- 1.2.2. [*Journalists do not have mechanism to receive official press release directly*].

1.2.2. [*Journalists do not have mechanism to receive official press release directly*] Before the existence of President web site, there is no mechanism which enable journalist to receive official press release quickly.

- 1.2.2.1. [*They have to wait the press release from ANTARA news agency*].

1.2.2.1. [*They have to wait the press release from ANTARA news agency*]. For Journalists which are not in Jakarta, they have to wait the press release from ANTARA news agency. By retrieving information from President Web Site, now many journalist in the other parts of Indonesia can obtain the press release, latest news from President easier and quicker.

- 1.2.2.1.1. [*ANTARA has to wait the official press release in hard copy form*].

1.2.2.1.1. [*ANTARA has to wait the official press release in hard copy form*].

1.3. [*Difficulty to write report quickly*]. Without news source than can be retrieved easily, journalist found difficulty to write as quick as possible

- 1.2.2.1. [*They have to wait the press release from ANTARA news agency*].

Using LWBG in Fig. 8.9, it has been shown the positive contribution of President web sites.

8.5 Sustainability and source code availability

Open Source play important roles in the project developed using the proposed method. The open source project has a greater change to be sustain. As an example is the sustainability of Distro localization As shown in Fig. 8.10. The results of the localization project of Open Source software can be used for other translation project or other Distros. The translated phrase collection are also available for public. The development model of Open Source project, makes other groups can continue projects without the involvement of the initiator. For example, in the distro development of Indonesia :

- Trustix Merdeka evolved into WinBI. Than it is continued by other groups and becoming Komura (Komputer Murah - Cheap Computer) and also RimbaLinux.
- BlankOn Linux [Hoe, 2006] which has some packages from RimbaLinux now is being continued by other groups using different distro as basis. Now BlankOn switches using Ubuntu instead of Fedora.
- The translation results or other products of each project can be used freely by other developer, such as other distro developer or other translator. The OSS development model can accelerate the bootstrap phase during the development.

The result translation effort of Open Source Software such the translations, translated phrase database, tools, user and developer documentations are always available for public. It creates possibility for other developer groups to start the translation effort faster as well as to continue the works of other translators. It is also demonstrated the continuation of Open Source Software without the involvement of the initiator. The result of localization project from proprietary software may not be used by other groups without getting permission from the vendor. For developers in developing countries establishing the vendor permission is not an easy task. Thus, whenever the initiator or the vendor do not want to continue the project, the work cannot be sustained. FOSS provides a better platform for delivering sustainable localization solutions.

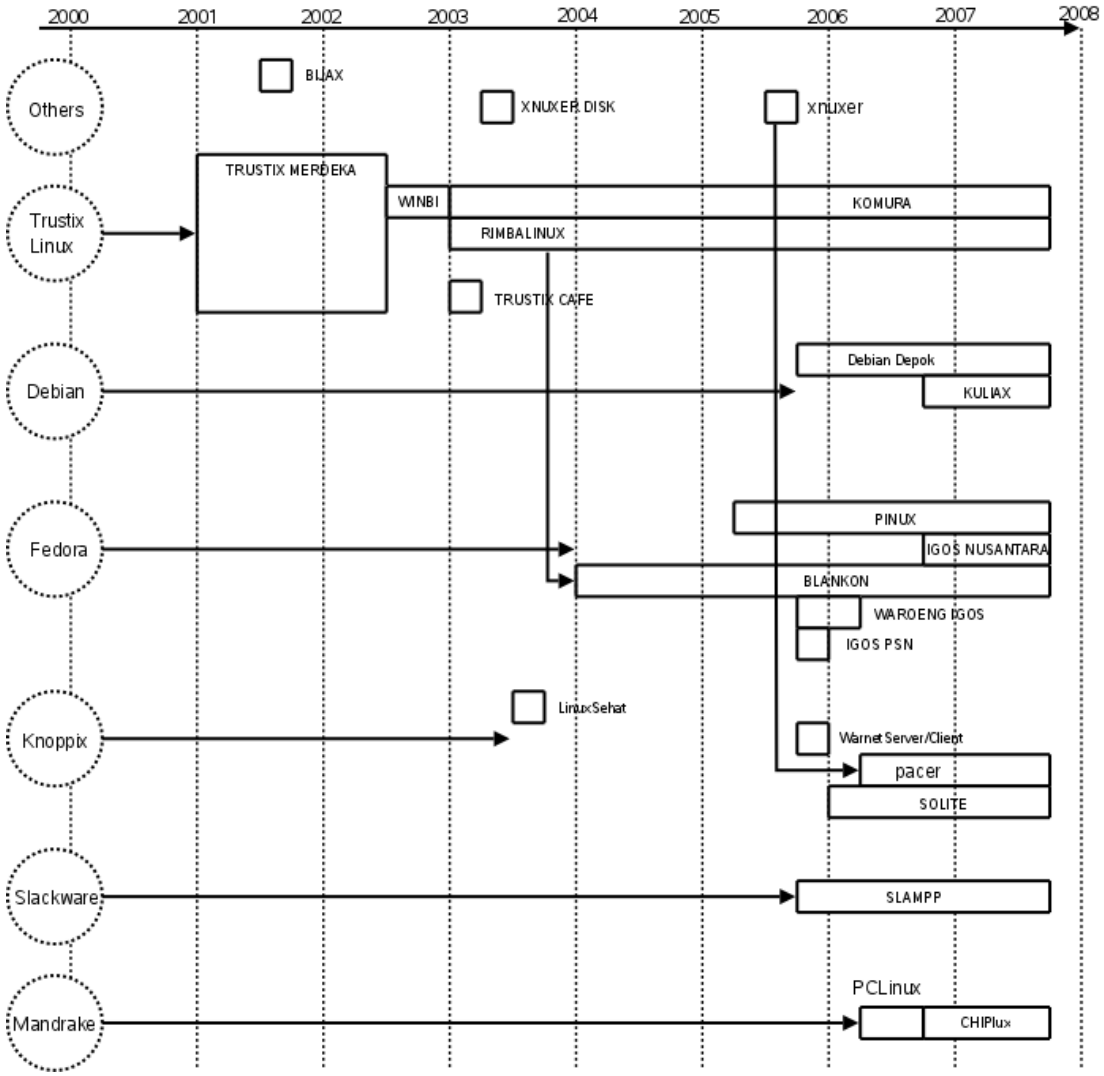

Figure 8.10: Evolution of distro development in Indonesia

Therefore, the availability of source code enables the possibility to customize, re-design or re-implement system according to users and their culture. The availability of source code may be fulfilled with the Open Source Software (OSS). Open Source Software (OSS) is part of open source culture OSS can be defined as computer software for which the human-readable source code is made available under a copyright license (or arrangement such as the public domain) that meets the Open Source Definition. The Open Source Definition is used by the Open Source Initiative to determine whether or not a software license can be considered open source. This permits users to use, change, and improve the software, and to redistribute it in modified or unmodified form. It is very often developed in a public, collaborative manner.

The Open Source Initiative (OSI) was formed in February 1998 by Eric S. Raymond and Bruce Perens. Open source software such as GNU/Linux is software where the author (the licensor) gives some fundamental freedoms to the user (the licensee), inside a license agreement:

- The freedom to study how the program works, and the freedom to adapt the code according specific needs. Access to the source code is a precondition for this;
- The freedom to improve the program (enlarge, add functions);
- The freedom to run the program, for any purpose and on any number of machines;
- The freedom to redistribute copies to other users.

As culture becomes critical issues, designers have begun to realize the role of culture in design and to develop the method and process of applying cultural factors on design. However, the customization of software sometimes may not be performed due to the license limitations, especially for proprietary software. The Open Source license, enables the customization, can be performed freely without a complicated legal process.

8.6 Summary

It has been shown how to perform evaluation using LWBA in this proposed development method. The evaluation can be performed in three different evaluations :

1. Type I. Comparison to similar system. This comparison can be easily performed if we have a similar projects, with more or less similar environment.

2. Type II. Comparison to the situation during absence of system. Many users are aware the function of system during the absence of system such as during a malfunction, or maintenance schedule .

3. Type III. Comparison with the expected unsatisfying situation. This comparison is important to understand, why the proposed model provide a good results.

Availability of source code also influences the sustainability of system. It has been shown in various comparisons in this work, that the availability of source will be better in ensuring the sustainability.

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Chapter 9

Bandung Bondowoso System Development Method

Once upon a time in Prambanan - Java Island, there were a war between two Hindu kingdoms, Pengging and Kraton Boko. Pengging Kingdom was a prosperous and welfare kingdom that is lead by a wise king named Prabu Damar Moyo who had a son named Raden Bandung Bondowoso. Kraton Boko was lead by a cruel and fully anger king named Prabu Boko who has a very beautiful daughter named Princess Loro Jonggrang.

A lot of soldiers died from both side Prabu Boko was killed by Raden Bandung Bondowoso. Raden Bandung Bondowoso finally arrives at Kraton Boko. He was surprised when he saw Princess Loro Jonggrang that is very beautiful, so he proposed her to become his wife. But the princess rejected it because Bandung Bondowoso had killed her father. Bandung Bondowoso insisted to agree for a union in marriage. She posed one impossible condition. Bandung had to build for her a thousand temples in only one night. He accepted the requests than he entered into meditation. Helped by supernatural beings, he succeeded in building 999 temples.

When the Bandung Bondowoso was about to complete the condition, Princess Loro Jonggrang intended to foil his effort to make the temples. She woke her palace maids and ordered the women of the village to begin pounding rice and set a fire in the east of the temple, attempting to make the prince and the spirits believe that the sun was about to rise. As the cocks began to crow loudly, fooled by the light and the sounds of morning time, the supernatural helpers stopped making the temple and fled back into the ground.

After counting the temple, Princess Loro Jonggrang refused to marry Bandung Bondowoso, because there are only 999 temples and still 1 temple lefts. The prince was


(a) Prambanan Temple


(b) Loro Jonggrang

Figure 9.1: The legend of Bandung Bondowoso [http://www.borobudurpark.co.id.]

> *furious about the trick and in revenge he cursed Lara Jonggrang to stone. It was a miracle that suddenly Princess Loro Jonggrang transformed to a stone statue. She became the last and the most beautiful of the thousand statues.*

This legend is widely known in middle and east Java. Inspired by the Bandung Bondowoso legend, many people in Indonesia, categorized a particular project in Indonesia as "***Bandung Bondowoso Project***" [Yudiman, 2003],[Indonesia, 2008]. This type of project, has following characteristics :

- The development project is performed in very short time (1 - 3 months). The decision of this short time of project is not due to the business profit but from other considerations such as the emergency situation or political consideration.
- The budget is limited. This budget limitation is also not due to profit consideration.
- The human resource cannot be selected freely. The available of human resource is also limited.
- The developer motivation is high and parties involved in the development process are social co-operative. But the environment sometimes is hostile environment.
- The project have big expectations and the project has to be success in the stakeholders point of view.

- There is no fixed definition or business process specification before the project begin.
- The organization that develops the system has not been well defined or appointed.
- Not all involved parties are bounded by official contracts. Enforcement a legal contract is very difficult.
- Sometimes, the projects can be rendered useless because of some non technical factors. There is always a threat to fail the projects, technical or non technical threat.

Although this type of project has some similarity with **Death March Project** (**DMP**) [Yourdon, 2003], but has some discrepancies such as :

- DMP is last about 3-6 months, but the Bandung Bondowoso Project (BBP) is shorter, it is about 1-3 months.
- There are similarity in limitations such as budget limitation, human resource limitation, time limitation. The different with Death March Project, is limitations in BBP are not due to the business decision from management but as product of a critical situation.
- In Death Match Project, the difficult situation of project due to the naivete of developer, or naive promise made by marketing or senior manager. The BBP has difficult situation due to the "*specific situation*" such as emergency situation, political consideration, intention to save people life.
- The Death Math Project's risk is bankruptcy or profit loss. The BBP's risk can be failure of save the people live, failure to achieve "*political goal*"
- The DMP is more in a company project settings. The BBP is more broad type of projects

- DMP is viewed as the "*failure*" of planning of organization, therefore should be avoided. But the Bandung Bondowoso Project cannot be avoided but should be managed in order to achieve the goal.

Unfortunately, many IT projects in Indonesia, especially in the government bodies in Indonesia has characteristics as above and can be categorized as the Bandung Bondowoso type of project. It is very difficult to employs software development methodologies that has assumptions are far from those characteristics.

Based on this fact in Indonesia, instead of avoiding this situation, this research attempts to define a software development method which can be applied in this situation, To remind with the risks of this type of project, I called the proposed methodology as "**Bandung Bondowoso System Development Method**" (**BBSDM**) because this method is developed to tackle the Bandung Bondowoso type of project. This methodology is derived, experimented and used in the real projects in Indonesia in which I involved as the system designer, developer and maintainer. Projects involved the government bodies in Indonesia. The projects demonstrate the effectiveness of this proposed methodology.

9.1 Characteristics of projects

As stated by Brooks [Brooks, 1987], there is no silver bullet that can be applied for all software problems . Hence, the identification the appropriate type of project for particular method is important before applying the method. The proposed model can be applied to handle projects that have following characteristics :

- **Activities**
  - The activities cannot be planned from the beginning.
  - It has infinite and continuously scalable results
  - Task can be divided into small independent tasks, and these small independent tasks have following characteristics:

    * Each task can be accomplished quickly
    * Each task shows feasible function
    * Each task has small resource requirement
    * Each task does not require complex coordination with other task

- **Organization**
    - Among involved parties, such as stakeholders, developers and users, a social cooperation is well established.
    - The development is performed by a small teams who are highly motivated
    - The team members are not in the same location. They communicate using various communication tools, such as telephone, SMS, Internet.
    - The development organization is flexible and loosely coupled. The organization involving in the works, are not bounded with strict contracts.

9.2 Proposed method

System engineering method can span many disciplines, including project management, analysis, specification, design, implementation, evaluation, quality assurance. Different methods require different techniques, sequences, steps and activities. The development methods can be classified into two big streams of approaches :

- **Heavyweight methodology**. This method include a large amount of formal process, paperwork and documentation. In this method strict attention to rules and procedures is demanded and the deviation from the standard is not suggested. This methodology has characteristics [Khan, 2004]:
    - Plan oriented. The requirement of project are completely locked in and frozen before the development begins.
    - Comprehensive documentation. Each development phase is documented thoroughly using a particular consensus or standard.

  - Predictive approach. Each step of development can be predicted or planned before the project is started.
  - Process oriented. Different roles are identified, each having clearly defined tasks.
  - Big design upfront. The goal of design process is to build a scalable and flexible architecture which is able to solve the complexity the problem.

- **Agile methodology**. This methodology is an attempt to answer more lightweight development process. Key elements of this method is simplicity and speed. A method is defined to be agile when the development has following characteristics [Pekka Abrahamsson, 2002]

  - Incremental. The objective is to produce a testable working system continuously. Releases and evaluation is performed more frequently to gather the feedback from users.
  - Cooperative. The relationship and communality of developer and the human play more important role. The individual and interactions is more important than the processes and tools.
  - Straightforward. The method is easy to learn and modify.
  - Adaptive. It means that the process should adapt new requirements and also ready for new risks.

The comparisons of both methods is listed in Tab 9.1. The choice of the method depends on the type of projects, as well as the constraints of the project.

Basically, this proposed model follows the agile practice. But it different with existing method because proposed method has following basic characteristics:

- **Semi formal**. Instead of enforcing the developer to analyze and formalize everything. I decided for this proposed development method to use a semi formal type of Why-Because Analysis (WBA) called **Lightweight Why-Because Analysis** (**LWBA**).

Table 9.1: Heavyweight vs Agile Method

Methodology	Characteristic	Example
Heavyweight	Plan oriented Comprehensive documentation Predictive approach Process oriented	Waterfall [Royce, 1970], SDLC, Cleanroom [Harlan Mills, 1987], Fusion [Derek Coleman, 1994], ESA standard [Jones et al., 1997], V-model `http://v-modell.iabg.de/`
Agile	Incremental Cooperative Straightforward Adaptive	Extreme Programming (XP) [Beck, 1999], SCRUM[K. Schwaber, 2002], Crystal[Cockburn, 2002], Adaptive Software Development (ASD)[Highsmith, 2002], Feature Driven Development (FDD) [S. R. Palmer, 2002],Dynamic System Development Method (DSDM) [Stepleton, 1997]

- **Constraints discovery.** Finding the constraints assists the design decision and focuses in on the QoS parameters that required by users. Furthermore, it is used to identify the problem that can be appear in the implementation phase. It can be performed effectively using LWBA.

- **Non judgmental**. Constraint identification is performed in a non judgmental manner (do not impose solution). Avoid to judge a value to the different situation, i.e. an unaccepted situation in particular culture may be a normal situation in other culture. Finding local model that can survive in particular situation is a good hit for this constraint identification..

- **Traceable decision**. Each decision is analyzed using LWBA, for example during the service refinement or conflict resolution in requirement elicitation. Therefore, change or simplification of design can be tracked clearly.

- **It will not enforce a particular model of organization**, but will identify the existing organization, the constraints and strength that can be exploited during the development. Some local culture has their own organizations and they have been performing well for a long time such as Dabbawalah in India and Subak in Bali. Dabbawalah collect and deliver each working day from

about 175,000 tiffinbox from wives or mother for workers in central of Mumbai [Mullins, 2008]. A team of Harvard statisticians has proved that the task of Dabbawalah is difficult to be performed without computers, mobile computer [Independent, 2006]. Forbes has awarded Dabbawalah the Six Sigma performance rating. It means that Dabbawalah has deliver its services with percentage correctness 99.999999 or more [Harding, 2002]. Dabbawalah now use SMS and Internet to support their operation without changing their organization [Vaswani, 2006]. Other good example or local organization is Subak in Bali [Kedi Suradisastra, 2002]. Subak is known as socio-religious agricultural association and it is considered to be one of the most effective hydraulic organization in the world. Imposing a different organization to the farmer in Bali, by consultant will only produced a worse performance [Lorenzen, 2006]. Therefore, it is more appropriate the use of technology should support the existing organization rather than to replace it.

- **Not only people oriented, but the communication among the people plays important role**. Among different cultures there are different styles of communication. There are four distinct listening styles [Chavan, 2007], I relate also this communication style with the Internet tools that they prefer to use:
  - **People-style listening**. People appears to find out the common interest with others and are responsive to their emotions. They prefers blogs, or social network tools.
  - **Action style listening**. People has this style prefers to receive concise, error-free presentations. Individuals appears to be impatient, and easily frustrated when listening to a disorganized presentation. They prefer academic style of reports, detail and thorough documentations.
  - **Content-style listening**. People who has this style prefer for receiving a complex and challenging information that they can evaluate carefully before deciding something or forming an opinion. They prefer long essay documentations.

Table 9.2: Methodological in Information System Development [Truex et al., 2000]

Privileged methodological	**Marginalized methodological**
A managed, controlled process	Random, opportunistic process driven by accident
A linear, sequential process	Processes are simultaneous, overlapping and there are gaps in between
A replicable, universal process	Occurs in completely unique and ideographic forms
A rational, determined, and goal-driven process	Negotiated, compromised, and capricious

  - **Time-style listening**. This type of listeners prefer for a brief and hurried interaction. They prefer the communication via messenger, SMS, or short presentation with bullet less than 15 pages.

- **Adaptive,** requirements can be changed, design decisions and implementation also should be responsive with the environment, but changes can be tracked and followed in a semi formal analysis

- **Distributed approach**. Members of developer team are not in the same location and do not belong to the same organization. In most agile methods, the developers are assumed to be located in a same room.

As described by Truex [Truex et al., 2000], not all information system development follow the privileged methodological development process, some of them are performed just using marginalized methodological development process. In the privileged methodological development method, it is assumed that the system is effectively managed and controlled by the system developers. The marginalized as the alternative is assumed that building the systems might be the natural outcome of a complex, multivariate setting affected by many uncontrolled events. This two different approaches are highlighted in Tab. 9.2. The privileged method projects commonly are accepted in plan-driven i.e. heavyweight development method. While the marginalized method have much in common with agile development method.

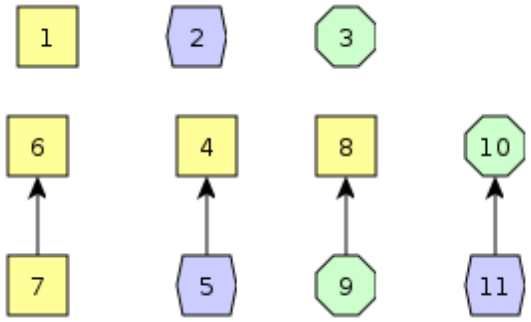


Figure 9.2: Nodes in Light Weight Why-Because Graph (LWBG)

Open Source Development have many similarities with Agile Method but different in some aspects [Pekka Abrahamsson, 2002]. In Tab 9.3, I contrast the BBSDM with various methods and extend this comparison from the comparison stated by Pekka [Pekka Abrahamsson, 2002] and also Boehm [Boehm, 2002].

9.3 How the proposed method evolves

Instead of formalizing the method based on literature of other development methods and testing it in a small work in laboratory experiment, I decided to involve directly with various real developments. The projects started without a decision to implement a particular system development. During my involvement with various real projects, I watched, and also participate by performing an action. Therefore, my works is similar with employing a model of ethnographic studies for system development research. I performed the interviewed, monitor the mailing lists, etc. The difference with the common ethnographic studies is the make use of semi-formal analysis method, called Light Weight Because Analysis (LWBA). The LWBA is used to capture and analyze the development process and interactions among involved parties.

LWBA as the extension of Why-Because Analysis is a important tools in this research, as well as in the proposed method. It helps as the analytical tool for the qualitative research. To provide an integrated description of the proposed method in this Chapter, I describe briefly the LWBA.

Table 9.3: Contrasting various approaches

Aspects	**Agile methods**	**Open Source**	**Heavyweight**	**BBSDM**
Developers	Agile, knowledgeable, collocated, and collaborative	Geographically distributed, collaborative, knowledgeable and agile teams	Plan-oriented, adequate skills, access to external knowledge	**Agile, collocated, and collaborative, not all knowledgeable but has intention to learn.**
Customers	Dedicated, knowledgeable, collocated, representative, empowered	Dedicated, knowledgeable, collaborative, and empowered	Access to knowledgeable, collaborative, representative, and empowered customers	**Dedicated, not knowledgeable, collaborative, representative**
Requirements	Largely emergent, rapid change	Largely emergent, rapid change, commonly owned, continually evolving - "never" finalized	Knowable early, largely stable	**Largely emergent, rapid change, continually evolving - "never" finalized**
Architectures	Designed for current requirement	Open, designed for current requirements	Designed for current and foreseeable requirements	**Designed for current and foreseeable requirements**
Refactoring	Inexpensive	Inexpensive	Expensive	**Inexpensive**
Size	Smaller teams and products	Larger dispersed teams and smaller products	Larger teams and products	**Smaller dispersed teams and small/larger products**
Primary objective	Rapid value	Challenging problem	High Assurance	**Rapid value some times with high assurance**

The main idea of LWBA are:

- Basically the LWBA, will be used to find the constrains of system. The constraints identification is performed in non judgmental way. Therefore, it is important to identify which node that can be changed by developers, or which node that requires an organization effort to change them.

- The analysis is performed by identifying the necessary causal factor (NCF), as shown in Fig. 9.2. Nodes as necessary causal factors will be classified into :

  - 1. is a general node. For example the node 6. has a causal factor node 7. which cannot be changed.

  - 2. is a node that its state can be changed by implementing software/hardware or organization/person. In the description of LWBG this node will be written as 2.◆. For example node 4. has the causal factor 5.◆. By implementing a software or change the node, the 4. can be avoided. Basically, the designed system has to cover the nodes in this category as countermeasure.

  - 3. is the node that its state is required to be changed, but it takes a longer time such as organization change, a new regulation is developed, public awareness is developed. In the description of LWBG, this node is written as 3.●. For example node 8. has causal factor 9.●. Developers understand that by changing the 9.● the node 8. can be avoided. However, the node 9.● required longer time to be established. Therefore, developer should find how to reduce the impact of this causality. These nodes will be part of organizational change and learning strategy.

To describe a LWBG, a traversal pattern as shown in Fig 9.3 is used as guideline :

1. Start with a top node, which is the main "preposition" that should be analyzed. Those statements can be :

- An incident, for example a security incident, a performance problem or any unsatisfying factors.
- A statement of evaluation conclusion.
- A predicted unsatisfactory that should to be avoided.

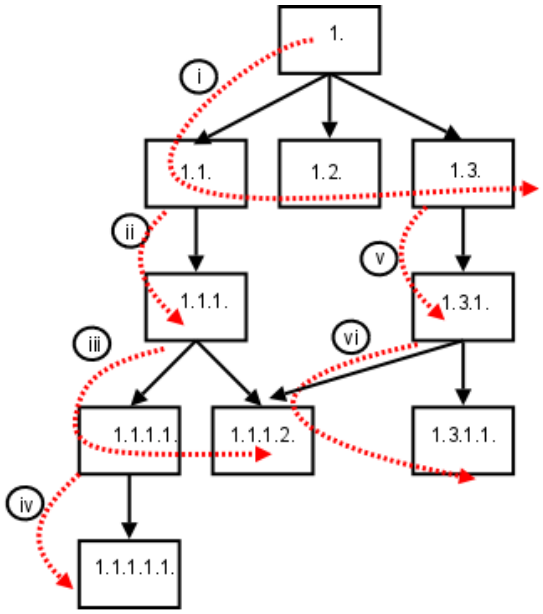
2. Traverse to the lower node and follow the nodes in the same level (nodes which are the NCF of the top node).
3. From the first node at that level, I traverse to the lower node and perform the same as step 2.
4. Find the node in this level which is the terminal node (do not have causal factor).
5. Describe the node when this node is terminal node (does not have causal factor)

This description is simple to be implemented using Wiki System. Each terminal node is a separate page in the Wiki system. Basically, the description of each nodes in LWBG are grouped into two categories :

- Description of node as terminal nodes
- Description of node as necessary causal factor of the node above of this node.

The LWBA in this research and the proposed method is employed for different goals :

- **Investigation tool**. For performing the investigation to find the problem in existing development methods, as well as to capture the development process in the real development project.
- **Development tool**. For deriving the requirement elicitation analysis, as well as to specify the developed system.
- **Explanation tool**. For investigating and finding the explanation of a decision.



(a) LWBG : Example

(b) Description of LWBG : Example

Figure 9.3: Example of LWBG

- **Communication tool**. For delivery the description to the stakeholders or other parties about a development decision.

The LWBA is used in this work in various parts in this work as shown in Fig. 9.4.

- To understand the acceptance of a method, as well as the cultural consequences as described in Chapter 3.

- To elaborate the development method which is sensitive to the cultural and users, in localization process, as well as finding the improvement by using LWBA.

- To understand the success factor and the requirement of new development model for a specific project in Chapter 5. The main characteristics as well as the similarities of other development models (OSS and Agile). The similarities of the proposed method with Agile method and Open Source development methods is also identified by employing LWBA.

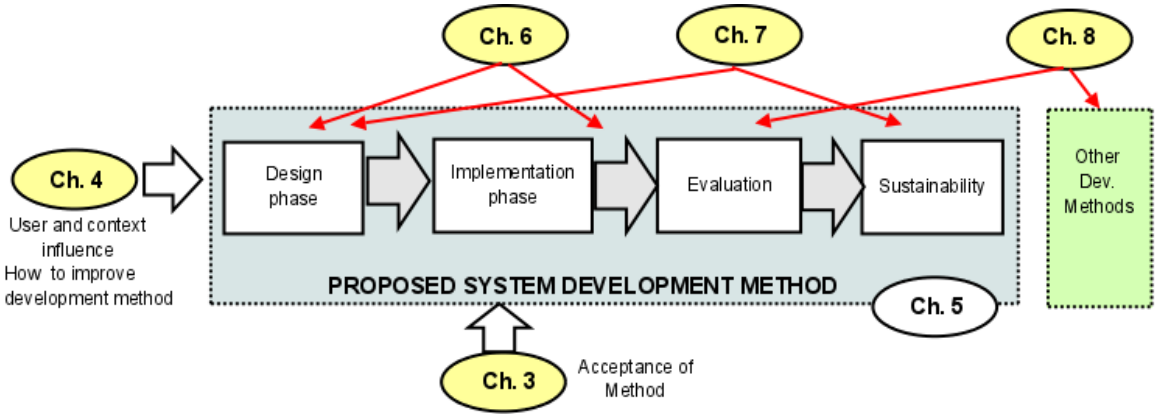


Figure 9.4: The role of LWBA in the proposed method evolution

- The development of system which based on the sustainable problem, Case-1, and how requirements are derived from the incident. And how the proposed method handles the unideal situation by adjusting the implementation, and how to track the change and consider with the risk, as in EWIS to ensure the sustainability of system
- The development of system which based on requirement and to ensure the sustainability of system. And how the sustainability problem is handle in Case-1, and Case-2. are described in Chap.7, about the President web site.
- To evaluate the proposed methods, and understand the strength and weakness of the proposed method in Chap. 8

9.4 The proposed development model

The proposed development model basically is an iterative and incremental development model. This idea is not new in the software development world. Even the Waterfall method, was initially introduced in an iterative style development model [Craig Larman, 2003]. The basic idea of iterative and incremental model is developers may take advantage of what was being learned during the development of earlier, and incremental, deliverable versions of systems. In this proposed model the iterations are performed in two different cycles :

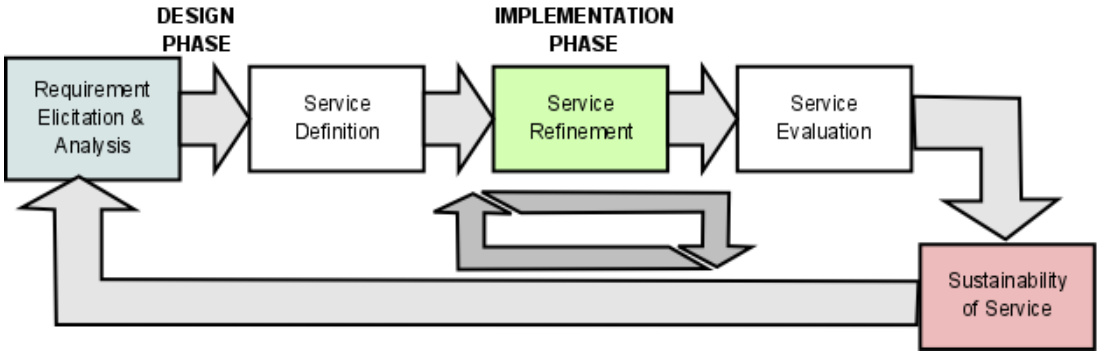


Figure 9.5: Proposed System Development Method

- **Big cycle**. Iterations are performed from the beginning until the end of the development. The new requirement sometimes should be derived, and new sub-system should be built.

- **Small cycle**. Iterations are performed during the implementation of the developed system. The workable prototypes are used during this cycle. Each cycle delivers a working system that can be used by users, the refinement of services, the components reductions are performed during this cycle.

This development model in the big cycle as shown in Fig. 9.5 has following steps:

1. **Requirement elicitation**.

   (a) Understanding the domain of problem. The domain of problem is not only about the process but also the environment, such as organizations, users, local culture where the system is employed.

   (b) Investigate who are users and who are stakeholders. Users are grouped according their role in the system. Every system has a purpose or mission. Most human-made systems are designed to fulfill and achieve the owner organization's role, missions and objectives. The success of the system is determined by HOW WELL the system is specified, designed, developed, integrated, verified, validated, operated and supported. In a system basically there are three type of users [Wasson, 2006]:

- **End user**. Individuals or organizations that receive benefits directly from the results of system, product or services.
- **Stake holder**. An individual or organization that has a vested interest in the outcome produced by a system in performing its assigned mission.
- **System user**. An individual or organization that employs a system, product or services or their by-product for purpose of accomplishing a mission-oriented or task.

(c) Find the cultural consequences of the problem. To find this cultural consequence, the culturability index from Hofstede can be used as guideline. The cultural consequences also determine the communication style that should be employed during the development as well as for the developed system.

(d) Find the constraints in developing the system. It also have to be identified, which constraints that can be negotiated, and which constraints that can be solved in a short time. Those constraints are :

- Organization constraints.
- Economics constraints.
- Legal constraints.
- Technical constraints.
- Human resource constraints.

2. **Service definition**

(a) Define the services or features that should be delivered by the system.

(b) The services is derived from the LWBG as the countermeasure. It is identified by the change that can be performed in the system.

3. **Service refinement.** Basically it is the implementation phase of the system. In this phase, the software will be coded, system will be installed, etc.

(a) Try to minimize the components and tasks without reducing the service being delivered

(b) The reduction is due to simplicity of system and cost reduction.

4. **Service evaluation**

(a) Understanding the parameters of Quality of Service (QoS) of the system. These parameters can be derived from the Requirement Elicitation phase as well as from the public understanding.

(b) Perform the evaluation (technical and public acceptance). The evaluation is derived not only from the direct measurement, but also from the indirect measurement, i.e. from media or public perception.

5. **Sustainability of service**

(a) Understanding the mismatches between intended user perception of system and real users perceptions.

(b) Understanding the unsatisfactoriness that raise after the operation of the systems.

9.5 Requirement elicitation

The design process has been described as "*process establishing which of several alternative ways (and with what tools) things could be done, which of these is most promising, and how to implement that choice with continual reviews, additions, and correction to work - designing*" [V. Hubka, 1996]. This definition is not complete, because how the alternatives is generated and chosen is not clear [Janet Burge, 2006]. Tong and Sriram [C. Tong, 1992] stated the important role of requirement in design - the need to conform to a specification meet certain criteria (such as performance requirements and resource constraints), and work within constraints such as technology and time limitations. The conformance with the requirement and constraints is what makes an alternative most promising.

In the development process the nonfunctional aspects should also be dealt from the beginning and throughout the software development process. Those non functional aspect are reliability, security, accuracy, safety, performance, look and feel requirements, as well as organizational, cultural and political requirement [Luiz Marcio Cysneiros, 2004]. Therefore, how to choose the alternative design, based on requirements and constraints, is important to the design process. This evaluation should be taken into account the various factors, technical as well as non technical such as human, organizations. The ability to perform the rigorous analysis off all factors influencing the choice of design alternative is crucial to develop a good design.

In this type of project, requirement cannot be defined from the beginning, because the stakeholders are so disconnected. The requirement will be defined at different times, by different people, using different methods. Instead of expecting the fixed requirement, the proposed method should be able to tolerate these inconsistencies. Therefore, the proposed requirement elicitation method should be able to capture, as well as to track the inconsistency. In the proposed methods, the requirement elicitation employed the LWBA which shown using LWBG. To perform the requirement elicitation following steps are taken:

1. The requirement elicitation is commenced by identifying bad examples. Bad examples can be found by asking the stakeholders or users. They can also be derived from the various sources such as media, mailing list, blogsphere. Usually, users are more sensitive to bad examples than good examples. Thus, starting from the bad example can be a good starting point in defining the services as well as the counterexample. Therefore the requirement is captured in following forms :

$$System_{Designed} \succ System_{example} \tag{9.1}$$

2. The bad examples is defined as unsatisfactory condition that should be avoided by the system. It also derives as main parameters of QoS of system. Each bad examples is used as the top node in each LWBG. If the requirement based on

an incident, the incident will be the top node of each LWBG.

3. From the top node, find the Necessary Causal Factors of each node until the terminal node. For each node in the LWBG, distinguish if the node is

   - Can be changed in short time, i.e., technical solution, for example by providing the software/hardware, and mark them as hexagon.
   - Required longer time to be changed, such as organization, change of perceptions, more information being disseminated to public. Mark these nodes as octagon.

4. The designed system can be derived to fulfilled the requirement which are reflected by the node which can be solved in short time. And the node that should be resolved but require longer time, may be used as the organizational strategy for the future, to guarantee the sustainability of system.

The most important step in employing the BBSDM is the identification of technical and non-technical aspects including the constraints in non judgmental manner. In the requirement phase it should be also identified the communication model that each stakeholders and parties prefer.

9.5.1 Example: Requirement based on Example

For the example I take the requirement elicitation and analysis in Chap. 7.

9.5.1.1 R1. Faster than detik.com

DETIK.COM [`http://www.detik.com`] is the most popular online news in Indonesia. Although, the page design of detik.com is always criticized by the page designers community in Indonesia, but the popularity of DETIK.COM makes many users still used it as reference. One major critique about DETIK.COM is the speed for retrieving the pages. Therefore, stakeholders of President web site did not want the developed website is slower than DETIK.COM. This preposition is used as the basic of requirement, the top node in Fig. 9.6.

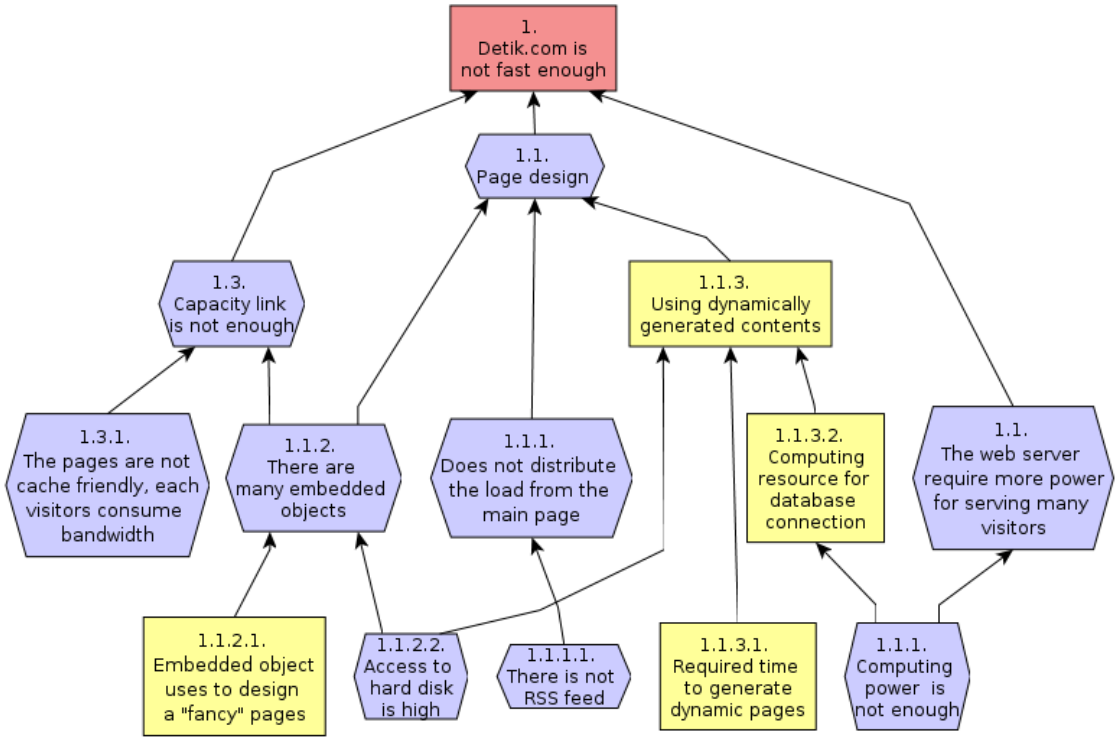


Figure 9.6: LWBG : Detik.com is not fast (R1)

Description of LWBG : Detik.com is not fast enough (R1). See Fig. 9.6

1. [*Detik.com is not fast enough*]. Detik.com [`http://www.detik.com`] is the most popular online news site in Indonesia. However, many visitors complains that the loading time of this site is very slow. Therefore, the president staffs emphasize that the President web sites should be faster than Detik.com.

- 1.1. ◆ [*Page design*]. A good web design will contribute to the speed of loading, since there are not many embedded objects, as well as the page is very small.
- 1.2. ◆ [*The web-server require more power for serving many visitors*].
- 1.3. ◆ [*Capacity link is not enough*]

1.1. ◆ [*Page design*]. The bad page design can make the retrieve time of a web page is long.

- 1.1.1. ◆ [*Does not distribute the load from the main page*]

- 1.1.2.◆ [*There are many embedded objects*]
- 1.1.3. [*Using dynamically generated contents*]

1.1.1.◆ [*Does not distribute the load from the main page*]. The detik.com does not distribute the page to several web servers, such as for images, for embedded object, or for the text. All objects are put in the same server

- 1.1.1.1.◆ [*There is no RSS feed*]

1.1.1.1.◆ [*There is no RSS feed*]. Detik.com decided not to have RSS, therefore visitors have to retrieve the whole main pages only to check the latest news.

1.1.2. [*There are many embedded objects*]. In the page of web sites, contains of many embedded objects, each object requires time to be retrieved.

- 1.1.2.1. [*Embedded object uses to design a "fancy" pages*]
- 1.1.2.2.◆ [*Access to hard-disk is high*]

1.1.2.1. [*Embedded object uses to design a "fancy" pages*]. Embedded object, such as java applet, flash are used to create a fancy web sites. A fancy web site is important for country like Indonesia, users in Indonesia tend to evaluate firstly based on the appearance than the functionality.

1.1.2.2.◆ [*Access to hard-disk is high*]. The high access to hard disk, decrease the speed to provide services. Time to access hard disk is now the bottleneck of system.

1.1.3. [*Using dynamically generated contents*]. At that time, DETIK.COM relied on the dynamic page generation. Each page is generated on the fly.

- 1.1.2.2.◆ [*Access to hard-disk is high*]
- 1.1.3.1. [*Required time to generate dynamic pages*]
- 1.1.3.2. [*Computing resource for database connection*]

1.1.3.2. [*Computing resource for database connection*]. Each connection to database require more computing resource, i.e. memory.

- 1.2.1.◆ [*Computing power is not enough*]

1.2.1.◆ [*Computing power is not enough*]. The computing power of server is not enough to serve the load

1.2.◆ [*The web-server require more power for serving many visitors*].

- 1.2.1.◆ [*Computing power is not enough*]

1.2.1.◆ [*Computing power is not enough*]. The server of DETIK.COM is not big enough to handle the load.

9.5.2 Example: Requirement based on Incidents (Sustainability Case-1)

For an example I take the explanation from Chapter 6. The Early Warning Incident as shown in Fig. 9.7. As the incident, in the top node is 1. [*Warning was not issued to the public*].

Description of LWBG : Problem of existing Early Warning System (See Fig. 9.7)

1. [*Warning was not issued to the public*]. As reported by several media, the warning was not conveyed to the public [Lewis, 2006], [Aglion, 2006], [Deutsch, 2006].

- 1.1. [*Gov officers did not release advisory to the public*]. Public in Indonesia knew the warning from the local authority, police department as well as other government bodies. But they did not release any warning.

- 1.2. [*Media did not release the warning to the public*]. There is no media, that reported the warning.

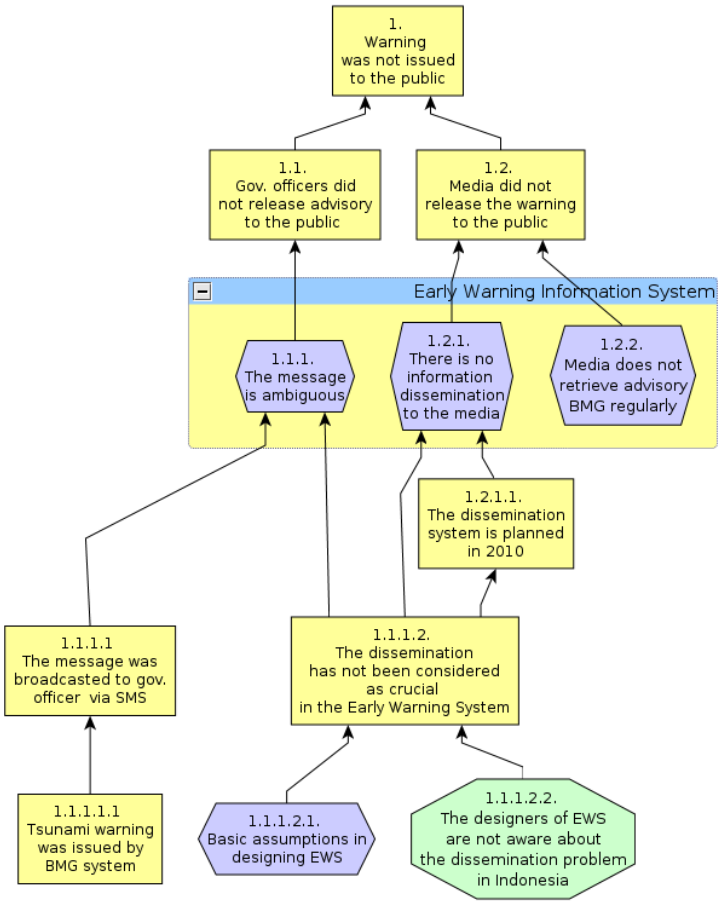


Figure 9.7: LWBG : Problem of existing Early Warning System

1.1. [*Gov. officers did not release advisory to the public*]. To prevent the panic in public, government officers decided not to release the warning to public [Edmonton, 2006].

- 1.1.1.◆ [*The message is ambiguous*]

1.1.1.◆ [*The message is ambiguous*]. The SMS message does not explain clearly the potential of Tsunami of the earthquake. The BMG message did not state it clearly.

- 1.1.1.1. [*The message was broadcasted to gov.officer via SMS*].
- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]

1.1.1.1. [*The message was broadcasted to gov. officer via SMS*]. The existing early warning dissemination system from BMG deliver the message to the government officers via SMS.

- 1.1.1.1.1. [*Tsunami warning was issued by BMG system*]

1.1.1.1.1. [*Tsunami warning was issued by BMG system*]. In this incident, the warning has been sent by the BMG.

1.2. [*Media did not release the warning to the public*]. The early warning system of BMG only broadcasts SMS to the police and government officers, but not directly to the TV or radio [Loewe, 2008]. In an emergency situation the public should be informed as soon as possible. As shown by Fig. 9.8, a survey in the people in Tsunami area, Nias, public still expects the Tsunami warnings are received from the local government, and media (TV, radio, news paper).

- 1.2.1.◆ [*There is no information dissemination to the media*]
- 1.2.2.◆ [*Media does not retrieve advisory BMG regularly*]

1.2.2. ◆ [*Media does not retrieve advisory BMG regularly*]. Media cannot retrieve the final advisory from BMG, they can only access the warning system in Internet but from other international resources.

1.2.1. ◆ [*There is no information dissemination to the media*]. The existing early warning system did not deliver the warning to the media, they only send SMS to government officers.

- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]
- 1.2.1.1. [*The dissemination system is planned in 2010*]

1.2.1.1. [*The dissemination system is planned in 2010*]. The dissemination of early warning information to the public is not considered as crucial aspect in the early warning system. The GITEWS planned the project will be installed on 2010 [GITEWS, 2009].

- 1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]

1.1.1.2. [*The dissemination has not been considered as crucial in the EWS*]. The main problem of the Early Warning System design such as GITEWS is the absence of Early Warning dissemination process to the public. The GITEWS focuses only on the detection, modeling and decision support

- 1.1.1.2.1. ◆ [*Basic assumptions in designing EWS*]
- 1.1.1.2.2. ● [*The designers of EWS are not aware about the dissemination problem in Indonesia*]
- 1.1.1. ◆ [*The message is ambiguous*]

1.1.1.2.2. ● [*The designers of EWS are not aware about the dissemination problem in Indonesia*]. The designers of GITEWS assumed that the dissemination to the public is not a significant problem in Indonesia. However, the Indonesia situation is very different with the situation of the designer of GITEWS. Most

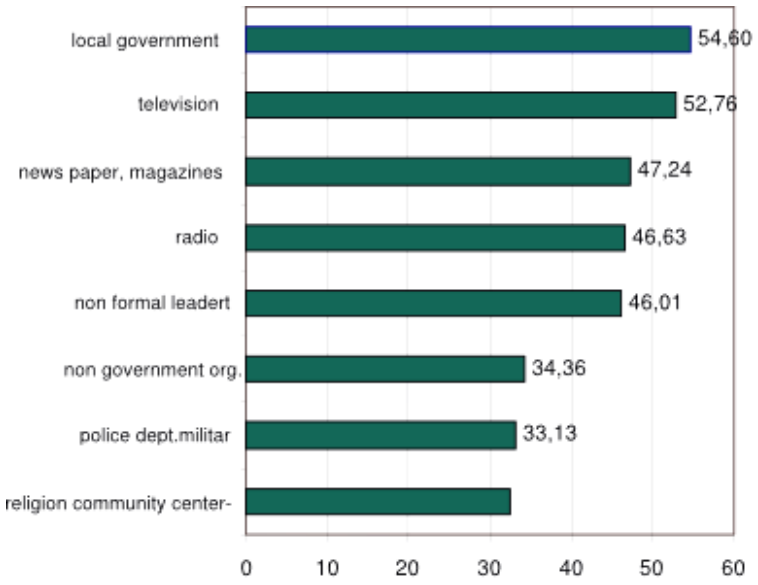


Figure 9.8: How public expect the warning information[Nugroho, 2007]

designers of GITEWS live in Germany. In Indonesia the dissemination and capacity building of the public should be put in the first priority before we can implemented the system. This node show how the sustainability Case-1 appears in this incident.

Improvement suggested by LWBG: From the LWBG shown in Fig. 9.7, in order to prevent the same incident as stated as the top node 1. [*Warning was not issued to the public*], EWIS should has following characteristics as countermeasures that prevent this node to appear.

- 1.1.1.◆ [*The message is ambiguous*]. The message format should be unambiguous. The recipient can interpret them correctly, the message is also robust to the error during delivery.

- 1.2.2.◆ [*Media does not retrieve advisory BMG regularly*]. Rather than expecting the initiative from the media, BMG should be more active in pushing the warning to media.

- 1.2.1.◆ [*There is no information dissemination to the media*]. The dissemination system should deliver the warning directly to the media such as television

and radio.

However to ensure the sustainability of system, it should be notified during the development :

- 1.1.1.2.2. [*The designers of EWS are not aware about the dissemination problem in Indonesia*]. It is the learning part of the proposed development method. In this proposed approach, it is identified that the learning process should be included as the consideration in developing the system.

9.6 Use of LWBG for service definition

Basically, the service definition is derived from the LWBG used in requirement elicitation. To perform the service definition following steps are used :

1. From the LWBG in the requirement analysis, : $LWBG_R$ is the LWBG of the Requirement (R), N is the node as causal factor, M is the node of causal factor that can be changed and under developer controlled, P is the node that can be changed but require longer time because it is not totally under developer control.

$$LWBG_R = \{N_0, N_1, ...N_n, M_0, M_1, ..., M_m, P_0, P_1, ..., P_k\}$$

2. List the node that can be changed by technical solution. In LWBG it is shown as hexagon.

3. The Service Specification (S) for each Requirement can be derived by providing the countermeasure of M

$$S = \{\sim M_1, ..., \sim M_n\} \tag{9.2}$$

4. Organizational Policy (OP) to provide a better system, for each Requirement can be derived by providing the countermeasure of P

$$OP = \{\sim P_1, ..., \sim P_k\} \tag{9.3}$$

5. The whole of service specification of systems, is the combination of the service specification derived from the requirements

9.6.1 Example: Service definition

I use the example from the Chap 7.

S1 : To provide faster web site than DETIK.COM

- 1.1.◆ [*Page design*]. The web page should be design as small as possible in order to reduce the required bandwidth.

- 1.2.◆ [*The web-server require more power for serving many visitors*]. Capacity of web server should be enough to handle the load.

- 1.2.1.◆ [*Computing power is not enough*]. The processor, RAM should be enough.

- 1.3.◆ [*Capacity link is not enough*]. The capacity link of Internet should be enough. The project cost should be cover the Internet cost.

- 1.1.2.◆ [*There are many embedded objects*]. The embedded object in the page design should be minimized.

- 1.1.1.◆ [*Does not distribute the load from the main page*]. The files should be distributed in different server.

- 1.1.2.2.◆ [*Access to hard-disk is high*]. The software design should minimizes the hard disk access.

- 1.1.1.1.◆ [*There is no RSS feed*]. The RSS feed should be provided in the developed system.

OP3: Organizational policy to provide web site which is better than other Government web site

- 1.1.1. [*Web sites are not considered as the important delivery channel*]. The government bodies should start to deliver more information to public via Internet.

9.7 Use of LWBG for service refinement

During the implementation phase workable prototypes are used instead of mock-up prototype. A prototype simulates the important interface and performs them main function of developed system. Installing the countermeasure such as firewalls, virus protections must take a good look at the organization, assets, and resources [Timo J. Wiander,]. Therefore, considering the design decision is not only technical consideration, but also non technical consideration such as the availability of human resources, license etc.

In some situations, the design cannot be fully implemented due to various technical and non technical reasons. Hence, some simplifications should be performed, i.e, the design decision cannot be implemented by developer. To track the simplification of design, the LWBG is used again in this following steps:

1. As the top node is the design decision that cannot be implement end. For example

$$\sim Decision_{design}$$

2. Find the causal factor until the terminal nodes.

3. From the this node, identify the node relates to the requirement. Which nodes that can be accepted because do not conflict with the requirement.

As an example of this phase is taken from the Early Warning Information System. In the initial design, I design the system employed the digital signature system for the

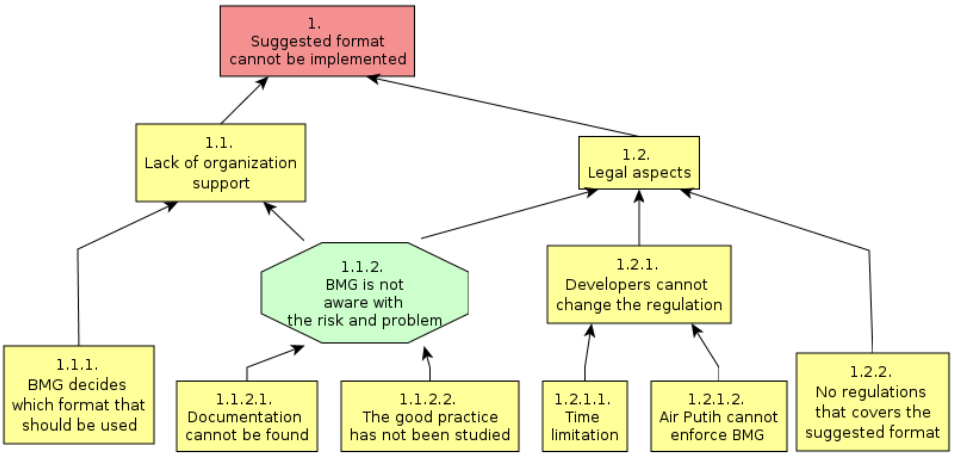


Figure 9.9: LWBG : Suggested format cannot be implemented

message.

9.7.1 Example: service refinement

For this example, I use the Early Warning Information System in Chapter. 6. In EWIS projects the suggested format cannot be fully implemented in the real implementation, but some adjustment was performed. To consider the problem in suggested message format acceptance, I draw LWBG as shown in Fig. 9.9.

Description of LWBG : Suggested format cannot be implemented. See Fig. 9.9.

1. [*Suggested format cannot be implemented*]. The BMG did not accept the suggested format, and developer did not carry on to implement it.

- 1.1. [*Lack of organization support*]
- 1.2. [*Legal aspects*]

1.1. [*Lack of organization support*]. BMG do not have human resource which has capability in analyzing the messages. The message is designed in ad hoc manner without risk consideration.

- 1.1.1. [*BMG decides which format that should be used*]
- 1.1.2. [*BMG is not aware with the risk and problem*]

1.1.1. [*BMG decides which format that should be used*]. BMG is the government organization which has power to determine which format that can be used to deliver the warning to public.

1.1.2. [*BMG is not aware with the risk and problem*]. From the meeting with the BMG representatives, it seems that there is no awareness of the risk of the message format.

- 1.1.2.1. [*Documentation cannot be found*]
- 1.1.2.2. [*The good practice has not been studied*]

1.1.2.1. [*Documentation cannot be found*]. During the development, BMG did not supply enough documentation about the message format.

1.1.2.2. [*The good practice has not been studied*]. Actually, there are many studies regarding the early warning information system, as well as the standard and good practice[RIzalid Boer, 2006]. However it seems that BMG ignored this information.

1.2. [*Legal aspects*]. The warning information is officially released by government to public. Therefore, the legal aspect such as regulation, organization which is responsible to issue the problem

- 1.1.2. [*BMG is not aware with the risk and problem*]
- 1.2.1. [*Developer cannot change the regulation*]
- 1.2.2. [*No regulations that covers the suggested format*]

1.2.2. [*No regulations that covers the suggested format*]. The suggested format has not been covered by any government regulation. The messages that are delivered to the public should base on government regulations.

1.2.1. [*Developer cannot change the regulation*]. The change of regulation, even for a simple thing such as the message format, requires a complex bureaucracy. Developers do not have power to change the regulation, they can only provide the suggestion.

- 1.2.1.1. [*Time limitation*]
- 1.2.1.2. [*Air Putih cannot enforce BMG*]

1.2.1.1. [*Time limitation*]. The time that was available to develop and install this system was only 1 month. It was also time for training the users, installation and the testing.

1.2.1.2. [*Air Putih cannot enforce BMG*]. As stated in the regulation, BMG is the official decision about the implementation of the EWIS. Air Putih foundation only provides the assistance in developing the system.

9.8 Use of LWBA for service evaluation

There are three type of comparisons that can be performed using LWBG in the proposed method. For each type of comparison the difference is the preposition used as the top node:

- **Type I. Comparison to similar system**. As the top node of LWBG is the preposition that states other similar systems ($S_{similar}$) performs inferior to the system being developed ($S_{developed}$) :

$$S_{similar} \prec S_{developed} \tag{9.4}$$

- **Type II. Comparison to the situation during absence of system**. As the top node as the preposition of the comparison of situation with the presence of the system being developed ($S_{developed}$) and situation without the system being

developed ($S_{absence}$).

$$S_{absence} \prec S_{developed} \tag{9.5}$$

- **Type III. Comparison with the expected unsatisfying situation**. The top node is a preposition in form of "*absence of predicted unsatisfying situation*". It can be derived from the requirement that should be fulfilled. Basically the unsatisfying condition ($UF_{predicted}$) is the requirement that cannot be fulfilled by the system. Using this as preposition at the top node of LWBG, I can identify which factors that contribute to the success of the system.

$$S_{developed} \rightarrow UF_{predicted} \tag{9.6}$$

$$Top =\sim (UF_{predicted}) \tag{9.7}$$

The evaluation can be performed using following procedure :

1. Put preposition as the top node, it depends on which Type of comparison.
2. Derive the necessary causal factors from the top node until reach the terminal node. These causal factors are derived based on several criteria such as :
   - Accepted measurement
   - Critique or comments of users, it can be gather via various media such as monitoring mailing lists, feedback comments, or blogsphere.
   - Critique or comments in media.
3. Identify from each node, and identify which nodes are part of the developed system.

9.8.1 Example: Type-I comparison

The example is taken from the comparison between translation in Windows XP and WinBi. This comparison has been described in Chap. 4.

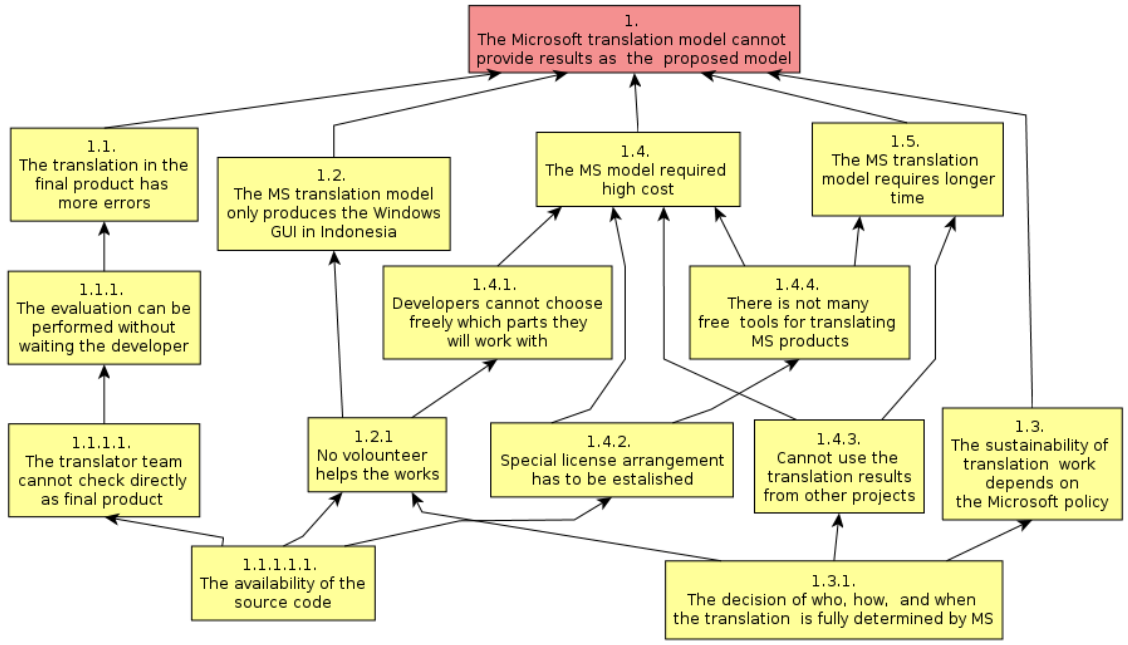


Figure 9.10: LWBG: the proposed model better than proprietary

Description of LWBG : Proposed model is better than proprietary (See Fig.)

1. [*The MS translation model cannot provide results as the proposed model*]. As described in Tab. 8.2

- 1.1. [*The translation in the final product has more errors*].
- 1.2. [*The MS translation model only produces the Windows GUI in Indonesia*].
- 1.3. [*The sustainability of translation work depends on MS policy*].
- 1.4. [*The MS model requires high cost*].
- 1.5. [*The MS model requires longer time*].

1.1. [*The translation in the final product has more errors*]. Some terminologies used in the Windows XP are not popular. Many user criticizes it in the mailing list.

- 1.1.1 [*The evaluation can not be performed without waiting the developer*].

1.1.1 [*The evaluation can not be performed without waiting the developer*]. The translator team can only submitted the translation to MS developers.

- 1.1.1.1. [*The translator team cannot check directly the translation as final product*].

1.1.1.1. [*The translator team cannot check directly the translation as final product*]. The translator teams cannot compile the program as final products, because this is the proprietary program that has a license limitation.

- 1.1.1.1.1. [*The availability of source code*]

1.1.1.1.1. [*The availability of source code*]. There is no available source code for the translators.

1.2. [*The MS translation model only produces the Windows GUI in Indonesia*]. The Indonesia language pack of Windows XP only covers the menu and GUI, without the on-line help, or manual books.

- 1.2.1. [*No volunteer helps the works*]

1.3. [*The sustainability of translation work depends on MS policy*]. As the MS DOS Indonesian translation, the decision to release to public or to continue the translation works is dictated by Microsoft.

- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*].

1.3.1. [*Other developer teams cannot continue the work without getting permission from MS*]. In Open Source translation, every body have right to continue the translation or to fork the translation effort. In the MS Windows translation, only translators that has been established the permission can execute the translation work.

1.2.1. [*No Volunteer helps the works*]. Volunteers cannot joint freely to the translation efforts. Only translators contracted by Microsoft may perform translation.

- 1.1.1.1.1. [*The availability of source code*]
- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]

1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]. In the proprietary software, vendor dictates who can continue the translation works. Sometimes, there is no business justification, the translation effort will be discontinued.

1.4. [*The MS model requires high cost*]. The cost of proprietary software, as well as the development tools

- 1.4.1. [*The developer cannot choose freely which part they will work with.*]
- 1.4.2. [*Special license arrangement has to be established*].
- 1.4.3. [*Cannot use the translation results from other projects*]
- 1.4.4. [*There is not many free tools for translating MS products*]

1.4.1. [*The proposed model, the developer take part what they want*]. The distribution of tasks is determined by the contract and the project manager.

- 1.2.1. [*Volunteers can help the works*]

1.4.2. [*Special license arrangement has to be established*]. To translate the proprietary software such as MS Windows, a special Non Disclosure Agreement usually is required.

- 1.1.1.1.1. [*The availability of source code*]

1.4.3. [*Cannot use the translation results from other projects*]. To avoid the complexity of license, the translation of MS Windows did not use the result of other translation work, such as from many Open Source software.

- 1.3.1. [*The decision of who, how, when the translation is fully determined by MS*]

1.4.4. [*There is not many free tools for translating MS products*]. There is no many free tools, such as KBabel, or other translation tools.

- 1.4.2. [*There is no need to pay license*]

1.5. [*The MS model requires more time*]. WinBI was finished in 3 months, but MS translation project required longer than 1 year.

- 1.4.3. [*Cannot use the translation results from other projects*]
- 1.4.4. [*There is not many free tools for translating MS products*]

Beside faster, WinBi was also done with smaller budget. Cost consideration is a critical factor for developing countries. Countries may develop a specific customization to fulfill the local needs without asking the permission of a company.

9.8.2 Example: Type-II comparison

To perform this type of comparison, I compare with the situation without EWIS, i.e. incident of Early Warning. It is shown in Fig. 9.11. This comparison is described in Chap. 6.

Description of LWBG: Absence of EWIS (See Fig. 9.11)

1. [*Public in Tsunami area is getting panic*]. Public in Tsunami area is getting panic, because there was no warning from the government officers.

- 1.1. [*Public knows that there is an earthquake*].

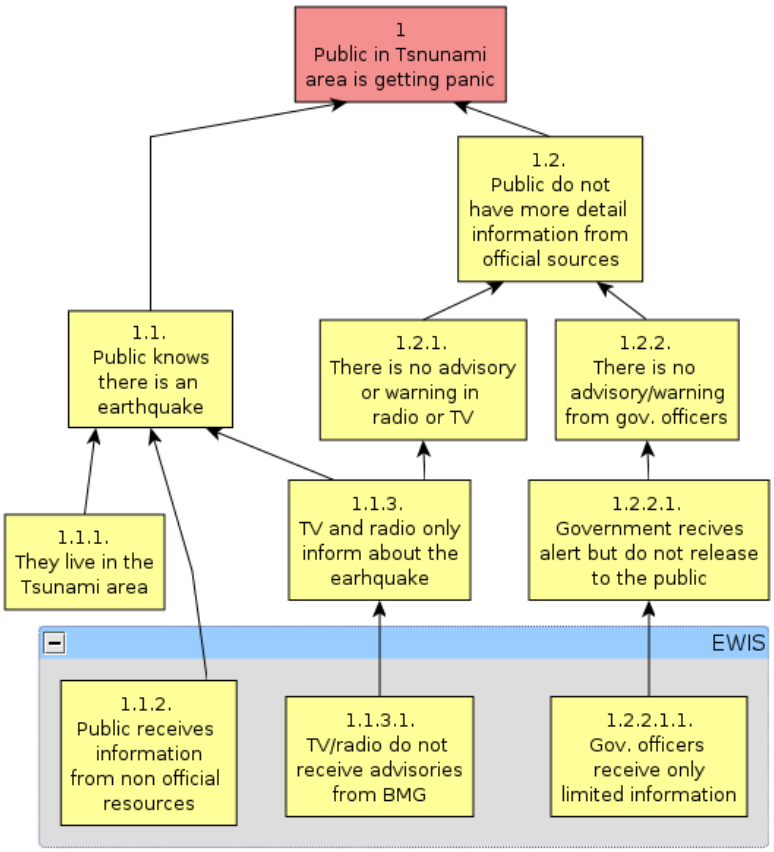


Figure 9.11: LWBG: Absence of EWIS

- 1.2. [*Public do not have more detail information from official resources*].

1.1. [*Public knows that there is an earthquake*]. In the area, public can feel the earthquake, but they do not know whether it is potential to be Tsunami.

- 1.1.1. [*They live in the Tsunami area*].
- 1.1.2. [*Public receives information from non official resources*].
- 1.1.3. [*TV/radio only inform about the earthquake*].

1.1.1. [*They live in the Tsunami area*]. They can feel it, because they are not far from the epicentrum.

1.1.2. [*Public receives information from non official resources*]. They also know from the friends, relatives, or other informal leaders.

1.1.3. [*TV/radio only inform about the earthquake*]. Many media, since they also live in the area, they also feel the earthquake and inform it.

- 1.1.3.1. [*TV/radio do not receive advisories from BMG*].

1.1.3.1. [*TV/radio do not receive advisories from BMG*] Advisory from BMG only delivered to government officers, police and military officers.

1.2. [*Public do not have more detail information from official resources*].

- 1.2.1. [*There is no advisory or warning in Radio or TV*].
- 1.2.2. [*There is no advisory or warning from government officers*]

.**1.2.1.** [*There is no advisory or warning in Radio or TV*]

- 1.1.3. [*TV/radio only inform about the earthquake*].

1.2.2. [*There is no advisory or warning from government officers*].

- 1.2.2.1. [*Gov. officers receive only limited information*].

1.2.2.1. [*Gov. officers receive only limited information*].

From the Fig. 9.11 the EWIS basically provide countermeasure of following nodes:

- 1.1.2. [*Public receives information from non official resources*]. By employing a countermeasure of this node, node 1.2. [*Public do not have more detail information from official resources*]. will be prevented to appear.

- 1.1.3.1. [*TV/radio do not receive advisories from BMG*]. By providing the advisory direct to the TV/radio, the successor nodes cannot be appear, i.e 1.1.3. [*TV/radio only inform about the earthquake*] and 1.2.1. [*There is no advisory or warning in Radio or TV*].

- 1.2.2.1. [*Gov. officers receive only limited information*]. There exist a system that provides 1.2.2. [*There is no advisory or warning from government officers*].

By employing the system that prevents those above node to appear, the top node 1. [*Public in Tsunami area is getting panic*]. can be avoided. Thus, the Early Warning Information System contributes to prevent the same incident..

9.8.3 Example: Type-III comparison

This example is taken from Chap. 7. To understand the impact of the developed system, it can be achieved by comparing with absence of the system. For example during the downtime of the system (failure, maintenance). This evaluation is shown in Fig. 9.12. The data of this evaluation is received from the journalists or users who uses the president web site as information resources, such as other news agency, news paper and magazines.

Description of LWBG: Journalist problem without the system (See Fig. 9.12)

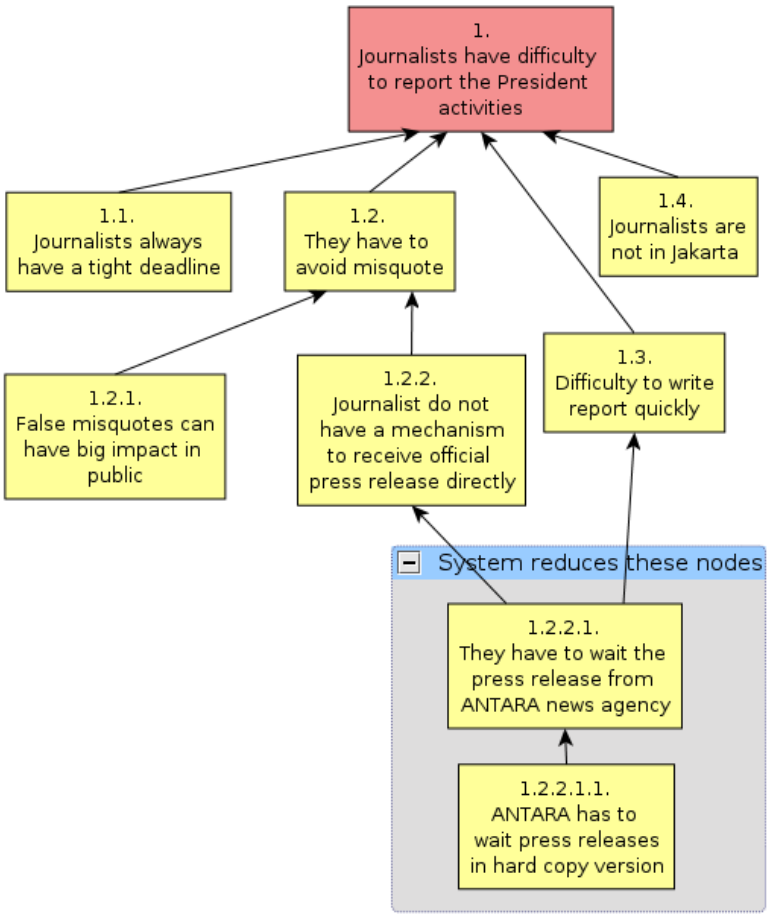


Figure 9.12: LWBG : Journalist problems without the system

1. [*Journalists have difficulty to report President activities*]. During the absence of the web site of president, journalists now find the difficulty without the president web site.

- 1.1. [*Journalists always have a tight deadline*].
- 1.2. [*They have to avoid misquote*].
- 1.3. [*Difficulty to write report quickly*].
- 1.4. [*Journalists are not in Jakarta*].

1.2. [*They have to avoid misquote*]. Journalist has to work carefully, therefore they have to quote properly. A misquote can create a problem and sometimes they can be brought to the court.

- 1.2.1. [*False quote can have big impact to public*].
- 1.2.2. [*Journalists do not have mechanism to receive official press release directly*].

1.2.2. [*Journalists do not have mechanism to receive official press release directly*] Before the existence of President web site, there is no mechanism which enable journalist to receive official press release quickly.

- 1.2.2.1. [*They have to wait the press release from ANTARA news agency*].

1.2.2.1. [*They have to wait the press release from ANTARA news agency*]. For Journalists which are not in Jakarta, they have to wait the press release from ANTARA news agency. By retrieving information from President Web Site, now many journalist in the other parts of Indonesia can obtain the press release, latest news from President easier and quicker.

- 1.2.2.1.1. [*ANTARA has to wait the official press release in hard copy form*].

1.2.2.1.1. [*ANTARA has to wait the official press release in hard copy form*].

1.3. [*Difficulty to write report quickly*]. Without news source than can be retrieved easily, journalist found difficulty to write as quick as possible

- 1.2.2.1. [*They have to wait the press release from ANTARA news agency*].

Using LWBG in Fig. 9.12, it has been shown the positive contribution of President web sites.

9.9 Sustainability of service

As described in Chap. 2, there are two main problems in sustainability of system :

- **Case 1 - Discrepancy of environment**. $E_{design} \neq E_{usage}$. The situation whenever environment between the environment in design phase and environment where the artifact is used.
- **Case 2 - Change of environment**. $E_{t_0} \neq E_{t_n}$. The different environment between the initial usage, E_{t_0} and the usage at some point of time in the future E_{t_n}.

From the sustainability of service analysts, It can be derived new requirements of a system by employing the same techniques as Requirement Elicitation.

9.9.1 Example: Case-1 : Sustainability

For the Case-1 sustainability, the LWBA can be employed in following steps :

1. For the top node, is the situation in which the intended design decision is perceived differently by users.
2. Find causal factors of the node until the terminal nodes.
3. Identity from each node to considers which is should be chosen

Figure 9.13: User comments

As example of the Case-1, I taken an example from the President Web Site project.

The Case-1 of sustainability as described in Chap. 2, is the discrepancy between the predicted environment and the real environment of the system. For example, the mental model of real users is different with the mental model being used by the designer. A real example is shown the problem in providing the user comment facility such as shown in Fig. 9.13.

What user perceives about this facility is different with what designer intended. Initially, this user comment facility is not designed to accept comment for President, but comments about the web site, and the information in the web site. To understand the problems I derive the LWBG of this situation and shown in Fig. 9.14.

Description of LWBG : User comments

1. [*Visitors leave message for President instead of for editors of web sites*]. To provide more open government web site, the President web site provides a user comment facility. The comments are moderated due to security consideration, and the selected comment will be displayed. However, it is not filtered based on the political view.

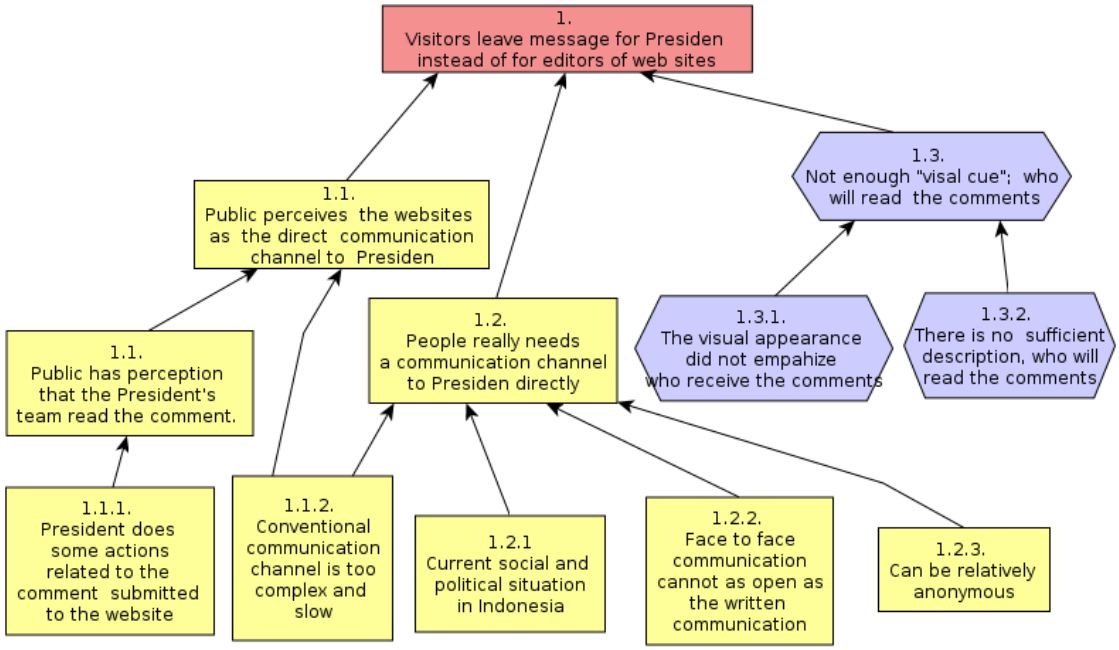


Figure 9.14: LWBG : User comments

- 1.1. [*Public perceives the websites as the direct communication channel to President.*]
- 1.2. [*People really needs a communication channel to President directly.*]
- 1.3.◆ [*Not enough visual cue who will read the comments*].

1.1. [*Public perceives the websites as the direct communication channel to President*]. From the users submission, most submission is written for the President of Republic of Indonesia, Users just neglect the description that has been provided.

- 1.1.1. [*Public has perception that the President's team read the comments*]
- 1.1.2. [*Conventional communication channel is too complex and slow.*]

1.1.2. [*Conventional communication channel is too complex and slow*]. Public in Indonesia find the bureaucracy in Indonesia cannot convey critiques and message directly to President in an efficient way. President had actually already provided with the special SMS number that can be used by public to send the critique. However, the length of message is the big obstacle for using SMS.

1.1.1. [*Public has perception that the President's team read the comments*]. Public finds that the President and his team read the comment submitted in the web sites.

- 1.1.1.1. [*President does some actions related to the comment submitted to the website*]

1.1.1.1. [*President does some actions related to the comment submitted to the website*]. President performs some action, that answers some comment submitted by users in the web site.

1.2. [*People really needs a communication channel to President directly*]. Public in Indonesia due to the history of government in Indonesia really wants direct access to president.

- 1.2.1. [*Current social and political situation in Indonesia*]
- 1.2.2. [*Face to face communication cannot as open as the written communication*]
- 1.2.3. [*Can be relatively anonymous*]

1.2.1. [*Current social and political situation in Indonesia*]. Public in Indonesia now want more direct communication with government officers. Formerly it is very difficult to be done, but not it changes,

1.2.2. [*Face to face communication cannot as open as the written communication*]. Due to the Indonesian culture, most Indonesian cannot have a direct and open communication in the face to face meeting, Therefore, a written communication can yield more direct and open message to be conveyed.

1.2.3. [*Can be relatively anonymous*]. Many people who want to submit the critique or to report the problem in government bodies, prefer to stay anonymous. For the public, Internet provide this anonymity in Indonesia [Lim, 2003].

1.3.◆ [*Not enough visual cue who will read the comments*]

- 1.3.1.◆ [*The visual appearances did not emphasize who receive the comments*]
- 1.3.2.◆ [*There is no sufficient description, who will read the comments*]

1.3.1.◆ [*The visual appearances did not emphasize who receive the comments*].

1.3.2.◆ [*There is no sufficient description, who will read the comments*]

The designed system cannot sustain, because what the designer design is different with what the user perception of this facility. The user feedback facility as request by stakeholders was designed for submitting user comment for the maintainer of President web site not for the President himself. However, as shown in top node 1. [*Visitors leave message for President instead of for editors of web sites*]. visitors still submit user comments for President.

Before I enforce a particular design decision to reflect the initial design decision, I investigated this problem by drawing the LWBG. From the LWBG, the users performs this action also shows different perception between users and designers, as shown in node 1.1. [*Public perceives the websites as the direct communication channel to President*]. This perception exists because of :

- 1.1.1. [*Public has perception that the President's team read the comments*]. 1.1.1.1. *President does some actions related to the comment submitted to the website.* It contributes the positive quality
- 1.1.2. [*Conventional communication channel is too complex and slow*]. Public find difficulty to send the comment to the government bodies. It is due to the inefficient work of bureaucracy in Indonesia. Therefore, most people do not prefer the written ways to convey message to the government officers.

This mismatch situation is also due to the situation as shown by node 1.2. [*People really needs a communication channel to President directly*]. This high demand of direct communication is not only due to 1.1.2. [*Conventional communication channel is too complex and slow*], but also caused by *:*

- 1.2.1. [*Current social and political situation in Indonesia*]. Public in Indonesia now wants more direct communication with government officers. Formerly it is very difficult to be done, but not it changes,

- 1.2.2. [*Face to face communication cannot as open as the written communication*]. Due to the Indonesian culture, most Indonesian cannot have a direct and open communication in the face to face meeting, Therefore, a written communication can yield more direct and open message to be conveyed.

- 1.2.3. [*Can be relatively anonymous*]. Many people who want to submit the critique or to report the problem in government bodies, prefer to stay anonymous. For the public, Internet provide this anonymity in Indonesia.

User can also has a unmatched perception duet to lack of visual cue of the web design. It makes user do not aware about to whom this comment will be submitted. It is shown in node 1.3.◆ [*Not enough visual cue who will read the comments*]. This lack of visual consequence

- 1.3.1.◆ [*The visual appearances did not emphasize whom receive the comments*].

- 1.3.2.◆ [*There is no sufficient description, who will read the comments*].

By considering the basic requirement, I did not stick with the initial design but decide to follow what the users think. The comment is received and published in the web site. Because the users perception yield positive acceptance of the web site a whole, and it make the system sustains for the future.

9.9.2 Example: Case-2 Sustainability

The second example is the Case-2, in this case the developed system that cannot sustain, due to the change in the environment of system, for example users, and technology trend. To tackle this Case-2 sustainability problem, these following steps can be performed :

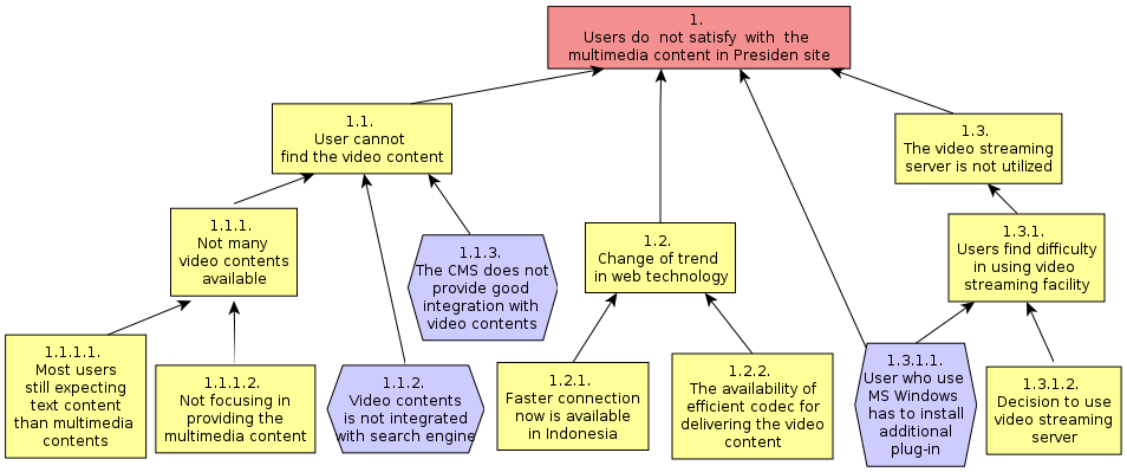


Figure 9.15: LWBG : The new requirement of video content

1. As the top node of LWBG, is the situation in which at the beginning of system was not a problem (had a good acceptance) but now it is not good accepted this situation is denoted as $E_{t_0} \neq E_{t_n}$

2. Find the necessary causal factors of this top node until the terminal nodes.

3. Identify the nodes to find, which node that can be changed in order to inhibit the top node.

As an example I show a LWBG in Fig. 9.15 which is taken from the President web site,

Basically, the steps in performing the Sustainability, Case-2, is similar with Requirement Elicitation and Analysis.

Description of LWBG : New requirement of video content

1. [*User do not satisfy with the multimedia content in President site*]. Users and stakeholders have requested more multimedia contest in the President web sites. They found the President Web site does not have many multimedia contents

- 1.1. [*User cannot find the video content*]
- 1.2. [*Change of trend in web technology*]]

- 1.3. [*The video streaming server is not utilized*]

1.1. [*User cannot find the video content*]. Users try to find the video content but they could not find it.

- 1.1.1. [*Not many video contents available*]
- 1.1.2. [*Video contents is not integrated with search engine*]
- 1.1.3. ◆ [*The CMS does not provide good integration with video contents*]

1.1.2. ◆ [*Video contents is not integrated with search engine*]. The video content is still provided as the separate services, because at the design phase, I predicted there was not many demand for the video contents. Users cannot search the video contents using the search engine, therefore they cannot find the video easily

1.1.3. [*The CMS does not provide good integration with video contents*]. The video content in Helix server was still not integrated with the main Content Management System. Because at the first year, the real demands of video content is still low.

1.1.1. [*Not many video contents available*] Due to the little demands of the video contents, the video content in President web sites has not been available

- 1.1.1.1. [*Most users are still expecting text content than multimedia contents*]
- 1.1.1.2. [*Not focusing in providing the multimedia content*]

1.1.1.1. [*Most users still expect text content than multimedia contents*]. Users who access the web site still need many textual data, such as the press release, or the photos.

1.1.1.2. [*Not focusing in providing the multimedia content*]. From the beginning of design, I did not focus on multimedia content, because the main goal, is to provide the information of President's activities as soon as possible, and also prevent the misquote

1.2. [*Change of trend in web technology*]

- 1.2.1. [*Faster connections now is available in Indonesia*]

1.2.1. [*Faster connections now is available in Indonesia*]. Now in Indonesia, many users access Internet using ADSL as well as the 3G connection via mobile devices. The availability of hot-spots in various places make users in Indonesia have better connections to the Internet. Thus, users now expect to access more video contents than 2 years ago.

1.2.2. [*The availability of efficient codec for delivering video content*]. Due to the popularity of the video sharing sites such as Youtube [`http://www.youtube.com`], Vimeo [`http://www.vimeo.com`], that uses Flash technology. Now it is possible for user with MS Windows or Linux to use the video streaming facility without installing extra plug-in.

- 1.2.2. [*The availability of efficient codec for delivering video content*]

1.3. [*The video streaming server is not utilized*]. From the log file, it can be evaluated that the video streaming server was not utilized by users.

- 1.3.1. [*Users have difficulty in using video streaming facility*]

1.3.1. [*Users have difficulty in using video streaming facility*], The video streaming server that was used require some complexity in user side to use it.

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]
- 1.3.1.2. [*Decision to use video streaming server*]

1.3.1.1.◆ [*User who use MS Windows has to install additional plug-in*].

1.3.1.2. [*Decision to use video streaming server*]

During the first 2 years operation, there was not many user demands for the multimedia contents such as audio and video streaming. Therefore, the problem shown by node 1.1. [*User cannot find the video content*] was not significant to the Quality of Services. The users acceptance did not influence by this deficiency. This deficiency is caused by:

- 1.1.1. [*Not many video contents available*]. Due to the little demands of the video contents, the video content in President web sites has not been available
- 1.1.2. [*Video contents is not integrated with search engine*]. Users cannot search the video contents using the search engine, therefore they cannot find the video easily
- 1.1.3.◆ [*The CMS does not provide good integration with video contents*]. The video content in Helix server was still not integrated with the main Content Management System. Because at the first year, the real demands of video content is still low.

However, due to the new trend in the web usage in Indonesia as shown by node 1.2. [*Change of trend in web technology*], the situation change drastically. It is caused by :

- 1.2.1. [*Faster connections now is available in Indonesia*]. Now in Indonesia, many users access Internet using ADSL as well as the 3G connection via mobile devices. The availability of hot-spots in various places make users in Indonesia have better connections to the Internet. Thus, user now expect to access more video contents than 2 years ago.
- 1.2.2. [*The availability of efficient codec for delivering video content*]. Due to the popularity of the video sharing sites such as Youtube [`http://www.youtube.com`], Vimeo [`http://www.vimeo.com`], that uses Flash technology. Now it is possible for user with MS Windows to use the video streaming facility without installing extra plug-in.

Now, users in Indonesia show more demands to video contents. Initially the system provides video streaming via the Helix streaming server [`http://helix-server.helixcommunity.org/`] an open source streaming platform. However, to use this facility as shown by node 1.3. [*The video streaming server is not utilized*]. The utilization is low because 1.3.1. [*Users have difficulty in using video streaming facility*]

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]. After stopping support to real media coded, users who use MS Windows have to install

- 1.3.1.2. [*Decision to use video streaming server*]

Improvement as suggested by LWBA:

After performing the LWBA, the video content will be provided using different implementation. The decision based on the countermeasure that can be provided by system in order to avoid the node 1. [*User do not satisfy with the multimedia content in President site*].

- 1.1.2.◆ [*Video contents is not integrated with search engine*]. The new video facility should be integrated with the search engine. It means if users search using the search engine can found the video content.

- 1.1.3.◆ [*The CMS does not provide good integration with video contents*]. The content team should be able to upload the video content easily via the Content Management System. The video content will be converted, tagged, and integrated with the existing contents.

- 1.3.1.1.◆ [*User who uses MS Windows has to install additional plug-in*]. In the new facility, uses do not require to install extra plug-in. Based on the log analysis in existing system, I not that most users have MS Windows with the Flash plug-in. Thus, using this approach, users do not require to install extra plug-in.

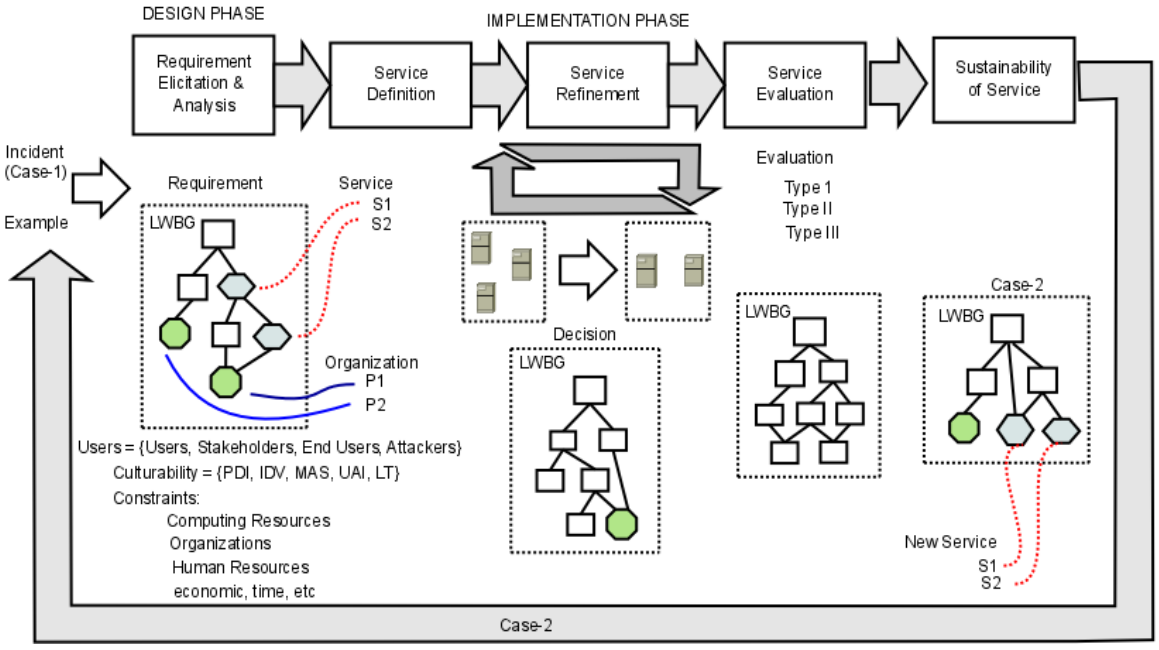


Figure 9.16: Integrated view of BBSDM

9.10 Integrated view of BBSDM

To summary how the BBSDM is performed, I provide an integrated view of BBSDM in Fig. 9.16. The LWBA with LWBG as visualization are extensively used in various steps of BBSDM. I decide not to employ many different notations and visualizations. The goals of this system development method is that can be used easily for various people with different backgrounds. A simple notation is always accepted than a complex and various notation.

Following description is a summary of how the BBSDM is performed :

- Requirement elicitation and analysis:
  - Finding the bad examples E_n

$$E = \{E_0, E_1, ..., E_n\}$$

  - or Incidents I_n such as in Sustainability Case-1 :

$$I = \{I_0, I_1, ..., I_m\}$$

- For each E or I the LWBG, find the causal factor, and identify which can be changed as countermeasures and which require longer time, i.e. policy or organizational change.
- To perform this analysis, the Culture Index from Hofstede is used as guideline to understand the constraint in a non judgmental fashion. Other constraints such as economic, politic, and human resource are also investigated. $LWBG_E$ is the LWBG of an Examples, N is a node in LWBG, M is a node that can be changed quickly, P is a node that can be changed but requires longer time and depends on other parties

$$LWBG_{E_0} = \{N_0, N_1, ...N_n, M_0, M_1, ..., M_m, P_0, P_1, ..., P_k\}$$

- From $LWBG_E$ Service Specification S can be derived

$$S_0 = \{\sim M_0, \sim M_1, ..., \sim M_m\}$$

- To ensure the sustainability system the organizational strategy and policy change that are expected to be performed

$$C_0 = \{\sim P_0, \sim P_1...., \sim P_k\}$$

- Service refinement, for each decision M, in which the design cannot be implemented

$$LWBG_{\sim M_0} = \{\sim M_0, N_1, ...N_n, \}$$

- Service Evaluation is performed in different type of evaluations such as :
  - **Type I. Comparison to similar system**. Compare similar systems ($S_{similar}$) with developed system ($S_{developed}$) :

$$S_{similar} \prec S_{developed} \tag{9.8}$$

– **Type II. Comparison to the situation during absence of system**. Compare with the situation without the developed system ($S_{absence}$).

$$S_{absence} \prec S_{developed} \tag{9.9}$$

– **Type III. Comparison with the expected unsatisfying situation**. Compare with the "*absence of predicted unsatisfying situation*". The unsatisfying condition ($UF_{predicted}$) is the requirement that cannot be fulfilled by the system.

$$S_{developed} \rightarrow UF_{predicted} \tag{9.10}$$

$$Top =\sim (UF_{predicted}) \tag{9.11}$$

- Sustainability can be evaluated in two different cases. Each case generates new requirements.

  – **Case -1. Discrepancy of environment.** Difference of environment in design phase E_{design} and environment where the artifact is used E_{usage}.

  $$E_{design} \neq E_{usage}$$

  .

  – **Case 2 - Change of environment**. Different environment in the initial usage, E_{t_0} and at some point of time in the future E_{t_n}.

  $$E_{t_0} \neq E_{t_n}$$

9.11 Summary

It has been described in this Chapter, the comparison between the proposed system development method, namely Bandung Bondowoso System Development Method

(BBSDM) with various system development method. This proposed system development method has similarities with Agile method as well as Open Source development method. The projects that employ this proposed development method are also evaluated.

The Lightweight Why Because Analysis is used in this development method in the entire development life cycle. It also has been described the step by step as well as examples in each phase of this proposed system development method. In this work, LWBA has also been used used to capture the good practice and develop a novel system development method based on the real experience.

The make use LWBA in the proposed system development method enable the specification of the system as well as the organizational and learning policy.

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Chapter 10

Conclusion

Sustainable development is a development that meets the needs of present generation while not compromising the ability of future generations to also meet their needs. It is defined two cases of sustainability problems. The Case-1 is due to discrepancy of the designer and users environment, and the Case-2 is caused by the change of environment of system. Users and cultural aspects play important roles in influencing the sustainability of system. Beside the parameters of system design, the boundary of system is also determined differently by different users. Different groups of users response differently to the same systems. Therefore, understanding the cultural consequence contributes to better sustainable system design.

To analyze the technical and non technical aspects in a system development, a semi-formal analytical method is introduced. The **Lightweight Why-Because Analysis** (**LWBA**) is used to understand the sustainable system and also to develop a sustainable system. This semi-formal analytical method investigates and finds the constrains of system. The analysis is performed by identifying the causal factor. The constrains identifications is performed in a non judgmental way. It identifies aspects that can be changed by developers, or which aspects that requires an organization efforts to change them. The cultural approach, such as make use of Hofstede index can be used as guideline for understanding the cultural consequence of actions and constraints.

A sustainable system attempts to maintain the Quality of Service (QoS) delivered by system. A service is defined as meaningful set of capabilities provided by an

existing or intended set of system to all who utilize it: subscribers, end users, network providers, and service providers – each seeing a different perspective of service. Quality is the totality of features and characteristics of a product or a service that bears on its ability to satisfy the given need. The definition of the parameter of QoS is determined by in which level of QoS domain. This level is defined with respect to design approach used in each level. It is described in level model of Quality of Services. Those levels are: QoS in infrastructure, QoS in network level, Software quality as QoS, Usability as QoS, Culturability, Acceptability and Actability. Each level has their own technologies as well as different parameters and evaluation methods.

The Case-1 of sustainability is due to discrepancy between the environment model in the design process and the real environment. To handle the Case-1 of sustainability system. software should be designed and customized according to the user and the context. Localization as an attempt to provide the software according to local users is the first steps to this direction. The development method itself is also influenced by users and its cultural factors. Even for a simple work such as software localization, the system development method has to be suited to match with local requirements. It has also been addressed, the adjustment of the localization method by using LWBA. The evaluation method for localization is also sensitive to the culture of users. It has been addressed the indirect evaluation method in order to handle the users in Indonesia. The LWBA is also used to perform this indirect evaluation.

A particular situation, such as emergency situation requires a specific development method. The development method itself can be used without predefining it. The development method evolves due to the flexibility of the method in order to achieve the goal. Basically, the development method is performed to ensure the sustainability of system. The Air Putih work during the tsunami relief action, that successfully provided the Internet infrastructure in Aceh, is a special type of work that requires special system development method.

I also address how to extract the successful but unknown method, by interviewing and involving actively. It is performed by utilizing the communication via Internet as well as collaboration. It also shown that Internet can be used as a research tool in a

novel way. Furthermore, the LWBG is used to extract the result of this ethnography study and to understand the nature of projects, as well as to derive the good practice and the system development of Air Putih. LWBA is also used to identify to formalize the new system development methods based on the experience in Air Putih works. This new development model has many similarities with Agile method and Open Source Development method. The requirements of new developed model are also derived using LWBA from the evolution of the good practices of real development.

Ignoring end users and their interactions in designing system can cost people life. I have elaborated how the discrepancy of environment between designers and users as known as Case-1, can yields an incident. This is known as Early Warning Incident in Indonesia. How the development is triggered by an Case-1 sustainability, i.e, is described in the Early Warning Information System (EWIS) project. From the incident the requirement and the design specification are derived by the make use of LWBA that is notated in LWBG.

In the real project, such as EWIS not all designs can be implemented, some adjustment and compromises should be made. It is defined as Service Refinement phase. To perform the refinement and to track the change as well as to consider the risk of change. LWBA is employed to investigate the limitations and risks. In this investigation, I consider technical as well as non technical aspects. The LWBA as extension of WBA is a suitable method to identify the non technical aspects, such as regulation, and organization. Using the LWBA, It can also be identified the learning process that should be embedded in the development process.

The flexibility is one of the key factors in this proposed method. The use of Component of The Shelf (COTS) system which can be customized freely provides a significant benefit in the implementation of proposed method. The use of availability of source code as in Open Source COTS enables developers to customize it beyond the component level. It is a positive contribution to the sustainable of system.

As one of the proof of the proposed method, the development and operation a critical web sites, namely the web site of President of Republic of Indonesia is addressed. This system should fulfill the performance, security, reliability as well

as the usability. The development is commenced by performing the requirement elicitation and analysis based on the bad examples. Then, the requirements are derived by using LWBA. After identifying the requirements, the service specification as well as the organizational change and learning can also be specified. To solve the requirement conflict the LWBA is also applied. It has been demonstrated how in the implementation decision LWBA is used to choose the type or platform and also model of web applications. The president web site was developed by utilizing Open Source Software. This decision is based on the LWBA and by contrasting with the goal, i.e. efficient in budget, security and sustainability.

The sustainability of service analysis is an important to ensure the sustainability of entire system. It can be performed by using LWBA in both case, Case-1, and Case-2. Int is also demonstrated the sustainability problem due to the different perception between designers and users (Case-1). The new requirement due to the change of technology trend is also described. This sustainability problem is categorized as Case-2. By employing LWBA it is also demonstrated how to identify the problems, and how to adjust the developed system in order to ensure the sustainability. Indirect measurement is also introduced and it can be applied by utilizing LWBA.

The development of President web site also demonstrated that participation of stakeholders should take place throughout the strategy and planning process in defining problems, setting vision, developing solution. Employing development methods which have their origin in the socio-technicals such as co-operative, collaborative, participatory or participative design, can accommodate better the user requirement. Equipped with better analytical tool such as LWBA, not only the technical improvement or decision that can be concluded, but also the non technical, such as organizational changing or learning actions.

An evaluation is important in ensuring the sustainability of system. The LWBA can also be used for comparing and evaluation the proposed method. The evaluation can be performed in three different evaluation (a) Type I. Comparison to similar system, (b) Type II. Comparison to the situation during absence of system, (c) Type III. Comparison with the expected unsatisfying situation. Availability of source code

also influence the sustainability of system. It has been shown in various comparison in this work, that the availability of source can produce better sustainability of system.

Particular type of project which widely known in Indonesia called Bandung Bondowoso Project is described in this work. It has following characteristics :

- The development project is performed in very short time (1 - 3 months). The decision of this short time of project is not due to the business profit but from other consideration such as the emergency situation or political consideration.
- The budget is limited. This budget limitation is also not due to profit consideration.
- The human resource cannot be selected freely. The available of human resource is also limited.
- The motivation of developers is high and parties involved in the development process are social co-operative. But the environment sometimes is hostile environment.
- The project have big expectation and the project has to be success in the stakeholders point of view.
- There is no fixed definition or business process specification before the project begin.
- The organization that develops the system has not been well defined or appointed.
- Not all involved parties are bounded by official contract. Enforcement a legal contract is difficult.
- Sometimes, the project can be rendered useless because of some non technical factors. There is always a threat to fail the projects, technical or non technical threat.

A novel system development method is formalized from the real projects during this research. The proposed development method, namely **Bandung Bondowoso System Development Method** (**BBSDM**), has characteristics similar with Agile or Open Source method, but with different approaches and assumptions. The proposed method is started requirement elicitation and analysis, service specification, service refinement and service evaluation as well as the sustainability analysis.

This thesis attempts to provide a proof through the real experiments with the real results. The system such as localization, EWIS, Internet infrastructure and also President Web site still sustain in operation until now, even though they are developed with the extreme limitations and constraints.

This work is a form of participatory action research that has produced a real impacts to public. Action researches makes it possible for the researchers to apply theories in practice in realistic work situation and make a change in that situation. The LWBA is used as various tools in this research work. It is also used as the new analytical tool to perform the ethnography studies via Internet. Moreover, it is also used as the development tools during the proposed development method and also as the communication and explanation tool during the development.

Being used as tool for performing the participatory action research and the development tool, Internet is also employed for for publishing activities during the research. Understanding how to reduce this knowledge gap between users and designers/researchers contributes a significant role the development a good system. The organizational change and learning process cannot be separated from the system development methodology. The communication of the design to the stakeholders is also important as well as the indirect measurement in public of the real system.

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