THESIS

EMERGENCY INFORMATION SYSTEM OF IDP (INTERNALLY DISPLACED PERSONS) NEEDS USING SMS GATEWAY FOR FLOOD DISASTER EMERGENCY RESPONSE IN SUKOHARJO REGENCY, CENTRAL JAVA PROVINCE

Thesis submitted to the Double Degree M.Sc. Programme, Universitas Gadjah Mada and Faculty of Geo-Information Science and Earth Observation, University of Twente in partial fulfillment of the requirement for the degree of Master of Science in Geo-Information for Spatial Planning and Risk Management

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THE GRADUATE SCHOOL
UNIVERSITAS GADJAH MADA
FACULTY OF GEO-INFORMATION AND EARTH OBSERVATION
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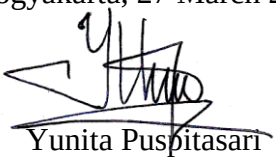
I certify that although I may have conferred with others in preparing for this assignment, and drawn upon a range of sources cited in this work, the content of this thesis report is my original work.

Yogyakarta, 27 March 2013



Yunita Puspitasari

Abstract

On flood disaster response phase, one of important activity to be done is fulfilling IDP (Internally Displaced Persons) needs. It needs support of correct data on short time that can be accessed by many institutions. Sukoharjo regency is one of regencies in Java Island passed by Bengawan Solo river experiencing annual flood. Needs fulfillment for flood victims in this area is currently done by receiving IDP data from phone call and using manual calculation. This research aims to improve information exchange during disaster response phase by utilizing SMS and automatic needs calculation to determine IDP needs in real time. This research discusses more about the use of SMS gateway and RDBMS to do real time needs estimation. It also focuses on using OGC standard maps on Emergency Information System (EIS) so that maps can be used by many parties. This research uses interview and literature review to understand real condition of IDP needs fulfillment. Researcher conducts user need assessment to know user requirements for proposed EIS prototype. This research involves local government agencies which are BPBD, Dinas Sosial, PMI, and SAR. Moreover, formats of predefined SMS are designed to allow system recognizes input data from SMS. Formula for need conversion is formulated from government regulations and actual needs of flood victims. On development process, SMS gateway application used is Gammu. Maps applied in EIS use OGC standards which are WMS and GML. Database servers utilized are MySQL for system database and PostgreSQL/ PostGIS for storing dynamic spatial data. Evaluation done is divided into user and system evaluation. User evaluation shows that in general users are satisfied with web appearance and functionalities. Meanwhile, system evaluation indicates that the use of Geoserver to produce WMS map has limitations especially in manual scripting. Furthermore, the use of dual database servers is not efficient in term of database management, system building, and content updating. Finally, the use of EIS prototype shows that real time calculation for IDP needs can be done in real time utilizing SMS gateway and RDBMS. The implementation of OGC standard maps helps various parties to use the maps without making further adjustments.

Key word: IDP needs fulfillment, SMS gateway, RDBMS, OGC standard, EIS

Intisari

Pada fase tanggap darurat, salah satu kegiatan yang sangat penting dilakukan segera adalah pemenuhan kebutuhan pengungsi. Kegiatan ini membutuhkan dukungan data yang tepat yang diperoleh secara cepat dan dapat diakses oleh semua pihak. Kabupaten Sukoharjo adalah salah satu kabupaten yang dilalui oleh sungai Bengawan Solo dan mengalami banjir tahunan. Pemenuhan kebutuhan pengungsi banjir di Sukoharjo dilakukan dengan menerima data melalui telepon dan perhitungan secara manual. Penelitian ini bertujuan untuk memperbaiki pertukaran informasi saat tanggap darurat dengan menggunakan SMS dan kalkulasi secara otomatis untuk menghasilkan kebutuhan pengungsi secara real time. Penelitian ini membahas mengenai penggunaan SMS gateway dan RDBMS untuk melakukan estimasi kebutuhan secara real time. Penelitian ini juga memfokuskan pada pemakaian peta berstandar OGC pada Sistem Informasi Darurat (EIS) sehingga peta-peta tersebut dapat digunakan oleh siapa saja. Wawancara dan studi literatur dilakukan untuk mengetahui bagaimana pemenuhan kebutuhan pengungsi dilakukan di lapangan. Peneliti melakukan penilaian kebutuhan pengguna untuk mengetahui kebutuhan pengguna terhadap prototipe EIS. Kegiatan ini melibatkan BPBD, Dinas Sosial, PMI dan SAR. Selanjutnya, format SMS dirancang untuk memudahkan sistem membaca data dari SMS yang diterima. Formula untuk konversi kebutuhan diformulasikan berdasarkan peraturan pemerintah dan kebutuhan aktual pengungsi banjir. Pada pengembangan sistem, aplikasi SMS gateway yang dipakai adalah Gammu dan standar OGC yang digunakan adalah WMS dan GML. Server database yang digunakan adalah MySQL untuk database sistem dan PostgreSQL/PostGIS untuk menyimpan data spasial yang bersifat dinamis. Evaluasi yang dilakukan adalah evaluasi pengguna dan sistem. Evaluasi pengguna menunjukkan hasil bahwa pengguna rata-rata puas dengan tampilan dan fungsionalitas web. Sementara evaluasi sistem menyatakan bahwa penggunaan Geoserver untuk memproduksi peta WMS memiliki keterbatasan terutama dalam penulisan script secara manual. Lebih jauh, penggunaan dua server database tidak efisien untuk manajemen database, pengembangan sistem, dan update data. Kesimpulannya, penggunaan prototipe EIS menunjukkan bahwa perhitungan kebutuhan pengungsi secara real time dapat dilakukan dengan memanfaatkan SMS gateway dan RDBMS. Implementasi peta berstandar OGC juga membantu berbagai pihak untuk menggunakan peta yang ada di web tanpa harus melakukan penyesuaian terlebih dahulu.

Kata kunci: pemenuhan kebutuhan pengungsi, SMS gateway, RDBMS, standar OGC, EIS

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Yunita Puspitasari

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Acronyms

BNPB	:	Badan Nasional Penanggulangan Bencana *(Indonesian National Board For Disaster Management)*
BPBD	:	Badan Penanggulangan Bencana Daerah *(Local Coordination Board for Disaster Management)*
BPDAS	:	Balai Pengelolaan Daerah Aliran Sungai *(Watershed Management Agency, a technical unit underMinistry of Forestry)*
BPS	:	Badan Pusat Statistik *(Statistics Indonesia)*
Bupati	:	Regent
Dinas Sosial	:	Department of Social
EIS	:	Emergency Information System
GIS	:	Geographic Information System
GML	:	Geography Markup Language
GPS	:	Global Positioning System
IDP	:	Internally Displaced Persons
PMI	:	Palang Merah Indonesia *(Indonesia Red Cross)*
Kementerian PU	:	Kementerian Pekerjaan Umum *(Ministry of Public Works)*
KML	:	Keyhole Markup Language
OGC	:	Open Geospatial Consortium
RAPI	:	Radio Antar Penduduk Indonesia *(Indonesian Citizens Radio)*
RDBMS	:	Relational DataBase Management System
SAR	:	Search and Rescue
SMS	:	Short Message Service
WMS	:	Web Map Service
XML	:	Extensible Markup Language

1. Introduction

1.1 Background

Response phase is a part of disaster management cycle (Asian Disaster Reduction Center, 2005). Response phase is all activities performed at the time of disaster or in emergency situation to evacuate the victims, reduce the suffering of the victims and minimize material losses in order to support the victims return to their normal lifestyle. UNISDR (2009) defined that on response phase, which is during or immediately after a disaster event, one of supporting activities for the survivors is to fulfill their basic subsistence needs. Basic needs including clean water and sanitation, food, clothing, health services, psychosocial services and evacuation shelter.

Response phase involves emergency services and public assistance. Emergency services engage certain agencies which have their own specific responsibilities to rescue and support people in emergency situations (UNISDR, 2009). The success of emergency response implementation is endorsed by many factors including information from disaster site. Information about disaster and its impacts, victims, and emergency aids is crucial for quick action and better response.

As one of important factors on emergency response, information about disaster must be disseminated rapidly from disaster location to surrounding areas or to government or other rescue organizations. There are various equipments as a means for distribution of information during emergency response such as *kentongan*, handy talkie, and mobile phone. For instance, on flood disaster management on Code River at Yogyakarta, communities along Code River use Handy Talkie as a tool for distributing information of water level rise on upper stream so that people on downstream areas can prepare themselves for evacuation.

The using of mobile phone also has been ubiquitous in many disasters. Agencies and many stakeholders share information during disaster event using both phone calls and SMS (Short Message Service). This method has the advantage of delivering information in short time. Coyle & Childs (2005) conducted research on several countries about the impact of mobile phones for communication on some types of disasters. They described that the use of mobile phone in disaster cycle is vary among different stages. As shown on Figure 1, during disaster impact and immediate aftermath phases require high intensity of communication.

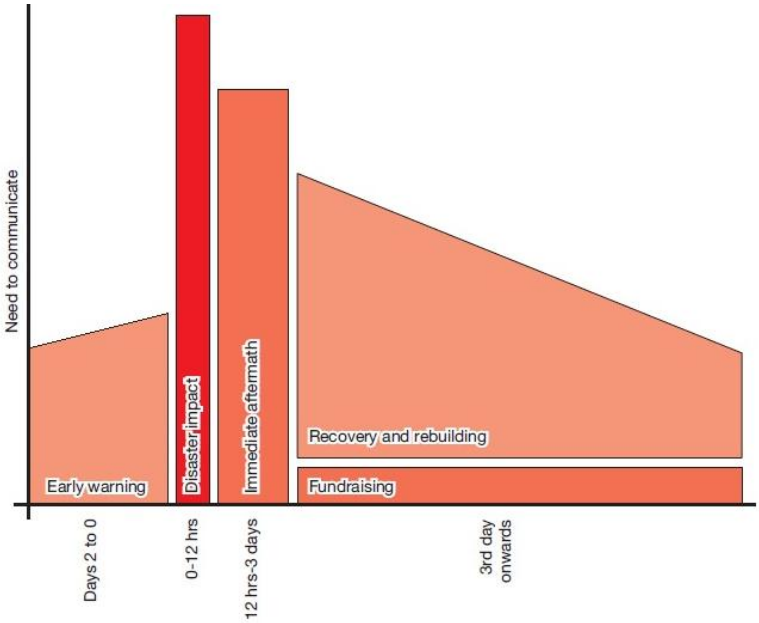

Figure 1. Communication needs at different phases of a disaster (source: Coyle et.al, 2005)

Table 1. Meeting communication needs at each stage of a disaster

Timeline	Early Warning	Disaster Impact	Immediate aftermath	Recovery
Communications needs				
	Broadcast to as many vulnerable people as possible; timely, one-way information	Emergency response – emphasis on live-saving; intra-operable, resilient emergency communications. Public demand for news of friends/family	Person-to-person contact, for swift exchange of news and developments; rapid recovery of 2-way communications amongst those affected and family, friends	Information exchange and coordination; dispersed 2-way communication for as many of those affected as possible
Best forms of communications				
	Many, to maximise reach, broadcast technologies, maybe supplemented by web backing up prior public information campaigns	Satellite most resilient, short term, if emergency services have access to it. All forms of communications available to public likely to be impaired	Mobile, as network recovers (especially for developing countries). Satellite for relief workers, if available	Mobile (especially for developing countries)
Distinctive mobile contribution?				
	NO: One amongst many	OFTEN: Inter-operable for use by different emergency services (although may be damaged in many circumstances). Congestion management required to balance competing requirements: SMS more effective	YES: Widespread means of decentralised, 2-way communication. Network recovery often after 1-2 days even when damage sustained	YES: Widespread means of decentralised, 2-way communication of needs. Very important in developing countries with little fixed-line alternative.

Source: (Coyle et.al, 2005)

Coyle & Childs also summarised the role of mobile phones for communication needs at each disaster stage and how they make the distinctive contribution, as presented in Table 1. It shows how mobiles have vital role for communication on disaster supported by its speed relative to other means of communication. On emergency situations, mobile phones support affected people, aid agencies and government institutions in sharing information rapidly and for receiving specific news for their necessities. Moreover, SMS is an effective way to send information to avoid network congestion in such chaotic situations. It is because text uses less bandwidth and can easily be queued. Text will be sent when there is free capacity of the network which therefore can reduce the congestion of the network.

Flood is the most occuring hazard in Indonesia among fifteen hazards in Indonesia, based on statistics from BNPB (2012). Flood causes damage and disruption on physical and socio economic aspects. It submerges houses, agricultural land, roads and bridges. Moreover, it disturbs school activities, disrupts trading activities and causes harvest failure. As recorded in BNPB, 2012b, on 1 January 2012, flood due to overflowing of Bengawan Solo River struck Sragen, Sukoharjo, Karanganyar and Klaten regencies in Central Java Province. It caused a bridge collapse, embankment breakdown and harvest failure caused by inundation on paddy fields. Further, it also submerged 1,459 houses and forced 2,800 people to evacuate.

In this research, victims of floods who evacuate to safer place are called IDP[1] (Internally Displaced Persons). IDPs are people who are constrained to move from their homes or area to other place but do not across national boundaries due to several reasons, one of which is natural or human-made disasters.

On evacuation, IDP needs basic needs such as food, clothing, and medicines quickly to support them soon after the strike of disaster. To provide the needs, government needs quick information about IDP's condition in order to distribute aids in short time.

There are many parties that may be involved in providing aid support for affected people including government agencies and other social organizations. Under emergency circumstances in Sukoharjo, BPBD acts as the main coordinator of other agencies. BPBD decides the amount and types of supplies to be distributed to shelter locations and coordinates with other institutions such as Dinas Sosial (Social Office) and PMI. To determine the aid support, BPBD receives information about IDPs' condition and their needs from each evacuation shelter via mobile calls or SMSs.

[1] http://www.unhcr.org/pages/49c3646c146.html

1.2 Research Problem

Flood disaster is annual problem in Sukoharjo district. It causes damage and disruption on physical and social aspects. Flood also causes many inhabitants to evacuate to safer places and stay there for several days. While staying on evacuation shelter, IDPs must be equipped with basic logistic supplies. It is important to help them survive and minimize the suffering condition.

Current process of fulfilling IDP needs at emergency phase in Sukoharjo for flood disaster has not been analysed yet previously. This research will study the current condition and propose new system to escalate fulfilling need process during emergency phase.

IDPs have to get sufficient aids for their needs in short time after they are in evacuations. Hence, quickly sending information from evacuation locations to government is important. Using the information, government can provide logistic and aids for each evacuation shelter based on IDP needs. Currently, the logistics for IDPs are defined by government officers manually. It can be more efficient if the calculation of IDP needs for each evacuation shelter is done automatically.

Another constrain on fulfilling IDP needs rapidly is coordination among logistic supplier agencies. Communication among agencies is done by using phone calls. BPBD contacts other agencies to prepare and distribute logistics that are not supplied by BPBD. At the same time, other agencies send their officers or volunteers to do IDP checking on flood location and deliver logistics by themselves.

BPBD and other agencies send officers to flood location to get data about IDP number and their needs. However, it takes times because usually transportation accesses are disrupted by inundation. Another way of sending IDP information is by using phone calls or Short Message Service (SMS) via mobile phone. It accommodates information dissemination in real time.

Information dissemination for quick response requires appropriate media. Internet network is one of the media that can present real time information which is accessible to the whole world. Moreover, website is a means from which data and information can be entered and disseminated through internet network.

The use of web portal for spreading information during and after disaster has limitation. Not all people (public and government sectors) can get access to the internet especially if they are at disaster site. Thus, the use of other media or device in spreading information should be considered. Nowadays, mostly people have their own mobile devices. Therefore, if they have mobile phones, they can send information through phone calls or Short Message Service (SMS). Data of IDP number can be sent through SMS from shelter location and be accepted by web

portal. Web system uses the data to calculate IDP needs. Further, information of IDP needs is displayed on web portal which can be accessed by anyone.

Information of IDP and their needs should be presented for each particular evacuation site. It will be beneficial for public or other organizations who want to get a map of evacuation sites if they are presented on a map which can be accessed and applied on many platforms. OGC (Open Geospatial Consortium) and ISO/TC 211 have set up standards that enable spatial data to be applied on various programs. The standards ensure data interoperability. It means that data in the website can be read and used by different systems and programs after it has been exchanged (IEEE & Engineers, 1991).

Finally, the research problem is how to improve information exchange during disaster response phase by utilizing SMS technology to receive IDP data and send information, calculating IDP needs, and displaying list of IDP needs on OGC standard maps for flood disaster management.

1.3 Research Objectives

The main objective of this research is to improve information exchange during disaster response phase by utilizing SMS and automatic needs calculation to determine IDP needs in real time. An Emergency Information System (EIS) is designed in order to studying the use of SMS gateway to receive data and send information and displaying IDP needs on OGC standard maps.

More specific objectives of this research are:

1. To understand the current system for communicating and fulfilling IDP needs.
2. To identify users of EIS and assess their needs.
3. To retrieve input data from evacuation sites using SMS gateway and estimate the types and the amount of IDP needs.
4. To display data of IDP needs on evacuation shelter map in EIS using OGC standards and to design EIS.
5. To evaluate the prototype of EIS.

1.4 Research Questions

To achieve the research objectives there are several questions that should be addressed. Research questions according to the objectives are presented on Table 2.

Table 2. Research Objectives and Research Questions

No	Research Objectives	Research Questions
1	To understand the current system for communicating and fulfilling IDP needs.	a. What process had been done to communicate and calculate IDP needs on previous flood events?

No	Research Objectives	Research Questions
		b. What are perceived deficiencies faced on the existing system?
2	To identify users of EIS and assess their needs.	a. Who are the users for the system? b. What are roles of each user? c. How would the users use the EIS? d. What are information needs of the users?
3	To receive input data from evacuation sites using SMS gateway and estimate the types and the amount of IDP needs.	a. Who are responsible to send information about IDP? b. What method is used to receive data of IDP structure using SMS gateway? c. What information is required to estimate the needs of IDP? d. What is the suitable method to do real time needs estimation using SMS gateway and Database Management System?
4	To display data of IDP needs on evacuation shelter map in EIS using OGC standards and to design EIS.	a. What method is used to display information of IDP needs on the EIS? b. What method is used to display shelter map using OGC standard on the system? c. What are components needed for EIS?
5	To evaluate the prototype of EIS.	a. What are user attitudes to the prototype of the emergency information system? b. What requirements of facilities and human resources are needed to run the system? c. What is the suitability of the selected tools to build the system?

1.5 Proposed Innovation

This research will develop web-based information system for providing information of IDP needs utilizing SMS gateway. Predefined SMS about IDP structure from each shelter location will be converted into IDP needs. Information of IDP needs will be displayed on top of OGC standard maps. Hence, the maps can be used by other agencies even though they use different system or program. Through this information system, BPBD as a leading institution on disaster management is expected to determine the amount and type of IDP needs rapidly and effectively.

1.6 Benefit of the Research

This research will provide an EIS that can calculate IDP needs on flood response phase. EIS will integrate various technologies: SMS gateway, RDBMS, and OGC standards, for real-time IDP needs calculation. SMS gateway will enable better communication between IDP and emergency agencies and OGC standards will

enable better communication between various agencies. Therefore, EIS is expected to lessen time for calculating needs and presenting initial report to the authority. Moreover, EIS also calculates the fulfillment of IDP needs from several sources of logistic stocks: BPBD, Dinas Sosial and PMI. By presenting logistic sources, communication and coordination among institutions for providing needs on emergency situation are expected to be more efficient.

Information about IDP needs which has been fulfilled and are still lacking can be accessed publicly. Therefore, donors who intend to donate aids could have overview of type and number of aids they can provide.

1.7 Research Limitations

This research is limited on flood hazard in Sukoharjo regency. The system will calculate needs for flood victims. It does not intend to do need calculation for other hazards, as characteristic of needs and the time length of evacuation for flood hazard is different from other hazards.

2. Literature Review

2.1 Disaster Management

Disaster management is continuous activities involving various organizations conducted to prevent the loss of lives, alleviate the suffering of victims, lessen loss and damage of property, provide information of risk, and accelerate recovery process on rehabilitation phase (Sudibyakto, 2011).

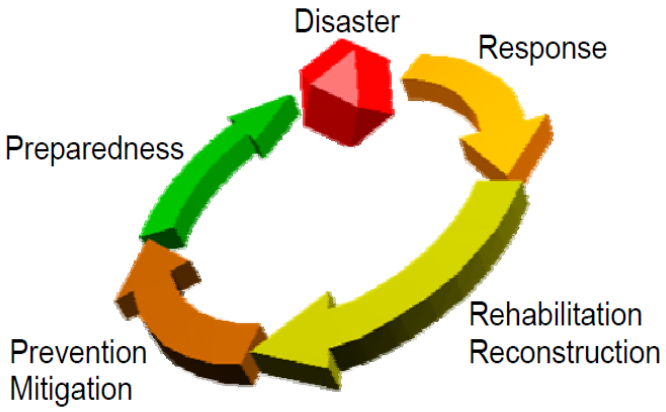

Figure 2. Disaster Risk Management cycle (Asian Disaster Reduction Center, 2005)

Figure 2 shows disaster management cycle which includes four stages: response, rehabilitation/reconstruction, prevention/mitigation, and preparedness. Each step was explained in (Asian Disaster Reduction Center, 2005) as following:

1. Prevention/Mitigation, efforts are made to prevent or mitigate damage (e.g. construction of dikes and dams against floods).
2. Preparedness, activities and measures for ensuring an effective response to the impact of hazards.
3. Response, activities as rescue efforts, first aid, fire fighting and evacuation.
4. Rehabilitation/Reconstruction, considerations of disaster risk reduction should form the foundations for all activities.

2.2 Flood Information System

Flood is excessive amount of water that inundate area which is normally dry land caused by overflow from water sources, mudflow, or collapse of land along water body ("Definitions," n.d.). Flooding is a serious threat because it can cause damage to infrastructure and livelihood and force people to move from their homes.

In order to minimize the impact of flood disaster, mitigation measures are carried as part of disaster management action. Mitigation measures conducted among others are building flood infrastructure, preparing early warning system, strengthening

community, and developing flood information systems. The latter has been created by many parties with their specific functions.

A flood information system developed by NOAH project integrating join partners from the Netherlands, Germany and Ireland is called FLIWAS - *FLood Information and WArning System* (de Gooijer et al., 2007) . FLIWAS is a web-based information system which consists of different independently usable modules that utilize historical data to generate prediction of flood occurrence.

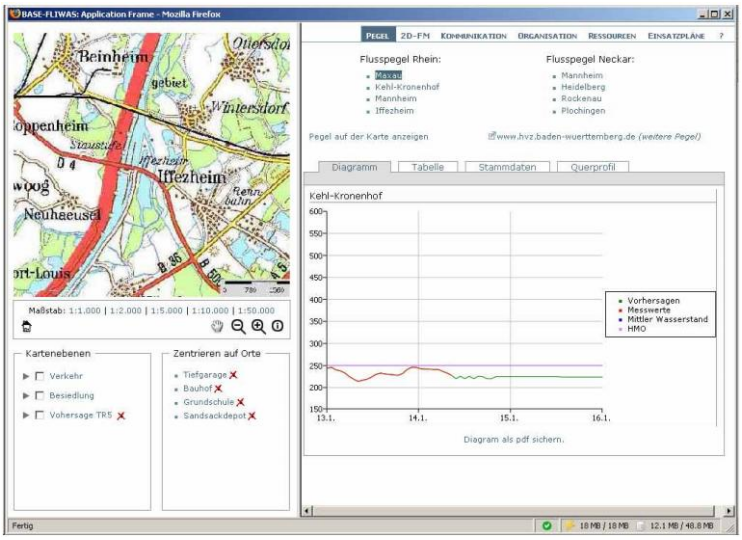

Figure 3. Monitoring measurements and forecasts of gauge Maxau (source: de Gooijer et al., 2007)

FLIWAS mainly devoted for water management professionals and decision takers on various level from local, regional to (trans) national level. Information provided by FLIWAS among others are prediction of the impact of potential flooding (available in information and maps format), measurements and forecasts moduls, maps with maximum water depth and waterfront, movies of expected flooding, and evaluation of occurred flooding. All information provided by FLIWAS can be accessed and manipulated via internet because they are managed using Geographic Information System (GIS) based application. An interface of FLIWAS showing measurement and forecast of gauge presented on Figure 3. Finally, FLIWAS provides accurate information so that decision makers can take the right decision to encounter the imminent flood event (de Gooijer et al., 2007 and de Gooijer et al., 2009).

Another web technology dedicated to provide information of flooding in Jakarta, capital of Indonesia, is called Dashboard BanjirOnline (Figure 4). This system was developed with collaboration between Jakarta Public Works and HKV consultants under project named Flood Control 2015. Dashboard BanjirOnline helps sharing information between agencies. Information such as water height level and rainfall can be accessed by data users. Data users acquire complete information and data from many organizations through user interface (Wagemaker et al., n.d.). Therefore,

the advantage of this Dashboard is transparency of accessible information for many parties at the earliest moment to forecast the imminent flood.

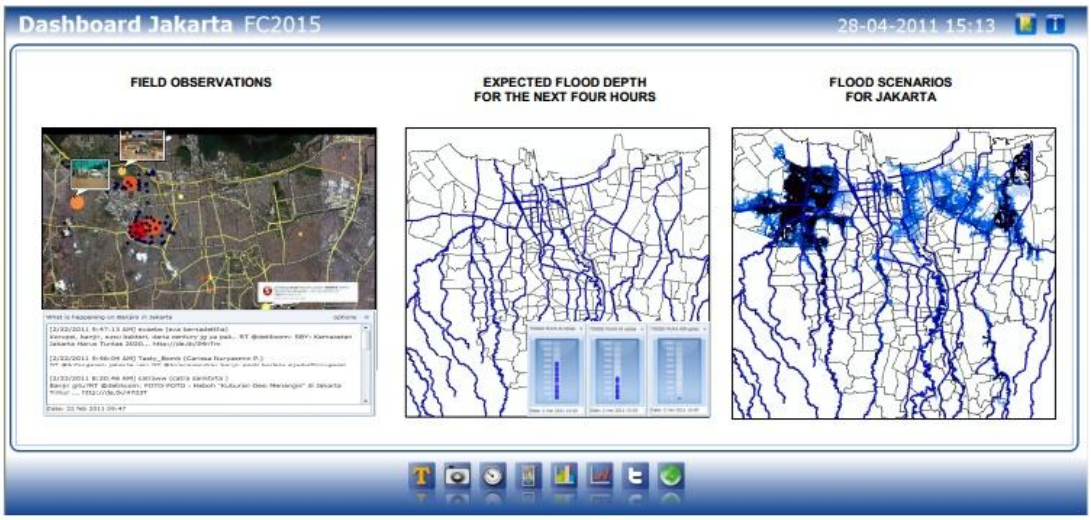

Figure 4. Screenshot of Dashboard BanjirOnline (source: Wagemaker et al., n.d.)

2.3 Emergency Information System (EIS)

Emergency information system is an information system providing real-time information that is intended for affected people, supporting government agencies and other emergency stakeholders to encounter disaster on emergency/response phase to support the right decision making (Atteih et al., n.d. and Jezierski, 2010). There are several terms of emergency information system such as Emergency Management Information System (Atteih et al., n.d.), Emergency Information System (Jezierski, 2010), and Dynamic Emergency Response Management Information System (Turoff et al., 2004).

One of emergency information system in Indonesia is a web map for after Merapi eruption disaster called Merapi Participation. The system was built utilizing Google Maps API as a base map and GoogleDocs (Spreadsheet) for collaborative document presentation, using Web 2.0 technology for community participation, and producing interchange GIS data (format GeoRSS/KML) for BNPB (National Agency for Disaster Management) use (Aditya et al., 2011).

Merapi Participation provides up-to-date information of camp location coordinates, structure of IDP (internally displaced people), IDP immediate needs, camps' facilities (health, infrastructure, education, security), and 3W (who does what where) mapping (Aditya et al., 2011). Information of IDP needs and IDP camps are supplied by volunteers working on the affected area by filling quantity and quality forms. This information can be accessed by many government institutions and national and international NGOs for further policy measures on Merapi eruption disaster response. Merapi Participation can be accessed in http://merapi-partisipasi.ugm.ac.id/.

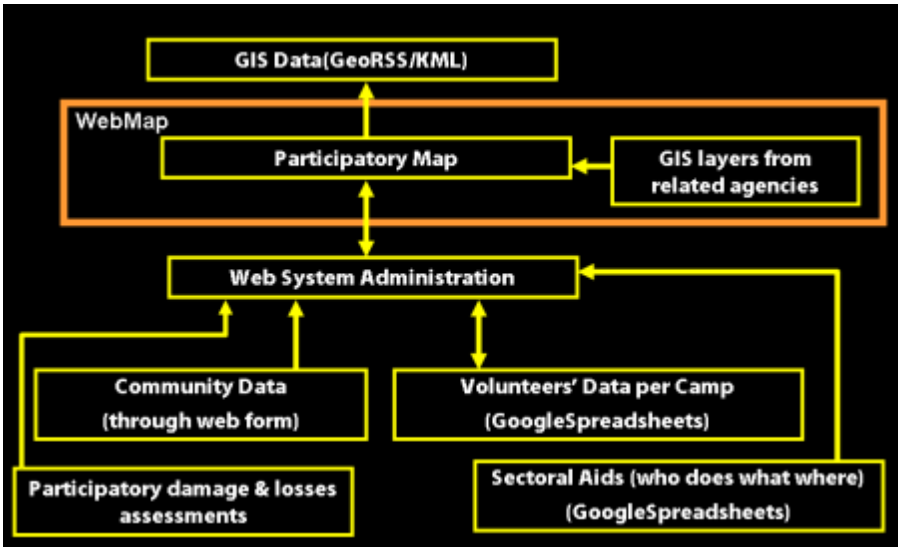

Figure 5. Design of Merapi Participation application (source: Aditya et.al, 2011)

One of options offered by Merapi Participation is interactive participatory mapping which facilitates community to input their knowledge of field condition in form of spatial annotation directly on the web map (Figure 5). Registered community members also can contribute on notifying damage and losses on their area. Mainly, there are three properties offered by Merapi Participation which are thematic layers mapping, Participatory monitoring on IDP camps, and Participatory damage and loss assessment. Thematic layers in the portal are derived from several government institutions and local and national agencies (Aditya et.al., 2011). Thematic layers on Merapi Participation are provided in KML format. KML is an XML language developed by Google for visually displaying map on internet. Since 2008, KML has been an open standard issued by OGC ("Keyhole Markup Language," 2013). Moreover, this EIS provides link for map downloading in pdf format.

In brief, Merapi Participation offers many useful features that support disaster management agencies to provide right decision for Merapi eruption disaster especially on disaster response and rehabilitation phases. However, data, both qualitative and quantitative, of IDP structure, IDP needs and IDP camps are collected manually by sending volunteers to evacuation sites. With respect to the length of coordination path, it would need time for collecting data on disaster location and entering data into web. Data collection and calculation of IDP needs will be more effective if they are done automatically by using SMS and system calculation. SMS sent by volunteers in evacuation sites can reduce the time required to report data.

2.4 Review of Components of Emergency Information System (EIS)

Web-based Information System (IS) in general emphasises on people, organizations, and strategies. The building of web-based information system uses multiview

perspective that employs iterative process. In the web IS development process, web developers learn the real conditions, build the web, discuss and gain feedback from practitioners, modify the web, and try the web IS again (Vidgen, 2002). Multiview framework (Figure 6) for web information system development methodology intends to accommodate present situation. Change agents and IS developers analyse the problem situation and create appropriate information system.

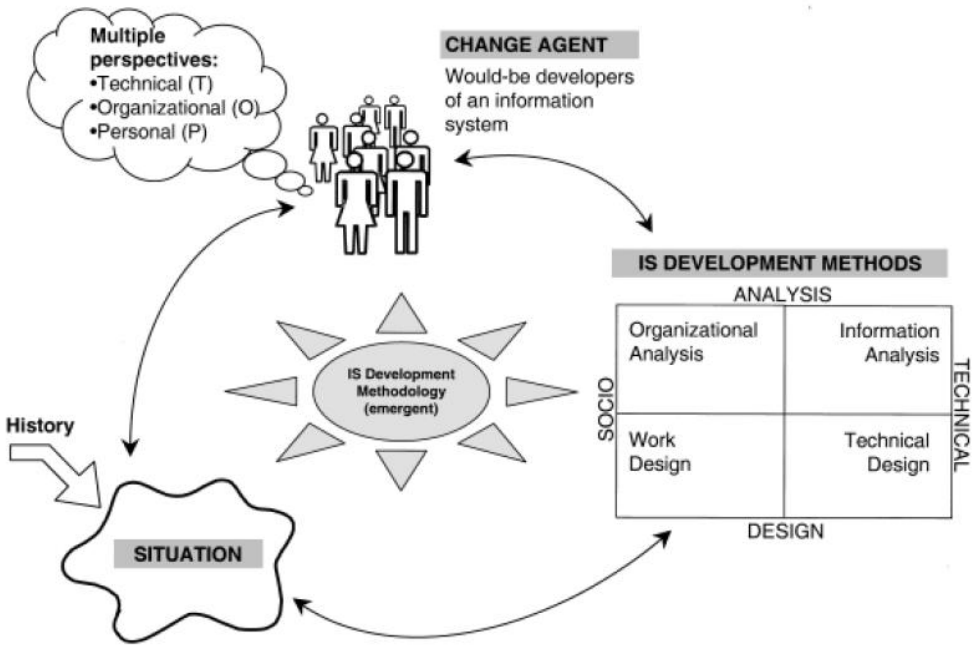

Figure 6. Multiview framework for web IS development methodology (Avison et al., 1998 in Vidgen, 2002)

Matrix of IS development methods on figure 6 consists of two methods differentiated in two dimensions: socio and technical, and analysis and design. Socio part gives a concern on organisations and individuals knowledge. Technical part concerns on technical aspect on building IS. Analysis part processes information to decide the requirement of the system. Lastly, design part is created to attain the goal of the IS development.

Emergency information system is built in order to provide specific information, for instance area affected, damage and losses, evacuated people, aid distribution points, and basic needs necessity. EIS integrates stakeholders and infrastructures so that EIS is a comprehensive system for all parties involving in disaster response.

EIS structure can integrate main information system with local media, government agencies and NGOs, and affected people. EIS processes data from sources and disseminating it to respondents through various media. Data may appear in text format or in geoRSS format. It collaborates local wisdom of community, special knowledge and policies of government and the ability of the system's algorithms to process data (Jezierski, 2010) as shown on Figure 7.

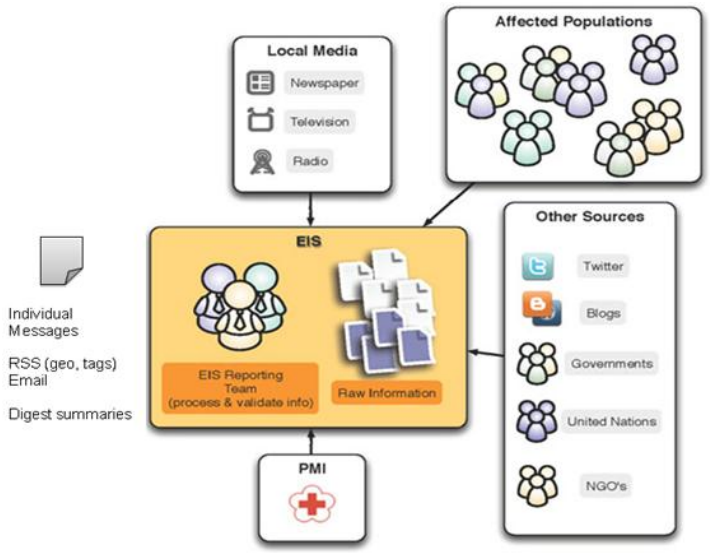

Figure 7. The EIS System by Thomson Reuters Foundation (source: (Jezierski, 2010)

2.4.1 Components of Existing EIS

Developing an Emergency Information System give a concern on components that construct an IS. One of EIS is Emergency Management Information System (EMIS) created for Saudi Red Crescent Commission (SRCC). EMIS is intended for supporting the work of emergency management staffs on emergency condition by utilizing various technologies in order to escalate the Emergency Life Cycle (Atteih et al., n.d.).

EMIS was developed by compromising four components. An overview of the components is hereinafter provided.

1. *Infrastructure*
   EMIS infrastructure covers communications, hardware, and network issues. **Communications** control access betwen ambulance staffs, hospitals and operation rooms via devices such as PDA and PC through internet. Moreover, there are severals **hardwares** used for supporting EMIS: a) servers, used for database, GIS and firewall; b) call receiver; c) switches, connecting equipments in area of the same local network; d) digital central, connecting all operations rooms using land lines; e) routers, connecting PCs to internet; and f) plasma screens. The last infrastructure, **network**, was established to connect operation rooms to internet by using available hardware such as switches, routers and servers.
2. *Application*
   Mainly EMIS offered three applications in a whole. Firstly, **Incident Command System** has function in recognizing phone caller identity and his position from incident location using specific developed algorithms. It also can help caller to achieve information of each ambulance's status whether it is during operation or

available for use. Secondly, **Electronic Patient Care Reporting (EPCR)** is responsible for collecting patient data and condition inputted by rescuer to his PDA. EPCR can store data in its local database while internet connection is not available and send the data to operation room server if connection is reverting. Lastly, **Central Operation Room Monitoring System (CORMS)** controls and monitors activities from all rescue units in fields including automatically generates position of the units utilizing GPS application planted on GPS devices, provides alarm mechanism of incidents for reporting and routing, serves a real-time map by utilizing GIS Maps, and monitors all 16 operation rooms.

3. *Data*
   EMIS manages very diverse data and information in its database. Data that is inputted is 16 operation rooms and the employees' data, emergency centers, ambulance teams' complete information, and others.
4. *Training*
   Training was done to prepare employees that had been worked with old system to migrate to this EMIS in order to make success of EMIS in real implementation.

2.5 Open Geospatial Consortium Standards

OGC (Open Geospatial Consortium) is an organization consisting of government institutions, commercial and non-profit companies, and universities that work to develop standards for geospatial processing needs. OGC standards are technical documents that support interoperability and geospatial technology including support for GIS data processing and data sharing. The standards support different software or applications to use same spatial information and services without further debugging ("About OGC | OGC(R)," n.d.).

Some technical specification of OGC used widely by spatial technology organizations are (Yuliardi, 2010 and Setiawan, 2012):

1. OGC 06-042: Web Map Service (WMS) Implementation Specification
   WMS is a spatial database services online which produces georeferenced maps. The maps are in picture format with extension PNG, GIS or JPEG.
2. OGC 04-094: Web Feature Service (WFS) Implementation Specification
   WFS is a service for spatial data through web. WMS allows user to access information of spatial data both geometry and attribute of data. WFS uses XML (Extensible Markup Language) and HTTP protocol as the delivery media.
3. OGC 07-067r5: Web Coverage Service (WCS) Implementation Standard
   WCS is a service for raster geospatial data (satellite imagery, arial photos) online.
4. OGC 05-007r7: Web Processing Service (WPS)
   WPS provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay. The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to

those processes. The data required by the WPS can be delivered across a network or they can be available at the server ("About OGC | OGC(R)," n.d.).

5. OGC 07-036: OpenGIS Geography Markup Language (GML)
   GML is an Extensible Markup Language (XML) format for expressing geographical information. GML support geographical data transactions on the internet by served as open interchange format. There are two parts of XML format which are the schemas that describes the document and the instance document that contains actual data. GML schemas enables users to create data sets of geographic data consist of points, lines and polygons data ("OGC Standards | OGC(R)," n.d.).
6. OGC 07-147r2: Keyhole Markup Language (KML)
   KML is an XML format that supports geographic visualization including displaying geographical data on the globe and also supports controlling user's navigation. KML also supports annotations of maps and images. KML is proposed by Google to be included within OGC consensus process. KML version 2.2 has been adopted as OGC standard. Moreover, KML has fit up with most of existing OGC standard such as GML, WFS and WMS ("KML | OGC(R)," n.d.).

2.5.1 Web Map Service (WMS) Operations

The use of OGC standard for representing maps in EIS is important. The use of KML in web is less suitable because KML is a file format that is not intended for web services. KML can access and display data such as XML and html but it can not perform operations for web services. Following, a discussion of WMS is presented as one of OGC standards supporting web services.

A WMS visuals georeferenced data into a map in image formats. WMS protocol reads geospatial database and interpret spatial data into specific parameters and display it in a map. To create a map using WMS protocol, there are three main operations for WMS (de La Beaujardière, 2006):

- **GetCapabilities** (required), provides metadata information of WMS service and parameters used in WMS map. GetCapabilites operation generates XML result that details information such as supported image format, projection and map layers.

  To use GetCapabilites request, user types an URL with defined parameters in a web browser. Example of using GetCapabilites request for WMS service is as below:

  ```
  SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
  ```

  The required SERVICE parameter shows what type of service is called to run the request. On example above, WMS is set to SERVICE parameter since client uses newer service version than version 1.0.6. Optional VERSION parameter defines version of WMS service being called. The required REQUEST parameter is set into what operation that user want to execute for the service.

- **GetMap** (required), results a map image from geospatial data. To create this map image, all dimensional parameters should be set clearly. Client can create layers using GetMap request by defining map format such as style, image format, spatial reference system (SRS), geographic boundary area (Bounding Box), width and height of a map, and transparency. Some maps that have same SRS and Bounding Box can be displayed as a combined map. Below is example of GetMap use.

  ```
  SERVICE=WMS&VERSION=1.1.1&REQUEST=GetMap&LAYERS=[layer_list]&S
  TYLES=[style_list]&SRS=[namespace:identifier]&BBOX=[minx,miny,
  maxx,maxy]&WIDTH=[output_width]&HEIGHT=[output_height]&FORMAT=
  [output_format]
  ```

  SERVICE, VERSION, and REQUEST parameters have the same description as those on GetCapabilites part. LAYERS parameter gives lists of layers that will be invoked. While there is more than one layer name to be called, values of LAYERS parameter consists of the layer names separated by comma(s). STYLES parameter calls list of styles that will be used to present each layer. Each layer is associated with a style. If user prefers to use default styles, they should just fill a null value in STYLES parameter (`"STYLES="`).

  SRS or Spatial Reference System parameter is coordinate reference system used to define value in the BBOX parameter. For example, SRS parameter with value of `"SRS=EPSG:4326"` means that the layers are defined in geographic WGS 1984 reference system. BBOX parameter defines corner coordinates of bounding box in SRS coordinates. For the example of EPSG:4326, bounding box coordinates are in decimal degrees. WIDTH and HEIGHT parameters give values of width and height of the map image in integer pixels. FORMAT parameter returns output format for resulted map. As the service used is WMS, the output formats are picture or graphic element formats such as, GIF (`"FORMAT=image/gif"`), JPEG (`"FORMAT=image/jpeg"`), PNG (`"FORMAT=image/ png"`), or others.

- **GetFeatureInfo** (optional), results information of features contained in a map. If GetFeatureInfo is activated, a map is marked as "queryable" and user can ask information about map image coordinates. To get the info, user adds particular parameters to the map URL (Uniform Resource Locator). Example of the use of GetFeatureInfo request is as below. GetFeatureInfo uses values defined by GetMap operation.

  ```
  SERVICE=WMS&REQUEST=GetFeatureInfo&BBOX=[minx,miny,maxx,maxy]&
  WIDTH=[output_width]&HEIGHT=[output_height]&FORMAT=[output_for
  mat]&LAYERS=[layer_list]&STYLES=[style_list]&SRS=[namespace:id
  entifier]&QUERY_LAYERS=[layer list]&INFO_FORMAT=[output
  format]&X=[value]&Y=[value]&EXCEPTIONS=[format]
  ```

  QUERY_LAYERS parameter defines layers that user want to retrieve the feature information. Client does not have to define all layers in the map, however the stated layers in QUERY_LAYERS parameter must be valid layers.

INFO_FORMAT parameter defines format to present feature information in MIME type. X and Y parameters demonstrates the selected location at which client want to know the information. Values of X and Y are counted from (0,0) pixel at the upper left corner of the map image. EXCEPTIONS parameter contains format for error report to be returned to client if the requested information is not found.

2.5.2 OGC Web Services (OWS)

OGC Web Service allows clients to access spatial data through OGC service even though they do not possess the data on local storage. Three principal types of georeferenced access service provided by OGC Web Service are WMS, WCS and WFS (de La Beaujardière, 2002). Concept of relation of some OGC Web Services is presented on Figure 8. It shows the three principal types and some other operations and services utilizing OGC Web Services.

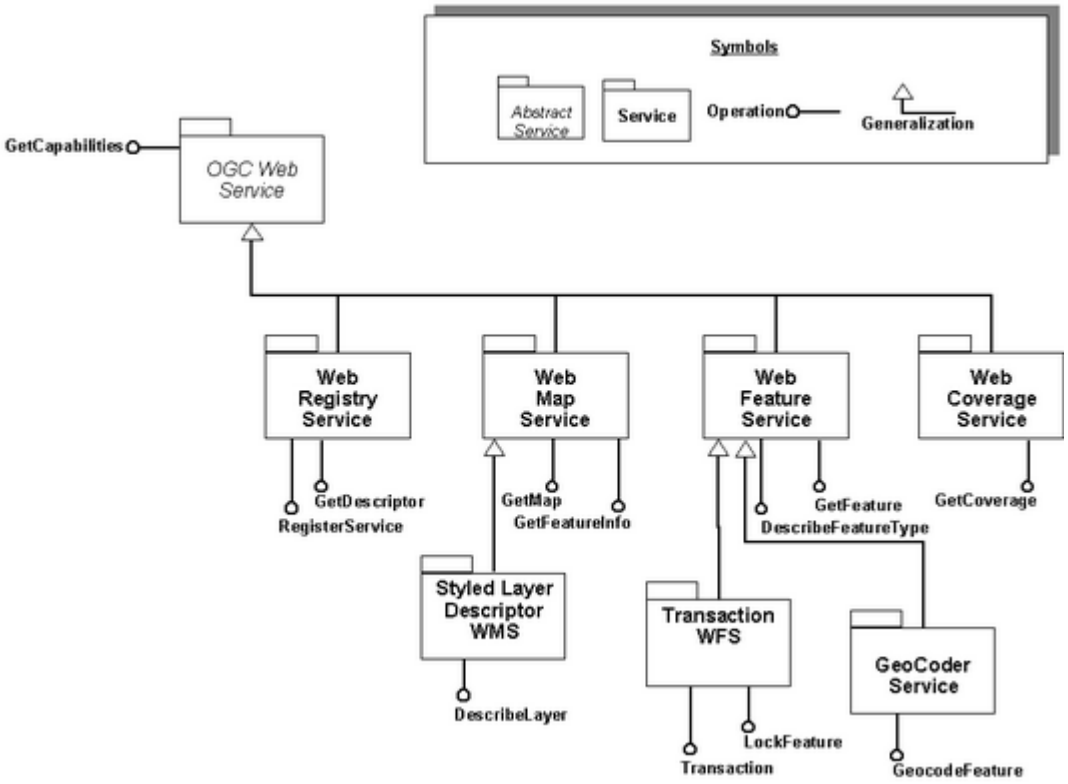

Figure 8. OGC Web Services Architecture (source: de La Beaujardière, 2002)

2.6 RDBMS (Relational Database Management System)

Database is collection of data that relates each other and are arranged in specific structure to be manipulated. Database is an important component in information system because it stores all needed information. To ensure the accuracy of data, database should be arranged in a system.

Database management system (DBMS) is a system for data management including storing, deleting and manipulating data. Benefits of database management are reducing data redundancy, avoiding inconsistency data, sharing data through network, managing data in standard, applying security restriction and maintaining data integrity (Timoshenko, n.d.).

Relational DBMS (RDBMS) is DBMS that is based on the relational model which based on mathematic theories introduced by E. F. Codd (Srikanth, 1997). RDBMS has advantages of the simplicity to understand and manipulate data. RDBMS allows data to have dynamic relationship between entities which ease data in a table to have relation with data on other tables only by using values of columns.

2.6.1 Table Structure and Relation

Construction of table in relational model is in two dimensional table format composed of rows and columns. Rows contain data related to entity, while columns contain data related to attribute of the entity. Terms used to explain rows and columns are different for user, model and programmer (Figure 9, "Relational Model," 2007). Every table should have unique name that differentiate it from other tables in the same database.

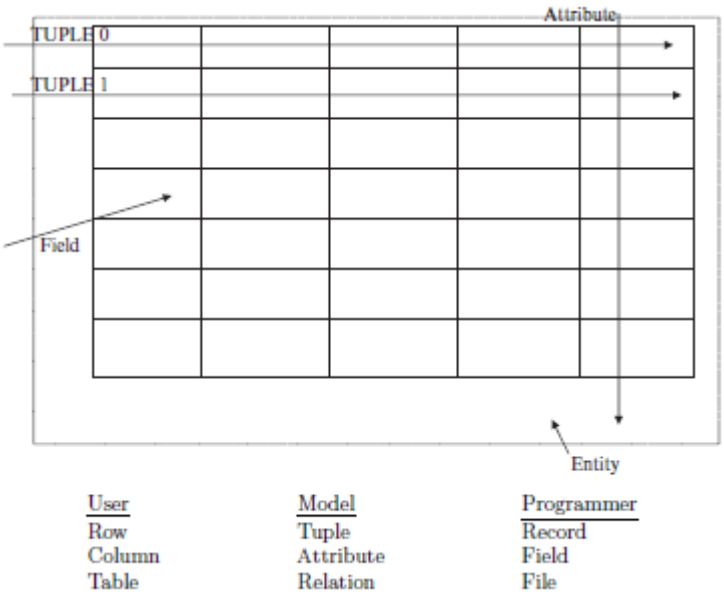

Figure 9. Row and column in a table of relational model (source: "Relational Model," 2007)

Each row or horizontal line of table is called tuple or record. Each tuple must contain a set of unique value which means that there are no two tuples had literally same data. Inserting data into tuple can be done randomly because information gathered from a table is not defined by data sequence in table rows. Column or vertical line is called attribute or field ("Relational Model," 2007). Each column must have unique name that differentiate it from other columns. Moreover, each column also has been appointed with spesific data type on which values of a column should be fit in the data type. The intersection of row and column, a single cell, has one value.

Table in general is different from the term relation. A table can be a relation if a set of rules are met ("Relational Model," 2007):

- A single cell, intersection of row and column, has only single value.
- Values in one column are in the same data type.
- Each row has unique value owned by that row.
- Sequence of rows is not significant.
- There are no two or more columns that have same column name.
- Sequence of columns is not significant.

2.6.2 Key in RDBMS

A relation/table should have key that is used to identify and to access data in each row of the table in data manipulation process. A key could be a single column or combination of several different columns. Classifications of key in relational model are:

1. Superkey
   Superkey is a set of attributes of a relation used to identify unique data in a relation. Superkey functions to ensure that each row has unique set of values different from other rows ("Relational Model," 2007).
2. Candidate key
   Candidate key is a minimal set of attributes as a part of superkey used to identify a unique row. A relation may have more than one candidate key. If a relation has more than one candidate key, a primary key should be assigned (Chamberlin, 1976).
3. Primary key
   Primary key is appointed candidate key. Primary key should not have null value and must have unique value for each row. An attribute or composite attributes assigned as primary key cannot have duplicate value in one attribute (Srikanth, 1997). In table Students (Figure 10) the primary key is

ELECTIONS

YEAR	WINNER-NAME	LOSER-NAME
1952	Eisenhower	Stevenson
1956	Eisenhower	Stevenson
1960	Kennedy	Nixon
1964	Johnson	Goldwater
1968	Nixon	{Humphrey, Wallace}
1972	Nixon	McGovern

PRESIDENTS

NAME	PARTY	HOME-STATE
Eisenhower	Republican	Texas
Kennedy	Democrat	Massachusetts
Johnson	Democrat	Texas
Nixon	Republican	California

Figure 10. Example of Elections and Presidents relations (source: (Chamberlin, 1976)

On relation Elections on figure 8, attribute Year is selected as primary key since it has no duplicate value, while on relation Presidents the primary key is attribute Name.

4. Foreign key
   Foreign key is a key or a set of attribute in a relation that is used to access data on another relation. In figure 8, attribute Name of relation Presidents is a foreign key for relation Elections in attribute Winner_Name. From the example, things should be considered about foreign key is: (a) a foreign key on one relation is not a primary key of the relation, (b) the foreign key does not have to possess the exactly same column name with its corresponding attribute name on the other relation (Chamberlin, 1976).

2.7 SMS and SMS Gateway

SMS (Short Message Service) has been an important part of basic mobile communication beside phone call. SMS or Short Message Service is a method to send and receive text messages between mobile phone devices and other devices equipped with internet connection. At first, SMS was designed to be exchanged using GSM (Global System for Mobile) standard. GSM is standard set by European Telecommunications Standards Institute (ETSI) for digital cellular networks ("Tech Info | SMS Gateway," n.d.). However, the development of SMS has been maintained wider over GSM standard as the technology is now being handled by 3rd Generation Partnership Project or 3GPP (Brown et al., 2007).

SMS or text message is a simple text format in cellular phone which has capacity to 160 characters. In 2010 there were 5 trillion SMS and it is expected to increase to 8.7 trillion messages in 2015. By growing number of SMS uses in many sectors (banks,

institutions, transport, etc), SMS is widely used by mobile phone owners including Smartphone owners. (“Seamless communication during emergency,” n.d.).

Originally, expectations of SMS were varied from a method to help provide information about new incidents to users, to a system that able to assist data collection. These expectations lead to the establishment of SMS three services as stated on GSM document issued on 1985 (Traynor et al., 2008). The functions as described in GSM 02.03 document (ETSI, 1996) are Short Message Mobile Terminated (SM-MT): SMS transmitted from network to mobile phone; Short Message Mobile Originated (SM-MO): SMS transmitted from mobile phone to network; and Short Message Cell Broadcast (SM-CB): from network to all mobile phones detected in transmitter’s extent. SM-MT and SM-MO are Point to Point service that deliver short message from one mobile phone sender to another mobile phone receiver.

2.7.1 SMS: Ways of Working

SMS is sent from sender mobile device to recipient device through SMS center (SMSC). Tools used to send and receive short messages are called Short Message Entities (SME). SME includes software and hardware such as software application on mobile handset, web dedicated for SMS like freeSMS.net, email, voice mail, facsimile, Internet server, modem, and others (Bodic, 2002 and Traynor et al., 2008). Before an SMS is sent to the designated mobile device, SMSC previously receives the SMS from sender and process the SMS.

Short Message Service Center (SMSC) has function to control the distribution of messages including receiving, storing, and forwarding messages from sender point to destination point. SMSC can work using store-and-forward or forward-and-forget modes. On store-and-forward method, SMSC keeps messages for certain specified time and deliver them to recipients. In a state of a message is failed to transmitted, SMSC tries to redeliver the message. On forward-and-forget method, SMSC transmission process is performed once to destination SME. If messages are not sent, SMSC does not resend them (Brown et al., 2007).

Short Message Mobile Terminated (SM-MT) and Short Message Mobile Originated (SM-MO) services are managed using store-and-forward mode by SMSC. SMSC receives SMS from sender and store it temporarily while trying to reach the designated recipient. If the recipient is available, SMS is sent to the address. SMS can be transmitted even though the destination device is in the middle of phone call or data connection process. Otherwise, if the recipient is unreachable for instance because the mobile station is off, SMSC stores the SMS temporarily and tries to deliver the SMS in regular basis. The time configuration is adjusted by SMSC, including the length of time that is used to store SMS (Brown et al., 2007).

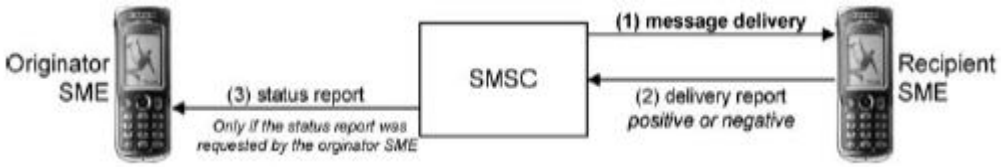

Figure 11. Message delivery process (source: (Bodic, 2002)

SMSC also can send message report to the sender (Figure 11). Message report is generated by recipient SME or until validity period end up. Validity period is deadline time that is used to allow SMS to be sent. If recipient receives the SMS, the report contains information of the success of delivery. On the contrary, if SMS is not delivered, the report informs that SMS is failed to be sent and the reason why it cannot be sent. Sender or originator SME can control his SME to receive message reports or not. Originator SME also has the ability to set limited time of validity period. For instance, if sender adjusted the validity period to 30 minutes, SMS should be sent to recipient at the specified time. If SMS remained undeliverable after the time elapses 30 minutes, SMS would not be sent to recipient and SMSC would remove the SMS from its storage (Bodic, 2002). In the case of sender does not specify the validity report, service provider sets validity report to default.

2.7.2 SMS Size and Concatenated Message

SMS for Latin characters uses 7-bit alphabet which accommodates 160 characters in one text message. It is a default SMS size set by GSM standard. Other sizes for a single message are 8-bit alphabet for 140 characters and 16-bit alphabet for 70 characters. Scheme of 16-bit alphabet is usually used for languages with spesific characters such as Arabic, Chinese, Korean or Russian (Traynor et al., 2008). Moreover, (Freire, 2011) stated that 16-bit encoding included in UCS2 (2-byte Universal Character Set) specifically supports non-Latin characters. However, aside of UCS2, some mechanisms should be applied so that those special characters can be read correctly. Some mobile devices might not implement the mechanisms properly which lead to wrong interpretation of the characters into square box.

In the case of text message consisting of more than single SMS's character numbers (160, 140 or 70), message is sent as "long SMS" in multiple parts. This long message, called concatenated message, can consist of several segments where each segment has lower size than a single message's size. Each segment of concatenated message consists User Data Header (UDH) and message text. Since UDH is part of a message payload, the size of text message is reduced from the normal single message size. UDH contains information related to format of the message which is UDH Length (UDHL) and information of segment elements (figure 9). UDHL explains length of user data header in octets (equal to 8 bits). UDHL is one octet length. The rest of UDH components is Information Element (Bodic, 2002).

Information Element (IE) containing information of message comprises of IE identifier, IE data length, and IE data (Figure 12). IE Identifier (IEI) defines type of IE for instance sound, picture, animation, concatenation descriptions, particular use of SMSC and others. IEI is presented in hexadecimal with length of one octet. IE Data Length (IEDL) is octet value and it functions to specify the length of IE data. IE Data (IED) explains information element of message content and type. If a message is concatenated message, information element data provides information of: 1) reference of concatenated message, the value must be the same for all segments or parts; 2) total segments of the concatenated message; and 3) number of the segment (Bodic, 2002). Therefore, for concatenated message information, IED contains 3 octets length.

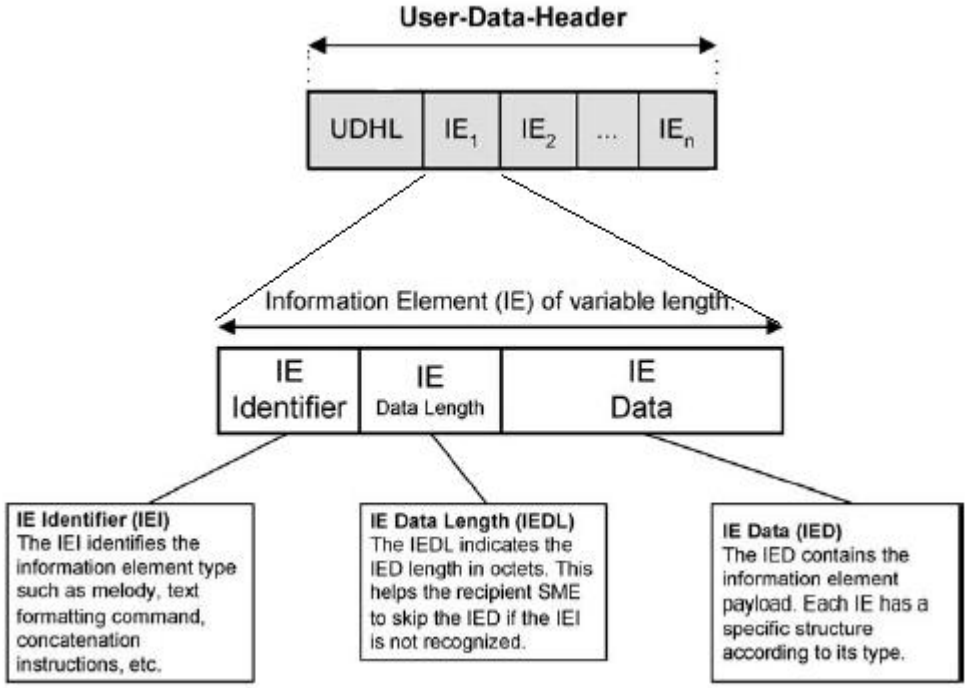

Figure 12. User Data Header components (adapted and modified from (Bodic, 2002)

Concatenated message is sent in several segments from the sender. Recipient device therefore has to combine all the segments as single long message by reading UDHs and structure the segments in proper order.

2.7.3 SMS Gateway

SMS gateway is an application to connect different communication protocols in exchanging SMS service. Different communication companies develop different communication protocols to send SMS set in SMSCs. Most of SMSCs are proprietary which means each SMSC has its own communication protocol. This condition causes two different SMSCs cannot connect each other. SMS gateway has a role to connect two different SMSCs by translating the protocol of SMSCs ("SMS Tutorial: What is an SMS Gateway?," n.d.). The illustration is shown in Figure 13.

Figure 13. An SMS gateway acts as a relay between two SMS Centers ("SMS Tutorial: What is an SMS Gateway?," n.d.)

SMS gateway can also send messages from mobile phone to computer and vice versa. SMS gateway connects a PC to a GSM handset through cellular network. Figure 14 presents the illustration of this work. GSM modem will receive messages that will be processed by SMS gateway application. The application will connect the messages with database server. The reply messages also will be taken from the database server which then sent to mobile phones.

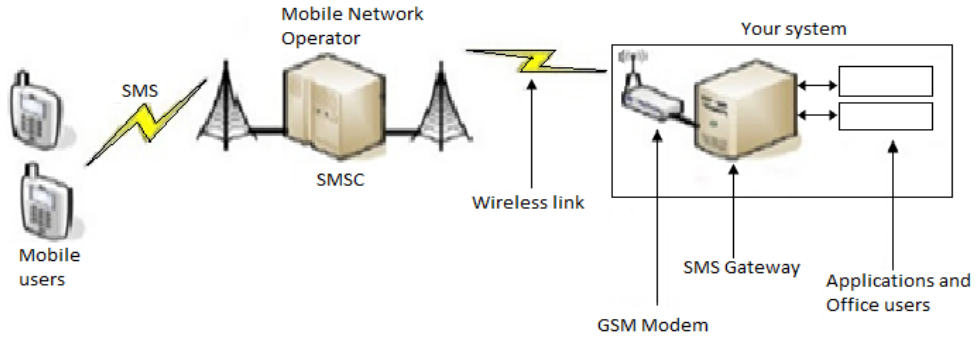

Figure 14. Architecture of SMS gateway connecting mobile phones and computer (source: Budidoyo, 2010)

2.8 User-Centered Design (UCD)

User-Centered Design (UCD) approach is a useful tool to develop a web which fulfills the need and requirements of the user. Web developing process of this research utilizes UCD approach. UCD focusses on users. Users are involved on every stage of web development including planning, design and development of a web product.

Definition of UCD is given in (webpage: What is User-Centered Design: About Usability: UPA Resources) as "*an approach to design that grounds the process in information about the people who will use the product. UCD processes focus on users through the planning, design and development of a product*".

UCD methodologies follows international standard of human-centered design process (ISO 13407). This standard defines general process in where human activities are included ("What is User-Centered Design: About Usability: UPA Resources," n.d.). The cycle of human-centered design is shown on Figure 15.

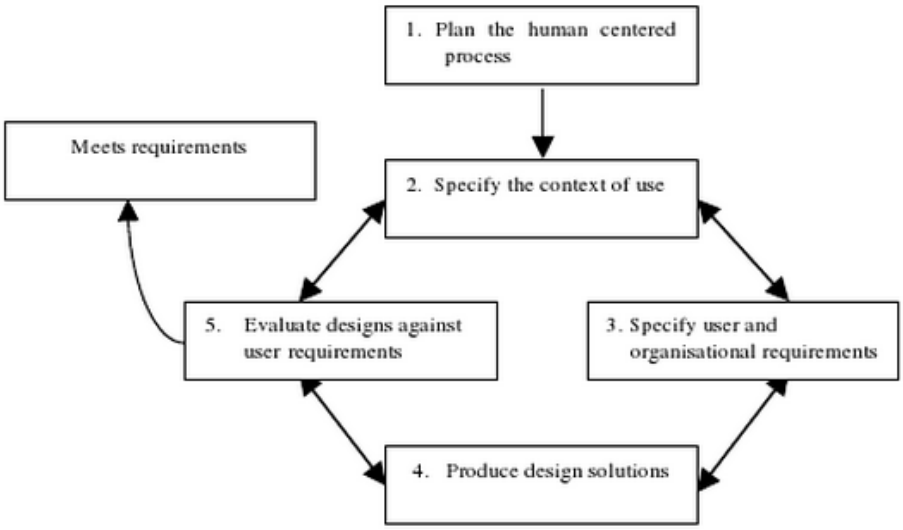

Figure 15. ISO 13407: Human-centered design for interactive system (Costabile, 2000)

UCD is applied in every stage of the web design development. It finds users' needs of the web or what they expect from the web. UCD is an iterative process where at every stage users will be evaluated of their expectations of the web.

3. Methodology

3.1 Study Area

Sukoharjo is regency in Central Java Province. It is divided into 12 subdistricts which consist of 167 villages. The subdistricts are Kartasura, Gatak, Baki, Grogol, Mojolaban, Polokarto, Bendosari, Sukoharjo, Nguter, Tawangsari, Bulu, and Weru as depicted on Figure 16. Sukoharjo regency has boundaries as follows:

- North : Surakarta municipality and Karanganyar regency
- South : Wonogiri regency and Gunung Kidul regency (DIY province)
- East : Karanganyar regency
- West : Boyolali and Klaten regency

BPS (Badan Pusat Statistik) reports that population of Sukoharjo regency in 2011 was 851,157 persons which consist of 421,776 male and 429,381 female. Therefore the sex ratio in Sukoharjo regency in 2011 was 98.23 which mean for every hundred female inhabitants there are 98.23 male inhabitants. Grogol subdistrict was the most populated area with 105,016 persons or 12.34 % population among 12 subdistricts. Kartasura was the densest area with 4,832 persons per km^2. In overall, Sukoharjo density in 2011 was 1,824 persons per km2 (Sasmokohadi, 2012).

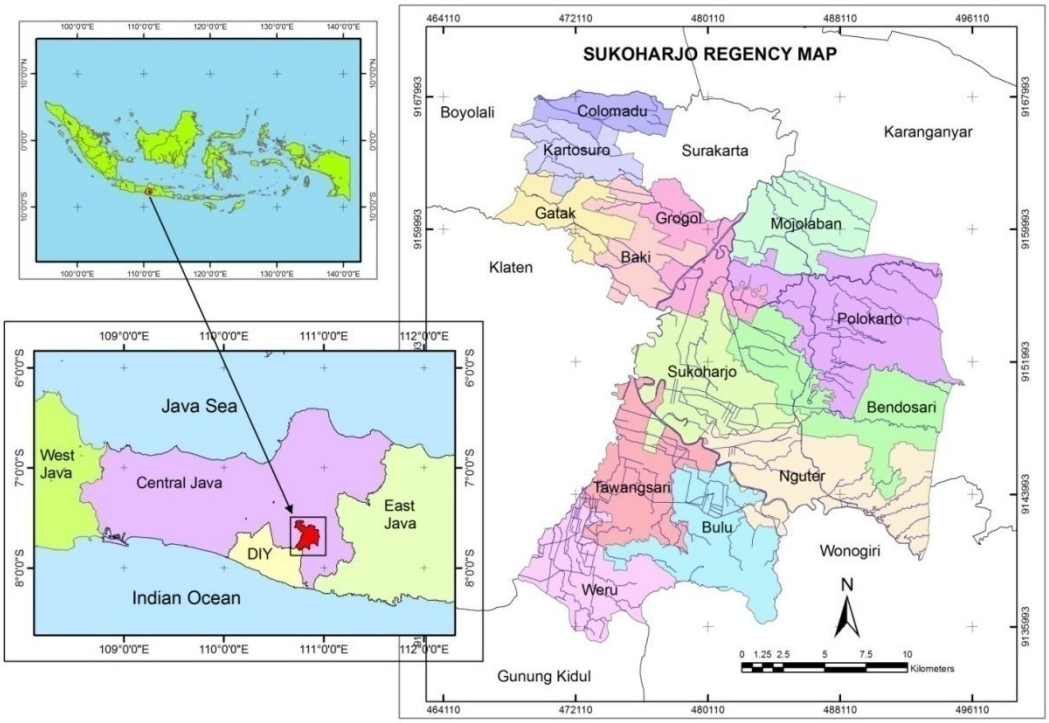

Figure 16. Location of study area

Sukoharjo is located in 7° 32’ 17”- 7° 49’ 32” S and 110° 57’ 33.70” - 110° 42’ 6.79” E. The area of Sukoharjo is 46,666 hectares or 1.43% of Central Java Province

area. Topography of the area is 95% located in plain area while 5% located in hilly area. Bengawan Solo river, the main river of Solo basin, divides the area into two parts. The northern part is lowland area and the southern part is highland and mountainous area. Sukoharjo elevation is ranging from 89 to 693 meters above sea level.

Throughout the year 2010, January had the highest number of rainy days with 21 days. The highest rainfall was occurred on April with an average of 23 mm. The highest number of rainfall was on March with intensity of 339 mm.

3.2 Flood Occurrence in Sukoharjo

Sukoharjo is located in upper stream of Bengawan Solo river watershed. Most areas of Sukoharjo regency are vulnerable to flood disaster as presented by Watershed Management Agency, Ministry of Forestry (BPDAS Solo, 2008). About 39,996.46 Ha of Sukoharjo are high vulnerable and 12,166.15 Ha are medium vulnerable to flood hazard.

Based on data from BPBD Sukoharjo, 2012, nine subdistricts among twelve subdistricts in Sukoharjo are vulnerable to flood disaster (Table 3). Characteristic of flood in sukoharjo is inundated flood caused by overflowing river. Commonly flood is occurred for 2 to 3 days. Due to the height of flood, people may evacuate to a safer place or choose to stay on their homes.

Table 3. Flood prone villages in Sukoharjo

Nr	Subdistrict	Village	Area (km^2)	Susceptible Household
1	Sukoharjo	Jetis	1.91	250
		Bulakrejo	4.11	60
2	Tawangsari	Lorog	4.07	50
3	Grogol	Madegondo	1.44	150
		Kadokan	1.92	490
		Telukan	3.25	80
		Langenharjo	1.95	75
		Pandeyan	3.64	30
		Parangjoro	4.87	50
4	Mojolaban	Gadingan	2.04	874
		Tegalmade	1.85	363
		Palur	4.09	300
		Laban	2.25	785
5	Nguter	Lawu	4.36	25

Nr	Subdistrict	Village	Area (km^2)	Susceptible Household
		Kepuh	3.95	40
		Kedungwinong	3.92	30
		Daleman	2.68	100
		Tanjungrejo	3.56	100
6	Polokarto	Pranan	1.94	40
		Bugel	1.54	35
7	Weru	Tawang	3.15	25
		Ngreco	4.70	50
8	Gatak	Blimbing	2.29	75
9	Baki	Ngrombo	1.26	125

Source: (BPBD Sukoharjo, 2012)

On 1 January 2012, flood in Sukoharjo inundated 12 villages in Grogol and Mojolaban subdistricts caused by overflow of Bengawan Solo river (Herusansono, 2012). The flood caused embankment damage on Bulu and Tawangsari subdistricts, submerged hundred houses, and forced 8,582 people to evacuate for more than three days. Based on report from Camat Grogol (head of Grogol subdistrict), the losses on Grogol subdistrict reached more than 450 million rupiahs.

More severe floods occurred at the end of December 2007 until the beginning of January 2008 affected ten regencies which are passed by Bengawan Solo river including Wonogiri, Karanganyar, Sukoharjo, Solo, Sragen, Ngawi, Blora, Bojonegoro, Tuban, Lamongan and Gresik (Kementerian PU, 2008). On 26 December 2007 Sukoharjo was struck by huge flood which inundated ten subdistricts among others Grogol, Mojolaban, Polokarto, and Sukoharjo (BPDAS Solo, 2008).

The 2007 flood in Sukoharjo caused by heavy rainfall, high water discharge of Bengawan Solo and the damage of dike at several points along Bengawan Solo stream (BPDAS Solo, 2008). This condition also was triggered by the opening of Gadjah Mungkur Reservoir floodgate on Wonogiri subdistrict. It caused the volume of water and elevation of Bengawan Solo river increased drastically. This incident led to a loss of 31.29 billion rupiahs and forced 9,662 people to evacuate (Kementerian PU, 2008).

3.3 Research Framework

The approach to develop web-based information system employs three main phases: preparation, design, and implementation and evaluation. The tasks for each phase are presented on Figure 17:

1. Preparation phase.
   This phase intends to analyze and to collect requirements for system building.
   a. Fieldwork
      Activities done on fieldwork are:
      i. Taking evacuation site coordinates
         Existing evacuation shelters on Sukoharjo regency are recorded directly from the field. What is meant by evacuations shelters is public building that once used as flood evacuation places at the time of the incidents. Coordinates of evacuation shelters are taken using GPS tool.
      ii. Secondary data collection
         Several data needed to develop the system are aggregated during fieldwork. Those data are type of needs, logistic stocks on BPBD, Dinas Sosial and PMI warehouses, and regulations related to logistic fulfillment for natural disaster victims.
      iii. Interview
         Interview is intended to collect data and information about current system and other historical data regarding flood condition and IDP need fulfillment.
   b. Literature review
      Literature review activity aims to learn: (1) the functionality of SMS Gateway, RDBMS, and OGC standards; (2) basic and special needs of IDP.
   c. User need assessment
      This work aims to collect data about process of IDP need fulfillment for flood victim on Sukoharjo and user requirements for the new system.
   d. System requirements
      Requirements of new system are formulated from results of user need assessment.
2. Design phase (modified from Alesheikh et.al., 2002).
   Designing system of the web information system is performed on this phase. There are several steps conducted to design the web information system.
   a. Conceptual design
      This step is to design data model and define the relationship among entities.

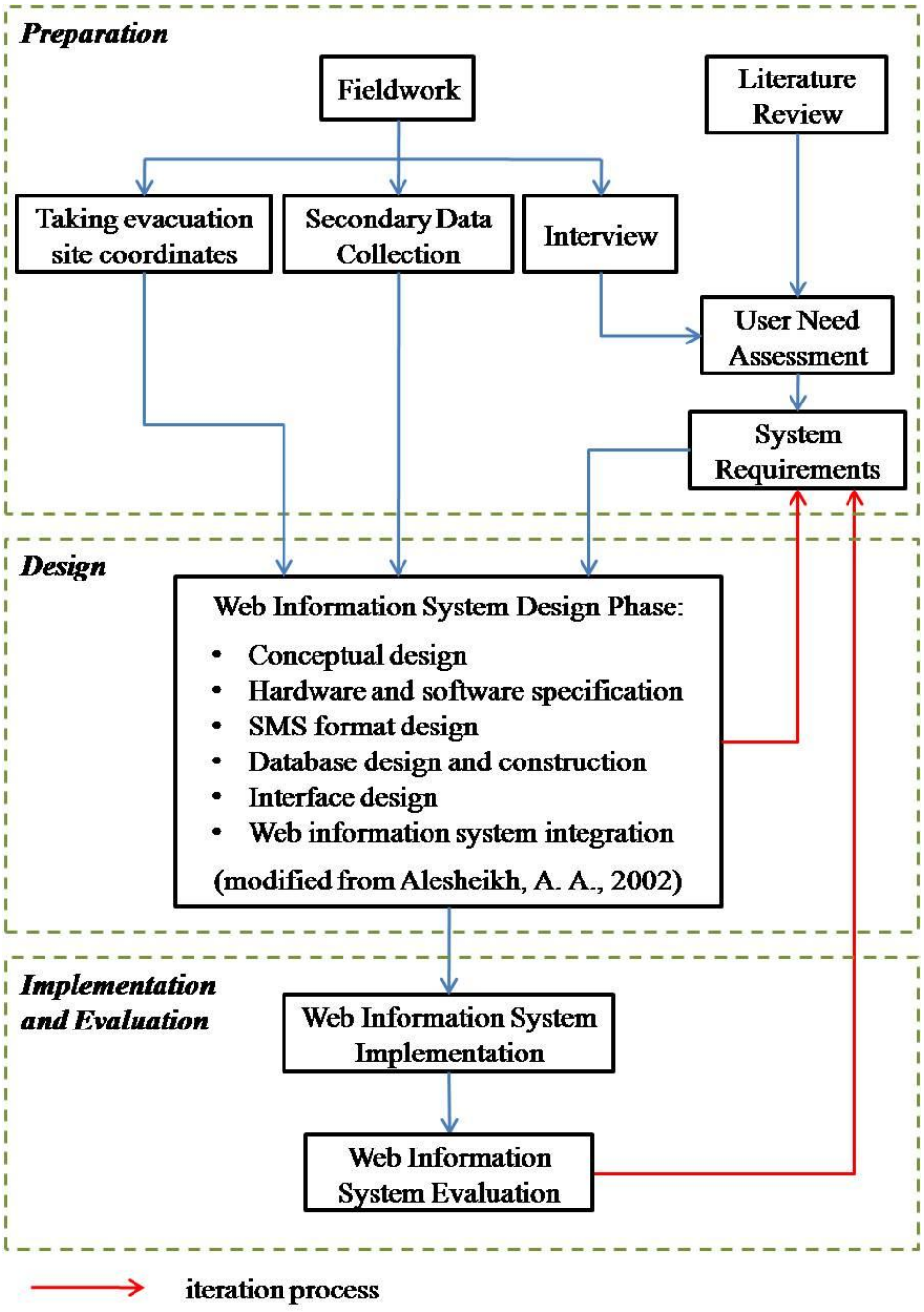

Figure 17. Research framework

b. Hardware and software specification
   In this step, the activity is selecting suitable software and hardware. Software selection depends on the functionality and performance of the web information system.

c. SMS format design
   Activities to be done:
   - Setting format of SMS.
   - Setting up procedures to handle receiving error SMS format.

d. Database design and construction
   Several activities will be done in designing database:
   - Creating database design.
   - Creating procedures for converting input data from SMS into list of IDP needs.
   - Defining procedures for managing and maintaining the database.

e. Interface design
   User interface of web information system is designed for public side and authority side.

f. Web information system integration
   After acquirement of hardware and software, construction of database, and design interface, the next step is to integrate different components of the hardware and software to check that the system works as expected.

3. Implementation and evaluation
   The last phase is to implement the web information system and do evaluation of the usability of the web information system. Evaluation is conducted with selected users.

3.4 Selected Users (Stakeholders)

On flood disaster response phase in Sukoharjo there are several institutions and organizations involved directly in overall process. Each of them has its own function and responsibility in flood disaster management including rescue effort, victim evacuation, first aid and basic need fulfillment. Not only organizations, communities through their self-support effort were also involved on response phase. However, since the aim of this research mainly focuses on producing information of type and number of IDP needs, communities are not considered as part of main subject of the research.

In accordance with research objectives, selected users for this research are institutions or organizations that are involved directly in IDP need fulfillment function and spreading emergency information. More specifically, the institutions are them that provide logistic needs and inform emergency condition during emergency response phase. Based on this requirement, selected users for the research are:

1. BPBD Kabupaten Sukoharjo (*Local Coordination Board for Disaster Management at Sukoharjo Regency)*
   BPBD Sukoharjo is institution that has role as coordinator, commander and executor on disaster management at regency level. BPBD Sukoharjo had been founded on 2011 which means BPBD has been working for about a year.
2. Dinas Sosial Kabupaten Sukoharjo *(Department of Social at Sukoharjo Regency)*
   On disaster management, Dinas Sosial has main function on providing logistic aids.

Dinas Sosial distributes logistic aids based on information from its members on field and also coordination with BPBD.

3. PMI Kabupaten Sukoharjo *(Indonesian Red Cross at Sukoharjo Regency)*
   PMI is organizations for social activities. PMI provide aids for disaster victims especially medicines. PMI receives donations from many organizations and individuals and distributes them to victims or other people in need.
4. SAR (Search and Rescue)
   SAR is volunteer organization that has main function on victim redemption. Beside coordination with BPBD, SAR also coordinates with other organizations such as SAR in other regions (Wonogiri, Karanganyar, Klaten, and Sragen) and management of Gadjah Mungkur Reservoir in Wonogiri. SAR receives information about river water level and level of danger from other regions. This information is used as basis to take rescue action against citizens in flood prone areas.

3.5 Interview

Interview was conducted to answer research problem 1 and 3. During interview some questions (Appendix 1) were given to collect data and information. Researcher collects data and information related to flood characteristic, evacuation condition and process, existing evacuation sites, and IDP logistic need fulfillment process. Interview was conducted with some stakeholders. The stakeholders are divided into two groups: a) community and subdistrict/village officers; b) institutions and volunteer organizations.

Interview that was held on institutions and volunteer organizations resulted on information and data related to flood events and logistic needs. The information gathered from interview are agencies' roles, logistic fulfillment process, real condition of flood occurrence such as villages that are usually strike by annual flood, and buildings that are usually used as evacuation sites. Moreover, researcher also collected data from the agencies which is regulations associated with victim need support and documents of logistic on agencies' warehouses.

Interview conducted with community and subdistrict/village officers was held in Grogol subdistrict, Mojolaban subdistrict, Kadokan village, Nusupan subvillage, Gadingan village, Laban village, and Tegalmade village. Information collected from community and officers are related to their experience on facing floods. Researcher received more specific information relating to logistic aids and the length of evacuation period.

3.6 User Needs Assessment

User needs assessment aims to collect data regarding web emergency information system. This activity used list of User Needs Assessment questions (Appendix 2).

Questions of the assessment were continuation and complement of interview activity. The first part of the assessment was to collect information about current system and users experience on logistic fulfillment. The second part was to gather users' requirements for the new system.

The assessment was conducted on selected agencies that are BPBD, Dinas Sosial, PMI and SAR. The preference of selected agencies based on their significant roles on logistic fulfillment. There are 10 respondents on total for the assessment. They are 3 respondents from BPBD, 2 respondents from Dinas Sosial, 3 respondents from PMI, and 2 respondents from SAR.

3.7 SMS Format and Procedure

One of functions of SMS in this system is to send information of IDP structure. SMSs are sent by contributors on shelter locations. Contributors for IDP structure SMS are people that have specific roles in IDP handling at evacuation shelters. To ensure that the contributors are specified persons who are acknowledge by BPBD, each contributor's phone number should be registered on the information system. SMSs will be received by SMS Gateway which will send the information in SMS into the information system. The information system will convert the information into list of IDP needs and display it on the web.

SMS format will be determined to simplify the information system identifying and converting the SMS. SMS should be set so that the information needed can be fit in 160 characters. SMS format will follow two kind formats, full format and simple format.

Full format of predefined SMS:

(shelter_code)#(m_old)#(f_old)#(m_ad)#(f_ad)#(m_ten)#(f_ten)#(m_ch)#(f_ch)# (toddlers)#(infant)#(pregnant)#(breastfeed)#(difable)#(households)

Simple format of predefined SMS:

(shelter_code)#(total_number_of_IDPs)

Explanation of the SMS format is:

- shelter_code : code of shelter location
- m_old : number of male IDP ≥ 60 years old
- f_old : number of female IDP ≥ 60 years old
- m_ad : number of male IDP between 18 – 59 years old
- f_ad : number of female IDP between 18 – 59 years old
- m_ten : number of male IDP between 13 – 17 years old
- f_ten : number of female IDP between 13 – 17 years old
- m_ch : number of male IDP between 6 – 12 years old

- f_ch : number of female IDP between 6 – 12 years old
- toddlers : number of toddlers (between 1 – 5 years old)
- infant : number of infants (< 1 year old)
- pregnant : number of pregnant women
- breastfeed : number of breastfeeding mother
- difable : number of difable people
- households : number of households
- total_number_of_IDPs : total number of IDPs

Age groupings in the SMS format follows age group that is determined by BNPB on BNPB Regulation Number 18/2009 about Guidelines for Disaster Relief Logistics Standardization.

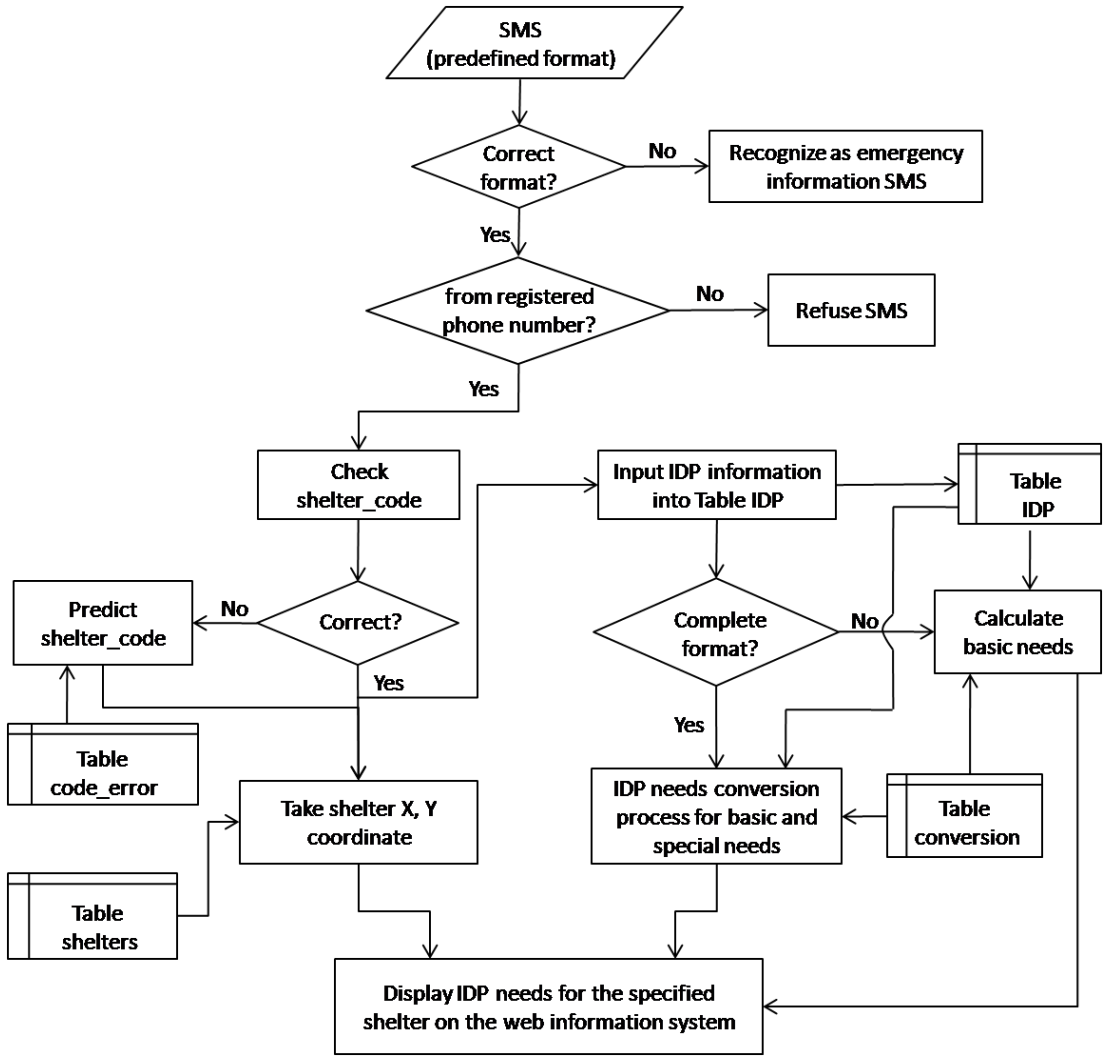

Figure 18. Flowchart of mechanism to display IDP needs on specified shelter location using information received from SMS

Mechanism of SMS used to calculate IDP needs at specified shelter location is shown on Figure 18. System will accept SMS if it is sent from registered phone numbers. Further, system will check whether the format is in correct format or not. SMS should be in predefined format that can be read by the system. If SMS is in correct format, the next steps are executed. System will analyze shelter_code from SMS to identify the shelter location by comparing shelter_code with code of shelter in shelter table. If they match, the shelter location is recognized. Meanwhile, if the shelter_code does not match any code of shelter in shelter table, system will predict the shelter location using code_error table. This table consists of possible spelling errors of each shelter code. After defining shelter location, information from the SMS will be extracted into IDP table.

The other task executed by the system regarding SMS of IDP is IDP data extraction. System will store IDP information from SMS into IDP table and use it to do IDP need conversion. Previously, system will check whether the SMS in complete format. If it is in complete format, conversion process will be performed and thus show basic needs and special needs of IDP. However, if it is in simple format, system will calculate only the basic needs. Result of this process is IDP needs for particular shelter site.

3.8 Need Conversion

To calculate IDP needs, it uses conversion list of needs. Conversion list stores data of logistic types and numbers for each IDP type. The construction of conversion list refers to:

1. BNPB Regulation Number 18/2009 about Guidelines for Disaster Relief Logistics Standardization.
2. Ministry of Social Regulation about Logistic Guideline of Social Aids for Natural Disaster Victims.
3. Actual needs of flood victims in Sukoharjo

Content of conversion list is presented on Appendix 3. Types of logistics are built based on BNPB and Ministry of Social regulations above and logistic stocks of BPBD, Dinas Sosial and PMI. The regulations explain victim needs in general, therefore the more detail types of logistics are build refers to agencies' logistic stocks.

Mainly, logistic needs in this research are distinguished into basic needs and special needs. Basic needs are needs to fulfill flood victim basic necessities and help them survive especially at the first time when they are in evacuation shelter. Basic needs include food and sleeping equipments. Further, special needs are needs for specific persons or necessities. Special needs include milk for babies, breastfeeding mothers and pregnant mothers, menstrual pad for adult women, bath supplies for babies, and medicines.

In formulating need conversion, there are constraints on deciding logistic types and the calculation for real needs. The constraints are:

- Some logistics mentioned in the regulations are not covered by the three agencies that are children and toddler clothes, footwear other than school shoes, and milk for breastfeeding and pregnant women. So that those items are included in the conversion list but not included in the need calculation.
- Some logistic items cannot be included in the conversion formula because they are given upon request from shelter coordinators. Those items include clothes and medicines. Basically, items include in the calculation are urgent basic needs and some special needs.

Types of logistics referring to BNPB and Ministry of Social regulations are distinguished into four types. They are food, clothing, medicines, and utensils. For conversion process these logistics are distinguished into more specific definitions:

1. Personal and public
   Logistics distinction as personal and public aims to define the target of logistic provision. It also uses to calculate the need conversion using specific calculation or formula. Personal and public needs have different provision.

   Personal needs are needs for individual purpose. Personal needs are calculated per person, such as rice, instant noodle, and mineral water. Meanwhile, public needs are needs for public use or public kitchen. BPBD sets up public kitchen on the third day after the flood first strike. Public needs for public use includes clothing type such as floor mats, praying clothes (*mukena*) for Muslim women, and valance. Public needs for public kitchen includes food and utensil types. Food type for public purpose such as cooking oil, sardine/canned fish, tea, sugar, and fast food package. Utensil type for public needs is kitchen utensils such as stove, frying pan, ladle and knife.

2. Piece and package
   Logistic units differentiate into piece and package. Piece unit means the logistic items consists of one entity per item name. Piece unit includes pack, piece, sheet, kg, liter, bottle, box, carton, sachet, can, and pair. Package unit means each package consist of several different items. Logistic in package unit can be given for one individual or several individuals. For instance, baby kit is given for one baby while family kit is given for one family. The package logistics are shown in Table 4.

   Table 4. Logistic packages

No	Package Name/Supplier	Content Name	Number
1	Family Kit/ BPBD, Dinas Sosial and PMI	- Bath soap “Lifebuoy” (85 gr) - Laundry soap “Rinso” (900 gr) - Shampoo “Sunsilk” (180 ml)	5 pcs 1 piece 1 bottle

No	Package Name/Supplier	Content Name	Number
		- Toothpaste “Pepsodent” (75 gr) - Toothbrush “Ciptadent” - Towel - Menstrual pad - Dish soap “Ekonomi” (340 gr)	2 pcs 3 pcs 1 piece 1 pack 1 piece
2	Baby Kit/ PMI	- Baby bath soap (80 gr) - Laundry soap (900 gr) - Baby shampoo (200 ml) - Baby powder (200 gr) - Minyak telon (60 ml) - Cajuput oil (60 ml) - Baby lotion (100 ml) - Diapers - Towels	1 piece 1 piece 1 bottle 1 piece 1 piece 1 piece 1 piece 1 dozen 1 piece
3	Fast Food Package/ BPBD	- Chicken *opor* + rice - *Rendang* + rice - *Tuna* + fried rice	10 cans 10 cans 10 cans
4	Nutrition Additional Food/ BPBD	- Green bean porridge - Red bean porridge - Soya milk	3 cans 3 cans 3 cans

Source: primary data

3. Given directly and on demand
   Determination of the number and types of logistics is also limited by request from shelter locations. Some logistics are calculated directly by system after receiving predefined SMS while others are not count directly. The latter will be distributed to shelter location if there is request such as medicines and some types of clothes. This is due to changing condition on shelter locations.

3.9Material

Basic dataset needed in the development of prototype of web emergency information system are shown on Table 5.

Table 5. Data needed and data source

Nr	Data needed	Data source
1	Administrative map	Topographic map from Bakosurtanal
2	Hazard prone map	BPBD Sukoharjo
3	Road network	Topographic map from Bakosurtanal
4	River network	Topographic map from Bakosurtanal
5	Existing shelter points	Taking shelter coordinates during fieldwork

3.10 Software

Software used for the development of prototype of web emergency information system are:

1. Apache, web server.
2. Geoserver, server for generating WMS map files.
3. MySql, database server.
4. PostgreSQL/PostGIS, database system for storing dynamic spatial data.
5. PHP, server-side scripting language.
6. Gammu, modul for SMS gateway.
7. Web browser (Internet Explorer, Mozilla Firefox, Google Chrome, etc).

4. Current System and New System Requirements

4.1 Current System for Need Fulfillment

Flood disaster management in Sukoharjo involved various institutions and organizations to work on handling flood and protecting victims. The main focus of this research is on emergency response phase where one of efforts on this phase is to provide basic needs for evacuees on evacuation shelter. The workflow of fulfilling IDP needs in general is shown on Figure 19. In general, many organizations also get involved in offering humanitarian aid. Those organizations such as military, clinic center and donors usually allocate aid for victims. Nonetheless, they don't have main responsibility which is contained in their main tasks which states that they have to provide the assistance for natural disaster victims in short time. Assistance that they offer is voluntary assistance.

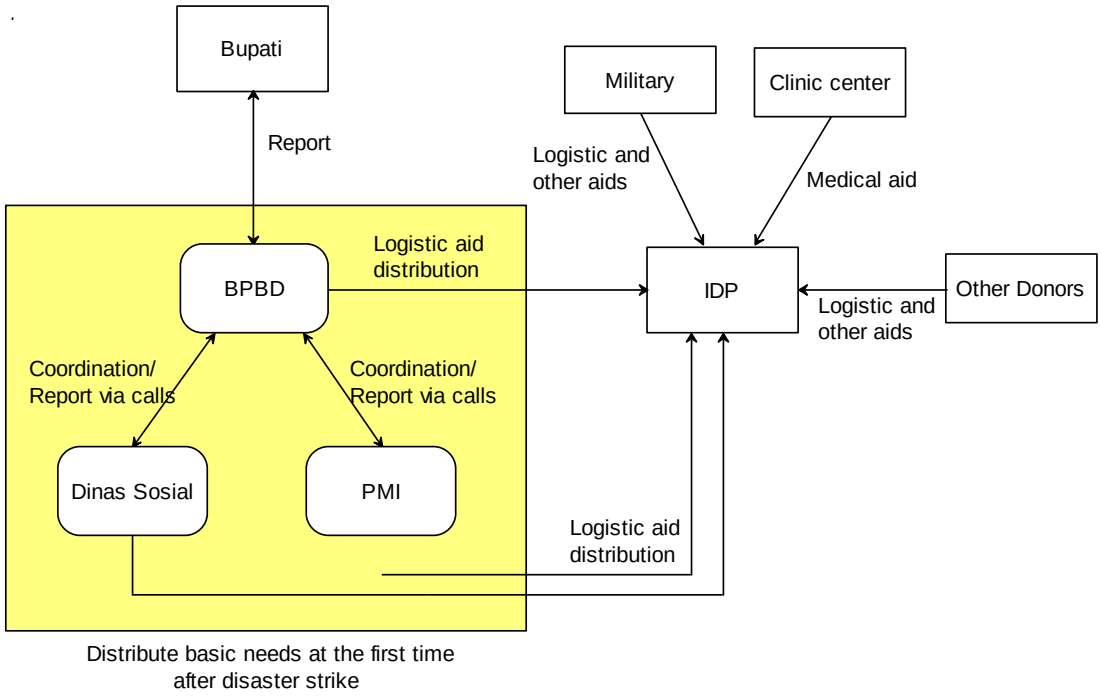

Figure 19. General workflow of aid distribution

There are three agencies involved directly on logistic support: BPBD, Dinas Sosial and PMI. They are responsible on providing logistic aid at the first time after flood disaster strike an area. They coordinate in preparing and distributing logistic aid. In regency level, they are responsible directly and give report for any emergency measure to Bupati who gives directive. BPBD has role as a leading institution that decide every measure under supervision of Bupati.

Currently, process of fulfilling IDP needs in Sukoharjo regency is done in manual process (Figure 20). Needs fulfillment is the responsibility and one of main tasks of the three agencies. Each of them has its own logistic stock on their warehouses.

The process starts in preparedness phase of disaster management cycle when Dinas Sosial provides logistic stock on evacuation shelter sites. This step intends to increase community preparedness in dealing with impending floods. Shelter locations selected to be provided by stock are shelters located in areas that experience annual flooding. Those areas are such as Gadingan village and Nusupan sub village.

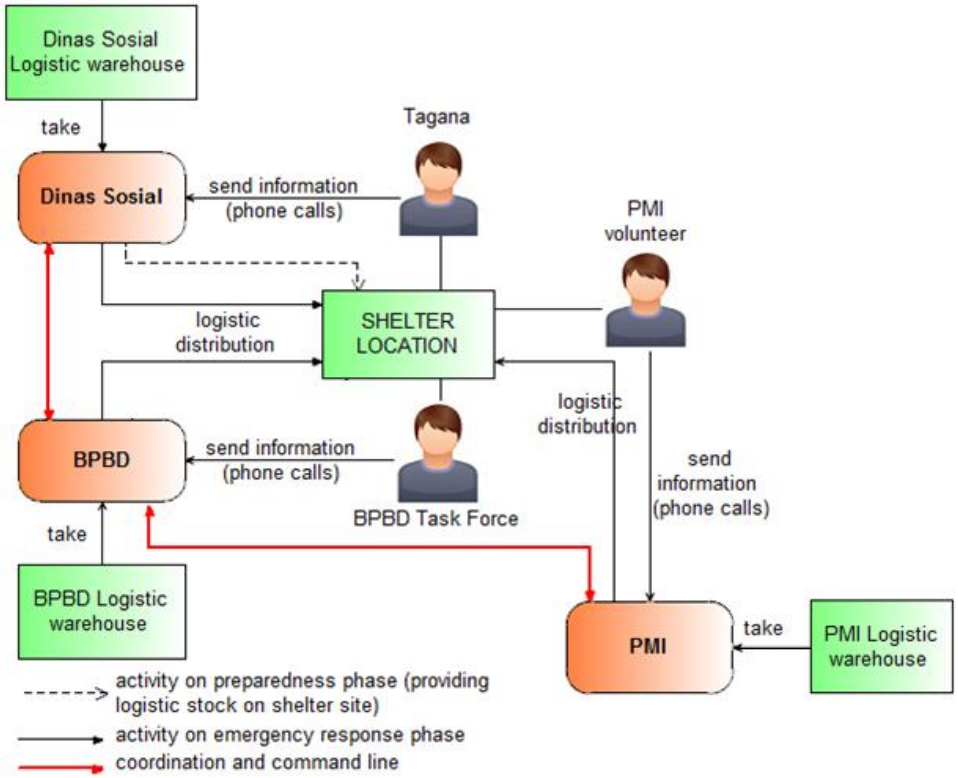

Figure 20. Current system of IDP needs fulfillment

On occurrence of flood, the agencies send their officers to affected area. BPBD has task force that consists of BPBD officer and volunteers from other organizations including Tagana (Disaster Preparedness Youth) from Dinas Sosial, PMI volunteer, SAR member, and fire brigade member. The volunteers work with their teams from their organizations under coordination of BPBD.

Task force on shelter location provides information of IDP condition and reports it to BPBD. Tagana and PMI volunteer also report the information to Dinas Sosial and PMI respectively. Information consists of shelter location, data of household number, and data of IDP number in detail such as number of male, female, children, babies, elderly and disabilities. The report is given every 30 minutes or 1 hour using mobile

phone and HT (handy talkie) because it is based on changes in the number of IDPs. The process of IDP recording starts from local administration officers. Village officers or subdistrict officers in shelter location record the IDPs. Hereafter, the officers give the data of IDP to BPBD task force who proceeds the data to the institution.

Task force including Tagana and PMI volunteers sends the data to their agencies. Based on this data, the agencies prepare logistics to be distributed to the shelter. Each of them calculate the logistics and adjust the type of logistics according to their stock in their warehouses. BPBD and Dinas Sosial prepare food and sleeping equipments, while PMI prepares medicines and special needs such as baby kit, family kit, and menstrual pads. Before the logistic distribution, Dinas Sosial and PMI coordinate with BPBD to ensure the logistic needs are suitable with the IDP needs on designated shelter location.

At the first time after people evacuate to shelter location, usually there is group of community that prepares food for the evacuees. This group consists of women from subdistrict area. They cook using public kitchen equipments prepared by Dinas Sosial and their own utensils. The food is for once or twice meal time before logistic needs from agencies arrive on shelter location.

The agencies provide logistic needs for one day. The first logistic needs sent to shelter location are basic and urgent needs. These needs have to be sent as soon as possible to help the victims survive. Based on changes of IDP structure and condition, BPBD coordinating with other agencies will distribute additional needs for the next day. Annual flood usually force people to evacuate for 1 to 2 days. However, on severe condition people have to stay on evacuation shelter for more than 3 days. On this condition, BPBD will build communal kitchen on the third day with consideration that people have to stay for longer time.

4.2 Perceived Deficiencies

The current system of fulfilling IDP needs has been helpful either for the institutions to coordinate or for flood victims to receive basic needs they required. Nevertheless, during interview some information related to real condition and shortage of victims need fulfillment was arising.

Several people who have ever experienced as flood victims and evacuees thought that the logistic assistance from government still needs time to reach them immediately after flood strike their area. In some cases, they had to wait for one day to obtain the logistics they expected. During period of waiting the logistic assistance, community support themselves by preparing any basic needs such as food and clean water by themselves. On one hand, community resilience towards possible hazard is one of government's programs to strengthen community on hazard prone area so that

they can survive and support themselves during critical time. The realization of community resilience is *Kampung Siaga Bencana* (Disaster Resilient Village). Through *Kampung Siaga Bencana* program, society is trained to deal with impending hazard by utilizing potency and resources own by them. On the other hand, some society groups still do not have the ability to withstand a certain level of danger that strikes them. In reality, although people can save themselves and survive from hazard, they still need logistic support from other sources to support their life. Consequently, they need assistance to be sent as quickly as possible.

Another deficiency of the current system is misconception on coordination process. Coordination on the first step is communication among agencies to report evacuee condition and their needs. The next step is to decide type and amount of the needs. In this step, sometimes an organization simply assumes that certain types of logistics are the responsibility of other agencies. Because of this misconception, sometimes there are discrepancies or flaws in logistic distribution. Although this shortcoming can be adjust, this is still need time to be surmounted.

4.3 User Requirements for Emergency Information System

Developing a new system should accommodate user perspective and requirements. User-centered design (UCD) is an approach applied in this research for developing the system prototype. In UCD method, targeted users are involved in every step of web development. System requirements are built based on user needs, interface design adjusted to user needs, and implementation is also conducted after system meets user requirements. Therefore, user requirements are important on designing a system. Andersen (1983) explained that implementing user needs and requirements on new product development can cause the success of the new product. New product should not only technically improve but also socially accepted.

To collect data of user requirements for emergency information system, questionnaire (Appendix 2) was used as a tool. The questionnaire was modified from Template for Need Assessment Questionnaire (HCI Group, n.d.) which is prepared for Human Computer Interaction (HCI) course provided by HCI group, part of EPFL, the Swiss Federal Institute of Technology in Lausanne. The questionnaire template is intended for the need assessment of a new software or website.

The questionnaire consists of four parts covering users' experience and system requirements. The four parts are experience of respondent, experience in IDP need fulfillment, web-based information system, and infrastructure. From the questionnaire, there are various needs of information that should be displayed on the web information system (Figure 21). This result is closely related to the role of each respondent on logistic need fulfillment.

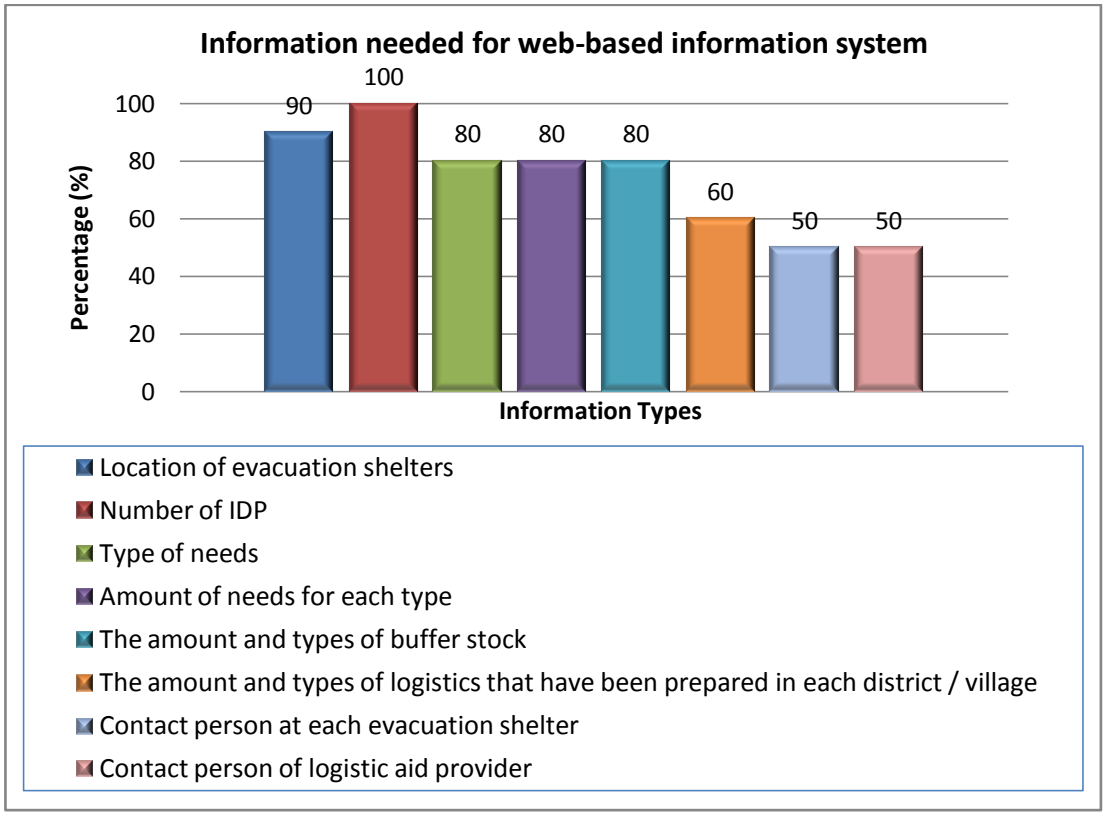

Figure 21. Diagram of identification of information needed for web information system (source: primary data)

From diagram above, information of IDP number was selected by all respondents meaning that this information is much required. One respondent of PMI did not select other options of information needed beside Number of IDP because of his task to collect data in the field. He prefers to choose only data of IDP based on his experience and need. A respondent from BPBD suggested that the web presents information of IDP number in detail. She preferred the information explaining the number of male, female, babies, elderly, pregnant women, disabilities and so on.

Furthermore, there was only one respondent who did not choose information about shelter location. Information about type of needs, amount of needs and buffer stock were selected by eight respondents. Amount and types of logistic stock in shelter location were not too concerned by respondents. Moreover, contact person for people at either shelter location or logistic provider gained the least choice. Only half of the total respondents thought that contact persons should be displayed on the web information system.

Infrastructure part of the questionnaire gives result that there is internet connection in BPBD, Dinas Sosial and PMI. BPBD has internet installation on the office using LAN (Local Area Network). Meanwhile, Dinas Sosial, PMI and SAR do not have internet installation but they use portable modem for internet connection. There are more than 4 active internet users in those agencies. Each agency has its own web

portal and they claimed that there is administrator in their offices who manage the websites.

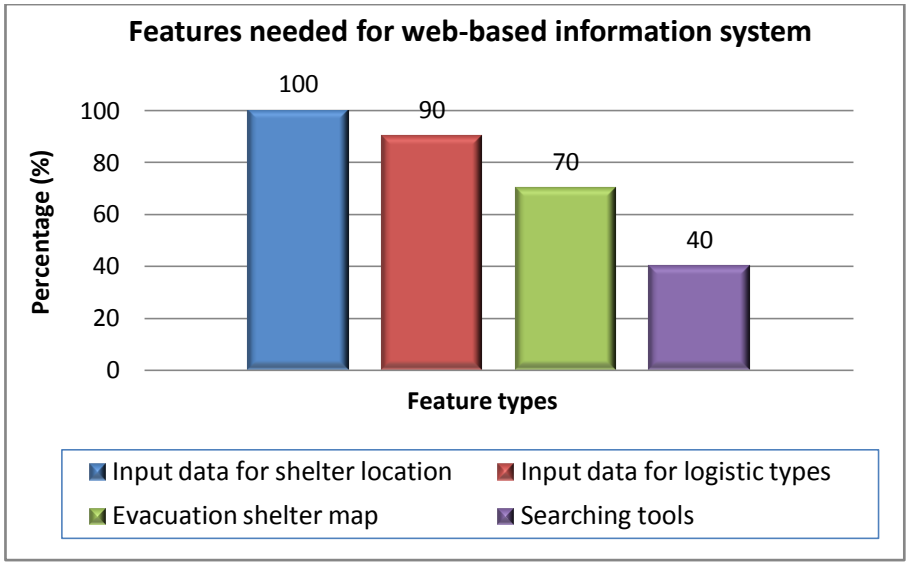

Figure 22. Identification of features needed for web information system (source: primary data)

There are various responses of web features (Figure 22) for the web information system. Features offered for web information system are input data for shelter locations, input data for logistic types, evacuation shelter map, and searching tools. All respondent agree that input data for shelter location is needed in the web. One respondent did not think that feature of input data for logistic types are needed. Moreover, there are three respondents that do not take evacuation shelter map feature as their concern. However, the other seven respondents agree that shelter map is needed in the web. Lastly, less than half of the respondents gave attention to the need of searching tools.

During need assessment process, some respondents gave suggestion about other features that they preferred to be accommodated by the web. The features are profile of institutions, detail information of shelter (clean water, toilet, the existence of communal kitchen, and accessibility), download and print facility for table of need, and facility for replying or sending SMS from administrator. The latter is intended to spread urgent information related to flood condition, logistic distribution, and other information from main administrator to contributors in the field.

5. Developing System Prototype

5.1. Proposed EIS Components

Emergency Information System proposed in this research focuses on providing information of needs for flood victims at the first time after flood occurred by utilizing SMS gateway, RDBMS, and OGC standard for displaying maps. SMS gateway has function as communication bridge between SMS senders and the system, RDBMS is used to manage databases for the system, and OGC standard is applied on displaying maps in order to allow exchangeable maps among different applications.

Proposed EIS offers components with regard to existing EIS application, EIS development and EIS components as discussed on section 2.3 and 2.4. Components of proposed EIS are classified into four groups as elaborated below.

1. Applications
   EIS includes four main features to manage the system works. Each feature has function related to specific task.
   - *SMS gateway*
     SMS gateway is used to receive SMSs, both predefined (section 3.7) and general SMSs, sent via mobile phones and store the SMSs in system databases. This is also used to send SMS from system to specified phone numbers. System uses existing SMS gateway application named Gammu[2]. Gammu is equipped with a database named **smsd**. This database is connected with system database for store, retrieve, and inject SMSs.
   - *Map layers*
     Maps displayed on system interface utilize OGC standards so that maps can be exploited by any institution. OGC standards applied in maps are WMS and GML (section 2.5). Tools used for constructing the maps are Geoserver[3], Google Maps API version 3[4], openLayers[5], and postGIS[6].
   - *Needs conversion*
     Needs conversion has function to convert predefined format SMS into basic needs and special needs by calculating IDP numbers from SMS and need conversion table in DBMS.
   - *Institution stock changes*
     This feature manages stock data on institutions including addition, subtraction, and mutation of stocks. Mutation process involves Need

[2] http://wammu.eu/gammu/
[3] http://geoserver.org
[4] https://developers.google.com/maps/documentation/javascript/
[5] http://openlayers.org/
[6] http://postgis.net/

Conversion feature which define mutation from institution warehouses to particular shelters. Moreover, the changes in stock can be provided to institutions' managers as reports in excel format.

2. Infrastructure

To build the EIS, it needs hardware support as it connects several institutions, manages data, and utilizes real-time communication. Infrastructure endorsement entangles some devices as shown on Figure 23.

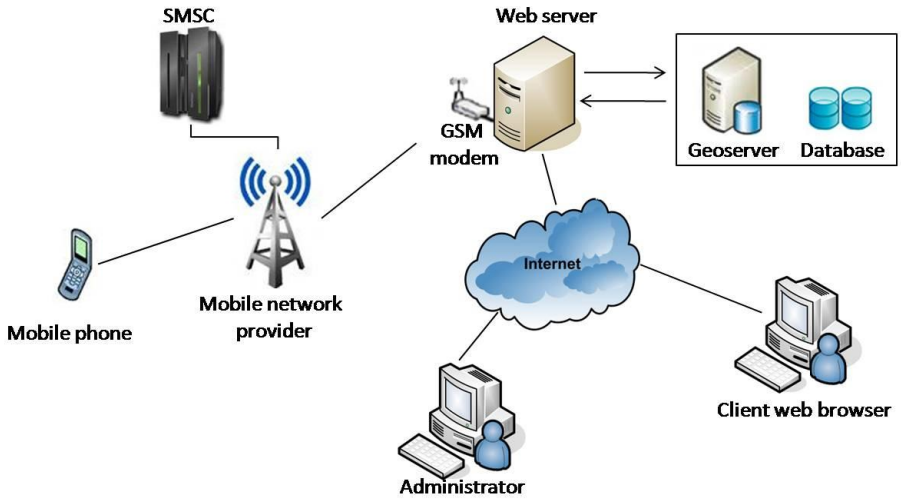

Figure 23. EIS general overview

For communication utilizing SMS, it uses GSM modem connected to server PC which has connection to internet. After GSM modem receives SMSs from mobile phones, SMS gateway draws the SMSs and stores them to system database.

The sytem requires specific conditions especially at the time of flood occurence in order to ensure that the system can still function well. These conditions are beyond the control of the system itself. The context requirements needeed by the system are:

- There should be backup electricity power to support hardware in case of power outages.
- Internet connection is absolutely necessary to connect all the institutions to the system.
- Signal of mobile phone communication network from network provider BTS (Base Transceiver Station) must be available.

3. Data

Data is a main part in a system as it comes from many sources and is used to give reliable result. RDBMS manages data for EIS. Existing shelters' coordinates are collected and inputted into database. Shapefiles collected from some sources are used to construct OGC standard maps such as administration map, WMS map, and hazard prone area map including shelter map. Lists of logistics provided by institutions are also entered equipped with conversion estimation for specific

logistics and IDPs. Logistic stock data of some institutions have been added as well.

4. People
   The proposed system needs involvement and cooperation of officers from engaged institutions. At least one person from each institution is needed to be an administrator to ensure that system functionality is going well.

5.2. Conceptual Design

The conceptual diagram of the web on Figure 24 presents the overview of the EIS workflow. The system will receive two kinds of information from contributor: emergency information and IDP structure. IDP structure is combination of numbers that represents number of IDPs based on determined age groups. Emergency condition will be sent via phone calls and SMS while IDP structure information will be sent via predefined format SMS. Those data will be forwarded into system database using two ways: SMS gateway and web administrator control.

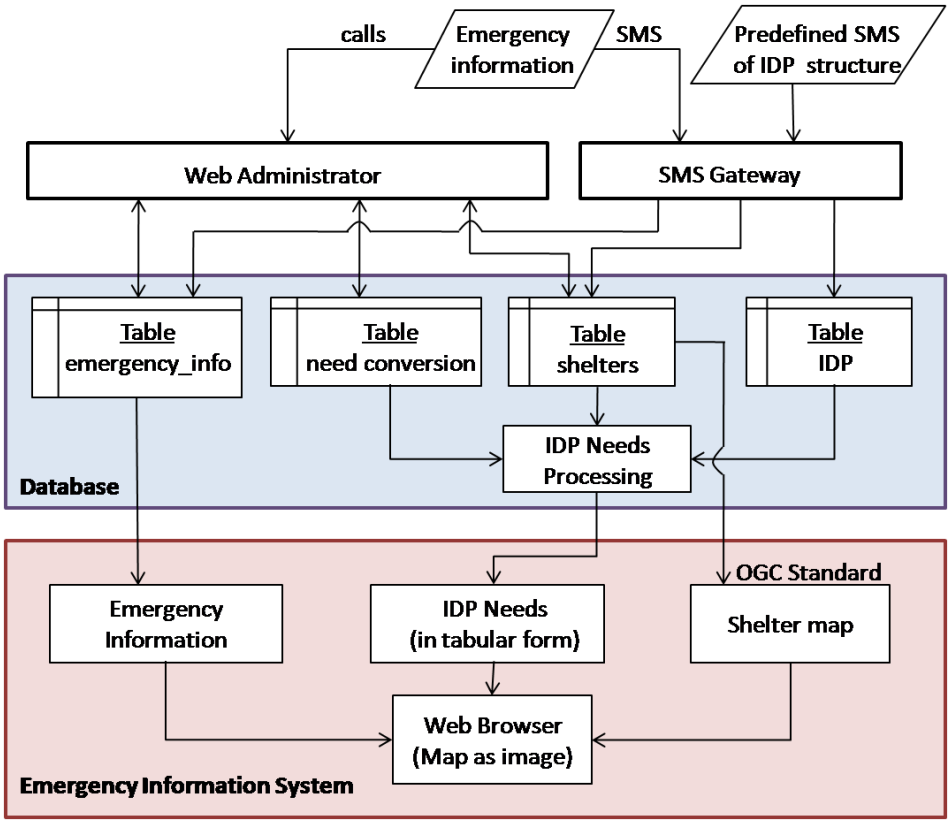

Figure 24. Conceptual design of displaying IDP needs on EIS

System will extract IDP needs based on predefined format SMS and needs table in database. Firstly, system identifies number of IDPs from predefined SMS and inputs the data into IDP table. Further, system extracts the needs by calculating number of IDPs and need conversion from needs table. Data from database will be presented in the web as emergency information and IDP needs. IDP needs are showed in tabular format.

5.3 Use Case Model

Based on user need assessment, the needs of the users for new system had been identified. The system will accommodate the need to provide information of IDP needs and emergency condition. Explaining system architecture will be done using Use Case Model of Unified Modeling Language (UML[7]) as outlined in (Larman, 2002). Use case modeling in this chapter follows requirements explained in (Larman, 2002).

5.3.1 Use Case Description

System accepts SMSs which consists of flood emergency information or general information from contributors. This type of SMS does not follow predefined format. Before the information from the SMS displayed on the web, the SMS should be validated first. It means administrator should approve the SMS. Validation of this SMS is only for the content. Administrator does validation process on authorized user interface.

Beside SMS info, system receives predefined SMS from contributors at shelters. Further, system will validate the SMS comprising phone number, format of the SMS, and shelter code. Sender's phone number must be registered in the system in order to allow system receives the formatted SMS. Further, system checks format of the SMS. There are only two formats recognized by system that are full format and simple format (subsection 4.6). If format follows the predefined format, system will check shelter code on the SMS. If the code of shelter is not correct, system will predict the code using spelling error combination. After all validation steps are completed, system calculates needs using IDP data from the predefined SMS. The needs must be approved by administrator and then it displays on the web.

Calculation process utilizes data from database which are conversion, shelter stock, and institution stock. Institution stock is controlled by each administrator from BPBD, Dinas Sosial and PMI. Each administrator only controls stock data of his institution. For instance, PMI administrator just manipulates data of PMI stock and cannot manipulate BPBD and Dinas Sosial stocks. Administrators need to login previously to manipulate data in system database. Furthermore, BPBD administrator is the only administrator who has full control toward database. Beside institution stock, BPBD administrator has authority to create, update and delete data of stock shelter, logistic type, shelter data and administration data.

Public users can access information about logistic needs per shelter, number of IDP per shelter, shelter information and information SMS from the web. Public user clicks shelter location on shelter map on the web. As a result, a pop-up window

[7] UML is a modeling language for designing, describing, visualizing, and documenting software using standard graphic notation (Larman, 2002). UML had been associated with object oriented programming/software engineering.

displaying data appears. This window presenting data and information of logistic needs, number of IDP, and shelter information. Furthermore, public users can read emergency information from SMSs on the web home page.

5.3.2 Use Case Specification

Figure 25 depicts architecture of the system using use case diagram of UML (Unified Modeling Language) as outlined in (Larman, 2002). Use case diagram has function to show interaction between actors and the system to attain specific goal. Actors are users, organizations or external system that will make use of the system. Use case diagram explains what actions executed by the system. It depicts functionality of the system.

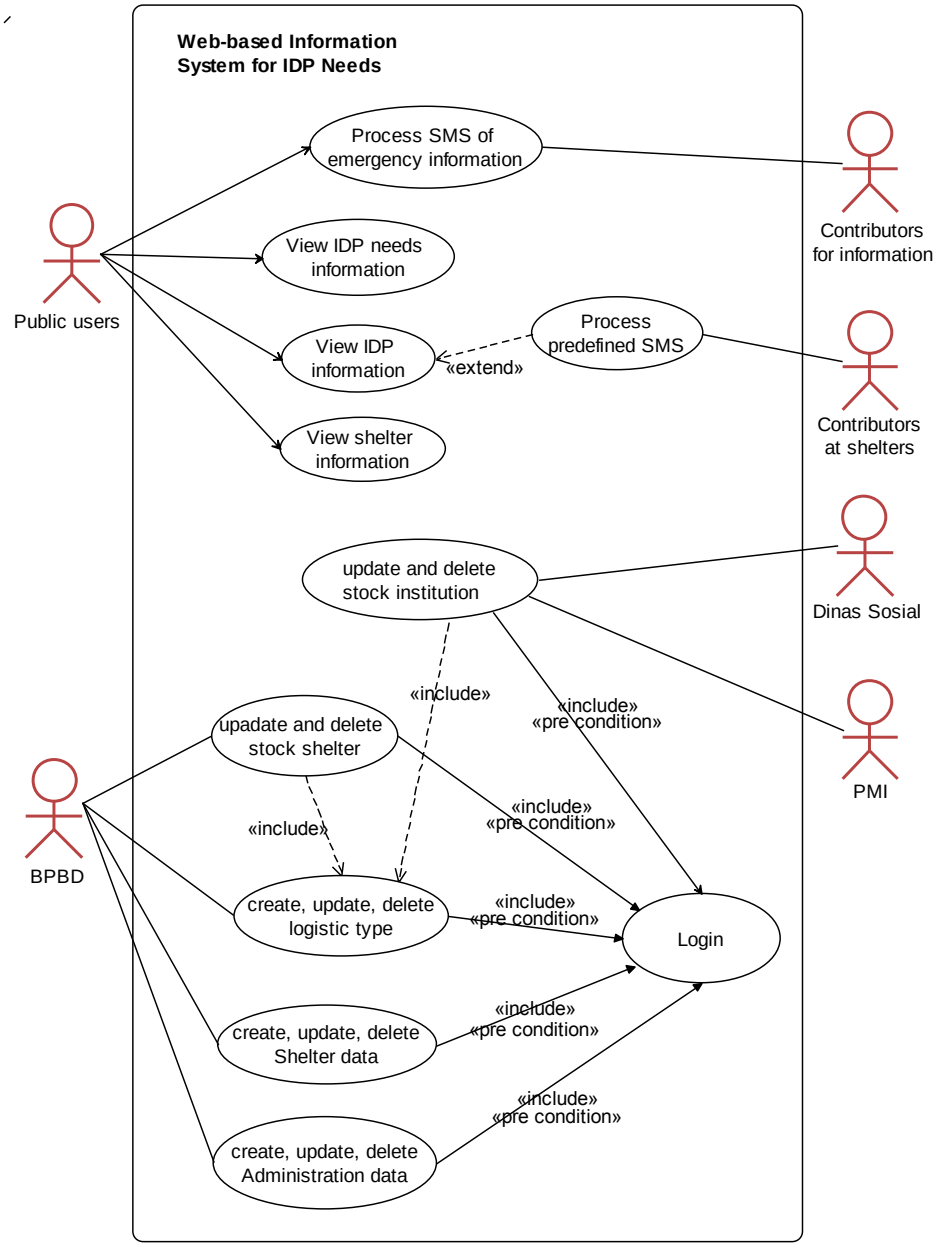

Figure 25. Use case diagram for web information system

A. Specifications

1. *Primary Actor*: BPBD admin, as super admin, has full access to manage the web including input data and validate SMSs.
2. *Stakeholders and Interests*:
   - Dinas Sosial admin: inputs stock data of Dinas Sosial and creates report of Dinas Sosial stock data
   - PMI admin: inputs stock data of PMI and creates report of PMI stock data
   - Contributors at shelters: sends formatted SMS containing data of IDP to the web from shelter locations
   - Contributors for information: wants to send information via SMS about flood related condition in Sukoharjo.
   - Public users: wants to access information of IDP numbers, logistic needs, shelter condition, maps and other information contained in the web
3. *Preconditions*: BPBD admin must login and be authorized. BPBD admin must approve SMSs. All admins must approve stock mutations.
4. *Success guarantee (postconditions)*: Information of IDP needs per shelter is correct. Information of aids support (amount, sources, fulfilled, shortage) appears clearly. Maps can be displayed correctly and gives the right information when user clicks on specific area or point.

B. Main Success Scenario (Basic Flow)

1. Contributor sends predefined SMS from shelter A to existing system number.
2. System accepts the SMS and sends a reply SMS mentioning that SMS has been received and will be processed further.
3. System stores the SMS in database with unapproved flag.
4. Super admin approves the SMSs. The flag changes as approve flag.
5. System automatically calculates basic needs and special needs based on data in the SMS using table conversion.
6. Result of need calculation is stored in table calculation with unmet flag.
7. System calculates required needs. The result displayed on the public user interface.
8. Administrators (BPBD, Dinas Sosial, PMI) check needs on shelter A. Furthermore, they decide what and how many needs they would provide and input the type and amount of needs support in the system. Super admin has right to provide additional information related to logistic needs fulfillment. The additional information would appear on IDP Data tab.
9. System calculates required needs, fulfilled needs, and shortage needs.
10. Public user clicks point of shelter A on shelter map in the public user interface and reads detail information of needs on shelter A.

C. Extensions (Alternative Flow)

2a. System does not recognize sender number as a valid number for sending predefined SMS:
   1. System refuses the SMS.

2b. System does not recognize either shelter_code from the SMS:
   1. System sends an error message to sender mentioning that shelter code is incorrect.

3-4a. Super admin has approved the SMSs but then receives newer predefined SMS from the same sender number or receive another SMS informs that the previous message was not valid:
   1. Super admin cancels the first recieved SMS. System signs the SMS as unapproved.
   2. Super admin approved the latter predefined SMS. System marks the SMS with approved flag.

5-9a. In case of super admin does not agree with result calculation from the system, e.g. the amount of logistic items:
   1. Super admin checks and changes input data on table calculation and reset system for recalculation.

D. Special Requirements

- Computer connected with GSM modem should be online 24 hours especially on critical condition of rainy season and notably at flood occurrence.
- Super admin must check incoming SMS periodically on critical condition.

E. Technology and Data Variations List

2a. GSM modem used by the system to catch and send SMSs must be included in the list of modems supported by Gammu.

F. Open Issues

- Explore the possibilities of adding subdistrict officers as contributors at shelters that submit predefined SMSs.
- Explore the possibilities of changing predefined-SMS-contributor's phone number in tight time.
- What customization should be executed to handle different level of technological awareness of contributors for predefined SMS?

5.4 Data Flow Diagram

Data Flow Diagram (DFD) is diagram model useful to illustrate the flow of data in a system. DFD describes the source of data, what process is used toward the data, and where the data will be stored. As DFD shows the flow of data, it does not explain process timing or sequence of process. DFD for the web information system begins from context diagram which is later broken down into more detail diagrams (Tao

et.al, 1991). The depiction of DFD in this section uses model developed by Gane and Sarson (Gane et.al, 1979).

5.4.1 Context Diagram

Context diagram is the top level of DFD. It describes the flow of data from external entities get into and out from the system (Ibrahim et.al, n.d.). In context diagram, there is only one entity of the system that comprises all processes in the system. Context diagram for the web emergency information system is depicted on Figure 26. There are five external entities connected directly to system processes. Each entity has data flowing to the system. The system also sends data out to external entity.

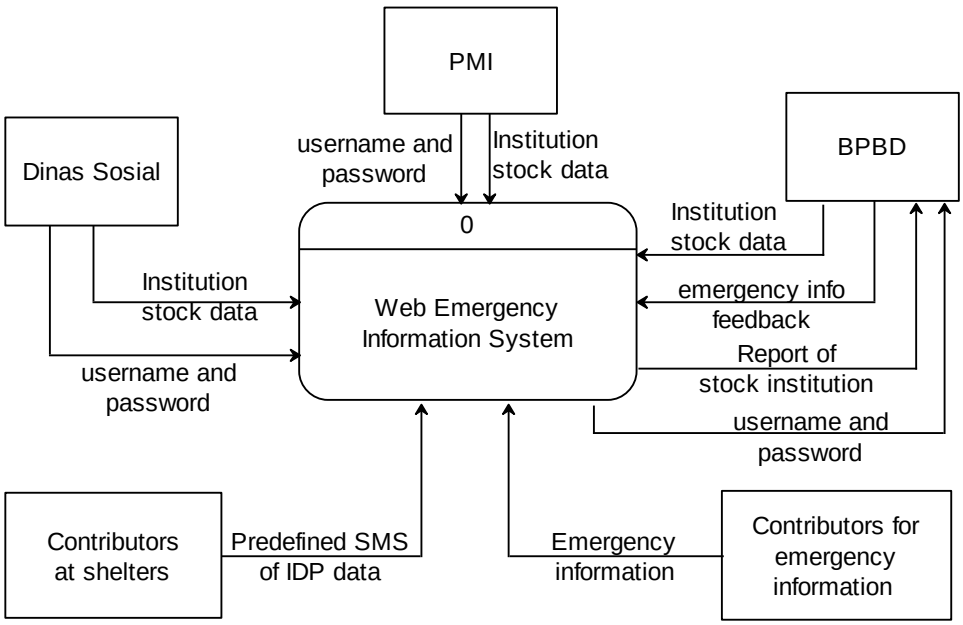

Figure 26. Context diagram of web emergency information system

5.4.2 Level 0 DFD

Based on context diagram, the system is exploded into six processes. Figure 27 shows level 0 DFD which displays processess included in the Web Emergency Information System entity. The processes are Check Predefined SMS, Calculate Needs, Transfer Stock, Login, Making Report, and Process SMS Info. Furthermore, there are ten data stores and five terminators or external entities. Based on Figure 27, processes that involves external entities directly are Login, Transfer Stock, Making Report, and Process SMS Info. The other two processes are executed by system functions.

1. Check Predefined SMS

   Checking of predefined SMS will be done when there is SMS from contributors at shelters. System needs data from phonebook, shelter and spelling_error tables to validate the incoming SMS. If the SMS is valid, data of IDP number will be store in IDP table. This process is done without interuption from external entities.

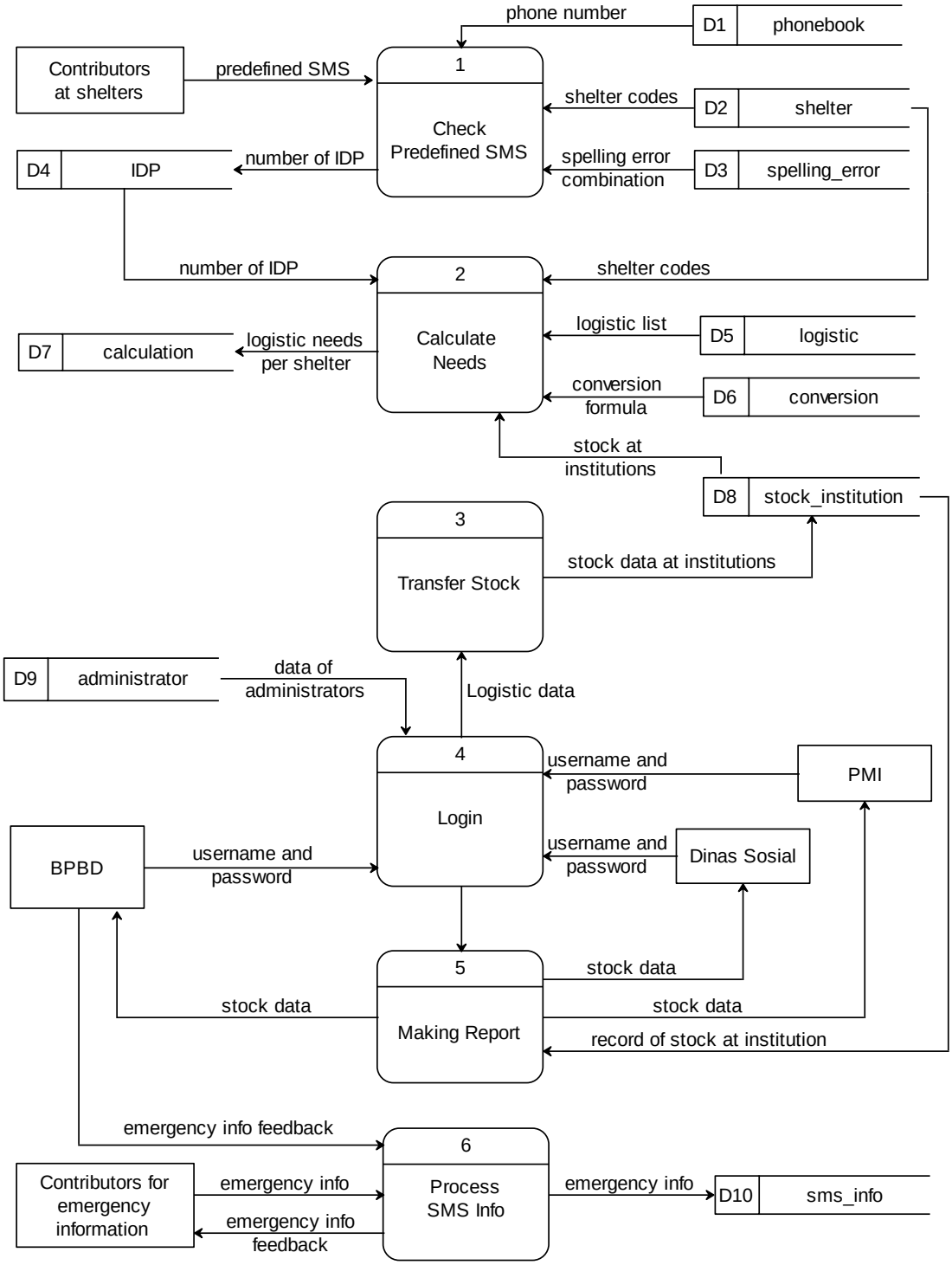

Figure 27. Level 0 DFD of web EIS

2. Calculate Needs

Calculate Needs process is also done by system function. This process takes data from several data stores to calculate needs of IDP. The data stores are shelter table for identifying shelter location that need aids, logistic table for listing types of aids, conversion table for taking the calculation formula, IDP table for

identifying number of IDP, and stock institution table for calculating the amount of the needs to be sent to the shelter. Needs for a particular shelter that is displayed on the web is calculation result stored in calculation table.

3. Transfer Stock
   Transfer stock process records number of stocks that have been delivered from institutions to shelter locations. Each institution administrator controls his institution stock movement.
4. Login
   All administrators should login into system to access the system and manipulate process and database of the system. Processes such as Transfer Stock, Making Report, and Process SMS Info require administrators to login into the system previously.
5. Making Report
   Only Institution administrators who can generate stock report of their institution by acquiring data of stock movement.
6. Process SMS Info
   This process is controlled by BPBD administrator. System receives data of emergency information from contributors and store it in sms_info data store. If BPBD admin found it important to provide feedback information to contributors, he has the authority to send SMS replies.

Each processes described above is explained in the more detail diagram at level 1 DFD. Diagrams of level 1 of the processes are shown on Appendix 4.

5.5 User Priviledge Distinction

Authorized and public users are expected end users of the emergency information system. Nonetheless, the limitation to access the information system is different for both of them. Authorized users will have full access to the system while public users will have limited access.

Authorized users are restricted to particular people. They have username and password to login into the system. Authorized users have privileged to control data in database (create, read, update, and delete) as shown in Figure 28. Unlike authorized users, public users cannot modify data in database. They have limited ability to only read data or information without being able to modify it. Therefore, both users will have different user interface regarding data modification.

Authorized users are distinguished into full administrator and restricted administrators. Full administrator is from BPBD who has full access to the system and manipulate the database. Meanwhile, restricted administrators are from Dinas Sosial and PMI who have restricted access to manipulate the database. Administrator from Dinas Sosial and PMI will only have privileged to manipulate data of institution stock.

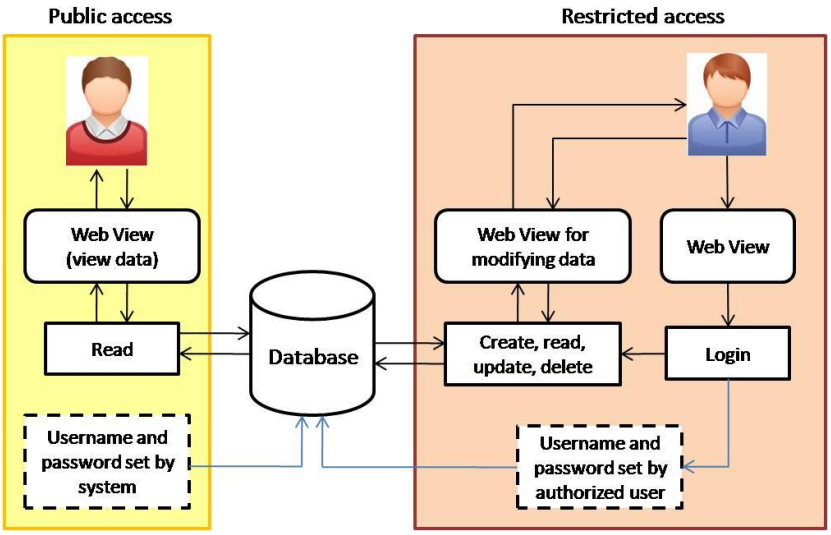

Figure 28. Public access and restricted access

5.6 Implementation

5.6.1 Database Implementation

Database servers used by EIS are MySql and PostgreSQL/PostGIS. MySQL database server is used for system databases, including smsd database for SMS gateway (discussed on section 5.6.2), and PostGIS is used for storing dynamic spatial data. The dynamic spatial data is coordinate data for shelter locations. Algorithms used to do data manipulation on the databases are discussed below.

Reading predefined SMS, SMS info, and spatial data

System receives predefined SMS, either full format or simple format, and processes it to calculate the needs. System will define whether the SMS is full format or simple format SMS or only regular SMS. If it is predefined SMS, system further checks if the sender's phone number is registered in the database. If this requirement fulfilled, system checks shelter code in the SMS (Listing 1). If shelter code is correct, system will calculate the needs directly, otherwise system will checks shelter code from spelling error code data (Listing 2). Spelling error code data is lists of possible error spelling for each shelter code. This data is entered by admin by predicting error code possibilities. If the shelter code is included in spelling error code data, system can continue to do calculation. Firstly, data of IDP number is inserted into table **idp**. Secondly, number of IDP is calculated with needs formula from table **conversion**. Lastly, the calculation result is saved into table **calculation** which further will be displayed on EIS web. Procedures to read predefined SMS and calculate the needs are covered in Appendix 5.

Listing 1. Function to check shelter code

```
function check_shelter($code){
    global $database;
    mysql_select_db($database);
    $result = mysql_query("select * from shelter where
    shelter_code='$code'");
    if (mysql_num_rows($result)>0) return true; else return false;
}
```

Listing 2. Function to check shelter code using spelling error checking mechanism

```
function check_spelling($code){
    global $database;
    mysql_select_db($database);
    $result = mysql_query("select shelter_code from spelling_error
    where error_code='$code'");
    if (mysql_num_rows($result)>0) {
       $line=mysql_fetch_array($result);
       return $line[shelter_code];
    }
}
```

Besides predefined SMS, system also receives regular SMSs or general text messages containing information of flood related condition. System recognizes an SMS as regular text message or SMS information if it does not follow requirements to be recognized as predefined SMS. When an SMS is identified as SMS information, the text will be saved into database and displayed on EIS web. Function to receive sms information is shown on Listing 3.

Listing 3. Function to check shelter code using spelling error checking mechanism

```
function sms_info($teks,$phone){
    global $database;
    mysql_select_db($database);
    mysql_query("INSERT INTO sms_info
    (ReceivingDateTime,SenderNumber,TextDecoded,Status) VALUES
    (now(),'$phone','$teks','false')");
}
```

Shelter points are spatial data stored in PostGIS database. To display shelter points on EIS web, system calls shelter data from PostGIS in “geom” field which stores geometry data. Procedure to call the data is presented in Listing 4. Shelter map is generated as GML format because some part of the shelter data is stored in MySQL whereas Geoserver does not support to access this data. The GML is actually generated using PHP which is some information retrieved from MySQL and some other from PostGIS.

Listing 4. Procedure to retrieve shelter coordinates from PostGIS database

```
for($i=0;$i<pg_numrows($res);$i++)
    {
        $id=pg_result($res,$i,0);
        $geom=pg_result($res,$i,1);
        $geom=str_replace(" ",",",$geom);
```

```
        $nama=pg_result($res,$i,2);

        //format GML
        echo '<gml:featureMember>
        <ogr:shelter fid="F'.$i.'">

        <ogr:geometryProperty><gml:Point><gml:coordinates>'.$geom.'</
        gml:coordinates></gml:Point></ogr:geometryProperty>
        <ogr:id>'.$id.'</ogr:id>
        <ogr:nama>'.$nama.'</ogr:nama>

        </ogr:shelter>
        </gml:featureMember>';
    }
```

Using the program, a test was held to check the result of predefined SMS received. The SMS was sent following full format intended to Grogol subdistrict office as shelter location. The result is shown on Figure 29 where the number of IDPs is distinguished to each age group.

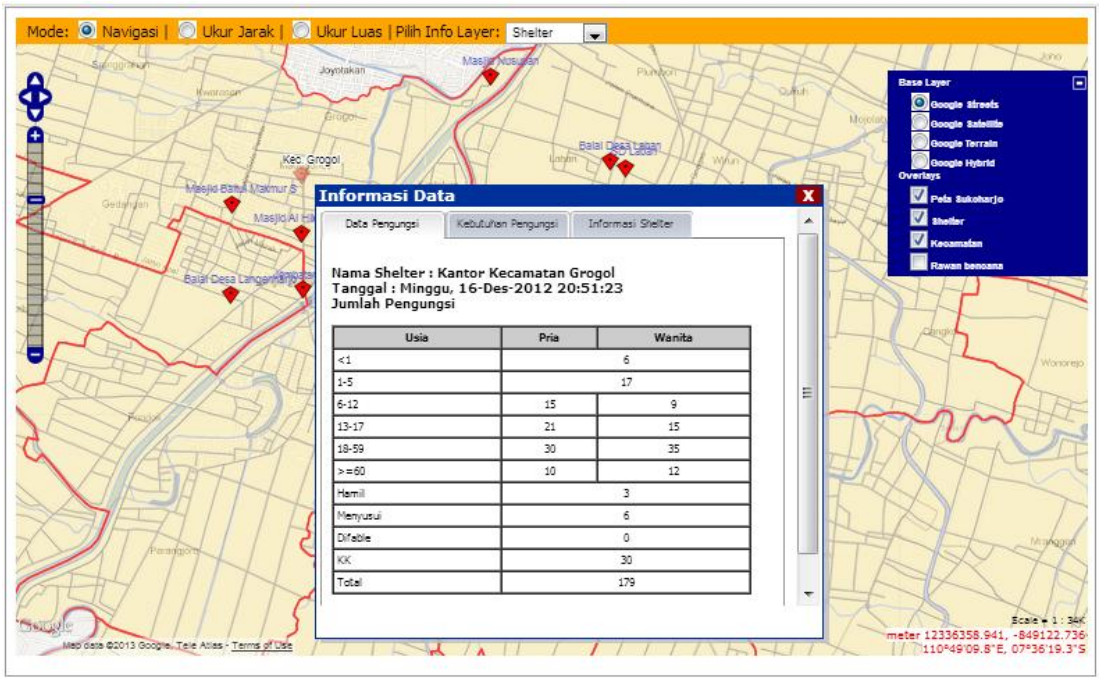

Figure 29. Information of IDP number based on predefined SMS received by EIS system

Logistic stock process

Stock process is process to manage changes of institutions' stock data which is composed of add stock data, transfer stock, and subtract stock. This process is controlled independently by the three administrators. Each administrator has authority to process data of his institution only. The scripts to execute those processes are shown on Appendix 5. Notice that substraction process can be caused by transfer stock or expenditure of warehouse stock for purposes other than aid for

flood victims. Figure 30 shows window for adding logistic stock data from administrator webpage.

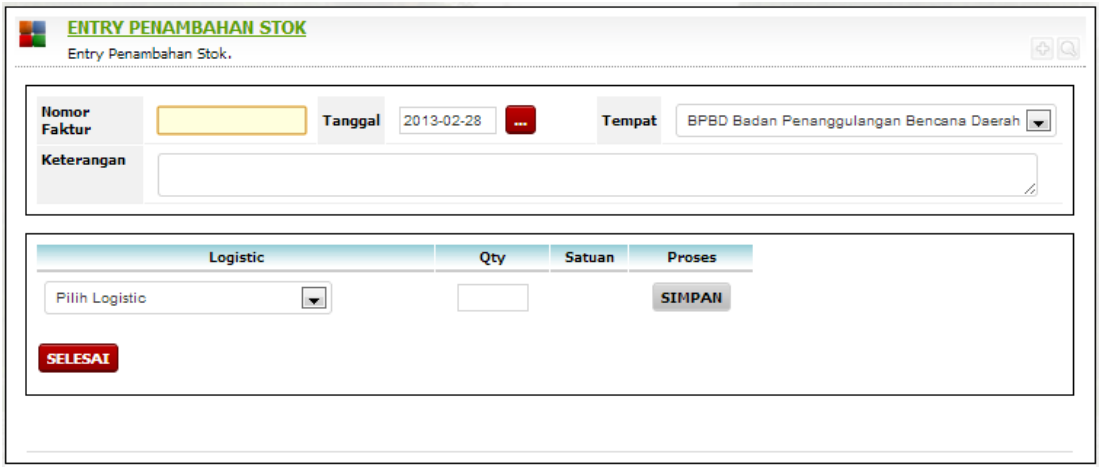

Figure 30. Adding Stock page for administrator

5.6.2 SMS Gateway using Gammu

Software application for SMS gateway used in this research is Gammu (GNU All Mobile Management Utilities). Gammu is free software built under GNU GPL (General Public License). It is developed based on project from Gnokii (www.gnokii.org) and MyGnokii (www.mwiacek.com) created by Marcin Wiacek and others[8].

Gammu is an open source command line utility that can be used to connect cellular phone providers to internet and conversely. It can be functioned on Windows as well as Linux operation system. Gammu package provides binary functions, Gammu SMS Daemon and Gammu library. Moreover, Gammu supports cellular phone and GSM modem from various manufactures. Gammu version used for this research is Gammu for Windows and modem used is ZTE MF 190 which is supported by Gammu[9]. To use Gammu SMS Gateway, configuration setting for hardware and database of user application should be done. Gammu has prepared configuration files for this purpose which are gammurc and smsdrc (Figure 31 and Figure 32).

In gammurc file, configuration set for modem is port and connection (Figure 31). Port indicates port location in where modem connected to computer. Connection for modem ZTE MF 190 is at115200. It means that connection between computer and modem using AT language with communication speed of 115200. Moreover, in smsdrc file, configuration is set for connecting gammu SMS daemon with gammu database (Figure 32). Content for user and password are followed mysql configuration.

[8] http://wammu.eu/gammu/
[9] http://wammu.eu/phones/zte/

```
8   [gammu]
9
10  port = com5:
11  #model = sony ericsson W200
12  connection = at115200
13  #connection = at921600
```

Figure 31. Modem configuration for Gammu SMS gateway in gammurc file

```
59  # ------------------------ SETTINGS FOR --smsd MYSQL -------------
60  user = root
61  password =
62  pc = localhost
63  database = smsd
```

Figure 32. Configuration for mysql database in smsdrc file

Gammu SMS Daemon, part of Gammu package, is a program that checks incoming SMS regularly from connected GSM modem and sends SMS through the modem to recipients. Gammu package is also equipped with database named smsd. Smsd database functions to store incoming and outgoing messages. In short, smsd database is storage from where SMS Daemon stores and retrieves messages. To use messages in smsd database for user application, smsd is connected with user database. Overview of SMS Daemon work is illustrated on Figure 33.

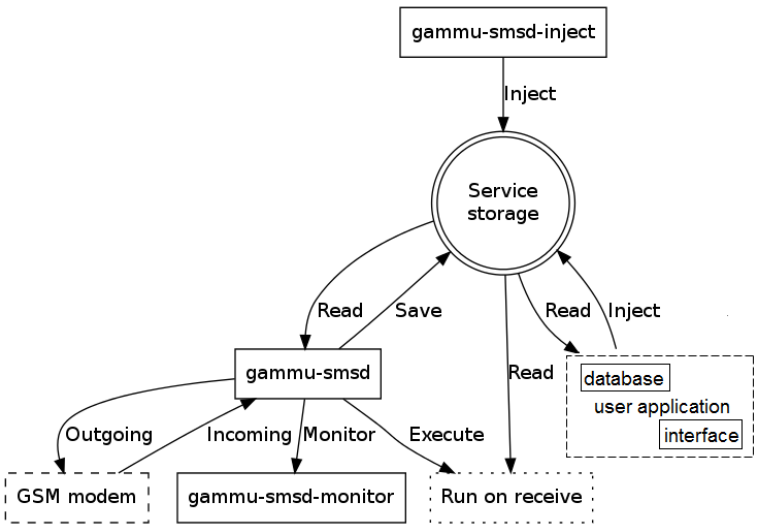

Figure 33. Interaction of smsd (SMS Daemon) with user application (modified from SMS Daemon overall schema[10])

To start SMS Daemon, some command line must be processed (Figure 34). The command lines are "`gammu --identify`" and "`gammu --smsd MYSQL smsdrc`". "`Gammu --identify`" has function to identify phone or modem connected to computer. The second command line has function to activate SMS

[10] http://wammu.eu/docs/manual/smsd/overview.html#overall-schema

service. After processing the command line, daemon configures backend service. The next step is executing message reading through several steps in looping process.

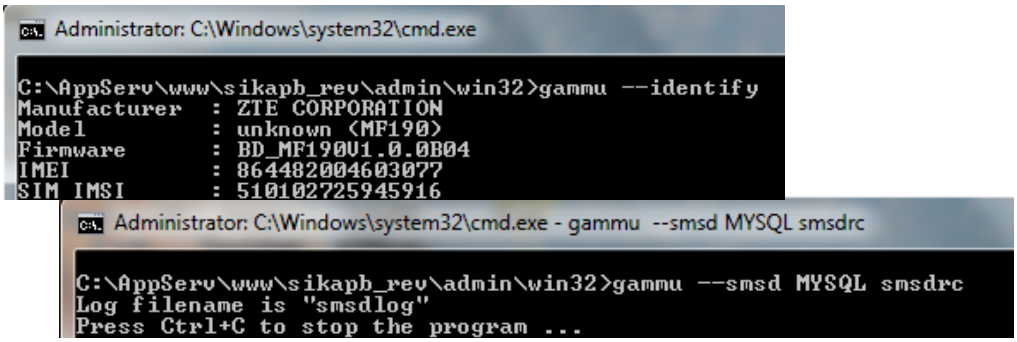

Figure 34. Gammu command lines

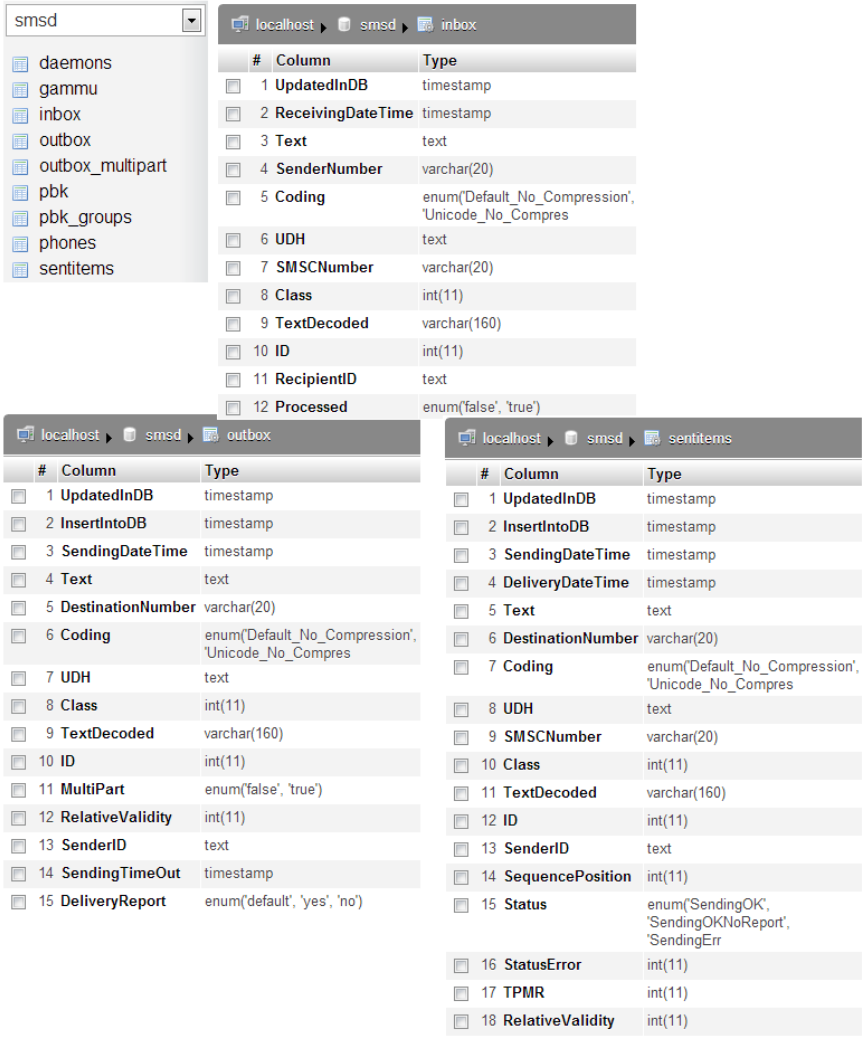

Figure 35. Structures of Gammu smsd database, inbox table, outbox table and sentitems table

To manage SMSs in database, firstly Daemon tries to connect to modem. Further, daemon checks for received messages in inbox table in smsd database (Figure 35). User application reads messages in inbox table and saves them into user database.

User application also prepares outgoing messages in its database. Outgoing messages from user database are injected to outbox table in smsd database. Regularly, SMS Daemon checks for outbox content. Messages in outbox content are sent to recipients via modem. Hereafter, sent messages are moved to sentitems table in smsd database. Message reading process from smsd database by SMS Daemon is executed in recurring basis. If daemon has finished working, backend service is freed.

Build up function to take messages from and inject reply messages to smsd database is shown in Listing 5.

Listing 5. Function to take and inject SMSs between user database and smsd database

```
1   function autorespon(){
2      global $db_sms;
3      mysql_select_db($db_sms,$konek2);
4      $qk=mysql_query("select min(ID) from inbox where Processed='false'");
5      $dk = mysql_fetch_array($qk);
6
7      if($dk[0] > 0){
8          $q = mysql_query("select ID, SenderNumber, TextDecoded from inbox
9          where ID=$dk[0]");
10         $data = mysql_fetch_array($q);
11
12         $send=check_sms_format($data[TextDecoded],$data[SenderNumber]);
13
14         mysql_select_db($db_sms);
15         $qsms=mysql_query("INSERT INTO outbox (UpdatedInDB, InsertIntoDB,
16         SendingDateTime, Text, DestinationNumber, Coding, UDH, Class,
17         TextDecoded, ID, MultiPart, RelativeValidity, SenderID,
18         SendingTimeOut, DeliveryReport )
19         VALUES (now(), '0000-00-00 00:00:00', now(), '',
20         '$data[SenderNumber]', 'Default_No_Compression', '', '-1', '$send',
21         '', 'false', '-1', '', '0000-00-00 00:00:00', 'default')");
22
23         if($qsms){
24            $qup = mysql_query("Update inbox set Processed = 'true' where ID =
25            $data[ID]");
26         }
27      }
28  }
29
```

Function autorespon consists of several steps to retrieve and incorporate SMSs. Line 4 is command to check messages in inbox table of smsd database that have not been replied. Line 12 is used to check format of SMS and the sender phone number. It checks whether there is a hash tag inside a message or not. It aims to separate predefined SMS from general SMS. The messages therefore are moved to user database. Line 15 to 21 functions to insert replied SMS from user database into outbox table in smsd database.

5.6.3 Maps Implementation applying OGC Standard

EIS web displays maps to provide information for users using OGC standard. OGC standards allow other parties to utilize maps on any software or applications without

making further adjustments. Therefore, it is easier for any institution or organization to use the maps provided in the EIS web. OGC standards used for the maps are GML and WMS. Maps presented are Sukoharjo map (using WMS standard) and shelter map, administrative map, and prone area map (using GML standard). Implementation of WMS and GML maps is depicted on Figure 36. EIS uses Google Maps API (Application Programming Interface) version 3 as base map and Geoserver to generate WMS map. The maps are displaying using OpenLayers as map framework.

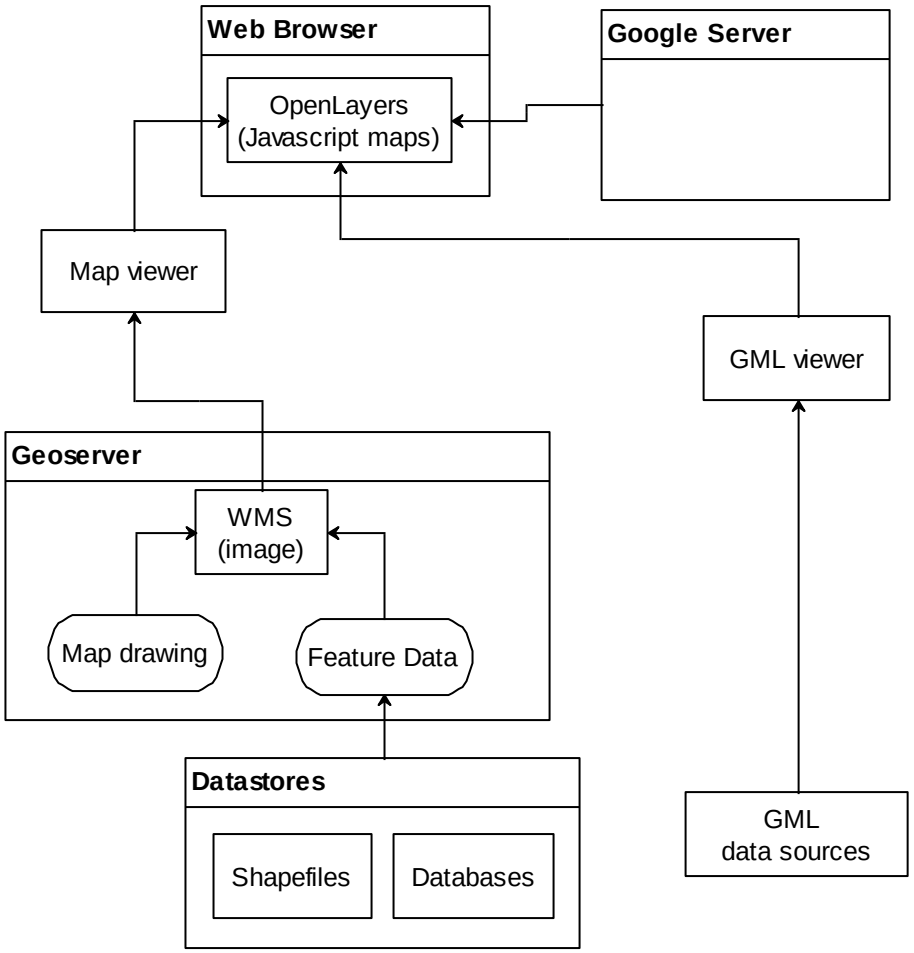

Figure 36. Diagram of WMS and GML maps implementation utilizing Geoserver, Google server and OpenLayers

Google Maps API and OpenLayers

JavaScript Google Maps API is a free service provided by Google that allows third parties to integrate Google Maps service on their website and supports users to display Google Map by requesting map data from database on Google server [11]. Map types offered by Google Maps API are Google Streets, Google Satellite, Google Terrain, and Google Hybrid. Google Streets shows the default road map with road's

[11] http://en.wikipedia.org/wiki/Google_Maps

name, Google Satellite presents images of Google Earth satellite of high resolution aerial photographs, Google Hybrid displays combination of satellite view and road map overlayed on top of satellite view, and Google Terrain depicts physical map based on terrain information.

For displaying map data from either WMS from Geoserver or GML, EIS uses OpenLayers. OpenLayers is a free Javascript API that allows web developers to put dynamic maps on their websites from any map source. OpenLayers support web developers to work without dependencies to map server. OpenLayers allows map formats such as KML, GML, GeoRSS, GeoJSON, and OGC standards as WMS and WFS[12].

To use Google Maps API, user inserts script tag that request map data from Google Server as follows.

```
<script src="http://maps.google.com/maps/api/js?sensor=false".
type="text/javascript"></script>
```

Meanwhile, to utilize OpenLayers functions on the web, the following script is inserted.

```
<script src="openlayers/OpenLayers.js"
type="text/javascript"></sc ript>
```

Requesting Google Maps from OpenLayers is done by adding `OpenLayers.Layer.Google`. Following script adds Google Streets in user website. The `numZoomLevels` defines total zoom levels to be used and `isBaseLayer: true` defines that Google Streets is used as a base map.

```
var gmap = new OpenLayers.Layer.Google(
    "Google Streets", // the default
    {numZoomLevels: 20, isBaseLayer: true}
);
map.addLayer(gmap);
```

Map Projection

Google Maps apply Spherical Mercator projection, also known as Web Mercator, for projections setting. Different from other map projections that view the earth as ellipsoid shape, Mercator projection assumes that the earth is sphere. Mercator projection does not project the real size and shape of objects on the earth as it increases the scale from the equator to the pole. The pole is projected as infinity which causes the pole to be not shown. Therefore, the projection makes distortion of size and shape of large objects. Mercator projection is used by commercial API providers such as Google Maps, Microsoft Virtual Earth, Yahoo Maps, and Bing Maps. Consequently, to overlay user maps on top of Google Maps, the maps should use this projection.

[12] http://en.wikipedia.org/wiki/OpenLayers

A projection for GIS is done by noticing the EPSG code. EPSG is a standard for spatial reference system set by the European Petroleum Survey Group under Oil and Gas Producers (OGP) association. EPSG code for defining geographic coordinate system WGS 84 is "EPSG:4326" which uses ellipsoid principle. It shows the X/Y value of coordinates of latitude and longitude. Meanwhile, Google Maps with its Spherical Mercator has unofficial code of "EPSG:900913". This code presents the X/Y value of coordinates in meter value. Though Google Map uses Spherical Mercator, the coordinates used for objects on its maps applies WGS 84. Because of the difference in projection usage, maps using WGS 84 patched on top of Mercator sphere projection map are not perfectly patch especially for local scale.

Maps presented on EIS web such as shelter map, subdistrict map, and prone area map are derived from shapefiles which use coordinate system (datum) WGS 84. Since the base map used is Google Maps, these maps are reprojected to web mercator. Map reprojection was executed in Geoserver. The Native SRS (Spatial Reference System) is WGS 84 and they are reprojected to EPSG:900913/Google Mercator. Projection is also set to define how the map will be displayed on the web as shown on Listing 6. Map projection as defined in Geoserver is EPSG:900913 as stated on `projection`. Meanwhile, the map will be presented in projection system WGS 84 (EPSG:4326) as defined by `displayProjection` (Listing 6). Furthermore, `maxExtent` and `maxResolution` are given in the WMS GetCapabilities derived from Geoserver.

The `displayProjection` will be used by `MousePosition` (Listing 7) to convert coordinates from the map's projection into a specified projection, in this case into latitude/longitude coordinates.

Listing 6. Script for setting map projection

```
var options = {
    controls: [],
    maxExtent: bounds,
    maxResolution: 132.50913671875014,
    projection: new OpenLayers.Projection("EPSG:900913"),
    displayProjection: new OpenLayers.Projection("EPSG:4326"),
    units: 'm'
};
```

Listing 7. Script for setting coordinates

```
function formatLonlats(lonLat) {
    var lat = lonLat.lat;
    var lont = lonLat.lon;
    var ns = OpenLayers.Util.getFormattedLonLat(lat);
    var ew = OpenLayers.Util.getFormattedLonLat(lont,'lon');
    return ew + ', ' + ns;
}
```

```
map.addControl(new OpenLayers.Control.MousePosition( {id:
"ll_mouse", formatOutput: formatLonlats} ));

map.addControl(new OpenLayers.Control.MousePosition( {id:
"utm_mouse", prefix: "meter ", displayProjection:
map.baseLayer.projection, numDigits: 3} ));
```

Display of the maps on EIS web is shown on Figure 37. Script to retrieve the maps is shown on Listing 8. It shows WMS map and GML maps on top of Google Streets map. WMS map, Peta Sukoharjo, is build from administrative, road, and river shapefiles. GML maps presented on Figure 37 are shelter map with red point mark and subdistrict map with red line. EIS web also shows coordinates of mouse position in coordinate meter of web mercator projection and latitude/longitude coordinates.

Listing 8. Displaying WMS and GML maps on OpenLayers

```
//Displaying WMS map
var admin = new OpenLayers.Layer.WMS(
    "Peta Sukoharjo", rootdomainmap+"/geoserver/wms",
    {
      LAYERS: 'skh_web',
      transparent: true,
      STYLES: '',
      format: format
    },
    {singleTile: false, ratio: 1, numZoomLevels: 20,
    isBaseLayer: false, opacity: .4
    }
);

map.addLayer(admin);

//Displaying GML maps
var shelter = new OpenLayers.Layer.Vector("Shelter", {
    protocol: new OpenLayers.Protocol.HTTP({
      url: "gml/shelter.php",
      format: new OpenLayers.Format.GML()
    }),
    strategies: [new OpenLayers.Strategy.Fixed()],
    styleMap: mystyle
});

map.addLayer(shelter);

var admin = new OpenLayers.Layer.Vector("Kecamatan", {
    protocol: new OpenLayers.Protocol.HTTP({
      url: "gml/kecamatan.gml",
      format: new OpenLayers.Format.GML()
    }),
    strategies: [new OpenLayers.Strategy.Fixed()],
    styleMap: stladmin
    });

map.addLayer(admin);
```

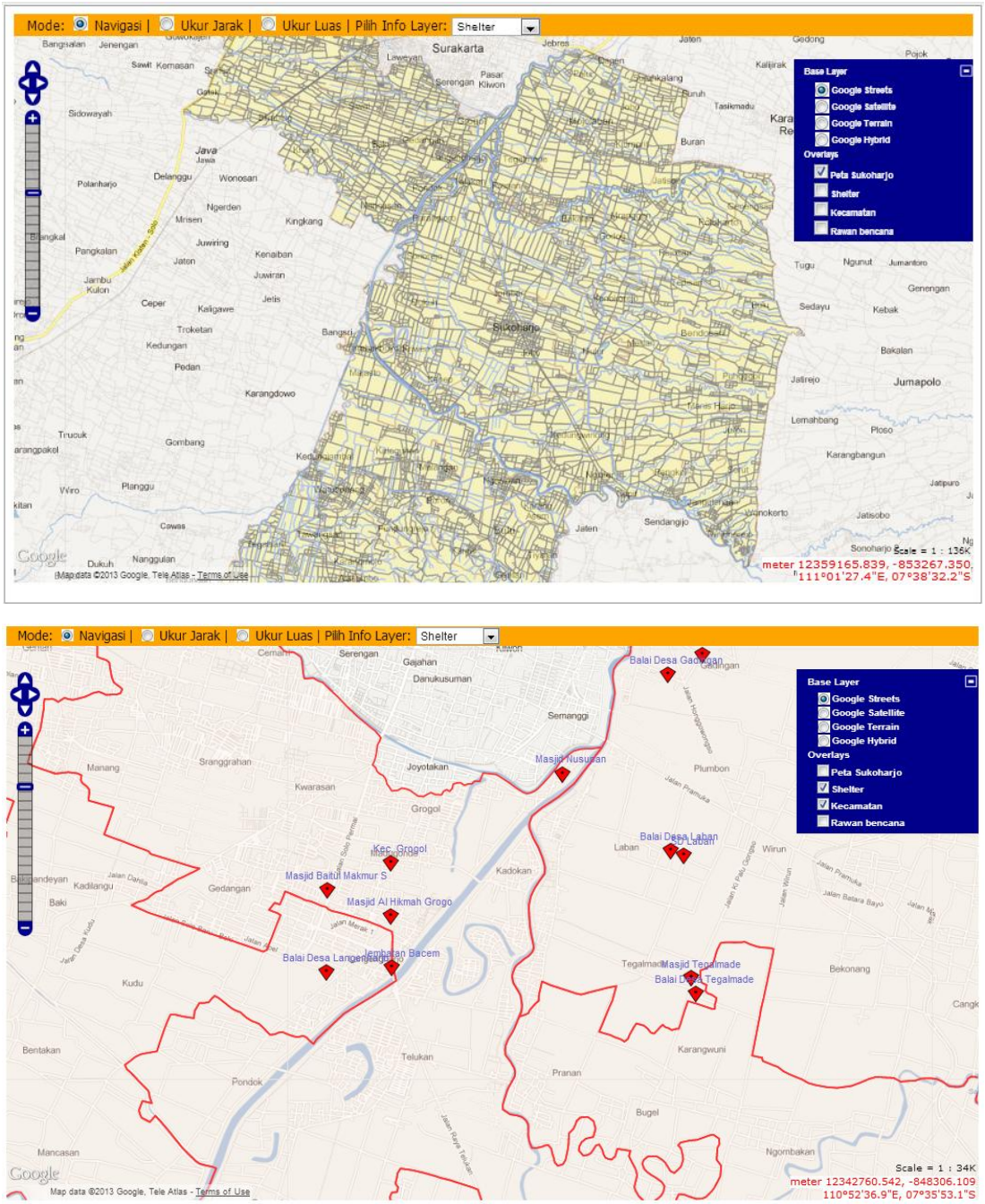

Figure 37. EIS web displaying WMS map (top) and GML maps (bottom)

5.7 Evaluation

5.7.1 User Evaluation

User evaluation done for this research aims to ascertain the web usability based on user expectations. The evaluation uses questionnaire which formulated to acquire user assessment of website characteristics and specific functionalities as posted in Appendix 6. It based on research by Marsico & Levialdi. Marsico et.al, 2004,

explained that usability test for software applications is useful to understand users' assessment based on their requirements and needs to improve the effectiveness of both the software and users themselves. Some aspects take an important role in executing usability assessment, one of which is that there has to be corresponding relationship between software functionalities and user's characteristics such as informative needs, knowledge and experience.

The evaluation attempted to ask users from the specific institutions to provide opinion related to EIS web functionalities. As explained at the introduction of evaluation session, the EIS web aims to provide information of flood IDP urgent needs at disaster response phase as soon as possible and in real time. Further, respondents are given brief explanation of the workings of the web and are asked to explore the web. Point to consider is users have different abilities on using website, motivations of providing and receiving information of IDP needs, priorities of their working environment, and job goals on flood response phase. There is a total of eleven respondents from different institutions.

The questionnaire was developed by combining valuation of website characteristics (appearance, navigation and information structured, and goal achievement) and website functionalities (information SMS, predefined SMS, and mapping features). Each question is assessed using degree of agreement, from strong agreement (A) to strong disagreement (E). The questionnaire consists of 9 sections with different number of questions. Section 1, 2, 3, 4, 6, and 7 consist of five questions while section 5, 8, and 9 consist of four, two, and three questions respectively.

Result of the evaluation is elaborated on Table 6. One of evaluation of website characteristic is represented by questions in section 2, web navigation. This category consists of five questions. On this category, mostly respondents believed that they are agreeing that web navigation is useful and understandable. Around 9.09% respondents had no option about menu categorization and web purpose. Finally, there is 9.09% respondents did not agree that there is guide around the web for navigation.

Furthermore, evaluation of web functionality such as section 5, predefined SMS feature, provides a more varied response. Most of respondents are strongly agreed and agree with statements in that category. However, there are respondents stated that they do not have opinion and do not agree with some statements. For instance, there are 27.27% and 9.09% respondents expressed that they do not know and do not agree respectively that predefined SMS format is easy to write.

Table 6. Result of evaluation in percentage

Questions per Section		**Answer Percentage (%)**				
		A	**B**	**C**	**D**	**E**
1	**Page views and layouts**					
a	The purpose and benefits of the web is easy to understand	18.18	81.82	0	0	0

Questions per Section		Answer Percentage (%)				
		A	**B**	**C**	**D**	**E**
b	Web display is relevant with the web category	18.18	81.82	0	0	0
c	The colors used are sound for the web category	9.09	63.64	9.09	18.18	0
d	Text are easily readable	36.36	63.64	0.00	0.00	0
e	The provided menus are easily understandable	18.18	72.73	9.09	0	0
2	**Web navigation**					
a	There is a guide for navigating around the web	36.36	54.55	0	9.09	0
b	The navigation is helpful	18.18	81.82	0	0	0
c	Menu categorization simplifies navigation	27.27	63.64	9.09	0	0
d	The terms used are clear and unambiguous	45.45	54.55	0	0	0
e	The terms used suit with web purpose	36.36	54.55	9.09	0	0
3	**Searching facility and search effectiveness**					
a	Searching facility is available	90.91	9.09	0	0	0
b	The searching facility is easily understandable	36.36	63.64	0	0	0
c	The searching facility is easy to use	36.36	63.64	0	0	0
d	It is easy to locate the page when switching menus	18.18	63.64	9.09	0	0
e	It is easy to return to the previous menu after doing search	27.27	54.55	18.18	0	0
4	**Clarity and suitability of website content**					
a	The information provided suits with the web purpose	18.18	63.64	18.18	0	0
b	The information provided is complete	9.09	45.45	45.45	0	0
c	The language used is easily understandable	27.27	72.73	0	0	0
d	The information is usefull for users	36.36	45.45	18.18	0	0
e	The services provided by the web are the expected ones	18.18	45.45	36.36	0	0
5	**Predefined SMS feature**					
a	Predefined SMS is easy to understand	54.55	27.27	9.09	9.09	0
b	Writing the predefined SMS is easy to do	27.27	36.36	27.27	9.09	0
c	Need calculation is useful for user	54.55	36.36	9.09	0	0
d	The result of need calculation suits with IDP needs	27.27	36.36	36.36	0	0
6	**Additional information SMS feature**					
a	Sending SMS to the web is easy to do	54.55	45.45	0	0	0
b	The display of additional information SMS is easy to read	27.27	72.73	0	0	0
c	Additional information SMS feature is useful for users	36.36	63.64	0	0	0
d	SMS sent need to be approved by the web administrator	36.36	63.64	0	0	0
e	SMS replies from the system is needed	81.82	18.18	0	0	0
7	**Map feature**					
a	Map view is easy to understand	36.36	54.55	9.09	0	0

Questions per Section		Answer Percentage (%)				
		A	**B**	**C**	**D**	**E**
b	Facility on the map view (shelter and subdistrict information) is easy to use	36.36	54.55	9.09	0	0
c	Information from shelter point is useful for users	9.09	72.73	18.18	0	0
d	Information from subdistrict map is useful for users	18.18	72.73	9.09	0	0
e	Switching between shelter icons is easy to do	27.27	54.55	18.18	0	0
8	**Needs table feature**					
a	Information in needs table is easy to understand	27.27	63.64	9.09	0	0
b	Information in needs table is useful for users	36.36	54.55	9.09	0	0
9	**Satisfaction of use**					
a	In general, the web is easy to use	54.55	36.36	9.09	0	0
b	Information provided is useful for users	54.55	36.36	9.09	0	0
c	Users obtain the desired information	45.45	36.36	18.18	0	0

By analysing the table of evaluation, generally respondents agree with the statements provided in the questionnaire. However, some respondents put abstain choice and a few of them does not agree with some statements. Thing to be highlighted from this evaluation is that some respondents are not directly involved in needs fulfillment which further influence their opinion in providing answers. Finally, in general users are satisfied with web appearance and functionalities as shown on section 9.

Besides filling the questionnaire, users also provided suggestions to improve the usability of the EIS web. They suggested the system to have push mechanism to send SMSs received by the system to super administrator's personal phone number. This is by noticing that super administrator may not control the system 24 hours. Moreover, they suggested that if this function has not yet available, super administrator should manage the system 24 hours specially when there is flood event. Therefore, every changes or incoming SMSs can be served right away.

Furthermore, result of section 5 and 7 shows that users need more explanation and training to use specific features on the EIS web. From questions related to web functionalities and user suggestions during evaluation session, it is known that requirements should be set for institution users especially the administrators. The user requirements are:

1. Institution users are them who have direct involvement with IDP needs fulfillment and have experience in handling with determining the type and amount of logistic needs.
2. Training to operate the system is highly important for institution users in order to understand the system works and using the system effectively.
3. Institution users are preferred to have basic knowledge on using internet.

4. BPBD administrator is required to manage the system all the time especially during flood events.

Besides user support for using EIS web, facilities support is also required as an important aspect. Facilities needed to support the system should have minimum requirements as:

- Internet connection in all institution offices, with minimum speed of 128 kbps.
- Web browsers such as Internet Explorer, Mozilla Firefox or Google Chrome. It is better to use the latest version of web browsers.

5.7.2 System Evaluation

Evaluation of the system is evaluation to the suitability of the components and features of the system prototype. The evaluation is expected to provide feedback to the development of a better system in the future. System is evaluated by a lecturer of Geography Faculty of Muhammadiyah Surakarta University who has experience and capability in building web-based GIS. One of his product is web-based GIS for Ground Water Management using PHP, Java, and MySQL Spatial for Department of Energy and Mineral Resources, Banyumas regency (Jumadi et.al, 2009). He tested and analysed the system in order to understand the components and the work of the system. Based on the analysis, there are several shortcomings of the system which had been emphasized. Following is the suggestions provided for the system evaluation.

1. Geoserver in one hand is easy to develop WMS/WFS. It is not need to work with scripting manually, but, on the other hand some features are not implemented easily such as it is difficult to retrieve map legend instantly and additional plug-in i.e. Java Runtime Environment should be installed in the server. Geoserver as software server for manipulating geospatial data is sufficient for web service uses. Geoserver supports WMS, WFS and WFS-T of OGC specifications that allow geospatial data implementation over the web. The support of Geoserver over OGC standards can be study in opengeospatial.org[13].
   The analysed system only exploits WMS feature which generates maps in image formats. It does not implement other features provided by Geoserver such as WFS and WFS-T for data updating. This is because the system updating spatial data is integrated in data form which later posted to PHP. PHP makes access to database and stores the data.
2. Dual database system which demonstrated in the system (i.e. MySQL and PostgreSQL/PostGIS) is considerably not efficient in term of database management, system building, and content updating. Therefore, single database is recommended to be better.

[13] http://www.opengeospatial.org/resource/products/details/?pid=584

3. SMS-based information is easy to implement, but, it is difficult to visualize in the spatial information unless the SMS senders were registered spatially in the database or the SMS text content spatial code such us administrative code.
4. Looking overall the system components, it is easy to implement but considering the system requirements, BPBD or local government should provide their own server, so that, SMS system and Geoserver can be installed properly in the server. It is impossible to use commercial server in Indonesia.

According to system evaluation provided above, it is obvious that the system prototype still need more improvement. The use of the tools to build the system has limitations in some cases. Geoserver is easy to create WMS map, however user cannot work with manual scripting and utilize sql queries to access data from DBMS directly. The use of two database servers is also considered inefficient for database management since data should be connected into two databases. Finally, the implementation of the system will need a server with Geoserver and modem connected to it. Since commercial servers in Indonesia do not offer Geoserver in their package, the possible way is for BPBD to provide its own server and install Geoserver on it. Moreover, modem for receiving SMSs should be connected to a computer server to make retrieval and sending of SMSs only utilize a little time. In short, the system prototype has used selected tools to support the system functionalities, however there are some shortcomings that must be noted to improve the development of the system.

6. Conclusion and Recommendation

6.1 Conclusion

Based on the research objectives, the following points explain conclusions deduced for this research.

1. Current system for communicating and fulfilling IDP needs.

   Currently, process of fulfilling IDP needs for flood victims is controlled by three agencies: BPBD, Dinas Sosial and PMI. Information of IDP needs is sent using phone calls and Handy Talkie. Those agencies held a meeting to determine the amount of logistic aids they will send from each of their stock. Moreover, there are two perceived deficiencies encountered in current system. The first one is arrival of logistic aids to shelter locations needs a long time. The other shortage of current system is misconception on coordination process. Sometimes during coordination for deciding type and amount of logistic needs, an organization may assume that certain types of logistics will be provided by other agencies. This causes discrepancies or flaws in logistic distribution.

2. Identification of EIS users and their needs.

   Based on information during interview, expected users for proposed system are institutions in Sukoharjo regency involved in disaster management which have direct role in providing logistic needs for flood victims and public users. The users are:

   - BPBD; has authority to manage input data such as logistic types, conversion formula, administrators' data and others; and to process incoming and outcoming SMSs.
   - Dinas Sosial; is only entitled to manipulate stock data, including input, delete, edit data, of Dinas Sosial and creates report of Dinas Sosial stock data.
   - PMI; is eligible to manipulate stock data, one of which is deciding type and amount of logistic aids for IDP, and creates report of PMI stock data.
   - Contributors at shelters; has specific role to send formatted SMS which contains data of IDP number based on specific structure defined previously.
   - Contributors for information; are anyone who willing to send information related to flood or any condition that may be a sign of flood occurrence.
   - Public users; are general users who can access information provided in the web for public.

3. Input data needed from evacuation sites using SMS gateway and estimation of the types and the amount of IDP needs.

There are several points to be explored in explaining input data for needs calculation and how to estimate the types and amount of IDP needs.

a. A person who sends data to the system must be registered member of institutions who has main duty to record IDP in a shelter. The person is member of BPBD task force whose phone number has been registered in the system database.
b. Input data used to calculate IDP needs are number of IDP and location of the shelter where the IDP evacuate. To enable system understand the content of the SMS, the SMS should be written in predefined format which has been identified previously.
c. Data used to calculate IDP needs is shelter location and number of IDP contained in predefined SMS. Format of predefined SMS is distinguished into full format and simple format. Full format SMS consists of code of shelter location and number of IDP based on age groups or IDP structure. Simple format SMS consists of code of shelter location and total number of IDP.
d. To do need calculation, this research develops calculation formula based on disaster regulations issued by government institutions and prediction of real needs based on real condition.

System receives data of IDP structure from SMS in predefined format. System serves to transform data form SMS into information of IDP needs. If the SMS is in full format, system calculates basic needs and special needs for IDP. Meanwhile, if the SMS in in simple format, system only calculates basic needs. If system receives wrong format of predefines SMS, it will send SMS back to registered user informing that the format is incorrect. Administrator also has a role to check every incoming predefined SMS. He can contact registered user via phone calls to ascertain the wrong format of sent predefined SMS. This can be done to accelerate checking process of wrong format SMS.

4. Displaying data of IDP needs on evacuation shelter map in EIS using OGC standards and designing EIS.

To display information of IDP need on EIS webpage, a method should be applied as depicted on Figure 16. Data of shelter location and IDP number received from predefined SMS is processed by EIS. The result of calculation is information of IDP needs in a shelter. This information therefore is displayed on the EIS webpage.

The information is displayed on top of maps which use OGC standards. OGC standards used in EIS are GML and WMS. The maps are derived from shapefiles as described on Figure 36. The maps are displayed on top of Google Maps API using OpenLayers as map framework. GML provides vector map that can be correctly shown on Google Maps. WMS is raster map derived using Geoserver.

In producing WMS maps, map projection issue must be in concern. Since shapefiles using WGS 84 coordinate system and Google Maps using Web Mercator projection, adjustment to the maps should be done. Therefore, shapefiles maps are projected into Web Mercator projection to make the maps adjust on top of Google Maps. However, since Google Maps uses WGS 84 for its map coordinate, there are a slight difference on displaying maps on top of Google Maps at local scale that make the maps are not perfectly adjust with Google Maps.

Furthermore, on designing EIS components of the EIS are important study. The components are classified into:

a. Applications
   EIS has four main application features that are SMS gateway, map layers, needs conversion, and institution stock changes.
b. Infrastructure
   To build the EIS, it needs hardware support. For communication utilizing SMS, it uses GSM modem connected to server PC which has connection to internet.
c. Data
   Data needed by EIS is existing shelters' coordinates, conversion data formulated from government regulations and actual needs, list of logistic, and shapefiles to construct OGC standard maps. RDBMS manages data for EIS.
d. People
   The proposed system needs involvement and cooperation of officers from engaged institutions. The officers need to have training to understand system functionalities and how to operate the system.

5. Evaluation of the prototype of EIS.

   Evaluation held to assess EIS consists of user evaluation and system evaluation. From user evaluation, it is known that in general users are satisfied with web appearance and functionalities as derived from questionnaires. Moreover, human resource requirements and facility requirements also conclude from the evaluation.

   Evaluation of the system works shows that the system can calculates IDP needs both basic needs and special needs based on predefined SMSs sent by registered users from shelter locations. It also supports agencies to supervise their logistic stocks and facilitates them to communicate and coordinate effectively during emergency response phase. Nevertheless, the system do not provide algorithm to manage either incorrect or incomplete formats of predefined SMSs. It only sends SMS to the sender informing that the previous sent SMS is in wrong format.

6.2 Recommendation

Based on the results achieved by this research, there are several recommendations offered for EIS development:

1. User need assessment and user evaluation involves officers from specified agencies with various knowledge and experience on needs fulfillment and determining types and amount of the needs. It is better if the activities focus on them who have specific knowledge and experience so that the result of user need assessment and user evaluation could be more detail and directed.
2. EIS is tested with each agency on different time and location. This consumes more time and provides some contradictory statements from each party. Therefore, it is recommended to conduct the experiment with all parties at the same time and place. It is expected to derive the same understanding which can lead them to utilize the system with same intention.
3. Test for analysing SMS receiving and delivering time need to be done. The test can be used to study the effectiveness of SMS gateway and to simulate the real condition.
4. The tools that are choose in developing the system should be analysed further. As explained in the system evaluation, the utilization of dual database servers makes the system to be less efficient. Therefore, the use of one database server that accommodates spatial data management will be better for the system.
5. The use of Geoserver for generating WMS maps has limitation especially in manual scripting, such as to retrieve map legend instantly, and utilize sql queries to access data from DBMS directly. Therefore, to create maps by exploiting manual scripting, software such as Mapserver can be considered.

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Appendix

Appendix 1. Interview Questions

Respondent: Institutions/Volunteer organizations

1. What are your institution roles in handling flood victims?
2. What agencies are involved in flood victim handling?
3. Activites of institutions related to logistic support:
   a. What kind of logistical support provided?
   b. How much the amount of the logistics?
   c. What is the standard used in determining the type and amount of the logistic aids?
   d. Who are provide the resources of logistic aids?
   e. What information is needed to determine the type of aids to be provided?
   f. Who is providing information about IDP needs?
   g. How does the person who give information (on point f) send the information?
   h. How long does it take to calculate the amount of logistical support?
   i. How do you calculate the amount of logistics to be provided?
   j. Are there any difficulties in the provision of logistic aids?

   Linkages with other agencies:
   k. Who is coordinating these activities (whether your own agency or under instruction from other agencies)?
   l. How do you communicate or coordinate with other agencies?
   m. Are there any obstacles in communication regarding the provision of logistics to IDPs?
   n. In your opinion, how is the effective way for supplying logistic support?

4. Activities of volunteer organization:
   a. What is your organization role on flood disaster?
   b. Is your organization involved in logistic support for flood victims?
   c. Is there agency that coordinates your activities?
   d. How did your organization communicate with other agencies?
   e. What do you think is most needed by the flood victims in the first time after they are affected by the floods?
   f. How do you obtain information about conditions at flood location / who sent the information?
   g. What information do you receive?
   h. In your opinion, what obstacles / difficulties in your activities?
   i. In your opinion, what needs to be done to streamline your activities?

Respondent : community/subdistrict or village officers

A. General Information

1. Where are buildings or locations that are usually used for evacuation locations?
2. Who are coordinator(s) on shelter locations?
3. How do the coordinators usually record data about IDP (people who evacuate)?
4. How long does people evacuate during annual flood?
5. How does people receive basic needs such as food and floor mats at the first time when they are on evacuation?

B. Case study of 2007 flood

6. When did people start to evacuate?
7. How many people are in one evacuation site and from what area?
8. How long did they stay on evacuation?
9. What kind of aids were needed by affected IDPs?
10. Were the aids arrive on time?
11. Were the logistic aids sufficient for IDP needs?
12. What were agencies or donates that gave aids for IDPs?
13. Were the aids distributed directly to evacuations sites or were there any temporary collection point?
14. Who distribute the aids to IDPs?

Appendix 2. User Needs Assessment Questionnaire

This questionnaire is part of research aiming to develop prototype of information system for flood IDP (internally displaced persons) needs in Sukoharjo regency. This questionnaire is intended to study the procedures for meeting the needs of flood victims as well as the ability you expect from the new system. The information you provide will be useful for us to develop the information system for IDP needs. The answer you give is confidential and will be used solely for the purposes of scientific research.

Your answers will be combined with other respondents' to determine information needs, usage patterns, features needed, format preferences, and overall quality. Thank you for your cooperation and willingness to fill out this questionnaire.

Researcher	:	Yunita Puspitasari
Department	:	Geo-Information for Spatial Planning and Risk Management
Research Title	:	Prototype of Emergency Information System of IDP Needs Using SMS Gateway for Flood Disaster Emergency Response in Sukoharjo Regency, Central Java Province
Email	:	yunee_fath@yahoo.com

Date : ____/_____/2012

Identity and Experience of Respondents

Name : _____

Institution : _____

Ministry/Local Govt./NGO : _____

Sector : _____

Position : _____

Telephone/email : _____

1) What is your main task?
2) What is the role / function of your agency in handling the needs of IDP?
3) Are you directly involved in handling the needs of IDP and what is your role?
4) If you are directly involved (nr. 3), who are your colleagues in your agency working together with you and what are their roles?

5) If you are directly involved (nr. 3), what are other agencies that work with your agency?

Experience in IDP Needs Fulfillment

6) Who is responsible to record the number of IDP in each shelter?
7) How is information about the number of IDP submitted to the authorities?
8) Who does determine the amount of needs required by IDP?
9) How is information about the number of IDP needs communicated to the authorities?
10) How do you determine the amount of aid to be sent to every evacuation shelter?
11) How do you calculate the amount and types of aids that will be distributed?
12) What parties are assigned to fulfill IDP needs in the first moment after the disaster occurred?
13) Are there any obstacles in fulfilling IDP needs activities?

Use of Web-Based Information Systems

14) If there is a system that can assist in providing information needs of IDP, what kind of information that you think needs to be displayed?
    - Location of evacuation shelters
    - Number of IDP
    - Type of needs
    - Amount of needs for each type
    - The amount and types of buffer stock
    - The amount and types of logistics that have been prepared in each district / village
    - Contact person at each evacuation shelter
    - Contact person of logistic aid provider
    - Other, please specify:

      _____

15) If there is a system that can assist in providing information needs of IDP, what functions / facilities do you think needs to be displayed?
    - Input data for shelter location
    - Input data for logistic types
    - Evacuation shelter map
    - Searching tools

 Other, please specify:

_____

16) In your opinion, how long will it take to get the system to display the logistic needs of IDP?

Infrastructure

17) Is your agency has a website?
a. Yes b. No

If yes, please specify:

_____

18) Is there an internet connection in your office?
a. Yes b.No

19) Is there a website administrator in your office?
a. None
b. 1 person
c. 2 persons
d. More than 2 persons

20) Is there an active internet users in your office?
a. None
b. 1 – 2 person
c. 3 – 4 persons
d. More than 4 persons

Thank you for your participation

Appendix 3. Conversion list

Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
Food																	
personal																	
Rice	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2	-	-	-	-	-	-	kg	per day
Instan noodle	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-	pack	per day
Side dish	2	2	2	2	2	2	2	2	2	-	-	-	-	-	-	package	per day
Baby milk	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	box	per 4 days
Baby biscuits	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	carton	per 2 days
Instan poridge	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	carton	per 2 days
Milk	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	carton	per 4 days
Maternal milk	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	carton	per 4 days
Breastfeed milk	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	carton	per 4 days
Mineral water	2	2	2	2	2	2	1	1	1	1	-	-	-	-	-	bottle	per day
public																	
Soy sauce	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	bottle	per day
Cooking oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	liter	per day
Sugar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	kg	per day
Palm sugar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	kg	after day 2
Flavoring (Masako)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	sachet	after day 2
Salt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	pack	after day 2
Garlic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	kg	after day 2

Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
Onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	kg	after day 2
Shrimp crackers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	kg	after day 2
Coconut milk (Kara)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	pack	after day 2
Tomatto chilli sauce	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	bottle	after day 2
Flour	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	kg	after day 2
Sardine/canned fish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	can	after day 2
Tea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	pack	per day
Milk coffee sachet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	pack	per day (opt)
Clean water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	liter	per day
Fast food package	-	-	-	-	-	-	-	-	-	-	-	-	-	-		package	per 15 adults
Nutrition additional food	-	-	-	-	-	-	-	-	-	-	-	-	-	-		package	per 9 adults
Clothing **personal** Sheath	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	sheet	on demand
Long cloth	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	sheet	on demand
House dress	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	sheet	on demand
Blanket	1	1	1	1	1	1	1	1	1	-	-	-	-	-	-	sheet	
Baby blanket	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	sheet	
children shirt	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	sheet	on demand
Male elementary	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	sheet	on demand

Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
uniform																	
Female elementary uniform	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	sheet	on demand
Male middle school uniform	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	sheet	on demand
Female middle school uniform	-	-	-	-		1	-	-	-	-	-	-	-	-	-	sheet	on demand
Male elementary shoes	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	sheet	on demand
Female elementary shoes	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	sheet	on demand
Male middle school shoes	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	sheet	on demand
Female middle school shoes	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	sheet	on demand
Children male pants	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	sheet	on demand
Adult female underwear	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	sheet	on demand
Adult male underwear	1		1		1	-	-	-	-	-	-	-	-	-	-	sheet	on demand
Child male underwear	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	sheet	on demand
Child female underwear	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	sheet	on demand
Adul male/female sandals	1	1	1	1	1	1	-	-	-	-	-	-	-	-	-	pair	on demand
Child male/female sandals	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	pair	on demand

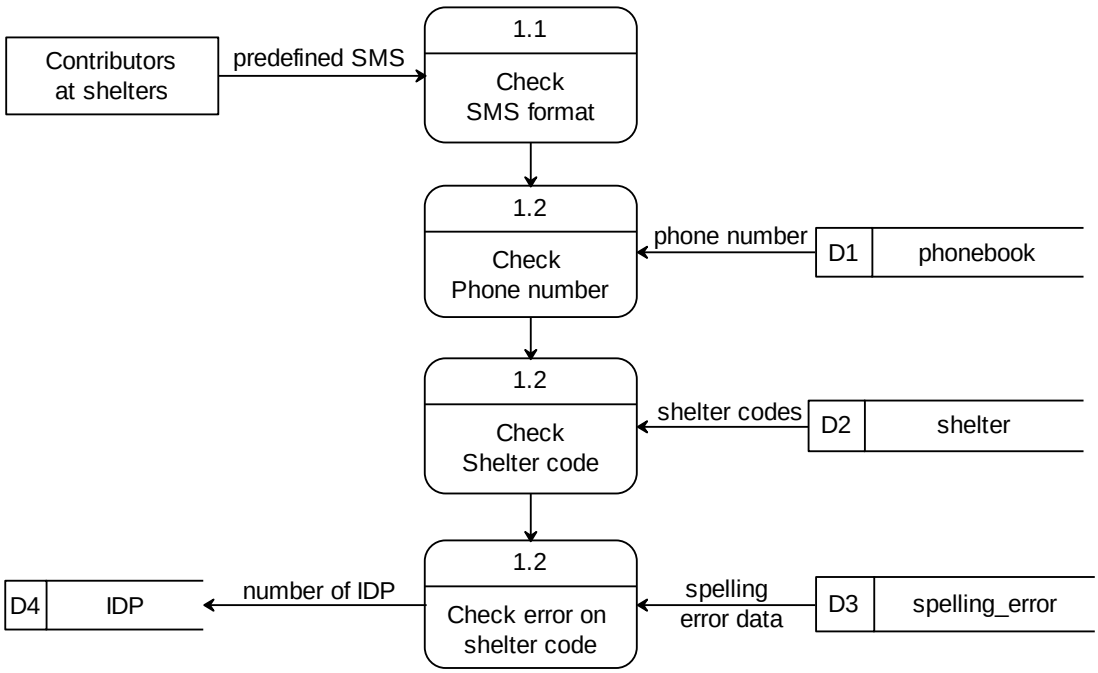
Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
Menstrual pad	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	pack	after day 2
Baby kit	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	package	per week
Kids ware	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	package	per week
Family kit	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	package	per week
Paket sandang	1	-	1	-	1	1	-	-	-	-	-	-	-	1	-	package	per week
Pampers	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	pack	Pampers
Bath supplies	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	package	per week
public Floor mats	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	sheet	
Praying clothes	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	sheet	on demand
Valance	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	sheet	on demand
Medicines Vitamin A																	on demand
Mask																	on demand
Cajuput oil																	on demand
Ointment																	on demand
Oxican																	on demand
Iodium																	on demand
Kassa																	on demand
Bandage																	on demand
Vitamin C																	on demand

Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
Utensils																	
personal																	
plate	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	piece	after day 2
spoon	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	piece	after day 2
glass	1	1	1	1	1	1	1	1	1	1	-	-	-	-	-	piece	after day 2
public																	
Gas stoves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		or oil stoves
Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Oil/Gas stoves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large frying pan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large pot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Small pot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large cormorant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Kettle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Rice bowl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large wooden ladle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Plastic rice ladle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large spatula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Small spatula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Large ladle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Small ladle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		

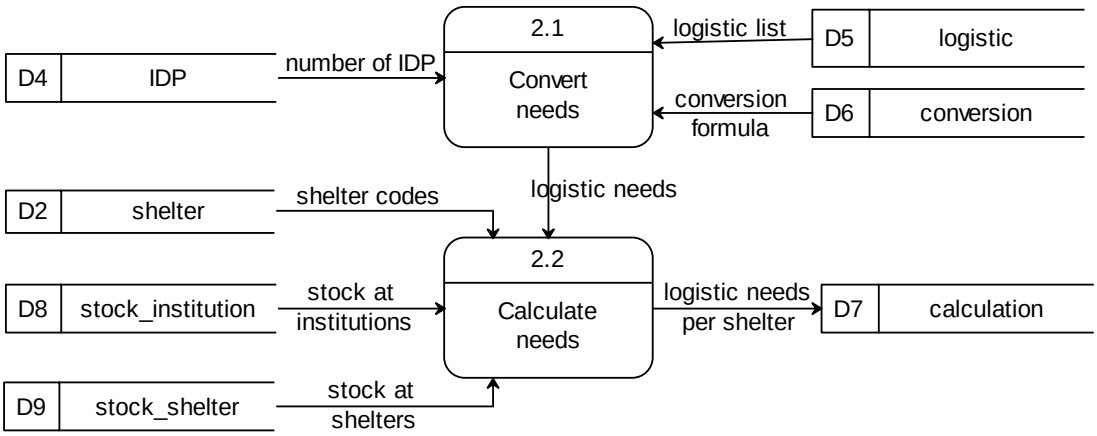
Item	Quantity																
	male ≥ 60	fem ≥ 60	male 18-59	fem 18-59	male 13-17	fem 13-17	male 6-12	fem 6-12	toddlers (2-5 thn)	babies (0-2 thn)	pregnant	breast feed	difable	House hold	public	Unit	Periode/ Description
Pestle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Knife	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Wasbasin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Bucket cap, capacity 40 lt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Open bucket, capacity 20 lt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Jerrycan, capacity 20 lt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Multipurpose stove	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Rantang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Jumbung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Plastic sacks	-	-	-	-	-	-	-	-	-	-	-	-	-	-			on demand
Kitchen utensils	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		
Flashlight	-	-	-	-	-	-	-	-	-	-	-	-	-	-			on demand
Hoe	-	-	-	-	-	-	-	-	-	-	-	-	-	-			on demand
Shovel	-	-	-	-	-	-	-	-	-	-	-	-	-	-			on demand

Appendix 4. Level 1 DFD

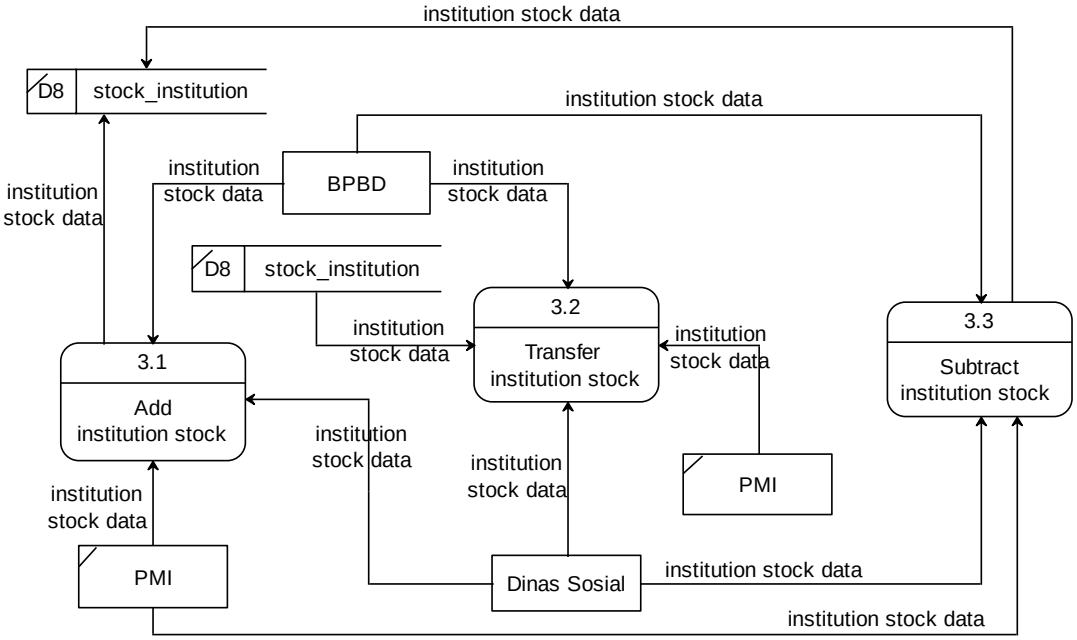
Level 1 Process 1 DFD



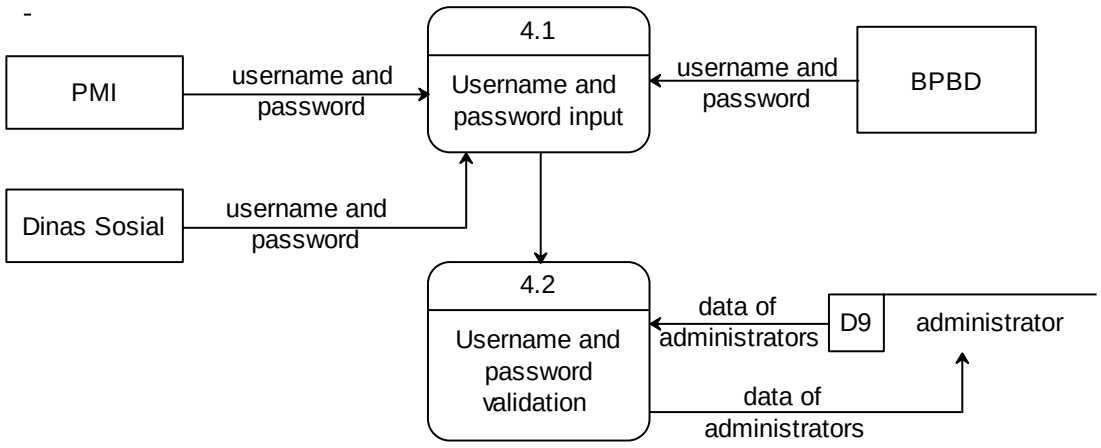
Level 1 Process 2 DFD



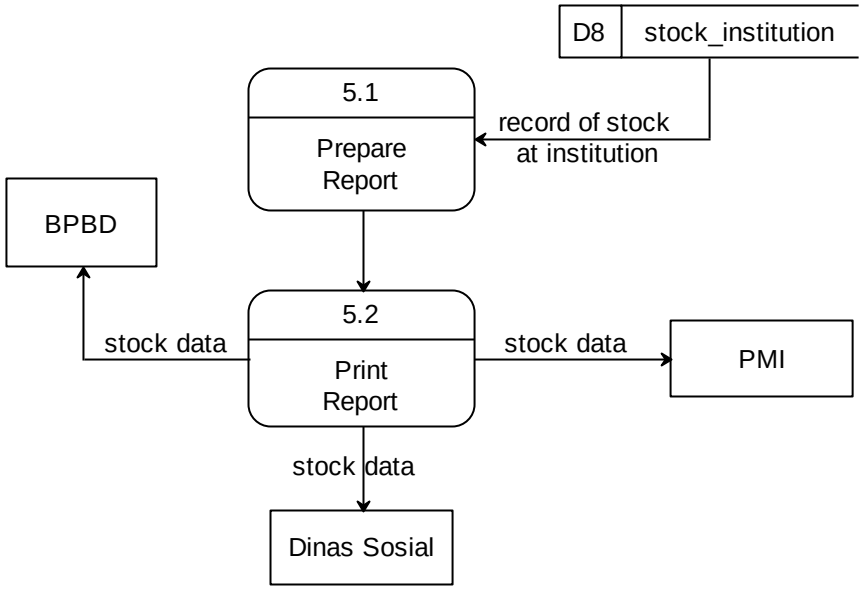
Level 1 Process 3 DFD



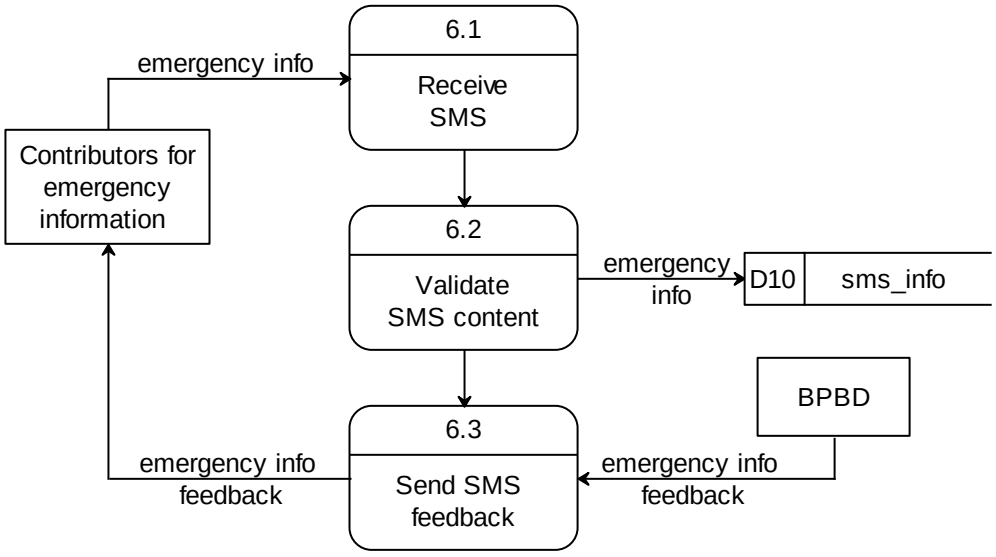
Level 1 Process 4 DFD



Level 1 Process 5 DFD



Level 1 Process 6 DFD



Appendix 5. Script for calculating IDP needs from predefined SMS

Listing 5.1 Procedure for Needs Calculation from full format SMS

```
if (count($sms)==15){

 if (check_contact($phone)){

   if (check_shelter($sms[0])){

     mysql_query("INSERT INTO idp (shelter_code, m_old, f_old,
     m_ad, f_ad,m_ten, f_ten,  m_ch, f_ch, toddlers, babies,
     pregnant, breastfeed, difable,households, date,phone) VALUES
     ('$sms[0]','$sms[1]','$sms[2]','$sms[3]','$sms[4]','$sms[5]'
     ,'$sms[6]','$sms[7]','$sms[8]','$sms[9]','$sms[10]','$sms[11
     ]','$sms[12]','$sms[13]','$sms[14]',now(),'$phone')");

     $idp_id=mysql_insert_id();

     $hasil=mysql_query("select * from conversion");
     while ($baris=mysql_fetch_array($hasil)){

       $need=(($baris[m_old]*$sms[1])+($baris[f_old]*$sms[2])+($
       baris[m_ad]*$sms[3])+($baris[f_ad]*$sms[4])+($baris[m_ten
       ]*$sms[5])+($baris[f_ten]*$sms[6])+($baris[m_ch]*$sms[7])
       +($baris[f_ch]*$sms[8])+($baris[toddlers]*$sms[9])+($bari
       s[babies]*$sms[10])+($baris[pregnant]*$sms[11])+($baris[b
       reastfeed]*$sms[12])+($baris[difable]*$sms[13])+($baris[h
       ouseholds]*$sms[14]));

       if ($need>0) mysql_query("insert into calculation
       (shelter_code,log_code,need,idp_id,date_disaster)
       values('$sms[0]','$baris[log_code]','$need','$idp_id',now
       ())");

     }
     $kirim = "Thank you for your SMS";

   }
   else {

     if (check_spelling($sms[0])!=""){

       mysql_query("INSERT INTO idp (shelter_code, m_old, f_old,
       m_ad, f_ad, m_ten, f_ten, m_ch, f_ch, toddlers, babies,
       pregnant, breastfeed, difable,households, date,phone)
       VALUES
       ('".cek_spelling($sms[0])."','$sms[1]','$sms[2]','$sms[3]
       ','$sms[4]','$sms[5]','$sms[6]','$sms[7]','$sms[8]','$sms
       [9]','$sms[10]','$sms[11]','$sms[12]','$sms[13]','$sms[14
       ]',now(),'$phone')");

       $idp_id=mysql_insert_id();

       $hasil=mysql_query("select * from conversion");
       while ($baris=mysql_fetch_array($hasil)){
```

```
            $need=(($baris[m_old]*$sms[1])+($baris[f_old]*$sms[2])+
            ($baris[m_ad]*$sms[3])+($baris[f_ad]*$sms[4])+($baris[m
            _ten]*$sms[5])+($baris[f_ten]*$sms[6])+($baris[m_ch]*$s
            ms[7])+($baris[f_ch]*$sms[8])+($baris[toddlers]*$sms[9]
            )+($baris[babies]*$sms[10])+($baris[pregnant]*$sms[11])
            +($baris[breastfeed]*$sms[12])+($baris[difable]*$sms[13
            ])+($baris[households]*$sms[14]));

            if ($need>0) mysql_query("insert into calculation
            (shelter_code,log_code,need,idp_id,date_disaster)
            values('".check_spelling($sms[0])."','$baris[log_code]'
            ,'$need','$idp_id',now())");

          }
          $kirim = "Thank you for your SMS";

        }
        else $kirim = "Shelter code is unrecognized";

      }
    }
    else kirim = "Your phone number is unregistered";
  }
```

Listing 5.2 Procedure for Needs Calculation from simple format SMS

```
if (count($sms)==2){

    if (check_contact($phone)){

      if (check_shelter($sms[0])){

        mysql_query("INSERT INTO idp (shelter_code, total_idp,
        date,phone) VALUES ('$sms[0]','$sms[1]',now(),'$phone')");

        $idp_id=mysql_insert_id();

        $hasil=mysql_query("select * from conversion");
        while ($baris=mysql_fetch_array($hasil)){
          $need=($baris[total_idp]*$sms[1]);
          if ($need>0) mysql_query("insert into calculation
          (shelter_code,log_code,need,idp_id,date_disaster)
          values('$sms[0]','$baris[log_code]','$need','$idp_id',now
          ())");
        }

        $kirim = "Thank you for your SMS";
      }
      else {

        if (check_spelling($sms[0])!=""){

          mysql_query("INSERT INTO idp (shelter_code, total_idp,
          date,phone) VALUES
          ('".check_spelling($sms[0])."','$sms[1]',now(),'$phone')"
          );

          $idp_id=mysql_insert_id();
```

```
            $hasil=mysql_query("select * from conversion");
            while ($baris=mysql_fetch_array($hasil)){

               $need=($baris[total_idp]*$sms[1]);
               if ($need>0) mysql_query("insert into calculation
               (shelter_code,log_code,need,idp_id,date_disaster)
               values('".cek_spelling($sms[0])."','$baris[log_code]','
               $need','$idp_id',now())");
            }
            $kirim = "Thank you for your SMS";

         }
         else $kirim = "Shelter code is unrecognized";
      }

   }
   else $kirim = "Your phone number is unregistered";
}
```

Listing 5.3 Script for adding, transferring and substracting stock data

```
//add stock data
$desc="Entry";
if ($_GET['action']=="edit"){
    $query="SELECT * from stock_shelter where log_code=
    '$_GET[log_code]' and shelter_code='$_GET[shelter_code]'";

    if (!$result=mysql_query($query)){
    echo mysql_error();
    exit;
    }
    $barrowsis=mysql_fetch_array($result);
    $desc="Edit";
}

//transfer stock data
$desc="Entry";
if ($_REQUEST[table_code]){
    $fract=explode("||",$_REQUEST[table_code]);
    $_REQUEST[table]=$fract[0];
    $_REQUEST[code]=$fract[1];
}

if ($_REQUEST[factur_number]){
    $result = mysql_query("select * from stock where
    factur_number='$_REQUEST[factur_number]' AND
    transaction='substract' order by stock_id limit 1");
    $rows = mysql_fetch_array($hasil);
    $_REQUEST[table_code]="$rows[table1]||$rows[code1]";
    $_REQUEST[table]=$rows[table1];
    $_REQUEST[code]=$rows[code1];
}
```

```
//substract of stock data
$desc="Entry";

if ($_REQUEST[table_code]){
    $fract=explode("||",$_REQUEST[table_code]);
    $_REQUEST[table]=$fract[0];
    $_REQUEST[code]=$fract[1];
}

if ($_REQUEST[factur_number]){
    $result = mysql_query("select * from stock where
    factur_number='$_REQUEST[factur_number]' order by stock_id limit
    1");
    $baris = mysql_fetch_array($result);
    $_REQUEST[table_code]="$rows[table1]||$rows[code1]";
    $_REQUEST[table]=$rows[table1];
    $_REQUEST[code]=$rows[code1];
}
```

Appendix 6. Questionnaire for website evaluation

Questionnaire of Web-Based of Information of Refugee Needs Using SMS Gateway for Disaster Response in Sukoharjo District, Central Java Province

(adapted from Marsico, M. D., & Levialdi, S. (2004). Evaluating web sites: exploiting user's expectations. *International Journal of Human-Computer Studies)*

Researcher	: Yunita Puspitasari
Program	: Geo-Information for Spatial Planning and Risk Management
Research title	: Web-Based GIS for Information of Refugee Needs Using SMS Gateway for Flood Disaster Response in Sukoharjo District, Central Java Province
Email	: yunee_fath@yahoo.com

Thank you for your willingness to fill out this questionnaire. Filling this questionnaire will be used solely for the purposes of scientific research.

Put a tick (✓) at the answer that best fits your choice.

A) Strongly agree
B) Agree
C) Do not know, do not argue
D) Do not agree
E) Strongly disagree

1	**Page views and layouts**	**A**	**B**	**C**	**D**	**E**
a	The purpose and benefits of the web is easy to understand	[ ]	[ ]	[ ]	[ ]	[ ]
b	Web display is relevant with the web category	[ ]	[ ]	[ ]	[ ]	[ ]
c	The colors used are sound for the web category	[ ]	[ ]	[ ]	[ ]	[ ]
d	Text are easily readable	[ ]	[ ]	[ ]	[ ]	[ ]
e	The provided menus are easily understandable	[ ]	[ ]	[ ]	[ ]	[ ]
2	**Web navigation**	**A**	**B**	**C**	**D**	**E**
a	There is a guide for navigating around the web	[ ]	[ ]	[ ]	[ ]	[ ]
b	The navigation is helpfull	[ ]	[ ]	[ ]	[ ]	[ ]
c	Menu categorization simplifies navigation	[ ]	[ ]	[ ]	[ ]	[ ]
d	The terms used are clear and unambiguous	[ ]	[ ]	[ ]	[ ]	[ ]
e	The terms used suit with web purpose	[ ]	[ ]	[ ]	[ ]	[ ]
3	**Searching facility and search effectiveness**	**A**	**B**	**C**	**D**	**E**
a	Searching facility is available	[ ]	[ ]	[ ]	[ ]	[ ]
b	The searching facility is easily understandable	[ ]	[ ]	[ ]	[ ]	[ ]
c	The searching facility is easy to use	[ ]	[ ]	[ ]	[ ]	[ ]
d	It is easy to locate the page when switching menus	[ ]	[ ]	[ ]	[ ]	[ ]
e	It is easy to return to the previous menu after doing search	[ ]	[ ]	[ ]	[ ]	[ ]

4	**Clarity and suitability of siwebte content**	**A**	**B**	**C**	**D**	**E**
a	The information provided suits with the web purpose	[ ]	[ ]	[ ]	[ ]	[ ]
b	The information provided is complete	[ ]	[ ]	[ ]	[ ]	[ ]
c	The language used is easily understandable	[ ]	[ ]	[ ]	[ ]	[ ]
d	The information is usefull for users	[ ]	[ ]	[ ]	[ ]	[ ]
e	The services provided by the web are the expected ones	[ ]	[ ]	[ ]	[ ]	[ ]
5	**Predefined SMS feature**	**A**	**B**	**C**	**D**	**E**
a	Predefined SMS is easy to understand	[ ]	[ ]	[ ]	[ ]	[ ]
b	Writing the predefined SMS is easy to do	[ ]	[ ]	[ ]	[ ]	[ ]
c	Need calculation is useful for user	[ ]	[ ]	[ ]	[ ]	[ ]
d	The result of need calculation suits with IDP needs	[ ]	[ ]	[ ]	[ ]	[ ]
6	**Additional information SMS feature**	**A**	**B**	**C**	**D**	**E**
a	Sending SMS to the web is easy to do	[ ]	[ ]	[ ]	[ ]	[ ]
b	The display of additional information SMS is easy to read	[ ]	[ ]	[ ]	[ ]	[ ]
c	Additional information SMS feature is useful for users	[ ]	[ ]	[ ]	[ ]	[ ]
d	SMS sent need to be approved by the web administrator	[ ]	[ ]	[ ]	[ ]	[ ]
e	SMS replies from the system is needed	[ ]	[ ]	[ ]	[ ]	[ ]
7	**Map feature**	**A**	**B**	**C**	**D**	**E**
a	Map view is easy to understand	[ ]	[ ]	[ ]	[ ]	[ ]
b	Facility on the map view (shelter and subdistrict information) is easy to use	[ ]	[ ]	[ ]	[ ]	[ ]
c	Information from shelter point is useful for users	[ ]	[ ]	[ ]	[ ]	[ ]
d	Information from subdistrict map is useful for users	[ ]	[ ]	[ ]	[ ]	[ ]
e	Switching between shelter icons is easy to do	[ ]	[ ]	[ ]	[ ]	[ ]
8	**Needs table feature**	**A**	**B**	**C**	**D**	**E**
a	Information in needs table is easy to understand	[ ]	[ ]	[ ]	[ ]	[ ]
b	Information in needs table is useful for users	[ ]	[ ]	[ ]	[ ]	[ ]
9	**Satisfaction of use**	**A**	**B**	**C**	**D**	**E**
a	In general, the web is easy to use	[ ]	[ ]	[ ]	[ ]	[ ]
b	Information provided is useful for users	[ ]	[ ]	[ ]	[ ]	[ ]
c	Users obtain the desired information	[ ]	[ ]	[ ]	[ ]	[ ]

Thank you for your participation