

Smart Response Concept for Fire Emergency Response in Surabaya City

Fonita Andastry Bontang Sari
Faculty of Architecture, Design, and Planning
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia

Eko Budi Santoso
Faculty of Architecture, Design, and Planning
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia

Adjie Pamungkas
Faculty of Architecture, Design, and Planning
Institut Teknologi Sepuluh Nopember
Surabaya, Indonesia

Abstract— The city of Surabaya is one of the second major cities in Indonesia. At present the growth and development of the city of Surabaya is very rapid in various fields. Increased population density, the number of office building developments, residential areas, industries that are increasingly developing, causing vulnerability to fires. Fire events in the city of Surabaya tend to fluctuate. But the number of events is quite large, especially in 2017. So it is necessary to have innovative efforts to reduce losses due to fires in the city of Surabaya. This fire incident certainly gives a big loss not only materially but also casualties. In this case the Government of Surabaya has begun to implement smart city as one of the steps to deal with various problems in the city of Surabaya, one of which is fire. Through the concept of smart city, it is expected to help reduce losses caused by fires. In line with this, the aim of this research is to formulate a concept of smart fire response to reduce fire losses that occur and as an innovation in fire management. To support the implementation of the research, a triangulation analysis of stakeholders will be carried out (confirmation process from the formulation of researchers related to intelligent response concepts based on existing conditions and results of literature review of expert theories) which then results in stakeholder triangulation as the final result of this intelligent response concept formulation.

Keywords—Fire; management fire, smart response, smart fire response

I. INTRODUCTION

The city of Surabaya has an area of ± 326.81 km² which is divided into 31 sub-districts and 131 sub-districts. The city of Surabaya is one of the big cities in Indonesia. Surabaya City ranks second as the Big City after the City of Jakarta. As a Big City Surabaya City has a high population density as seen from the population in the city of Surabaya based on the 2010 population census of 2,765,487 inhabitants. At present the growth and development of the city of Surabaya is very rapid in various fields. Increased population density, the number of office building developments, residential areas, industries that are increasingly developing, causing vulnerability to fires. In line with the increasing population, it will increase the need for shelter, resulting in a tendency to increase buildings which then increases the potential for fire threats in the city of Surabaya [1].

Fire events in the city of Surabaya occur repeatedly every year. In 2012 there were 573 fire incidents, in 2014 there were 596 fire incidents, in 2015 there were 600 fire incidents. But there

was a decrease in fire events in 2016, where only 300 fire incidents occurred in the city of Surabaya. But the occurrence of kebakaran has increased throughout 2017, there were 321 fire incidents in the city of Surabaya. Based on the number of fire incidents that occurred throughout 2017, the losses were quite large [2].

Losses due to fire incidents that occurred in the city of Surabaya throughout 2017 from 321 total fire incidents (January-November period) amounting to 18.2 billion rupiah. The fire burned 82 houses and 14 factories and spent as much as 225 land of grass land. While losses based on fatalities from fires were known as 21 people were injured and 1 person died. In an effort to reduce fire losses, the Surabaya City Government implemented e-government that helped the process of managing regional development and community services. E-government also has a system such as a disaster alert system that can help the government in monitoring the occurrence of traffic accidents, fires, fallen trees. This system makes it easier for the government to find the location of the disaster. For example, if a fire occurs, the PMK officer can search for the nearest water source from the location of the fire and the dashboard of his car.

This E-Gov is part of an effort to implement the smart city concept. At present the city of Surabaya is being aggressively developing smart cities. According to Nijkamp et al (2009) states that smart cities are cities that are able to use human resources (HR), human capital, and modern telecommunications infrastructure to realize sustainable economic growth and high quality of life. According to Cohen (2010) the main dimensions of the smart city are 6, including smart governance, smart mobility, smart environment, smart people, smart economy, and smart living. From the 6 dimensions that exist, in its application each city can focus on one dimension that exists. For now the city of Surabaya has tried to apply the concept of smart city by providing public services known as command centers that can be accessed by the public through the complaint number 112. As well as known there are also e-dishub applications related to transportation in the city of Surabaya, which is also a efforts to realize smart mobility [3].

In line with this, there is currently no research related to fire management based on smart mobility. The principle of smart mobility can be applied to optimize the response to disaster

reports / news. Based on the principle of smart mobility a "smart response" will be formulated for a fire disaster in the city of Surabaya. Therefore this study focuses on formulating the concept of quick response to fire in the city of Surabaya. Based on this, this study wants to find out how the right quick response concept is based on the principle of smart mobility for fire disaster emergency response as an effort to reduce losses due to fire disasters which are still a threat due to constraints of fire fighting facilities in reaching fire locations.

II. RESEARCH METHODS

There are several stages in this study, first is to compare the results of interviews with stakeholders generated through an in-depth interview process which is then analyzed using content analysis. The results of content analysis then become input in the next stage to formulate the concept of intelligent response to fire in the city of Surabaya. The analysis results in the form of a list of potential and problems faced in the effort to handle fires faced by the Surabaya City government.

At the next stage the potential results and problems are compared with the intelligent response criteria that have been prepared based on a collection of expert theories and existing conditions in the city of Surabaya. This stage is done by making a comparative and triangulation table (where the results of the concept of intelligent fire response concept will be confirmed again to the relevant stakeholders), then the final results are obtained in the form of "intelligent fire response concept in Surabaya City".

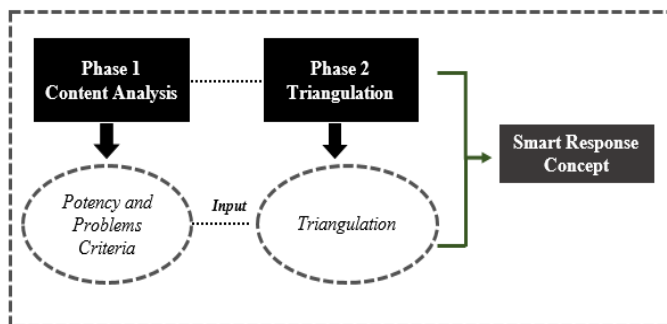


Fig. 1. Research Methods

III. SMART RESPONSE VARIABLE

Based on the results of library synthesis from several theories related to this study, it was found that several variables that could support this study included the following:

TABEL I. RESEARCH VARIABLES

Theory	Indicator	Variable
Smart Response	Response Time	Time to Recieve News
		Travel Time
		Tools Preparation Time On Site
	Search for Victims	Number of Victims Found
		Number of Search Personnel
		Availability of Search Tools
	Rescue Victims	Number of Vitims Rescue
		Number of Rescue Personnel
		Availability of Rescue Tools
	Evacuation Victims	Number of Victims Evacuation
		Number of Evacuation Personnel
		Availability of Evacuation Tools

Responsive	Vehicle Routes
	Vehicle Access
	Personnel Access
	Mobility of Evacuation Vehicle
	Mobility of evacuation Victims
Integration of ICT	Smoke Sensor
	Fire Sensor
	Gas Sensor
	Utilization Application as a Reporting System
	Navigation based on Application
	Traffic Light Sensor

IV. RESULTS AND DISCUSSION

A. Illustration Tables of Comparative

The formulation of this concept is based on the potential and problems faced in handling fire disasters in the city of Surabaya and the criteria that have been formulated from several experts. There are 11 point of criteria from this study:

1. Use of Technology in an effort to extinguish fires
2. Emergency response (response quickly, medium and full)
3. Periodic skills training for personnel
4. Technology-based Communication Network (Communication Protocol, Use of Social Media as a Communication Tool, Data Interface Emergency Access)
5. Sensor Technology (Use of Remote Sensing, Unmanned Vehicles, Sensing Integration, Remote Communication, Sensors Improved platform reliability, use of robotic technology as search and rescue personnel, development of forensic timelines based on stationary sensors that provide information throughout incidents, synchronization with sensors brought by residents, the use of social media as a tool included as a source of data that can be mined and utilized)
6. Simulation Technology (Simulation for training and education, simulations for outreach and continuation)
7. Implementation of Sensor Technology
8. Standardize the performance of sensor environments that depend on data
9. Smart Building and Sensor Robot Technology
10. Smart Fire Fighting Equipment and Robot Mapping Technology
11. Smart Outage Personnel Regulations

And then to formulate the concept, potency and problems, criteria smart response and existing condition will be compared to analyze and then will be confirmed to stakeholders. The illustration of this proses can be seen this below:

NO	Indikator	Variabel	Smart	Non Smart	Kriteria	Pendapat Responden	Konsep
1.	Smart Response	Waktu Penanganan Berita	+ Command Center 112 yang bisa terus dikembangkan sebagai sistem siaga bencana di Kota Surabaya + Efisiensi sistem pelaporan dalam satu langkah + Potensi rencana pengembangan mungkin dilakukan	+ Potensi utnana yang bisa dikembangkan adalah response time 7 menit dan sudah lulus uji nasional + Koordinasi antar OPD yang berjalan lebih mudah karena dalam satu tempat yang sama + Adanya pos-pos penanganan berupa PMK sebanyak 21 unit	12. Penggunaan Teknologi dalam upaya penanganan kebakaran 13. Respon darurat (respon secara cepat, messaging, dan pemulih) 14. Jaringan Komunikasi berbasis Teknologi (Protokol Komunikasi, Penggunaan Sosial Media sebagai Alat Komunikasi, Akses Darurat Antar Muka Data)	Pada saat ini sistem pelaporan kebakaran dan kebencanaan didasarkan pada layanan telepon biasa yaitu, dimana laporan masyarakat bisa langsung diterima oleh operator untuk segera ditangani. Di Kota Surabaya sendiri, sistem layanan telepon biasa pilasan ini sudah mulai diberlakukan sejak tahun 2017 lalu melalui call center 112 Surabaya. Hal ini dilakukan sebagai upaya optimalisasi dalam penanganan bencana kebakaran.	Pemusunan konsep ini didasarkan dari hasil potensi, masalah, kriteria, dan pendapat stakeholder yang kemudian akan dirumuskan menjadi konsep yang dapat diterapkan dalam meningkatkan respon kebakaran secara cepat di Kota Surabaya berdasarkan prinsip smart response sebagai berikut: Pengembangan Sistem Komunikasi dan Peralatan Pemadam a. Pengembangan layanan Command Center 112 dengan memperbaharui peralatan komunikasi menggunakan sosial media secara maksimal dengan memanfaatkan sosial media whatsapp, facebook, instagram, dan website. b. Jaringan komunikasi dalam sistem Command Center 112 menggunakan teknologi 4G (internet of things). Dengan layanan video call layanan pendeteksi lokasi pelapor yang terkoneksi dengan peta. c. Tim yang bertugas respon petugas perlu dikembangkan sistem
2.	Waktu Perjalanan			+ Pos-pos pembantu dan posko terpadu yang tersebar di seluruh wilayah di Kota Surabaya + Masalah kemacetan yang menjadi penghambat waktu perjalanan	1. Penggunaan Teknologi dalam upaya penanganan kebakaran 2. Respon darurat (respon secara cepat, messaging, dan pemulih) 3. Pelatihan Keterampilan Personil secara berkala 4. Jaringan Komunikasi berbasis Teknologi (Protokol Komunikasi, Penggunaan Sosial Media sebagai Alat Komunikasi, Akses Darurat Antar Muka Data) 5. Teknologi Sensor (Penggunaan Pengendaraan Tak Berawak, Penggunaan Robot, Penggunaan Platform, penggunaan	Secara umum pos-pos pembantu merupakan fasilitas yang harus dimiliki oleh Dinas Pemadam Kebakaran yang ditempatkan dengan jarak tertentu untuk dapat mencapai lokasi kejadian secara cepat. Terdapat 6 pos terpadu yang di tempatkan di masing-masing satu di wilayah administrasi Kota Surabaya. Selain itu untuk membantu kinerja pos-pos terpadu, pemadam kebakaran Kota Surabaya juga membangun pos-pos	Pemusunan konsep ini didasarkan dari hasil potensi, masalah, kriteria, dan pendapat stakeholder yang kemudian akan dirumuskan menjadi konsep yang dapat diterapkan dalam meningkatkan respon kebakaran secara cepat di Kota Surabaya berdasarkan prinsip smart response sebagai berikut: Pengembangan Pos-Pos dan Fasilitas Pendukung Pemadam Kebakaran a. Penempatan layanan pos pembantu kebakaran berupa penambahan layanan pradi demografi wilayah tertentu, upadung data lokasi secara berkala, sensor api, sensor gas, dll) e. Peningkatan fasilitas kendaraan berkecepatan mobil TRV (Tactical Response Vehicle) yang dibekali dengan kabin kebakaran kecil, atau kendaraan BKV (Bicycle Response Vehicle) yang dibekali dengan alat pemadam yang cukup besar dan minimal ada 1 kendaraan lapangan bosus untuk kebakaran skala besar.
5.	Penyelamatan Korban (jumlah korban diselamatkan, personil penyelamatan, peralatan penyelamatan)		+ Tim Rescue juga bertugas membantu penyelamatan korban + Tim TGC siap siaga 24 jam di posko terpadu untuk ditugaskan ke lokasi kejadian + Bantuan tambahan dari PMI + Tim TGC terdiri dari dokter dan perawat di poskoma-poskoma yang ada di Kota Surabaya	1. Pelatihan Keterampilan Personil secara berkala 2. Jaringan Komunikasi berbasis Teknologi (Protokol Komunikasi, Penggunaan Sosial Media sebagai Alat Komunikasi, Akses Darurat Antar Muka Data) 3. Peralatan Pemadaman Kebakaran Pinter dan Teknologi Pemadaman Robot 4. Peralatan Pinter Personil Pemadaman	Pada saat ini tim rescue yang dimiliki terdiri dari tim dokter dan perawat yang ada di poskoma-poskoma di wilayah Kota Surabaya yang bertugas 24 jam secara bergantian di pos-pos terpadu.	Pemusunan konsep ini didasarkan dari hasil potensi, masalah, kriteria, dan pendapat stakeholder yang kemudian akan dirumuskan menjadi konsep yang dapat diterapkan dalam meningkatkan respon kebakaran secara cepat di Kota Surabaya berdasarkan prinsip smart response sebagai berikut: Pengembangan Kemampuan Tim Penyelamatan, Pencarian dan Evakuasi a. Pemanfaatan tenaga medis yang tersedia di poskoma-poskoma yang ada di Kota Surabaya. b. Masing-masing pos terpadu harus ditambahkan Tim Rescue Tim Kesehatan yang siap 24 jam c. Fasilitas pendukung dan peralatan kesehatan harus tersedia secara lengkap (obat-obatan, tangki, mobil, mobil ambulance, dll) d. Pelatihan keterampilan secara berkala untuk masing-masing Tim Rescue Tim Kesehatan juga diberikan peralatan sender dan komunikasi yang terhubung dengan smartphone. e. Masing-masing Tim Rescue Tim Kesehatan juga diberikan peralatan sender dan komunikasi yang terhubung dengan smartphone.	
6.	Evaluasi Korban (jumlah korban diturunkan, personil pencarian, peralatan pencarian)		+ Tim Rescue juga bertugas membantu evakuasi korban + Pembuatan bantuan papan, pangan dan sandang untuk korban kebakaran + Korban yang merupakan warga asli Kota Surabaya	1. Pelatihan Keterampilan Personil secara berkala 2. Jaringan Komunikasi berbasis Teknologi (Protokol Komunikasi, Penggunaan Sosial Media sebagai Alat Komunikasi, Akses Darurat Antar Muka Data) 3. Peralatan Pemadaman Kebakaran Pinter dan Teknologi Pemadaman Robot 4. Peralatan Pinter Personil Pemadaman	Pada saat ini tim rescue yang dimiliki terdiri dari tim dokter dan perawat yang ada di poskoma-poskoma di wilayah Kota Surabaya yang bertugas 24 jam secara bergantian di pos-pos terpadu.	Pemusunan konsep ini didasarkan dari hasil potensi, masalah, kriteria, dan pendapat stakeholder yang kemudian akan dirumuskan menjadi konsep yang dapat diterapkan dalam meningkatkan respon kebakaran secara cepat di Kota Surabaya berdasarkan prinsip smart response sebagai berikut: Pengembangan Kemampuan Tim Penyelamatan, Pencarian dan Evakuasi a. Pemanfaatan tenaga medis yang tersedia di poskoma-poskoma yang ada di Kota Surabaya. b. Masing-masing pos terpadu harus ditambahkan Tim Rescue Tim Kesehatan yang siap 24 jam c. Fasilitas pendukung dan peralatan kesehatan harus tersedia secara lengkap (obat-obatan, tangki, mobil, mobil ambulance, dll) d. Pelatihan keterampilan secara berkala untuk masing-masing Tim Rescue Tim Kesehatan juga diberikan peralatan sender dan komunikasi yang terhubung dengan smartphone. e. Masing-masing Tim Rescue Tim Kesehatan juga diberikan peralatan sender dan komunikasi yang terhubung dengan smartphone.	

Fig. 2. Comparative Table formulation of Smart Response Concepts

The picture above shows the process of drafting the concept of fire rapid response that will be applied in the city of Surabaya. The formulation process will be explained as follows: 1) In the first column explain the indicators of this research, namely rapid response; 2) then the second column explains each research variable; 3) in the next column will be compared between the results of potential fire handling problems in the city of Surabaya, the results of rapid response criteria, and the results of interviews with stakeholders and then the appropriate response concept can be formulated and can be applied in the city of Surabaya.

Based on the above process from the comparative table, the formulation of intelligent response concepts can be applied that can be applied in emergency response to fire in the city of Surabaya. The formulation of this concept is based on the results of potential and problems faced and intelligent response criteria from the results of the study of several theories and interviews with relevant stakeholders. There are 12 main concepts that have been formulated in the study can be seen in the pictures below:



Fig. 3. Smart Response Concept Point 1 to 4

From the picture above, it is known that there are 4 concepts out of a total of 12 main concepts that can be developed in rapid fire responses in the city of Surabaya. This concept consists of : 1) Development of Communication Systems and Fire Fighting Equipment; 2) Development of Post and Fire Fighting Support Facilities ; 3) Optimization Team Fire Fighting Capability; 4) Optimization Fire Fighting Departemen Personnel.

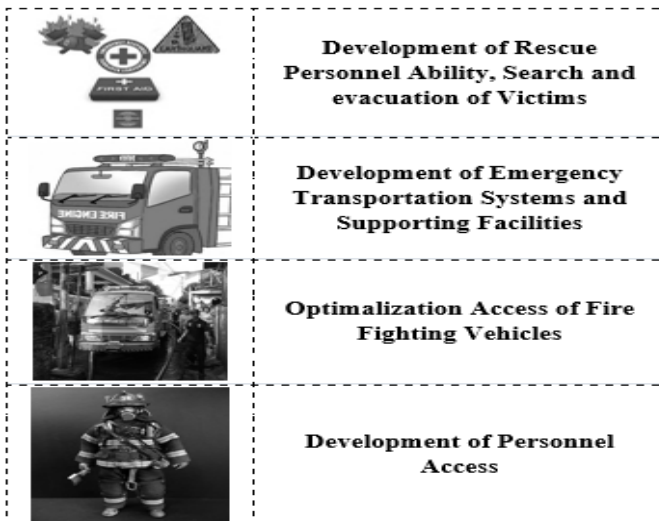


Fig. 4. Smart Response Concept Point 5 to 8

From the picture above, it is known that there are 4 concepts out of a total of 12 main concepts that can be developed in rapid fire responses in the city of Surabaya. This concept consists of : 1) Development of Rescue Personnel Ability, Search and Evacuation Victims; 2) Development of Emergency Transportation Systems and Supporting Facilities; 3) Optimalization Access of Fire Fighting Vehicles; 4) Development of Personnel Access.

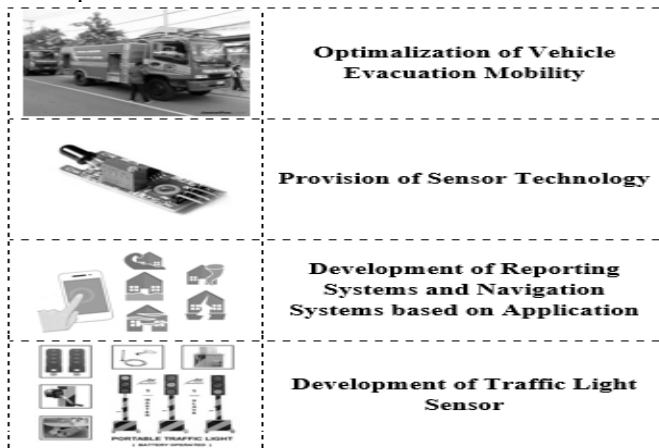


Fig. 5. Smart Response Concept Point 9 to 12

From the picture above, it is known that there are 4 concepts out of a total of 12 main concepts that can be developed in rapid fire responses in the city of Surabaya. This concept consists of : 1) Optimalization of Vehicle Evacuation Mobility; 2) Provision of Sensor Technology; 3) Development of Reporting Systems and Navigation Systems based on Application; 4) Development of Traffic Light Sensor.

V. CONCLUSSION

There are 12 main concepts of Smart Response Fire Fighting from this study. This concept consists of : 1) Development of Communication Systems and Fire Figthing Equipment; 2) Development of Post and Fire Fighting Support Facilities ; 3) Optimalization Team Fire Fighting Capability; 4) Optimalization Fire Fighting Departemen Personnel, 5) Development of Rescue Personnel Ability, Search and Evacuation Victims; 6) Development of Emergency

Transportation Systems and Supporting Facilities; 7) Optimalization Access of Fire Figthing Vehicles; 8) Development of Personnel Access, 9) Optimalization of Vehicle Evacuation Mobility; 10) Provision of Sensor Technology; 11) Development of Reporting Systems and Navigation Systems based on Application; 12) Development of Traffic Light Sensor.

ACKNOWLEDGMENT

Thank you to all the respondents, stakeholders, and my mentors for all their help while compiling this journal. I am also very grateful to all agencies involved in assisting in the preparation of this journal including the Command Center 112 Surabaya, Surabaya City Police, Surabaya City Fire Department, Surabaya City Transportation Department and also Surabaya City Disaster Management And Community Protection Department which have been very helpful and contributed data in this study. I also thank my parents and all my friends who supported me to finish this journal to the end.

REFERENCES

- [1] Bappeko Kota Surabaya. 2018. "Rencana Pembangunan Jangka Menengah Kota Surabaya Tahun 2016-2021".
- [2] Rahmawati, D, dkk. 2016. "Participatory Mapping for Urban Fire Risk Reduction in High Density Urban Settlement". *Procedia. Social and Behavioral*. vol 227. pp. 395-401.
- [3] Caragliu, A, Del Bo, C, Nijkamp, P. 2009. "Smart Cities in Europe". 3rd Central European Conference in Regional Science-CERS.
- [4] Albino, V, Umberto, B, Rosa, 2015. "Smart Cities: Definitions, Dimensions, Performance, and Initiatives. *Journal of Urban Technology*. Vol 1. pp. 3-21. <http://dx.doi.org/10.1080/10630732.2014.942092> accessed on March 13, 2018.
- [5] Saraswati, FD, and Cahyono, B, A. 2017. "Analisis Daerah Resiko Bencana Kebakaran di Kota Surabaya Menggunakan Sistem Informasi Geografis". *Jurnal Teknik*. vol 6;2. pp. 1. ITS.
- [6] Larasati, K, D, dkk. 2016. "Penerapan Participatory Mapping untuk Mewujudkan Capacity Building Dalam Mengurangi Resiko Bencana Kebakaran". *Jurnal Teknik*. ITS.
- [7] Sariffudin, S. 2015. "Peluang Pengembangan Smart Mobility untuk Mewujudkan Kota Tangguh di Kota Semarang. *Jurnal Teknik Perencanaan Wilayah & Kota*. Vol 36. pp. 32-38.
- [8] Nurulandari, F, S. 2016. *Kajian Mitigasi Bencana Kebakaran di Permukiman Padat (Studi Kasus: Kelurahan Taman Sari, Kota Bandung)*. *Jurnal INFOMATEK*. vol 18. Universitas Pasundan.
- [9] Hertfordshire Fire and Rescue Service. 2017. *Final Report. "SMART Firefighting"*. England.
- [10] Grant, C, Hamins, A, Bryner, N, Jones, A, and Koepke, G. 2015. *NIST Special Publication 1191. "Research Roadmap for Smart Fire Fighting"*. National Institute of Standars and Technology.