BUILDERS D4.7 Indonesian Case “Using Mobile Operators’ Data to Locate, Protect and Evacuate Tourists and Other Vulnerable Groups in Disasters”

Project acronym: BuildERS

Project title: Building European Communities’ Resilience and Social Capital

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Executive Summary

This report D4.7 demonstrates the possibilities of mobile positioning data (MPD) usage in the crisis management area. This report is based on the task 4.7 that is aiming for product innovation for more precise rescue planning and emergency management in Indonesia.

The University of Indonesia together with Positium demonstrate a product innovation of how mobile operators' data can be used to locate, protect and evacuate tourists and other vulnerable groups in disasters. Such maps will more precisely inform the professional rescuers about tourists' whereabouts at different locations and times and help to deliver better need-calibrated relief services. Positium and University of Indonesia are looking at crises like volcano eruption, earthquakes, tsunamis, floods. Locating people that have no understanding of local circumstances and are unable to act rationally, must be done swiftly and determinedly to protect them and avoid public chaos.

For this case study, Positium has built a dashboard based on MPD in Indonesia. The dashboard that has been built by Positium demonstrates how near real time MPD (24h lag) could be used for crisis management. It shows visually how many tourists are in different areas, where they are from and if and where they are moving to.

The dashboard was validated by multiple end users in an online focus group discussion. This dashboard presents how many tourists were in the crisis area, where they are from and if and where they are moving to. This information can be used to

- estimate tourists counts that were potentially affected by the crisis;
- let embassies know, how many people from their countries were in the area;
- assess, if crisis notifications reach vulnerable people understandably and on time;
- assess, how many tourists are moving out of the area and how many are still there.

The dashboard reaches its highest usefulness when combined with already existing databases and dashboards. There are different data sources already existing. The wider the view and the more integrated dashboards with different aspects, the better overview of the crisis situation will rise.

MPD is a great data source that has a lot of scientific and technological potential that could be used for crisis management. In order to make it easier and clearer on if and how this dashboard could be used, MPD usage for crisis management should clearly regulated by EU and on a national level as well.

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List of Acronyms

BASARNAS	National Search and Rescue Agency
BuildERS	Building European Communities Resilience and Social Capital project
BMKG	Meteorological, Climatological, and Geophysical Agency
BNPB	National Disaster Management Agency
BPBD	Regional Disaster Management Agency
CDR	Call Detail Record
D	Deliverable
DoA	Description of Action
FGD	Focus group discussion
GDPR	General Data Protection Regulation
GoI	Government of Indonesia
inDRA	Indonesia Disaster Rapid Assessment
MNO	Mobile network operator
MOFA	Ministry of Foreign Affairs
MPD	Mobile positioning data
PDM	Positium data mediator
SAR	Search and Rescue
SMS	Short Message Service
WP	Work Package

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1. Introduction

The overall focus of the BuildERS project is to help improve government policies aimed at enhancing the disaster resilience of European populations, with a focus on disadvantaged groups and the effects of false information. There are 7 international case studies within Work Package (WP) 4. Multiple case analysis of WP4 has the following objectives:

- tools and guidelines development, since the practicalities related to technologies and other tools must be field-tested, piloted or simulated before considering their up-scaling and transferability to other contexts;
- demonstrations of the tools, techniques or technologies can be applied and utilized;
- empirical testing of what works and what does not work in practice; the cases serve also policy, strategy and other recommendations given in latter work packages;
- multiple case studies offer additional material for comparative analyses and supplement the field surveys and questionnaires offering wider base for synthesis and increase of reliability and validity of conclusions drawn from the research;
- innovation identification and proof-of-concepts.

This report D4.7 demonstrates the possibilities of mobile positioning data (MPD) usage in the crisis management area. This report is based on the task 4.7 that is aiming for product innovation for more precise rescue planning and emergency management in Indonesia.

The University of Indonesia together with Positium demonstrate a product innovation of how mobile operators' data can be used to locate, protect and evacuate tourists and other vulnerable groups in disasters. Such maps will more precisely inform the professional rescuers about tourists' whereabouts at different locations and times and help to deliver better need-calibrated relief services. Positium and University of Indonesia are looking at crises like volcano eruption, earthquakes, tsunamis, floods. Locating people that have no understanding of local circumstances and are unable to act rationally, must be done swiftly and determinedly to protect them and avoid public chaos. As MPD is anonymous and does not allow identifying any individuals or groups based on socio-economic values, we are seeing all tourists in the hazard area potentially vulnerable. You can read more about data anonymisation in chapter 3.

For this case study, Positium has built a dashboard based on MPD in Indonesia. The dashboard that has been built by Positium demonstrates how near real time MPD (24h lag) could be used for crisis management. It shows visually how many tourists are in different areas, where they are from and if and where they are moving to.

This dashboard is mostly meant to be used during the crisis where the end users can see with almost real time updates how many tourists are potentially affected, might need help and to monitor if and where they are moving to. Also, the dashboard can be used after a crisis to analyse previous disasters and events to assess if processes should have been different or to analyse if notification systems are

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reaching vulnerable groups understandably and on time. Based on this knowledge, planning of resources and processes for future crises can be adjusted. This dashboard's goal is to give rescuers enough information so that they could predict population behaviour in crisis situations, plan their resources and processes better and by doing that, reduce the costs on aid and relief for emergency proliferation.

The dashboard was validated by multiple end users in an online focus group discussion. All participants could freely elaborate, if and how they could use this dashboard in the perspective of their organisation and area of expertise.

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2. Alignment to the theoretical framework

As a country located in the Pacific Ring of Fire, in which several major tectonic plates intersect and collide, Indonesia often experiences natural disasters on its many islands, such as earthquakes, tsunamis, and volcanic eruptions occurring due to tectonic activities, as well as debris flows, landslides, and slope failure due to its steep topography. According to the 2018 World Risk Index, Indonesia ranked as the 36th country with high disaster risk out of 172 countries assessed. Furthermore, The National Agency for Disaster Management (BNPB) stated that almost all districts in Indonesia are prone to hazard, where 80% of its districts are categorized as disaster high-risk areas.

The occurrence of natural disasters is often unpredictable, hence it exacts a severe toll in terms of the economic impact, losses of human lives, and physical damage. According to risk assessment data published by the BNPB in 2016, Indonesia has to bear social losses of 86,247,258 lives, physical structure losses of IDR 406,689,834, and economic losses of IDR 182,185,171. To reduce these disaster risks, Indonesia needs to have an effective disaster and crisis management policy that promotes disaster risk reduction, increases regional resilience, and minimizes social vulnerability.

Vulnerability

Disasters impacted an immediate hazard to the human and natural environment as well as the social, economic, and built environment (Antronico et al., 2020). People may experience different impacts on the same disaster events due to their vulnerability level (Bakkensen et al., 2017; Kuran et al., 2020). Vulnerability was firstly referred to as the potential for loss when a natural hazard occurs (Cutter, 1996). Winser et al. (2004) defined it as the characteristics of a person or a group of people in terms of their capacity to anticipate, cope with, resist, and recover from the natural hazard impact. Vulnerability was also viewed as the susceptibility state to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt (Adger, 2006). Social vulnerability is a confinement of a community against the impact of natural disasters that affect their ability or resilience to recover from the results experienced (Cutter & Emrich, 2006).

Literature showed that there are different categorizations of social vulnerability depending on the aspect, sector, and contextual study. Some academics argued common indicators of social vulnerability consist of age, functional needs (water, food, and others), medical condition, language, and diversity (Fekete & Rhyner, 2020; Morrow, 1999). Wilfong (2004) suggested 11 indicators that should be considered in social vulnerability during a disaster, which include age, time travel, circumstances, subject profile, medical and physical conditions, clothing, weather, terrain, hazards, and equipment profile. Other academics emphasize socioeconomic status, gender, race and ethnicity, age, employment, urban/rural, occupation, family structure, education, medical services & access, social dependency, and the quality of the built environment (Roncancio et al., 2020). Moreover, each area has a different level of social vulnerability (Flanagan et al., 2011; Siagian et al., 2014), since specific geographical areas contribute to local characteristics that need to be involved when dealing with social vulnerability (Antronico et al., 2020).

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The quantification of social vulnerability assessment plays an important role in disaster mitigation planning and to better understand disaster risk (Tate, 2013; Solangaarachchi et al., 2012). Cutter et al., (2003) had developed an approach to measure the social aspects of vulnerability, widely known as Social Vulnerability Index (SoVI). It has been used in a study by Siagian et al. (2014) to identify the location of socially vulnerable groups in Indonesia. With three driving factors affecting social vulnerability of socioeconomic status and infrastructure, gender, age and population growth, and family structure, their study showed that there are 51 highly vulnerable districts located among Indonesian districts, with 76% of them located in the Eastern part of Indonesia including the main tourist destination districts.

Tourists have been considered as groups of people that are vulnerable to natural disasters in the regions they are visiting because of their lack of preparedness and knowledge, inadequate place-based disaster and vulnerability assessments (Becken et al., 2014), and they have language barriers as the non-native speakers (Marlowe & Bogen, 2015). Moreover, the tourism industry often has limited integration with national disaster management systems, hence tourists lack the understanding and competency in knowing critical information and actions they need to take to protect themselves in the occurrence of disasters (Hystad & Keller, 2008; Uekusa, 2019).

The objectives of the BuildERS project explore how various population strata have been affected by life-threatening emergencies, whose exposure have been magnified by pre-event social, individual and institutional fragility, and which might need highly targeted help and protection. To this end, innovative practices, measures and technologies are proposed to reduce vulnerability and mitigate harms inflicted by past, present and future hazards by altering and/or adjusting the contextual features and processes to remove gaps and inadequacies in public safety, security and social inclusion.

Resilience

Approximately 42 percent of the population living across Indonesian cities are exposed to natural disasters (Gunawan et al., 2015), and this percentage is expected to increase along with the growth of urban population, inadequate regulation of urban development, projected effects of climate change, and increased occurrences of land subsidence. Therefore, disaster mitigation efforts in order to build community's resilience must be scaled up across institutions, infrastructure, the economy and society, to minimize loss of life, reduce disaster effects on assets and the economy, ensure business continuity, and protect and further enhance prosperity, as well as inclusiveness and livability of Indonesia's areas.

Resilience is referred to as the ratio between preparedness and vulnerability. According to the UN, it is the "ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009). The resilience of a community in regard to potential disaster events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need. Therefore, resilience is considered as an ability related to the availability of resources and the organisation of a community, especially in the disaster preparedness phase. However, the need

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of resilience in disaster management cycle is not only emphasised in the preparedness phase but also in response phase (see D1.2 for BuildERS model).

Resilience is often considered as the antonym of vulnerability. Therefore, in order to build the community and societal disaster resilience in Indonesia as a disaster-prone tourist destination country, Positium's tool was developed to be a decision-making support system for both the disaster management agencies and the end-users that see tourists as a vulnerable group. The tool broadens their data usage possibilities. This tool allows the rescue operations and aid provisions to be conducted more effectively, hence the number of casualties can be reduced. The more the dashboard has been used during the disaster occurrences, the more it obtained information regarding the tourists, such as their counts and behaviour. Hence, these past crises' knowledge can be used as reference that can increase disaster resilience in the future.

Social Capital

Social capital has been defined as the groups, networks, norms, and trust that people have available to them for productive purposes (World Bank, 2004). It has also referred to its different aspects, such as structural social capital that refers to the types of groups and networks that people can utilize, and cognitive social capital that refers peoples' subjective perceptions of the trustworthiness of other people and trust in the key institutions in society, and norms of cooperation and reciprocity influencing the capabilities of people to work together to solve problems. Moreover, According to MacGillivray (2018), the definition of social capital also refers to different analytical units and relationships: including (1) Bonding capital/networks (family, closest friends); (2) Bridging capital/networks (neighbours, local community); and (3) linking capital/networks (relationship to authorities and institutions).

According to a study conducted by Partelow (2021), social capital can be the foundation for disaster resilience of a community, as it can enable collective action, which further provide self-organized social, psychological, financial and material resources following a disaster. While disasters create collective action problems where collective response and recovery processes are needed, creating an institutional space where the degree of usefulness, meaning and function of social capital can be recognized where external aid is insufficient. Social capital and disaster can be linked because people and communities are often connected through emotive and common shared experiences, actions and activities. Understanding the degree of this relationship can build a mechanism through which social capital enhances resilience by enabling collective action providing needed aid and help during disaster occurrences.

Vulnerability is dependent on social structures and power relations in their interaction with personal conditions and specific situations in complex trajectories. In this regard, enhancing social capital can be a way to minimize vulnerability and become more resilient. Furthermore, according to the study conducted by Dokhi et al. (2017) in Indonesia, social capital also positively influences knowledge of disaster preparedness. Persons with a high level of trust, tolerance, social networking and collective action tend to have a higher knowledge of disaster preparedness. On the other hand, peoples' social capital can also be increased when the disaster management agency has a good disaster management

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system, as they feel they have support from the leaders and are taken care of. Therefore, well-planned disaster risk preparedness strategies for vulnerable groups in Indonesia should be developed to increase the social capital.

The Indonesian case study applies various methods to build the social capital. It explores how to enhance social preparedness (e.g., civil safety, climate-change countermeasures) and resilience (social, and technical investments) using the different governance resources and powers (e.g., social, economic and administrative). By doing so, it emphasizes the critical role of public institutions (transnational, national and local) as protectors of human welfare and social inclusion through actions at various administrative and legal levels. It strongly emphasises on providing security and safety particularly for the most vulnerable subpopulations whose life conditions or situational endangerment make them in need of special care, aid, information or professional attention, whose delivery might require involvements of the country-specific administration apparatus.

Risk Awareness

There are several institutions involved in the process of disaster management in Indonesia, including BPNB, Regional Disaster Management Agency (BPBD) at the local level, National Search and Rescue Agency (BASARNAS), Meteorological, Climatological, and Geophysical Agency (BMKG), mass media, as well as national and local governments. For natural disaster occurrences, BMKG will verify information about the disaster when it occurs, and once it has been verified, BMKG will deliver that information to BPBD and the regional Search and Rescue (SAR) office in the areas nearby the disaster location, while simultaneously sending the said information to mass media outlets to provide early warning the public.

The information regarding the occurrence of disasters is disseminated immediately using BNPB's social media accounts, BNPB website, and the mass media (news on television and radio). In addition, BNPB also has a media that uses GPS technology to determine the position of volunteers and members who are available to carry out disaster response operations. This information is located on the website of inDRA (Indonesia Disaster Rapid Assessment). Furthermore, in the wake of a tsunami disaster, people are also notified using an early warning system that combines the technology and the capacity of the community to respond to the information provided, called InaTEWS. Only BMKG has the task of calling for tsunami early warning. The warning from the BMKG needs to be followed up by the BPBD, which is also in charge of building and implementing anticipatory measures. After receiving information from BMKG, BPBD and the regional SAR office will immediately provide initial information to the local public through both mass media and social media, so that people can be evacuated when it is considered necessary.

The developed tool helps disaster management stakeholders, particularly the ones responsible during the preparedness and response phases, to be more aware of the disaster risk. The tool can be used in the preparedness phase to learn from past crisis scenarios regarding how people moved. And during the response phase, it can be used to manage technical, material and human resources better, to gather knowledge on how many tourists are in the area, going in there or moving out of the area, and to better communicate with foreign consulates about how many of their tourists are affected by the

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crisis event. In general, it helps rescuers to make more accurate decisions and resource planning during the disaster occurrences, hence increasing the survival rate of the victims, which in this case are tourists that are regarded as a vulnerable group.

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3. Description of mobile positioning data and the developed dashboard

3.1 Mobile positioning data

MPD in the context of this dashboard refers to passive mobile positioning, meaning the data that is automatically collected by the mobile network operator (MNO) based on customer billing, network maintenance and performance monitoring. Passive MPD has been becoming a more popular data for statistics. There are multiple reasons for that, such as the fact that data is collected passively and without any burden on people. There are many data points per person within a longer period, which gives the data consistency throughout the whole time period and does not only reflect one day, week or a season, but the changes throughout a longer period as well. MPD is also not as expensive as surveys that reflect less and the results can be used in many different domains, such as tourism statistics, transportation planning, mobility analysis and population statistics.

The most common form of passive MPD is call detail records (CDR). MNO-s collect location data (records) from subscribers each time a subscriber uses data, makes a call, receives a call, sends an SMS or receives one. The spatial accuracy of passive MPD is not as high as with GPS (which is active mobile positioning method), since passive MPD locations are calculated from cell towers' coverage areas with probability algorithms. MPD is anonymous. When MNO sends their data to Positium for calculations, subscriber ID-s are already anonymised with their own confidential algorithm and outside the MNO the personal information is not known, meaning that individual persons cannot be identified.

In the Table 1 below is presented how raw data structure from MNO looks like. Subscriber ID in MNO's database could be the phone number for example, but when data is made available for Positium, all IDs are anonymised. Second column shows the time of the record, meaning timestamp of call/SMS/data usage activities. Third column Cell ID shows to which cell tower subscriber was connected to perform this activity. Usually, each subscriber has many data rows like this per day, especially when mobile data is being used. One data row is called a 'record'.

Table 1. Raw data structure from MNO.

Subscriber ID (anonymised)	Time of the record	Cell ID
123456789	2019-05-12 18:21:58	12345

Having mobile phones and being connected to the internet are very common in Indonesia, as it is said as the fourth-largest smartphone market worldwide after China, India and the United States. In 2019, there were 171.28 million smartphone users in Indonesia, reaching up to 73% of its population (Statista, 2019). This number was estimated to increase to 224.37 million by 2022. Therefore, collecting data from MNOs is a very good method for analysis and statistics since it covers the majority of the population.

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MPD is divided into three parts: domestic, inbound and outbound.

- **Domestic** MPD data covers subscribers with local SIM-cards that are present in a certain country for most of the year (local people). For domestic data Positium has subscriber ID, record time and location for each record.
- **Inbound** roaming data covers foreign visitors (SIM-cards registered in foreign countries) that come to a certain country. For inbound data Positium has subscriber ID, record time and location for each record and the country code where the subscriber comes from.
- **Outbound** roaming data shows local people (local SIM-card) travelling to foreign countries. For outbound Positium only has subscriber ID, timestamp of the record and the country where the subscriber went to, but no exact location or information about records done in the foreign country.

In the Task 4.7 Indonesian case study, only inbound data is used. This is why only tourists can be shown on the developed dashboard. Indonesian domestic MPD (local people) is enormous and calculating it overnight is unfortunately not possible.

Positium's technology is called Positium Data Mediator (PDM), which cleans raw data, does the calculations and forms results. The first thing PDM does is cleaning the data. This means for example removing all invalid rows, duplicates and machines (machines that use SIM-cards but are not phones, such as security cameras, vehicle's GPS devices etc) from MNO's raw data.

Unlike in the Task 4.3 Estonian case study, in Task 4.7 Indonesian case study anchor points (e.g. home or work locations, regularly visited areas) are not calculated. There are many reasons for this. For example, in order to be able to calculate anchor points, at least 6 months of data is needed. This is a huge amount of data and cannot be calculated overnight. Also, anchor points are mostly meant to understand domestic data, which Positium does not have in Indonesia. As for inbound data, tourists do not stay in the country long enough so that they could even have long-term anchor points. If a tourist stays in the country longer than 91 days, then in PDM's methodology they are not considered tourists anymore. For more information about anchor points see D4.3.

After data cleaning, on an individual but still on an anonymous level, stays and moves are calculated. On the Figure 1 below you can see how a 'pipeline' of each subscriber's records can be drawn. Based on this pipeline, it is also possible to take out movements between different areas that are shown in the origin-destination matrices layer on the dashboard. In the Indonesian case study, Positium only knows movements between different areas, but unlike in the Estonian case study, there are no anchor points (e.g. home and work locations).

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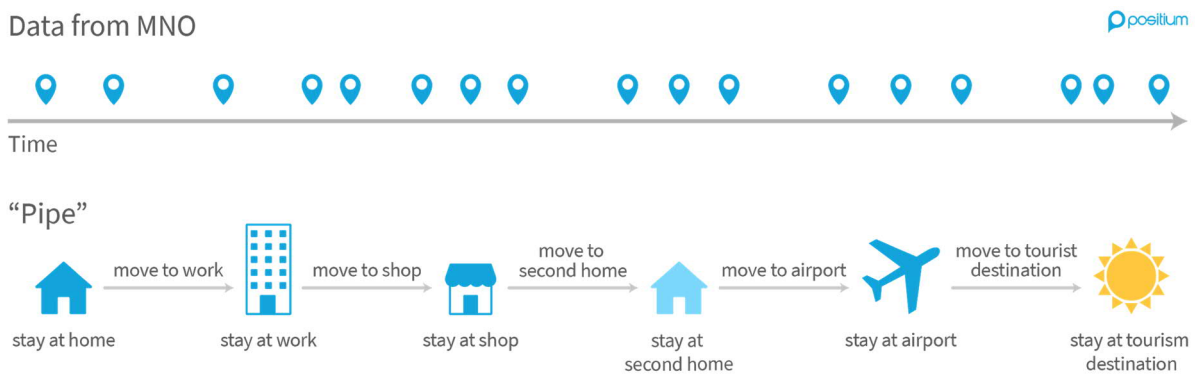

Figure 1. Stays and moves pipeline

After calculations are done on an individual level, PDM generalises the results to the whole population. This means that no individual results are shown, only general count of subscribers or movements between areas. Furthermore, all values under ten are either shown as '<10' or excluded from the dashboard for privacy reasons.

3.2 Limitations of mobile positioning data and the dashboard

There are some limitations of using MPD. Gathering real time data during a crisis can be complicated due to the fact that in case of power outage or physical damage to the cell towers can cause connection being down. In case of power outage, backup generators can prolong the time when connections are still there, but in case the cell tower physically breaks due to an earthquake for example, connection is down. People start to connect to other cell towers nearby if possible. This means it might be impossible to gather new data.

Second limitation of MPD is that it can not be used to identify individuals or subscriber groups based on their socio-economic backgrounds. This sets limitations for very detailed crisis management planning, but it is not a limitation in other domains like tourism statistics and infrastructure development. When Positium gets the data from MNOs, all subscriber ID-s are already anonymised. Additionally, Positium generalises the individual results to general results. Also, results smaller than 10 are either hidden or left out of the dashboard to make sure no individuals can be tracked (GDPR). Due to the ID anonymisation, this developed dashboard cannot be used to notify subscribers.

The dashboard shows the exact number of tourists in the area (no coefficients are used), but it is important to understand that Positium has MPD from one MNO who has the majority of the market share (around 60%), which means that tourists who only connect to other operators' cell towers are not included in the data. Also, tourists who have one SIM card in their phone and they have replaced it with a local SIM card, are not in the data as in the eyes of the algorithm, they are domestic subscribers and their data is stored in another database. If a subscriber has two SIM cards from which one is foreign and other local, subscriber is in the inbound data that is used for this dashboard. If a tourist is in the domestic data as he/she has bought a local sim-card, currently, there is no methodology how to distinguish them from local people and to transfer their data from the domestic database to the inbound database.

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Recently and suddenly, the data access conditions in the main data provider in Indonesia have changed due to changes in internal data sharing policy. Positium is currently working with the data provider to sign a new data access agreement. It is unclear how long the new arrangements will take as the data is of highly sensitive nature. This brings us to the fact that real MPD cannot be used for this case study.

Positium has access to an aggregate database of roaming subscribers from 2019, from which we are able to analyse tourism movement to some extent. It allows us to build simulated data that provide the input for building the tool described in D4.7. Cons of this approach is that it is a combination of the actual counts of tourists and movements' assumptions. The demonstrator has one level lower technological readiness level than previously planned. Pros of this approach is finishing on time and still being able to show what MPD is capable of in crisis management context in Indonesia.

Everything shown on the dashboard is possible to be shown with real data as well. Positium has been very careful in the scope with the simulated data and movements as Positium only wants to show functionalities that they are actually able to produce with real data as well. Tourists counts on the first day are based on actual information that we have from Tourism Dashboard (another project that Positium has in Indonesia). These numbers reflect reality. All movements on the dashboard for the next days are simulated synthetically.

3.3 Advantages of mobile positioning data and the dashboard

MPD has many advantages. The data is passively collected by MNOs anyway so that they could bill their customers at the end of the month. No extra effort for gathering the data is needed. MNOs are obligated to gather this data and also to store it for a certain amount of time. In case of tourism statistics, gathering data with MPD is 4 times faster and sample size is up to 200 times higher, compared to travel questionnaires. It is also more cost efficient and less burden on tourists. MPD covers most of the population as SIM-cards are widely used by almost everyone. Positium has over 15 years of experience and expertise in using MPD for statistics and developing tools and methodologies that help to calculate the data and present reliable results.

The dashboard that has been built helps rescuers create more accurate risk assessments for different crises. Dashboard is very case universal, meaning that it can be used not only for earthquakes and volcano eruptions, but also for floods, tsunamis, terrorism, bombings etc. Based on this dashboard, rescuers are able to more accurately plan risk assessments, evacuations and learn from past scenarios. Also, it can give accurate input for authorities for communication with foreign consulates (how many tourists from which countries were in the crisis area during the crisis and afterwards as well).

MNOs might collect the data with different structures or with different storing methods. For the Indonesian case study there is the strength, that Indonesia has been using MPD for tourism statistics for years. There are already systems in place and they are easy to combine with already existing tools or dashboards. There is already a contract with one MNO in place, their data has been assessed for

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quality and structure and Positium has knowledge and experience on how to use their data in Positium Data Mediator. If a new country wants to use MPD for statistics, a longer pilot project will have to take place first, but in the Indonesian case this is not necessary and the dashboard can be taken into use quickly (if data sharing policy within MNO becomes clear).

As mentioned earlier as well, MPD is anonymous and the security is guaranteed with different steps, such as

- storing and managing data safely in safe servers with different security methods (physically separated and virtually isolated server rooms with limited access, access only through special processes);
- anonymising all subscriber ID-s;
- creating aggregates based on individual (but anonymous) results;
- values smaller than 10 shown as <10 (not only on the dashboard, but also in the database).

This means that no one's privacy is compromised.

3.4. Dashboard

Positium has built a dashboard that helps rescue organisations plan their human and material resources more accurately during crises. Through more exact planning and knowledge of tourists' whereabouts during crisis, the processes of aid and relief during disaster can be faster and more effective.

The dashboard currently has simulated event data in it, but it was built and validated as if the data was real. On the dashboard, there is inbound data of 1-2 days prior to the crisis and daily updates for a couple of days afterwards as well. In case the data was real and a crisis is happening real time, data would come from one MNO. Currently the dashboard is built on a municipality level but Positium is able to display the results on a smaller area level as well if that reflects the crisis area better. It strongly depends on where the crisis happens and what kind of crisis is being dealt with.

	AUTHORITIES IN INDONESIA	MOBILE NETWORK OPERATOR	POSITIUM	RESCUE SERVICES
DAY OF DISASTER	Let Positium know of crisis area and time; agree on area size (county/municipality/village)	Makes inbound data of last 1-2 days available for Positium in a secure server	Does the calculations in Indonesian servers (as required by law) and updates the dashboard	Can see how many tourists were in the area during disaster and where they are from; resource planning; evacuation management
DAY AFTER DISASTER	Can use country of residence information in communication with foreign consulates; resource planning; evacuation management	Makes inbound data of the last day available for Positium in a secure server	Does the calculations in Indonesian servers (as required by law) and updates the dashboard	Can see how many tourists are still in the area and where they are from; see if they are moving out of the area; resource planning; evacuation management

Figure 2. Process flow of using MPD for crisis management in Indonesia.

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In case a crisis happens, this is the process flow (Figure 2). Firstly, authorities will let Positium know which type of crisis, when and where it happened and also lets Positium know what area size is needed (county, municipality or village). At the same time, MNO makes sure that the inbound data of the last 1-2 days is available for Positium in a secure server. Then Positium does the calculations in the Indonesian servers, as required by law (data is not allowed to be transferred outside of Indonesia) and updates the dashboard within 24 hours. Rescue services can then see how many tourists were in the area during disaster, where they are from and they can base their resource planning and evacuation management on this information.

Authorities will also see the results on the dashboard and they are able to use the country of residence information in communication with foreign consulates to let them know how many tourists from which countries were potentially affected by the crisis. Authorities can also support rescue services with resource and evacuation planning. Similarly to the first day, on the next days MNO makes daily new inbound data available for Positium. Positium does the calculations and updates the dashboard. On the next days rescue services and authorities can also see movements between different areas and how they have changed over days.

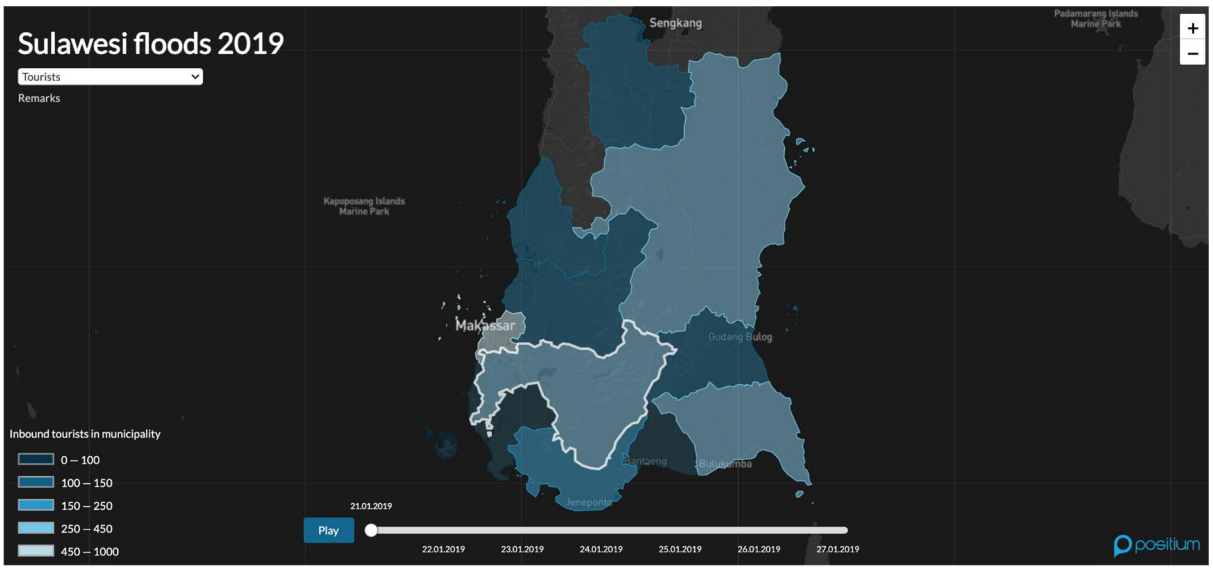

Figure 3. Dashboard's opening page.

Dashboard has Sulawesi floods from January 2019 as an example (Figure 3). Crisis area in this example is Gowa in the South Sulawesi area. Dashboard has municipality as the area size. Please bear in mind that if this dashboard is taken into use, area size, the location and crisis type might be different and these factors will be clear first when the crisis occurs. Therefore, this information on the dashboard is a demonstrator of possible functionalities MPD has to offer and a wider thinking and focus on just the functionalities is needed.

3.4.1. Tourists' layer

This layer shows the amount of foreign tourists in the chosen municipality (Figure 4Figure 5). This layer can be used to determine the amount of tourists in an area for each day.

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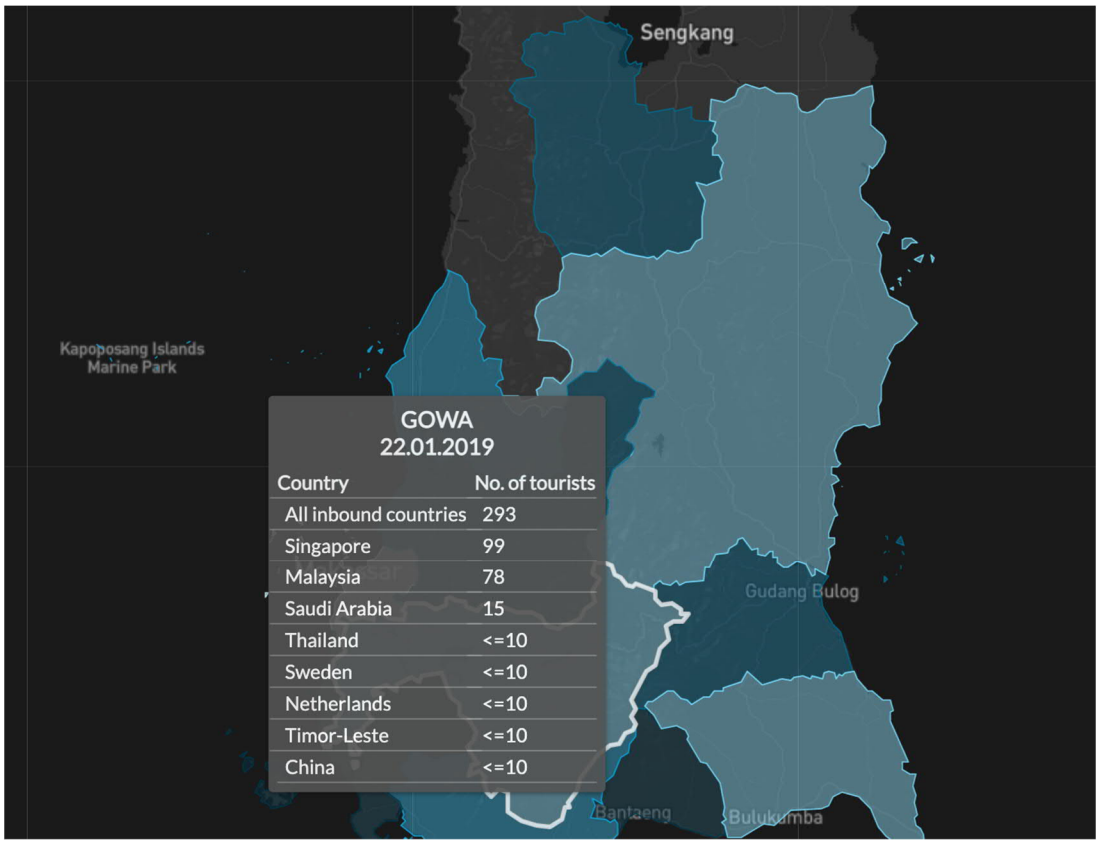

Figure 4. Dashboard showing number of tourists per country on 22nd of January 2019 if mouse is hovered over the area.

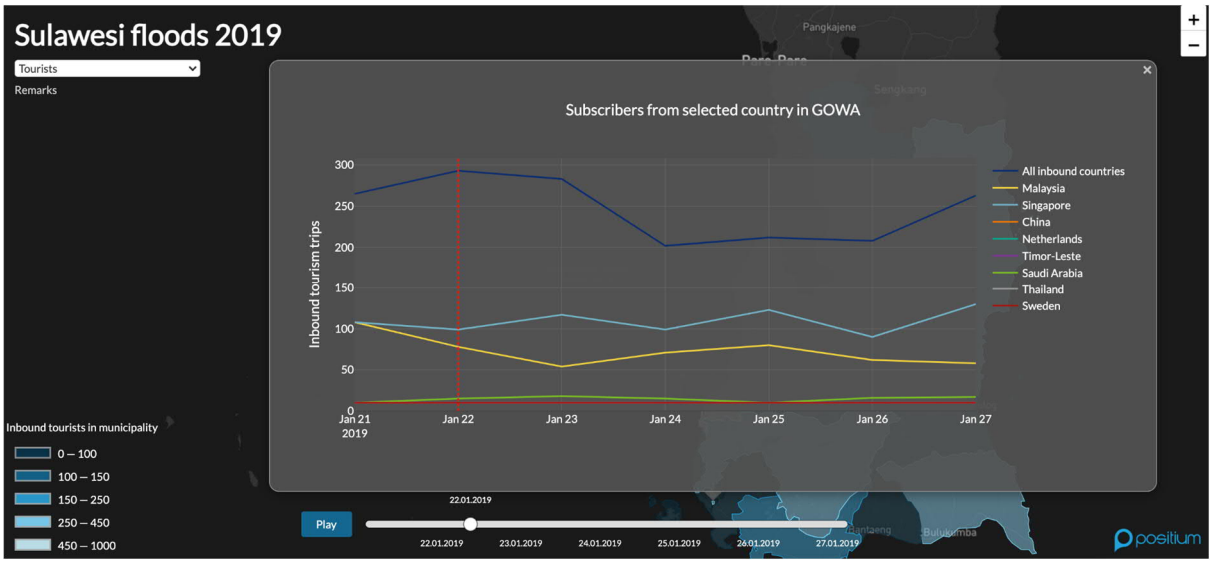

Figure 5. Dashboard showing the change in number of tourists over the whole period if clicked on the area. This change in real life is visible several days after the crisis (each day, one day's data is added).

"All inbound countries" shows the sum of all the different inbound countries per municipality. Additionally, 8 most popular inbound countries were selected for the South Sulawesi region.

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Definitions and usage description on tourists' layer:

- **Foreign tourist** is a subscriber with a foreign SIM-card that is linked to Indonesian cell towers e.g. to perform calls, sending SMS-s or to use mobile internet.
- **Hover** over an area, to see a tooltip showing how many subscribers were in the chosen area at the chosen day per country of origin.
- **Click** on a municipality to see the change of the same data over multiple days on a line graph.

3.4.2. Movements layer

This layer (Figure 6) can be used to see how many movements of foreign tourists and to which directions are happening between the municipalities and helps to determine which roads to block/unblock first or to estimate the amount of resources needed for different purposes. It can also be used to evaluate if tourists are moving out of the crisis area.

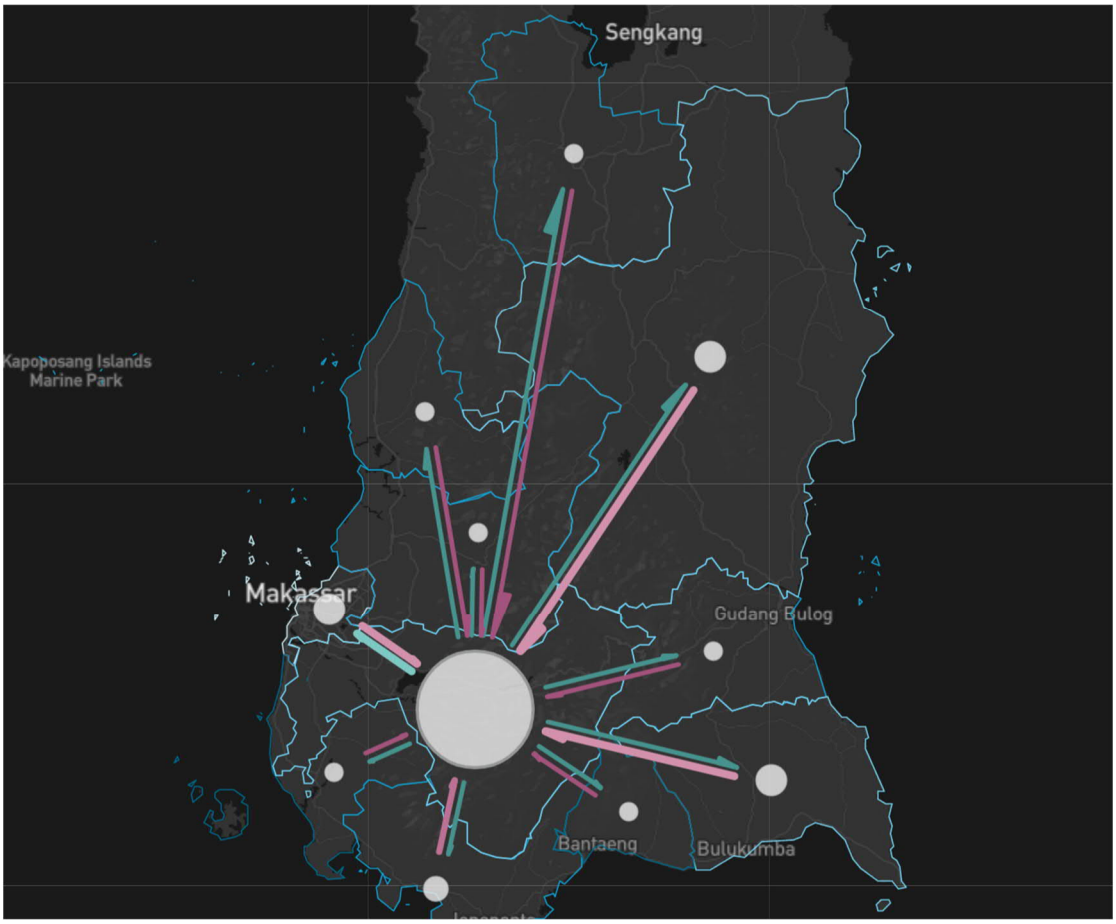

Figure 6. Movement's layer starting page showing movements' directions from crisis area (Gowa) to nearby areas.

Definitions and usage description on mobility layer (Figure 7):

- **Incoming** movements show movements from other areas into the chosen area.

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- **Outgoing** movements show movements from the chosen area into other areas.
- **Total** movements show the sum of incoming and outgoing movements.

Hold the mouse on the bubble of the area you want to see. You can see three columns:

- **Today:** this number shows how many movements out of or into the area were made on the chosen day.
- **Change from yesterday:** this number shows the movement count's difference between yesterday and the chosen day. This can be used to monitor if tourists have started to move out more than on the previous day.
- **Change from first day:** this number shows the movement count's difference between yesterday and the first day. This can be used to monitor if tourists have started to move out more than on the first day.

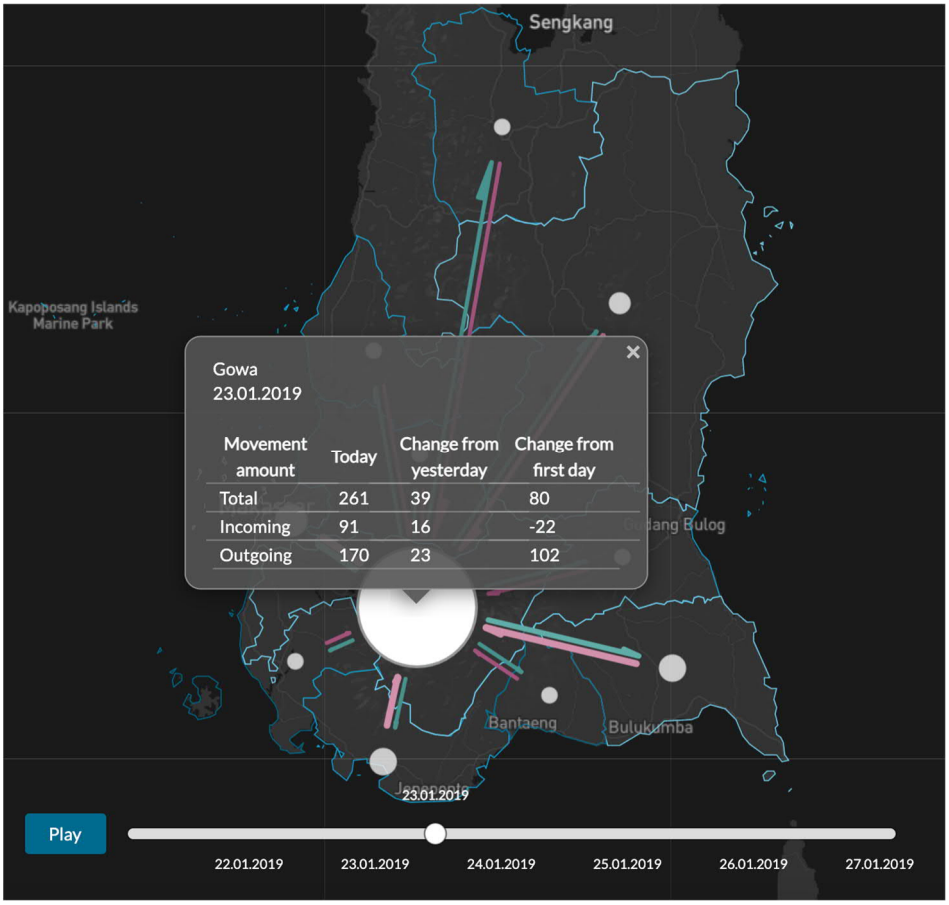

Figure 7. Dashboard showing movement counts from crisis area (Gowa). During the chosen day 23rd of January, tourists made 261 movements, 170 out of the crisis area and 91 into the area.

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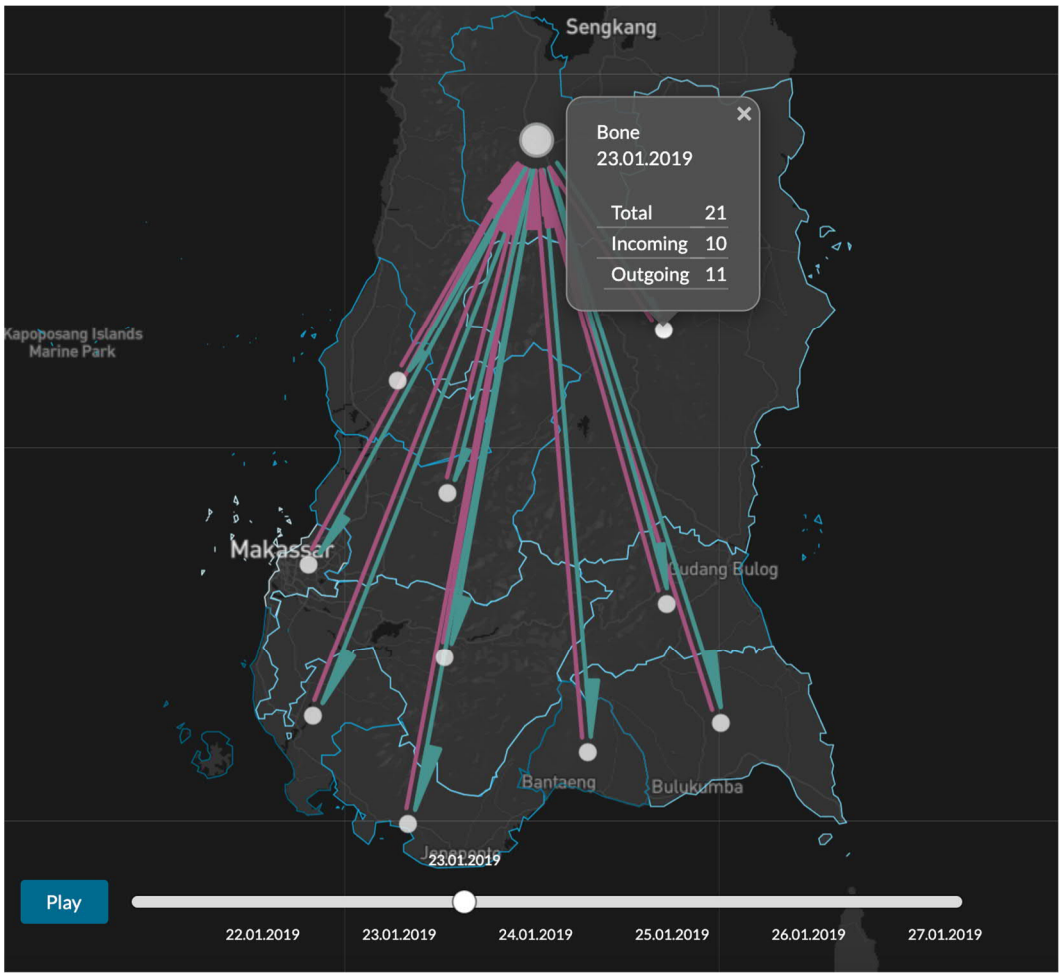

Figure 8. Dashboard showing that you can choose any area nearby to see movements linked to the other areas as well. Tooltip shows movements between the chosen area Soppeng and Bone municipality.

User is able to also see the incoming and outgoing movements of nearby areas as well as seen on Figure 8.

Other information about the dashboard

- This dashboard is just a demonstrator. Dashboard demonstrates what MPD is capable of. This kind of functionality can be displayed in all areas of Indonesia, on different area sizes and can be used to cover different crises (floods, earthquakes, volcano eruptions).
- Almost all numbers shown in the dashboard are simulated amounts, not exact amounts. The tourist count is based on real MPD but the movements and changes in tourists counts are simulated and might not reflect reality.
- All values under 10 in subscriber counts are shown as <10 and less than 10 movements are shown in the dashboard as 10 in order to keep the privacy of all subscribers.
- If the dashboard is used in real life, data updates will take place every 24h, starting from the day after the crisis. This means there is near real-time data, but with a one day lag. Every day, one day's data is added
- Please note that movements inside the same area are not shown on the graph. Movements are only shown if the tourist goes from one area to another.

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4. Methodology of empirical testing

A focus group discussion (FGD) was conducted online to validate the dashboard that has been developed by Positium. The purpose of the validation is to gain more insight on how the dashboard could fit better into the local disaster management system, by taking into account the expertise and experience of relevant institutions.

Around 30 people participated in the FGD, representing various government institutions (i.e., National Planning Agency, Ministry of Foreign Affairs, Statistics Indonesia, National Search and Rescue Agency, National Disaster Management Agency, etc.) and also non-government organizations (i.e., PetaBencana.id).

In the beginning of the FGD, the participants were asked to introduce themselves, along with the organizations that they represent. Following the introduction, Positium presented the audience with the overview of MPD, the process flow during disasters, and also the dashboard demonstration.
After the participants were presented with the explanation, they were given the opportunity to ask questions and share their thoughts on the presentation. The purpose of this Question and Answer session was to address the concerns that the participants might have, and to clarify on matters that are still unclear to the participants. During the Q&A session, the participants were also allowed to share their opinion and experiences dealing with disaster management.

The Q&A session was followed by a case scenario. We presented the participants with case scenarios. The first case scenario was intended to gather information on the usual process during and after disasters. For the other case study, the participants were presented with a case of disaster, and were asked their expectation towards the information presented on the dashboard, and how the information could help with the decision making process 1 day, 2 days, and 3 days after the disaster.

A total of 4 questions were presented to the participants following the case studies: 1) How long should the data update take place?; 2) Who would be interested in seeing the results?; 3) What should be changed in the dashboard for it to be more useful?; and 4) What are the best qualities about this dashboard?

Before the end of the discussion, the participants were asked to fill out 2 online questionnaires. The first questionnaire (Annex 1) is intended to further evaluate the dashboard and the implementation of it, while the second questionnaire is intended to evaluate the FGD itself (Annex 2).

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5. Results

5.1. Results of the focus group discussion

On April 21st April 2021, a focus group discussion was held with end-users to validate the usefulness of the dashboard. Participants were from different agencies to cover more parts of the emergency processes. There were the Indonesian Ministry of Foreign Affairs, Ministry of Tourism and Creative Economy, Ministry of Development Planning, National Disaster Management Agency (BNPB), National Statistical Office, Ministry of Social Affairs, and Provincial Government, and representatives from the Non-Government Organizations, and Civic-Tech organizations. The organizing team consists of the University of Indonesia and Positium team who was responsible for managing the overall processes of the workshop, while the VTT team (Finland) was also present as observers. Here is a conclusion of what end-users thought of the dashboard.

1. The dashboard could complement the existing tourists' management dashboard

At the beginning of the focus group discussion, it was discussed how crisis management currently works in Indonesia. The government of Indonesia (GoI) has a dashboard aiming to monitor emergency service provided to foreign nationals. The service is provided by the Ministry of Foreign Affairs (MOFA) according to the Vienna Convention on Diplomatic Relations of 1961 and 1963 concerning notification and consular access. As a signatory of the convention, GoI is obliged to assist the citizens of a country that has an embassy in Indonesia. The MOFA's dashboard provides information about the cases, individuals identity including country of origin, and the types of assistance given to each individual. During the covid pandemic, the dashboard was also used to record and monitor the number of foreign individuals found with the positive covid test, recovering patients, and death.

MOFA is the agency that has the authority to issue medical evacuation for foreign citizens in Indonesia. The way the MOFA's dashboard works is that MOFA received a notification via WhatsApp, Short Message Services (SMS) or by phone from the Indonesian Disaster Management Agency (BNPB). BNPB will report the number of casualties, country of origins, and the location (hospital, hotel, school, etc). MOFA will then notify the local embassies based on the nationalities of each of the tourists. The embassy will then contact the hospitals/doctors to get regular updates. The embassies will then do necessary actions to ensure the safety of their citizens, including medical evacuation. MOFA will help with the access clearance to ensure that the medical evacuation could be executed without any issues. MOFA is using data from the dashboard for the decision making in the emergency such as when deciding for issuing the medication evacuation.

Based on the discussion during the workshop, the dashboard developed by Positium could complement the existing dashboard managed by MOFA in the following ways:

a. The ability to locate tourists who have moved from one area to the others are also important. Most tourists came from major entry gates such as Jakarta or Bali. They will then go on to different areas including some of the remote areas. It would be difficult to locate the tourists

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only based on the information from the data gathered by the immigration authority at the entry gate.

b. The data gathered by BPNB is based on findings on the ground, which means BNPB's staff has to be able to directly locate and interview the tourists to identify the number of affected foreigners in the area. The issue here is that sometimes the BNPB would not be able to physically locate the tourists or the delay in which the BNPB would be able to locate the tourists. The dashboard could provide information about total tourists' count in the area that are potentially in danger.

MOFA has expressed that they are open for collaboration to improve the existing dashboard. They also welcome follow-up discussions in a small group meeting together with BNPB to explore the needs and solutions that could be developed from MPD and how it could complement already existing dashboards.

2. End-users expressed concerns regarding personal data privacy

According to Article 4(1) of the EU's General Data Protection Regulation (GDPR), personal data are defined as "any information which are related to an identified or identifiable natural person"[1]. The regulation specifies that the information that could be used to directly or indirectly identify a person may include a name, an identification number, location data, an online identifier, or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

In relation to the dashboard developed by Positium, the end-users were keen to understand how the data processing and analysis have followed legal framework regarding personal data protection in Indonesia as well as the tourists' country of origin (for example, GDPR issued by the European Union). As of April 2021, the draft of the Personal Data Protection (PDP) law in Indonesia is still being finalized by the parliament. Although currently, the Ministry of Communication and Information Technology's regulation number 20 of 2016 has also provided a guideline in terms of protecting personal data, including how and where personal data needs to be stored.

In response to this concern, Positium team explained that raw data was all anonymised and no personal information was being shared. Hence, it makes it impossible to identify an individual subscriber. In addition, an official from the National Statistical Agency also explained the best practice that has been used in their collaboration with Positium in the last 4 years to protect data privacy when processing and analysing MPD for tourism statistics. The official ensured that all data is handled securely and according to laws.

[1] https://gdpr.eu/

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3. Data Integration with other disaster risk dashboards

During the workshop, the end-users also put forward several interesting ideas on how the dashboard based on MPD could also be integrated with other disaster management dashboards that have been developed using various technologies such as mobile app distress signal and crowdsourcing data.

SafeMyLife Application

A participant also pointed out the possibility to combine data from the dashboard with SafeMyLife, a mobile application developed by the University of Indonesia. The SafeMyLife application relies on GPS technology that could send an exact location when a person sends a distress signal by tapping an emergency button on the app. This application needs to be downloaded by the tourists and prefilled with information on health conditions, which rescuers use to prioritise their doings.

This SafeMyLife application could complement location data provided by Positium's dashboard, which has people's whereabouts calculated based on coverage areas of the cell towers. Combining data from SafeMyLife would increase data validity and also the effectiveness of search and rescue efforts, especially if the distress signal could confirm the movement and locations of the tourists made available by the dashboard.

On the other hand, the dashboard provides the rescuers with the ability to see how many people were in the area at different times and how the count has changed during disasters. These kinds of information could complement data received from the distress signal app. Instead of only identifying and locating a single person, the knowledge of subscriber counts, movements' volumes and directions made it possible to plan more exactly the number of resources needed to help people in the crisis area.

PetaBencana[2]

The knowledge of subscriber counts, movements' volumes and directions provided by the dashboard could also be used to complement data from crowdsourcing applications such as PetaBencana (translated as "Disaster Map"). When a disaster happens, PetaBencana automatically maps the events based on the reports that are coming from the residences via social media or instant messages. Hence, the map creates a real-time situational report regarding the disaster environment. The map is open for anyone to use to understand the situation and make decisions about their safety in the event of a disaster. Currently the dashboard is in English. If it gets taken into use, translating the content to Indonesian is an option so that local people with no knowledge of English would understand as well.

These verified user reports are displayed alongside relevant emergency data collected by local and government agencies. Yet, while the dashboard could provide people counts, movements, volumes and directions, the real-time situational map will help to provide additional information for residents, humanitarian agencies, and government agencies to make more informed decisions during emergencies. For example, roads may become blocked or closed due to collapsed pavement or debris, which could be reported via PetaBencana. Having this information, the rescue team would be able to plan the route accordingly or use different vehicles to deliver supplies to the disaster area. A

[2] https://petabencana.id/

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combination of the dashboard and crowdsourcing data could guide movements and help people out of the crisis area.

Notification services for the tourists

The end-users also brought up the possibility of incorporating cell broadcast service or SMS broadcast into the dashboard. These technologies have been used for public warning systems that can alert and inform residences of the potential hazards and enable them to act in a timely manner to reduce the impact of the hazard. This implies that the systems applied for public warning must alert the targeted population, but also provide them sufficient information in an understandable manner.

A participant suggested that integrating such technologies into the dashboard could provide tourists with information as well as guidance to act in the event of a disaster. Positium explained to this suggestion, that Positium does not have anyone's phone numbers and therefore the notifications cannot be done through this dashboard. It can be done by cell broadcasting or by finding a way with the MNO for them to send out the notifications. Moreover, with data from the dashboard, it is also possible to analyse how warning notifications have changed people's behaviour as it is possible to see movements and changes in population counts.

4. Possible further development of the dashboard

Several other suggestions have also been made for future development of the dashboard, most notably regarding the ability of the dashboard to identify foreign tourists with the local SIM card and the ability to detect crowd-gathering at the tourist area.

Tourists with the local SIM Card

The end-users raised the question regarding the dashboard ability to detect foreign tourists who have switched to the local SIM card once they arrived in Indonesia. Unfortunately, for this type of subscribers, once they have made the switch, the algorithms would consider them as domestic subscribers. In the case where the subscribers used a dual SIM card and one of them is foreign, the dashboard would still be able to detect them as tourists. Unfortunately, currently there is no methodology how to distinguish tourists with local SIM card from domestic database and there is no method for solving this problem now.

Crowd Tracing

To prevent the spread of COVID-19, the Ministry of Tourism is also planning to develop an application that could trace crowd-gathering in the tourist spots. As the pandemic is still spreading, the government has decided to ban the Idul Fitri tradition of *Mudik* (homecoming) but still open tourist attractions in the area. It is hoped that with the crowd detection application, people can monitor conditions at a tourist spot. If it is too crowded, tourists can choose another location. Also, the application will be useful for owners of tourist attractions in controlling the crowd at their locations.

5. Users feedback on the four asked questions

During the focus group discussion, after the dashboard had been demonstrated, users were asked to answer 4 questions on a Miro board. Here are the questions and answers and how many times these were mentioned:

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1. How long should this kind of updates take place? There were some examples given, but stakeholders had the possibility to add their own answers as well. 6 people voted:
    a. 3 days (4x)
    b. 5 days (2x)
2. Who would be interested in seeing these results? Whom would these help? (Which organisations, people or service providers?). Stakeholders could write their own answers. Results were:
    a. embassies (3x),
    b. BNPB (2x),
    c. ministry of foreign affairs (2x),
    d. tourists' families back home (1x),
    e. ministry of tourism (1),
    f. search and rescue team (1x)
3. What are the best qualities about this dashboard? Stakeholders could write their own answers. Results were:
    a. Impactful, especially for the untraceable tourists in the area (1x)
    b. The movement and tourism information are great. Moreover, a feature should be implemented to see the movement of the victims. (1x)
    c. Time based comparison across places (considering privacy concerns are resolved) (1x)
    d. Know the numbers of foreigners in a certain area (possible up to Kecamatan?) (1x)
    e. Utilizing MPD as everybody uses mobile phones nowadays (1x)
4. What should be changed in the dashboard for it to be more useful? Stakeholders could write their own answers. Results were:
    a. Detect the tourists who change their SIM to the local one (2x)
    b. Develop an integrated system that syncs with government, develop real time information (1x)
    c. Combine with dashboards (1x)
    d. Can be accessed by public (not only particular agencies) (1x)
    e. Combine with immigration data (1x)

These results show that if this dashboard gets taken into use, updates should last up to 5 days and the main stakeholders are different embassies, BNPB and ministry of foreign affairs. The best qualities about this dashboard is using MPD as everybody has phones, it is impactful and helps to find otherwise untraceable tourists in the area. Also, movements and tourists' count information are great and these can be compared between different areas. Main concerning area was the missing capability of identifying tourists who switch to a local SIM card. As future development ideas, combining with dashboards and immigration data were suggested and that the dashboard could be available for the whole public, not only particular agencies.

Finally, it is important to note that at the beginning of the FGD, Positium team provided an overview of the dashboard, showing what MPD is capable of and how to use the dashboard. Also, accesses were given to all participants so that they would be able to look around in the dashboard on their own as well. However, during the case scenario exercise, the participants did not fully participate or provide responses. This could come from cultural reasons or the fact that there were too many participants in the meeting (more than twice more people attended the meeting than it was originally planned). Hence,

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it was unclear for organisers how easily the end-users found different information from different layers, although some participants were able to make general comments regarding the potential use of the MPD during the event of crises.

If the dashboard was to be implemented for real-life scenarios, more thorough training with specific target users needs to be done to analyse how the data and different functionalities could be used during the event of a disaster. This step could be done as part of the project implementation. If this dashboard would be implemented, discussions within a smaller group are needed to make sure all parties understand in the same way what are the capabilities of MPD and how the combination with already existing dashboards could look like.

In conclusion, it was found that this tool alone does not help crisis management better, but if it was combined with already existing dashboards and other information sources, it could give a much better overview of the crisis situation. All data sources look at the crisis from different perspectives and all have their own limitations. Hence, the more different datasets there are, the better overview of the crisis situation will appear.

5.2. Preliminary evaluation of the dashboard – VTT questionnaire results

Preliminary results of the evaluation of the case study show that the dashboard could be applied vastly in different phases of crisis management (see the BuildERS model). The evaluation was done using questionnaire targeted for end-users i.e. those who participated in the workshop. The questionnaire consisted of 7 sections: Background information, Usability of the tool, Perceived risks or challenges of the tool, Ethical acceptability of the tool, BuildERS model, Technical readiness of the tool and Free word. In total there were 12 questions that had different statements. Likert-scale 1-5 was used in all questions that were applicable (i.e. other than multiple choice questions in the Background information section and Free word section). Depending on the question, in the scale 1 stands for strongly disagree, very unlikely or very minor, while 5 stands for strongly agree, certain or very serious. Due to the nature of the questions and target group, respondents were also given the “I do not know” option. In the spirit and guidelines of the BuildERS project, the questionnaire was translated to Bahasa Indonesian and respondents were able to answer the survey in their native language. There was also the possibility to answer in English and some respondents made a good use of this option.

In this preliminary evaluation of the tool, sections ‘Background information’, ‘Usability of the tool’ and ‘Free word’ are pre-analysed. Final evaluation of the tool will be done in Work Package 6 and results will be reported in Deliverable 6.4: End-user assessment of the new tools and technologies for disaster management. Evaluation of the tool took place in the FGD that was organised as a Zoom meeting. Invitations were sent to many organisations. 12 ‘yes’ and one ‘maybe’ RSVPs were gathered by the day before the meeting. Based on this, organisers agreed to have the discussion in one group. But it turned out that some of the invited organisations sent more people to participate in the discussion. There were around 30 participants in the workshop (number changed throughout the meeting), of which 6 were organisers from BuildERS project and 3 observers from VTT, so these results are

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evaluated with the assumption that there were 21 end-users and 9 of them responded to the survey. Thus, roughly about 43% of the exercise participants answered the survey. 67% of the respondents represent the government, 11% were citizens / individual users, 11% from non-governmental organisations, and 11% from research organisations or universities. 33% of the respondents indicate that they used the tool and 67% said that they have not used it.

Regarding question number 4: "Please indicate your opinions of the tool, in regard to the following statements (from 1: strongly disagree to 5: strongly agree)", there was quite a lot of variation in responses to different statements (see Table 2). However, in all statements at least 67% of the respondents agree or strongly agree, and there are only two statements, where some respondents disagree with the statement. There were also two statements, "The tool or technology is suitable for crisis management" and "The tool or technology is suitable for Disaster Risk Reduction (DRR)", where 11% of the respondents indicated that they do not know if the tool is suitable for crisis management or DRR.

67% of the respondents agree (33.4%) or strongly agree (33.3%) that the tool is effective in achieving its purpose, but 11% disagree with the statement. Respondents also mostly agree or strongly agree (78%) that regular use of the tool would be efficient use of resources. It also seems that the tool was found to be useful and respondents indicate that the tool should be in regular use in their country (89% agree or strongly agree). Usability of the tool can be considered to be quite good as most of the respondents (78%) agree or strongly agree that they would be willing to use it again and that it was easy to use, and there are clear instructions on how to use the tool.

All respondents indicate that the tool is suitable for civil protection, but there was a little more deviation when crisis management and DRR were considered. 89% said that the tool is suitable for crisis management (11% selected 'Do not know') and 78% indicate that tool is also suitable for DRR (11% selected 'Do not know').

In the light of this questionnaire, accessibility of the tool is a bit unclear as the responses were divided quite evenly on the scale from 2 to 5, which might be a result of unclear understanding of the accessibility. It was expected that the term might be new and/or unclear, so the term was briefly explained in the questionnaire. The distribution of responses to the Usability related statements is presented in Table 2.

Table 2. Usability related statements and distribution of responses to them.

	1 (Strongly disagree	2	3	4	5 (Strongly agree)	I do not know
The tool or technology is effective in achieving its purpose	0%	11.1%	22.2%	33.4%	33.3%	0%

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Regular use of the tool or technology would be efficient use of resources (such as money or working time)	0%	0%	22.2%	33.3%	44.5%	0%
The tool or technology should be adopted to regular use in my country	0%	0%	11.1%	55.6%	33.3%	0%
I would be willing to use the tool or technology again	0%	0%	22.2%	44.5%	33.3%	0%
The technology or tool is easy to use	0%	0%	22.2%	33.3%	44.5%	0%
There are clear instructions how to use the tool or technology	0%	0%	22.2%	33.3%	44.5%	0%
The tool or technology is suitable for civil protection	0%	0%	0%	44.4%	55.6%	0%
The tool or technology is suitable for crisis management	0%	0%	0%	44.5%	44.4%	11.1%
The tool or technology is suitable for Disaster Risk Reduction (DRR)	0%	0%	11.1%	33.3%	44.5%	11.1%
The technology or tool is accessible	0%	11.1%	22.2%	33.4%	33.3%	0%

In ‘Free word’ section respondents were allowed to answer openly e.g. how they would develop or improve the tool. The answers to this question relate to development ideas. For example, it is indicated that information about disasters should be more shown in a more clear way, so that use of the tool would be easier. Currently the tool only shows tourists and other people with foreign SIM cards, and respondents suggested that domestic data should also be included in the tool. This requires some further investigation and development and there are also some legal, contractual and data volume issues to be handled in order to have specific datasets available in the tool. This also applies to the suggestion to open the tool for the public to raise awareness of the public during disaster response phase. There might also be risk of ethical issues if the location data would be made available to the public, and it should be thought through carefully.

Furthermore, respondents are suggesting that if the tool would be developed further, it could be used e.g. to support search and rescue in the post-disaster phase or to track movement of people in the pre-

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crisis phase and to give disaster alert and other information to the people. However, the tool was developed to be used in other contexts and uses historical data, and thus it is not meant to be a real-time data analytics tool, alerting tool or individual tracking tool currently (as explained in the previous sections).

From the view of preliminary evaluation, it could be said that the tool or similar tool could be beneficial in different phases of the crisis management for authorities and to raise awareness of the public. However, some further development is needed to make the tool more usable and to have vaster datasets available. Responses also indicate that there is a demand for a similar tool that could be used with real-time data to support search and rescue, and to provide other information to authorities. However, such tools could have potential risk of serious ethical issues and it should be researched extensively before large scale deployment. This preliminary analysis did not consider all the questions and responses to them, so further analysis is needed. The detailed analysis regarding the tool will be reported in Deliverable 6.4.

5.3. Feedback on the meeting

We received 7 responses on the FGD evaluation questionnaire. Regarding the clarity of explanation, 71.4% of participants think that the information related to the use of the technology has been explained clearly and thoroughly, while the other 28.6% think that it wasn't clear enough. This is understandable considering the language barrier between the participants and the presenter. As for the percentage of new information that is acquired by the participants, 42.9% of them get around 25%-50% of new information from the discussion, while only 28.6% of the participants acquired >50% of new information from the discussion. According to 71.4% of the participants, the duration of the event is just right - not too long, but not too short. The remaining responders think that the duration of the event is too long. We also found out that event platform (71.4%), quality of discussion (71.4%), and quality of speakers (57.1%) were the 3 main aspects that the participants find most satisfactory.

As for the technology itself, all respondents agreed that Indonesia should adapt similar technology to improve search-and-rescue efficiency during and after disasters.
From the open-ended questions, we've gathered some feedback on how we could improve the FGD and the dashboard itself:

- Be clearer on our expectations toward the participants.
  Some of the invited participants were confused about their role on the FGD, whether they would be the one giving presentations or whether they would be the audience. For future events, it would be important to clarify on this matter in the invitation and also when the participants confirmed their attendance.
- Integrate with the existing systems
- Collaborate and coordinate with relevant stakeholders with similar vision and mission

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6. Innovation potential

There are several innovation potentials that we have derived from the concerns raised by various stakeholders throughout the case study. The innovation potentials could be grouped into scientific, technological, and process innovation, depending on the nature of the innovation.

Scientific innovations

Current methodologies do not allow data researches to distinguish foreign tourists with local SIM card from domestic data. This is something that could be researched by MPD data analysts to find out if it is possible or not. It could be researched in future if and what kind of coefficient could be used on this dashboard to cover also the tourists who are in the area but are not in the data because they have either switched their foreign SIM card to a local one or because they have only connected to other MNOs' cell towers (currently we do not know what its probability is to be connecting only to other MNOs' cell towers).

Currently, Positium does not use domestic data in Indonesia. It has many reasons, such as data access problems, but also because the data just is enormously big, that it simply does not fit into the servers shared with Positium. Usage of domestic data could be explored so that if e.g. 3-5% of domestic data is calculated and generalised on the whole population, how exact this could be. It needs a separate research to understand this approach's validity.

Passive MPD is relatively standard everywhere, and the methodology developed for the dashboard is easy to transfer to other countries where MPD data is available. Information on the location and movement of tourists with a precise time and space units, is needed in many areas, in addition to risk management, also in transport and urban / regional planning, etc. Also, as it was mentioned during the focus group discussion, tourist areas during corona time could be monitored to avoid overcrowding. Hindsight into needed future development in using MPD in disaster management - here the communication with rescue workers is very useful.

Technological innovations

As for the technological innovation potential, one of the innovation that could be implemented in the future is blasting evacuation information through SMS to disaster victims. It would be very beneficial if, as an additional feature, we could send information regarding the nearest evacuation route or assembly points, along with the first responder's contact information during disasters. Therefore, the tourists could have a clearer idea on what to do, where to go, and whom to call or contact during disasters. Unfortunately, this cannot be done with Positium's dashboard, but there could be done with UI's application SafeMyLife.

Process innovations

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There are also some improvements that could be made on the current process, such as integrating dashboards with the ones currently implemented by the local institutions. Currently, the local institutions, such as the ministry of foreign affairs, has already implemented a dashboard containing data of foreign tourists who were impacted by disasters, as well as tourists who were hospitalized. The government institutions have shown their interest to integrate their dashboard with the one developed by Positium, as it can be leveraged to rapidly inform respective embassies. In addition to the ministry of foreign affairs, integration with the information system implemented by the BNPB and BASARNAS should also be considered, since they are the first responders during the disaster.

Different databases are already being used, all having their own view and limitations. One shows the count of people found on-site, one shows with GPS the tourists that have asked for help. Positium's dashboard could fill in the missing view that shows how many tourists in general were in the area potentially affected by the crisis. The wider view and more integrated dashboards with different aspects, the better overview of the crisis situation will rise.

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7. Conclusion and policy recommendations

Conclusion

This dashboard presents how many tourists were in the crisis area, where they are from and if and where they are moving to. This information can be used to

- estimate tourists counts that were potentially affected by the crisis;
- let embassies know, how many people from their countries were in the area;
- assess, if crisis notifications reach vulnerable people understandably and on time;
- assess, how many tourists are moving out of the area and how many are still there.

The dashboard was evaluated by multiple stakeholders in a focus group discussion where it was found that it reaches its highest usefulness when combined with already existing databases and dashboards. There are different data sources already existing. E.g. one shows the count of people found on-site, one shows with GPS the tourists that have asked for help. Positium's dashboard could fill in the missing view that shows how many tourists in general were in the area potentially affected by the crisis. The wider the view and the more integrated dashboards with different aspects, the better overview of the crisis situation will rise. Stakeholder MOFA has already shown interest in future collaboration in regard to integrating this dashboard to their systems. Main stakeholders of the dashboard are different embassies, BNPB and the ministry of foreign affairs.

This dashboard has many great advantages, but also some limitations. Advantages are near real-time data updates, flexibility on area sizes, locations and different crises. Also, it gives a general overview of how many tourists were in the area, where they are from and if and where they move to. Also, this dashboard can be used for other purposes besides crisis management as well. Stakeholders found that using MPD for crisis management is a great idea as everybody uses phones nowadays. It was said that this dashboard is impactful and helps to find otherwise untraceable tourists in the area. Also, movements and tourists' count information are great and these can be compared between different areas.

There are also limitations such as if a tourist replaces his/her foreign SIM card with a local one, he/she will not be in the data anymore. Also, if e.g. earthquake physically breaks the cell tower(s), no new data can be gathered in the next days after the crisis. Additionally, Positium has data from one MNO who covers the strong majority of market share, but if a tourist has only connected to another MNO's cell towers, he/she will not be in the data that Positium uses. Therefore, the users of this dashboard must always bear in mind that these numbers on the dashboard are not final and are actually bigger than they are on the dashboard (add some percentage for tourists who connect to other MNOs' cell towers and the ones who have switched their SIM cards to local ones).

In order to be able to build this tool to be ready to use and to integrate it with existing dashboards, firstly internal data sharing policy inside the local MNO's office needs to be cleared out. If there is no cooperation or data access from them, this dashboard cannot be used in Indonesia. Secondly, discussions with stakeholders need to be had to find out how to connect Positium's systems with theirs

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and how they want this dashboard to be built (there are many factors that can be modified depending on stakeholders wishes, such as area sizes, how many nearby areas are included in the calculations, how movements or subscriber counts are displayed etc). To enable crisis responders to use the tool in disaster situations, long-term stability in laws and agreements regarding handling MPD is needed. This needs all-around agreements regarding privacy policy.

Policy recommendations

Based on the results of the FGD and Positium's long experience with MPD, authors have come up with several policy recommendations.

Government regulation no. 23/2008 Art. 17 paragraph 1 states that in terms of assistance for disaster management coming from a foreign country, the Head of BNPB is obliged to coordinate with the minister whose duties and responsibilities are in the field of foreign affairs. This policy could be modified so that BNPB could coordinate directly with the foreign organization without having to go through the ministry of foreign affairs.

There should be clear laws about passive MPD usage for dashboards like this. At the moment use of MPD is differently regulated in various countries and there is a lot of insecurity in future accessibility to data. This also restricts the use of the dashboard geographically and puts rescue workers in a doubtful situation: should they make investments to start using such a tool, if, at some point, they cannot add new data into it.

MPD should be allowed to be used for scientific researchers so that new dashboards, applications and solutions could be developed. Restricted data access can also drastically slow or even stop scientific and technological advancements in the use of MPD in disaster management. Also, MPD usage should be standardised, including having unified definitions.

Adding main indicators of MPD to the composition of official statistics so that simpler indicators could be used to solve everyday problems. As in Indonesia and in other countries as well, disaster management includes different institutions, many of whom have different responsibilities in disaster situations, using some indicators of MPD as official statistics could accelerate benefits of MPD. Many of the institutions would not necessarily need access to all using opportunities of the dashboard but only some (perhaps more aggregated) statistics, but if they had all the knowledge of the main indicators, all institutions would have a more unified overview of the situation. By using MPD, authorities can assess the risk exposures of populations in disaster scenarios. As opposed to the static picture painted by census records, MPD shows where people actually move, which is a great benefit considering that people are mobile.

The unique value of MPD in disaster situations is that the data is passively collected with regular intervals without one-on-one interaction. MPD also allows people to look back in time to compare behaviour during 'normal' scenarios or during previous disaster scenarios. Therefore, the use of MPD could also help with communication between various stakeholders, assuming that they have access to the same dashboard. For instance, it could help BNPB to communicate the current disaster situations to the Ministry of Foreign Affairs. Instead of merely stating the numbers of victims, the Ministry of

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Foreign Affairs could get a clearer visualization of the movements of tourists and therefore could accurately forward the information to respective embassies.

These policy recommendations would help crisis managers to reach better level of preparedness, stable trust in MPD usage in the future and therefore also to reach the goals of the BuildERS project.

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9. Annexes

Annex 1. VTT questionnaire

Background information

Background information is used to evaluate if the tool or technology is seen differently by different type of users. In addition, purpose is to find out, what tool or technology was used and whether the tool or technology was used or only demonstrated to respondent.

Do you represent:

- Citizen / individual user
- Non-governmental organisation (NGO)
- Municipality
- Local authority
- Government
- Rescue organisation
- Police or border control
- Industry
- University / research organisation
- Education, shools
- Other (specify

2. Which of the technologies or tools you are evaluating?

Select the option that represents the tool or technology that you are evaluating. All questions will be related to the selected technology.

- Indonesia: mobile positioning
- Other, please name or describe the tool or technology

3. Have you used the technology or tool in question?

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- Yes
- No

Usability of the tool or technology

Purpose of the following questions is to evaluate user experience and usability of the tool and thus, the technology readiness level, too.

4. Please indicate your opinions of the tool or technology, in regard to the following statements (from 1: strongly disagree to 5: strongly agree)

	1 (Strongly disagree	2	3	4	5 (Strongly agree)	I do not know
The tool or technology is effective in achieving its purpose						
Regular use of the tool or technology would be efficient use of resources (such as money or working time)						
The tool or technology should be adopted to regular use in my country						
I would be willing to use the tool or technology again						
The technology or tool is easy to use						

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There are clear instructions how to use the tool or technology						
The tool or technology is suitable for civil protection						
The tool or technology is suitable for crisis management						
The tool or technology is suitable for Disaster Risk Reduction (DRR)						
The technology or tool is accessible*						

* Accessible means that website and mobile dashboards and their contents are such that anyone could use them and understand what is meant in them.

Perceived risks or challenges of the tool or technology

Following questions are used to evaluate potential risks and challenges related to implementation of the tool or technology.

5. Please indicate your opinions on the risks and challenges potentially related to the tool or technology, in regard to the following statements (from 1: strongly disagree to 5: strongly agree)

	1 (Strongly disagree	2	3	4	5 (Strongly agree)	I do not know
Benefits of the tool or technology are unclear						

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The costs of the tool or technology are unclear						
The costs of implementation are too high compared to the benefits						
The operating costs are too high compared to benefits						
Technological maturity of the tool or technology is not sufficient for practical use						
Implementation of the tool or use og the technology is prevented by regulatory barriers						
Vulnerable groups may be affected in an adverse way						
Acceptance of the tool or technology by the general public is unclear						
Acceptance of the tool or technology by general public is not likely						
The tool or technology violates privacy or otherwise does not meet applicable data protection requirements						

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Ethical acceptability of the tool or technology

Following questions are used to evaluate ethical aspects regarding the tool or technology. Purpose ise to find out if the usage of the tool or technology might have negative impact on lives of individuals.

6. How likely is it that the following risks will be realised when the tool or technology is used? Please state your opinion on following risks (on the scale from 1: Very unlikely to 5: Certain)

	1 Very unlikely	2 Unlikely	3 Likely	4 Very likely	5 Certain	Do not know
Discrimination of individuals						
Deprivation of personal autonomy of an individual person						
Infringement of privacy						
Abuse of a relationship of trust						
Causing personal disadvantage for an individual person						
Stigmatisation of individuals						
Inequality of individuals						
Inequality of different groups of people						

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No freedom of choice to opt-out of the use of the tool or technology						
Restriction of individual's life						
Security of personal data is compromised						
Collection of non-essential personal data						
Automatic profiling						
Accessibility* requirements will not be met						

*Accessibility means that websites and mobile dashboards and their contents are such that anyone could use them and understand what is meant in them.

7. How significant are the negative impacts to an individual or a group if the following risks related to the technology or tool are realised? Please state your opinion on the following risks (on the scale from 1: Very minor to 5: Very serious)

	1 (Very minor)	2 Minor	3 Moderate	4 Serious	5 Very serious	Do not know
Discrimination of individuals						
Deprivation of personal autonomy of an individual person						

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Infringement of privacy						
Abuse of a relationship of trust						
Causing personal disadvantage for an individual person						
Stigmatisation of individuals						
Inequality of individuals						
Inequality of different groups of people						
No freedom of choice to opt-out of the use of the tool or technology						
Restriction of individual's life						
Security of personal data is compromised						
Collection of non-essential personal data						
Automatic profiling						

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Accessibility* requirements will not be met						

*Accessibility means that websites and mobile dashboards and their contents are such that anyone could use them and understand what is meant in them.

BuildERS model

The section includes questions regarding the tool or technology in the context of BuildERS model.

BuildERS model is described below (Figure 9).

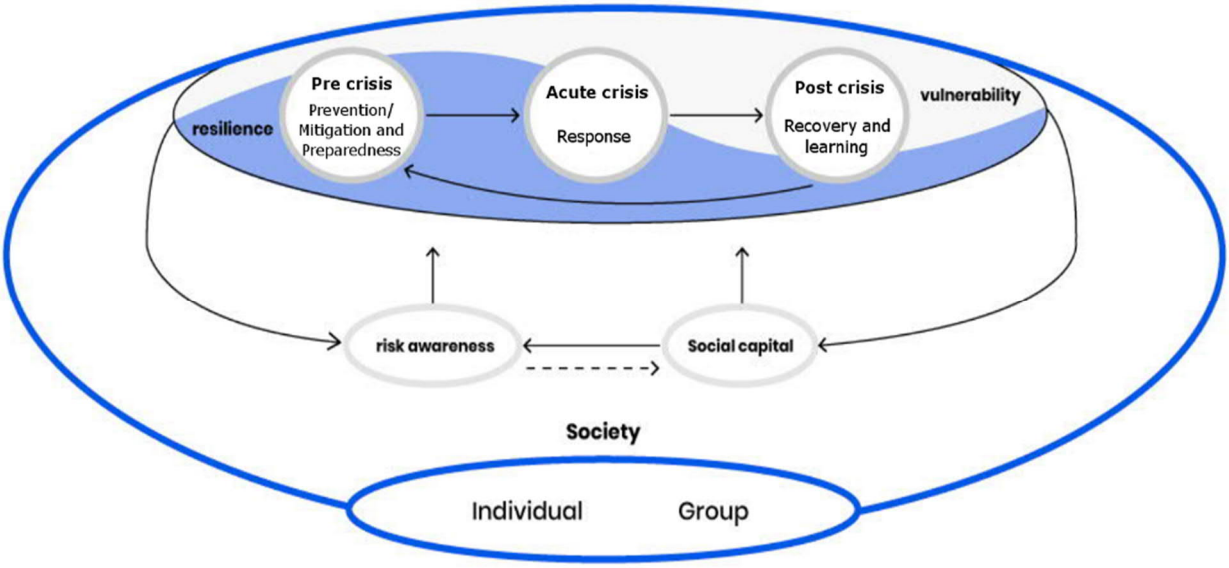

Figure 9. BuildERS model

Before crisis (prevention, preparedness), acute crisis (response), after the crisis (recovery, learning). Reslience impacts more before risk and during the risk. Vulnerability increases during the crisis and is highest immediately after the crisis. Risk awareness and social capital affect fundamentally to reslience and vulnerability of individuals, groups and society. By learning from crisises and preparing to them, it is possible to increase risk awareness and social capital.

This section includes special terminology of BuildERS project. The terminology is described below

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Resilience: Processes of proactive and/or reactive patterned adjustment and adaptation and change enacted in everyday life, but, in particular, in the face of risks, crises and disasters. (BuildERS definition)

Risk awareness: Collective (groups and communities) acknowledgment about a risk and potential risk preventing and mitigating actions, fostered by risk communication. (BuildERS definition)

Social capital: Networks, norms, values and trust that entities (individuals, groups, society) have available and which may offer resources for mutual advantage and support and for facilitating coordination and cooperation in case of crisis and disasters. (BuildERS definition)

Vulnerability: Dynamic characteristic of entities (individuals, groups, society) of being susceptible to harm or loss, which manifests as situational inability (or weakness) to access adequate resources and means of protection to anticipate, cope with, recover and learn from the impact of natural or man-made hazards. (BuildERS definition)

8. In which phases of the crisis management or emergency management circle (BuildERS-model) is the technology or tool relevant? Please, express your opinion with a number from 1 (Not relevant at all) to 5 (Highly relevant).

	1 Not relevant at all	2	3	4	5 Highly relevant	Do not know
In the Pre-crisis (prevention / mitigation and preparation)						
In the Acute crisis (response)						
In the Post-crisis (recovery / learning)						
Other possibilities? Please specify						

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9. Please indicate your opinion on the scope of the technology or tool. Please, state your agreement with the statements from 1 (strongly disagree) to 5 (strongly agree).

	1 (Strongly disagree	2	3	4	5 Strongly agree	Do not know
The technology can be used to improve the protection of Individual citizen in crisis						
The technology can be used to improve the protection of Specific groups in crisis						
The technology can be used to improve the protection of the Whole society in crisis						

10. How does the technology or tool contribute to resilience building in a crisis? Please indicate whether you agree with the following statements, from 1 (Strongly disagree) to 5 (Strongly agree).

	1 (Strongly disagree	2	3	4	5 Strongly agree	Do not know

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The use of the technology / tool can improve risk perception of an individual citizen						
The use of the technology / tool can improve risk awareness of specific groups						
The technology / tool is beneficial for society at large in terms of improved risk awareness and social capital						
The use of the technology / tool can improve social capital of individual citizen						
The use of the technology / tool can improve social capital of specific groups						

Technical readiness of the tool or technology

These questions are used to evaluate the Technology Readiness Level (TRL) of the tool. TRL is a method for estimating the maturity of technologies. The purpose is to determine the level of development to guide authorities and others in selection of suitable tools for Disaster Risk Reduction (DRR).

	1 (Strongly disagree	2	3	4	5 Strongly agree	Do not know

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The technology or tool provides the functionality you expect						
The technology or tool operates in a reliable manner						
The technology or tool requires further development to be relevant for practical use						
A prototype of the technology or tool has been implemented and validated in relevant environment						
Technical feasibility of the tool or technology has been fully demonstrated						
The tool or technology has been demonstrated in real operational environment						
The tool or technology has been accepted for practical use (by at least one intended user)						
The technology or tool has been utilised in real operating environment for its intended purpose						

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The technology or tool is available on the market for large-scale deployment						
The technology or tool meets applicable accessibility* requirements						

*Accessibility means that websites and mobile dashboards and their contents are such that anyone could use them and understand what is meant in them.

12. Free word

Here you can stat e.g. how you would develop or improve technology or tool in question.

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Annex 2. Feedback questionnaire

- Do you think that the information regarding the use of the technology has been explained clearly and thoroughly?
  - Yes
  - No
- What percentage of the presented information was considered new to you?
  - <25%
  - 25%-50%
  - 51%-75%
  - >75%
- What do you think about the duration of this workshop?
  - Too long
  - Just right, not too long and not too short
  - Too short
- Please indicate what aspect of the event you're satisfied with?
  - Event platform
  - Speakers
  - Quality of discussion
  - Amount of sessions offered
  - Date and time of discussion
- In your opinion, how useful is this technology in dealing with disasters?
  - Really useful
  - Quite useful
  - Not that useful
- Should Indonesia adapt similar technology to improve search-and-rescue efficiency during and after disasters?
  - Yes
  - Not really necessary
- Are there any improvements that can be made to the event?

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