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The Concept of Participatory Urban Management Using Web-based SDSS

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Abstract

Decision Support Systems have been popular in the field of information studies, but one of their significant drawbacks is the inability to consider geographical and temporal data. Many decision issues in the real world are spatially related problems, as a result, in recent decades, the Spatial Decision Support System has been a surge in academic interest which integrates Geographic Information Systems with DSS. However, these SDSSs have been seen as centralized, bureaucratic, and top-down techniques implemented by municipal planning offices, authorities, and other stakeholders in urban management. There is a growing demand for participatory urban management that can provide an interactive, open, democratic, communicative, group-based, and informed deliberation process that includes both experts and non-experts. The rapidly evolving Internet has the potential to overcome this limitation, the Web-based SDSS provides the flexibility for working in different places, participants' time convenience, and equal opportunities for participation. The objective of the study is to propose a concept of participatory urban management using Web-based SDSS that is built for all aspects of urban management participants in peacetime, moreover, which can be transformed as a useful disaster response tool when dealing with disasters situation. The result shows the adoption of this system only can optimize and facilitate urban management, but it was also found that participatory urban management and disaster management are somehow linked, and their functions are overlapped, their integration can realize the benefits of cost-saving and flexibility, help to increase the performance of urban governance and improve cities' capacity and resilience to disasters.

Keywords: Decision Support System, Spatial Decision Support System, Web-based Spatial Decision Support System, Participatory Urban Management, Web-based SDSS, Urban Management, Disaster Management

1. Introduction

One of the most difficult challenges of the twenty-first century is urban management. Cities, if efficiently managed, may operate as growth engines, providing residents with more work possibilities, better healthcare, housing, safety, and social development (Avis & R, 2016). The Decision Support System (DSS) is a computerized information system that has been proved as a valuable tool for municipal authorities and organizations at the management, operations, and planning levels, assisting them in making early decisions. However, a key shortcoming of DSS is its inability to consider spatial and temporal data (Sugumaran & Sugumaran, 2007). While Geographic Information System (GIS) has the potential to reduce the restriction of DSS. The GIS-based SDSS is a framework for integrating database management systems to analytical models, graphical presentation and tabular reporting capabilities, and the expertise of decision-makers (Ghavami, 2019). Spatial Decision Support System (SDSS) has been applied to a variety of industries, including agriculture, business, energy, firefighting, land planning, site selection, transportation, water resource management, disaster management (DM), etc. These techniques, on the other hand, have typically been characterized as centralized, bureaucratic, and top-down approaches implemented by municipal planning offices, authorities, and other stakeholders (Figure 1a). They have been criticized for not being able to solve complicated decision-making problems, engage various stakeholders, or democratize the planning process effectively. Previous research has found that communal geographical decisions are more successful than individual ones, implying that the spatial decision-making paradigm should shift away from traditional ways and toward a holistic, participative, communicative, and collaborative approach (Jelokhani-Niaraki, 2018). Thus, in urban management and planning, the use of collaborative/participatory approaches is recommended, because they can facilitate an interactive, open, democratic, communicative, group-based, and well-informed deliberative process in which experts and non-experts discuss, negotiate, and generate solutions (Figure 1b) (Jelokhani-Niaraki & Malczewski, 2015).

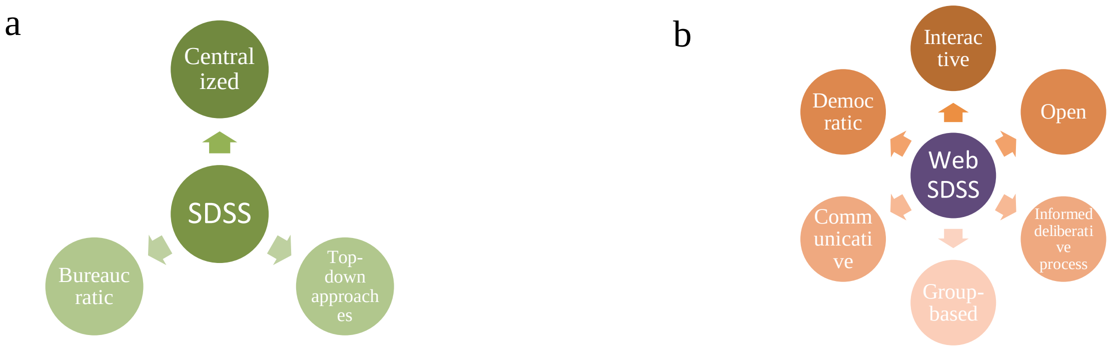

Figure 1. The disadvantages of traditional SDSS (a), and the advantages of WebSDSS (b)

The fast development of computers, the Internet, and especially World Wide Web (WWWW) technology has had a significant impact on architecture, landscape architecture, and urban planning education and practice during the past decades. The ability to overcome constrained resources in terms of time, data, and communication is one of the most significant advantages of employing web services in spatial decision-making. Web-based SDSS (WebSDSS) is a Web-based GIS and DSS integration solution that not only allows participants to work in multiple locations and at different times to suit their needs, but also gives equitable possibilities for participation (Jelokhani-Niaraki & Malczewski, 2015). Individual decision-maker's decision time was shortened and the accuracy was increased by using GIS as a component of SDSS (Herold et al., 2005).

At the same time, rapid urbanization and population expansion have exacerbated environmental issues such as resource depletion, global warming, and environmental devastation. Development has increased the occurrence likelihood of natural disasters (Jung & Jung, 2019). Thus, DM should be considered as one of the most important components of urban management. Apart from this perspective, the impact that a disaster occurs in urban areas can be much more severe than in rural areas, due to the high population density and centrally distributed infrastructures. Many disaster losses are predictable to a certain extent, making them manageable to some extent (Abdalla, 2016). Thus, it can be seen that DM plays a significant role in strengthening a city's resilience to both foreseeable and unforeseeable disasters that happen in urban areas.

The Internet can enable the communication of disaster-related information/data and has a tremendous influence and is now being utilized across the DM process. Using the Internet to establish a simple, user-friendly, GIS-based system would allow decision-makers in developing countries to access and adopt data and technologies that they would not otherwise have access to or be competent to use. Access to GIS technology will boost local capacity for DM and minimize dependency on international aid because accessibility is a precondition for utilization (Herold et al., 2005).

Through a comprehensive literature review, by utilizing the advantages of DSS, GIS, and Internet, as well as to realize a better urban management mode, in which DM elements can be considered, the objective of the study is to propose the concept of participatory urban management using Web-based SDSS (PWebSDSS) that is built for involving all aspects of urban management participants in peacetime, moreover, which can be transformed into a useful disaster management tool when dealing with disaster situations. It should be noted that the DM part of the proposed PWebSDSS in this study is designed for general disaster situations and it is still in the initial conceptual stage, due to the different data needs of different disasters as well as due to different factors in different countries including population distribution, socioeconomic characteristics, and resource bases, the actual detailed components and functions may also differ.

The rest parts of this paper are organized as follows: Section 2 describes the literature review on this topic. Section 3 illustrates the design of the proposed PWebSDSS. Section 4 discusses the value, deficiency, as well as future work of the study. A conclusion is made at the end of this paper.

2. LITERATURE REVIEW

2.1 Development of SDSS

SDSS combines two technologies: decision support system (DSS) and geographic information system (GIS). DSS has several shortcomings, one of which is its inability to process spatial data. GIS, on the other hand, is adept at storing and managing geographical data but falls short in decision-making and collaborative problem-solving issues. SDSS is divided into two streams: geospatial information-based systems and decision support-based systems. Figure 2 depicts a schematic illustration of the SDSS development process.

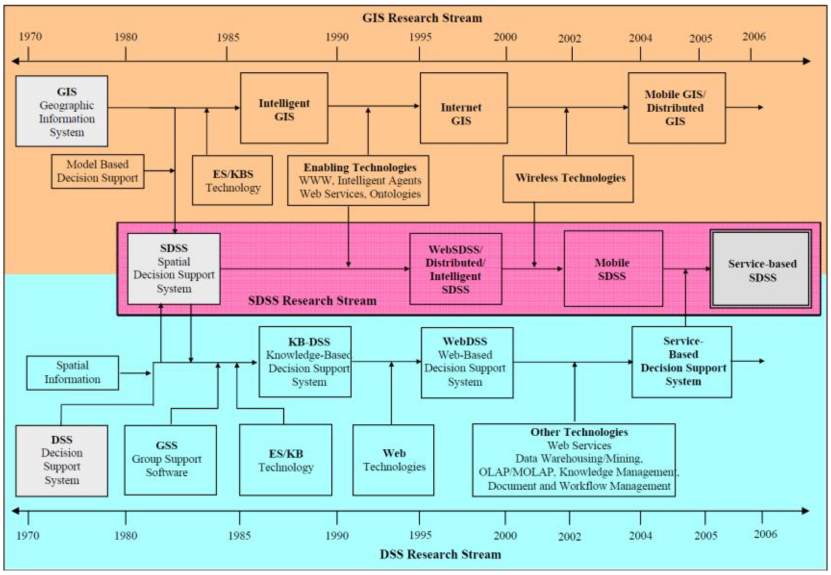

Figure 2. Progression of Spatial Decision Support Systems Development (Sugumaran & Sugumaran, 2007)

2.2 Decision Support System

According to Mohd et al. (2014), a DSS is a collection of tools and processes that work together to manage a certain system. Making decisions in a dynamic and fast-changing environment is difficult because multiple aspects are involved, including the decision-maker, conflicts of interest, the importance of the decision, the various criteria involved in the problem, and so on. It can optimize the decision-making processes in the system. In the face of complicated, uncertain, and contradicting situations, it has been frequently employed (de Lima et al., 2019).

Decision support can be described as the assistance for, substantiation and corroboration of an act or result of the decision. The following requirements should be met by DSSs:

1) Intended for the solution of semi-structured issues

2) Has the ability to combine analytical models with standard data and retrieval functions

3) Accessible and user-friendly for decision-makers with fewer computer skills

4) Adaptable to a variety of decision-making processes (Yatsalo & Sullivan, 2012).

The following are the components of a typical DSS framework:

1) Capabilities in analytical modeling

2) Database management systems

3) Graphical representation

4) Tools for reporting

5) The knowledge of the decision-maker (Oliveira et al., 2012).

2.3 Spatial Decision Support System

SDSS, the same as DSS, is designed to handle semi-structured spatial issues. It is developed from DSS by adding geographical elements. In addition to the aforementioned features of DSSs, SDSSs provide functions and tools for processing and analyzing spatial/geographic data. As a result, SDSS assists decision-making in terms of spatial alternatives analysis by integrating GIS functionalities with DSS tools for stakeholders (Yatsalo & Sullivan, 2012). In certain circumstances, the information is stored in a database like tables, and the linkages between the tables and locations are not visible. GIS allows us to see spatial data by attaching attribute information from tables to a geographic location (Sreekanth et al., 2021). SDSSs are often designed to give a decision-making environment that allows for the flexible analysis of both geographical and attribute components (Mansourian et al., 2011). The SDSS enhanced decision-making and is useful in areas with a significant spatial component, such as planning, monitoring, and assessing delivery, evacuation, intervention coverage, site selection, and accountability (Wangdi et al., 2016). SDSSs have been used in a variety of fields, including flood risk management, seismic catastrophes, infrastructure development, and public education management (de Lima et al., 2019). SDSSs can be used in disaster response to identify the best sites for rescue workers, plan evacuation routes, and assign evacuees to shelters (Nyimbili & Erden, 2017).

A SDSS combines GIS features including geographical data management and cartographic presentation with analytical modeling, a user interface that can be customized, and complicated geographical data structures. It provides the framework for integrating:

1) the ability to model spatially and analytically
2) handling of geographical and non-spatial data
3) domain knowledge
4) spatial display functions
5) Capabilities for reporting (Sugumaran & Sugumaran, 2007).

2.4 Web-based Spatial Decision Support System

Web-based SDSS has been suggested as a useful tool for participatory/collaborative/group spatial planning and decision-making (Jelokhani-Niaraki, 2018). Given the collaborative nature of many decision-making problems, by promoting information/knowledge exchange as well as software and model sharing, a participatory decision-making process is becoming more crucial for resolving conflicts and lowering uncertainty in spatial planning and decision-making (Mansourian et al., 2011). When a large number of people and a diverse group of stakeholders are involved in decision-making, the Internet can be considered as a desirable medium for communication between the public and urban planners (Mansourian et al., 2011). The challenge of transmitting geographical data in real-time has taken on a new dimension with the recent use of web services for various GIS applications (Sreekanth et al., 2021). Web technologies open up new opportunities for using SDSS in a participatory environment, allowing the traditional SDSS to evolve from a closed, place-based (time and location fixed) and synchronous process to an open, asynchronous, dispersed, and active process (Jelokhani-Niaraki, 2018). What the users need to access a WebSDSS is only a web browser that is installed originally on any PCs or mobile devices (e.g., PDA, smartphones). This revolution leads the transformation of decision-making from only individual data browsing, analyzing, and managing, to the group's participation and communication on scientific as well as social decision-making concerns (Mohd et al., 2014).

WebSDSSs have several advantages over stand-alone desktop systems, including platform independence, cost-saving, reduced maintenance complexity, simplicity of use, global data sharing, group discussion assistance, as well as more public accessibility in the decision-making processes (Yatsalo & Sullivan, 2012). Additionally, in the traditional way, citizens and permit applicants must visit the municipality office to submit their applications and track their progress. Therefore, the creation of a WebSDSS can help municipalities in making the transition from traditional urban planning and administration to an online public participatory spatial planning process (Mansourian et al., 2011).

2.5 Urban Management

There is no general definition for the urban management concept, perception of people and political-social demands also differ in different eras (Mahmudi & Saremi, 2015). Urban management is not only the administration of local government but also the management of human settlement activities. It comprises resources management, development, public services, urban growth, and any other partial urban concern (Mattingly, 1995). Urban management as an organizational framework, the governance, urban development, policymaking, projects, plans and operations, and also citizens' access to services and infrastructure, housing, and employment are concerned (khazaee & Razavian, 2012). To sum up, the general content of urban management is shown in Figure 3.

Figure 3. The general content of urban management

The term "urban management" refers to the process of implementing, coordinating, and evaluating integrated strategies with the guidance of city authorities, whilst also taking private sector objectives and citizen benefit into account, has the main goal of approaching sustainable economic development potential (Mahmudi & Saremi, 2015). In addition, according to Avis and R (2016), urban management:

1) Has a significant impact on the physical and social character of urban areas

2) Has an impact on the quantity and quality of local services as well as delivery efficiency

3) Determines how costs are shared and resources are distributed among various groups

4) Impacts citizens' capacity to engage in decision-making and access local government, impacting local government accountability and responsiveness to community demands.

2.6 Participatory Urban Management

Democratization means an increase in citizen participation in public affairs, citizen participation in urban management is one of the core values of a democracy (Mahmudi & Saremi, 2015). Participation of associated and non-associated citizens in the development, implementation, and/or evaluation of public policy aims to improve democratic governance by reducing citizen distrust of elected officials and providing more effective responses to broader community needs (Falanga, 2020). In urban management, participation can be described as the cooperation between private sectors and municipalities (Mahmudi & Saremi, 2015). Without empowering the municipality to assume full responsibility for planning its jurisdiction in a democratic and responsible framework, as well as coordinating with other authorities, urban planning and management operations will not be effective (Mansourian et al., 2011).

Different areas of expertise and stakeholders with varying levels of knowledge are required for urban planning and management activities. They represent their unique experiences, which results in diverse perspectives on desirable planning outcomes (Mansourian et al., 2011). Participants range from specialists to novices in defining decision knowledge and using spatial decision support tools, with varying levels of competence, experience, subject knowledge, and analytical ability. Due to a lack of expertise and self-doubt, novices' actions are influenced by the presence of others' perspectives within the group. Individual decision-makers need to exchange knowledge for participatory/collaborative urban management to be effective (Jelokhani-Niaraki, 2018).

Urban management should be based on the principles that create the fundament of the structure. These principles can be summed up as follows:

1) Civility in cities and citizen education

2) Consistent citizen polling

3) Norms for informing and directing citizens that are codified

4) Gaining the trust of the public and private sector

5) Assessing and correcting the activities that have already been completed (Mahmudi & Saremi, 2015).

2.7 Disaster Management and Urban Resilience

Disaster management (DM) is a strategy for increasing resilience and, as a result, preventing or mitigating the effects of natural disasters. Thus, DM is characterized as an ongoing process that consists of a series of activities that occur before, during, and after an incident and is divided into four key phases: disaster mitigation, disaster preparation, disaster response, and disaster recovery (Figure 4) (Herold et al., 2005; Horita & Albuquerque, 2013). Although there is growing recognition that these actions greatly overlap, preparedness and mitigation are regarded as pre-disaster activities, while response and recovery are considered during and post-disaster activities, respectively. Some recovery actions may occur at the same time as response efforts (Nyimbili & Erden, 2017).

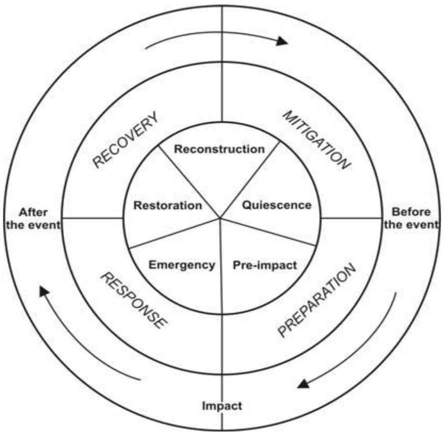

Figure 4. Disaster management cycle
(Herold et al., 2005)

DM plays a critical role in enhancing the power of urban resilience, i.e., improving the community's capacity to resist or adapt to extreme events and disasters, as the frequency and magnitude of catastrophic events and disasters increase, which are influenced by climate change (Horita & Albuquerque, 2013).

Assimilation and transmission of real-time information/data to diverse decision-makers are required for effective DM. The usage of GIS and remote sensing technology can greatly assist this process (Herold et al., 2005). To respond quickly to extreme events, emergency managers must make important decisions quickly. It is critical for policymakers to have the proper knowledge at the right time to react, plan, or mitigate disasters (Abdalla, 2016). The goal of disaster response in humanitarian relief chains is to give immediate relief to disaster-affected communities in order to reduce human death and suffering (Barzinpour & Esmaeili, 2013). Many relief measures for disasters from previous studies emphasize the importance of fast response, which basically relies on accessibility to the Internet and communication.

Furthermore, the establishment of a rescue command center, the collecting of information/data about the affected region, the identification of optimal shelter places, the selection of the best evacuation routes, vehicles for evacuation, the delivery of relief items, the installation of medical and fire prevention stations, and emergency construction facilities would all be major responsibilities of DM for urban areas. As a result, DM plans should cover the location of emergency bases and the distribution of relief supplies (Barzinpour & Esmaeili, 2013). DM requires the involvement of various ministries and departments (Madan & Routray, 2016). Apart from the city authorities and organizations, the participation of the public/citizens can have a significant role in this procedure. For example, by adopting the proposed PWebSDSSs, the public/citizens/victims can provide valuable data such as their accurate position coordinates, the casualties and site photos of the disaster area, their rescue and relief material needs, etc. These participatory and proactive means help to improve the DM efficiency as well as reduce the workload of rescue teams. The PWebSDSS can also be useful tools in the DM processes in urban areas. It could include modules for planning, monitoring, and assessing the delivery and coverage of interventions. For example, it can help to build indoor residual spraying and the distribution of long-lasting insecticidal nets to target populations, collecting spatial distribution data of infection cases, vaccinated population, etc.

3. DESIGN OF THE PARTICIPATORY URBAN MANAGEMENT USING WEB-BASED SDSS

Through the above comprehensive literature review in this paper, by analyzing and combining the advantages of DSS, GIS, Internet, participatory management as well as its overlapping nature with disaster management, in this part, we propose a Participatory WebSDSS (PWebSDSS) platform which is designed to establish a participatory method for mobilizing municipal resources and facilities, meeting the requirements of citizens, control and manage the urban area, as well as consider the DM aspects in urban management, then ultimately achieve sustainable urban management. This process and the benefits of the proposed PWebSDSS are shown in Figure 5.

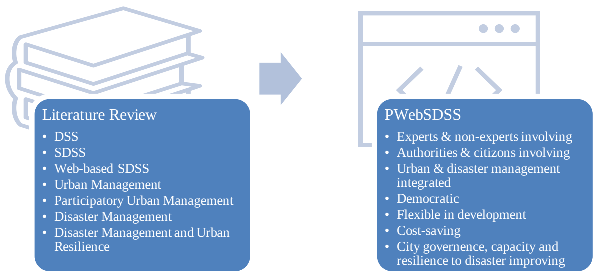

Figure 5. The design process of the proposed PWebSDSS

3.1 Participatory Urban Management Process

In the participatory urban management, for example, a permit applicant like a construction company could query the application process, download and upload the application forms directly from the platform, to save their time and reduce human touch, which shows a necessity, particularly during a disaster situation like Covid-19 pandemic; a citizen could also report the infrastructure failure, pollution area, uncivilized behavior by filling online forms, attaching the spot coordinates (automatically acquired from mobile devices), photos, contact number, and other information to the urban manager. The deployment of the "editing on map" function is an essential characteristic of our system. This enables the development of spatial features (points, polylines, and polygons) on the map, as well as the correlation of specific attributes with these features, and keeping the server-side database up to date. For example, a user could draw on a map or collect an area from mobile phones to establish a distribution center for critical supplies such as medicines, food, and water; or input a point or automatically acquire it from devices, along with a note describing how specific infrastructure, such as a collapsed house, has been affected by the disaster. Allowing users to dynamically update maps with updated data/information can improve the ability to give critical geographical information in a usable way to those who need it most (Herold et al., 2005).

3.2 Disaster Management Process

The system can be updated to bi-functional systems by developing the additional DM sub-system based on the original PWebSDSS. This integration approach has many benefits:

1) The involvement of public participants in their daily life can increase their accessibility, familiarity, interests, and dependence on the platform, accordingly, gaining a large number of local users

2) It can improve the efficiency of both urban management and disaster management role of the platform, due to the shared database that avoids repetitive data collection, the DM process can also feedback to the regular urban management role, to increase the city's capacity and strengthen its resilience

3) It can save costs in both development and maintenance processes, due to their functional overlap and the shared webserver

4) The dynamic transformation makes full use and improves the survivability of the platform, so as not to be idle or abandoned after the disaster relief works end.

In the regular urban management system, the general decision makers' role and their possible achieving means are set as follows:

1) Development and operation plan – online/electronic form, voting system, online/electronic map

2) Resource management – tasks allocation, online/electronic map, the query system

3) Policymaking – online/electronic form, voting system

4) Public service – forum, query system, online/electronic map, navigation system

5) Projects management – supervision system, online/electronic form, online/electronic map, volunteer recruitment

6) Publicity and education – manual, video, message.

Accordingly, the possible roles of the public participants and the activities they may participate in could be:

1) Development and operation plan – submit forms, vote, provide map features

2) Policymaking – submit forms, vote

3) Public service – discussion and suggestions, query, use maps, navigation

4) Projects management – report pollution and violations, view maps, register for volunteer

5) Publicity and education – online learning, receive notifications.

The possible roles of the permit applicants (such as construction companies) and the activities they may participate in could be:

1) Resource management – accept a mission, view maps, query

2) Projects management – self-inspection, submit forms, view maps, coordinate volunteers

3) Public service – complaint, query, use maps, navigation.

According to their working nature, the government departments could be flexible and may be involved in any of the activities, their main role is to partake and execute tasks from the decision-maker or other superiors, or sometimes coordinate between departments.

There are many possibilities for the design of the DM sub-systems, according to the category of the disasters, different disasters have different management modes and relief objectives, accordingly, different functions and data are required.

In the sub-system, the command center is designed instead of the decision-maker as the core role and its possible modules and functions are set as follows:

1) Risk management – risk alarm, online/electronic hazard map, query system, manual, video

2) Relief management – online/electronic form, online/electronic map, volunteer recruitment, supervision system

3) Victim service – query system, online/electronic hazard map, online/electronic form, navigation system.

Accordingly, the possible activities the citizens may participate in could be:

1) Risk management – receive alarms, view hazard maps, query, online learning

2) Relief management – submit forms, use hazards maps, register for volunteer, report risks

3) Victim service – query, use hazard maps, report relief materials requirement, navigation.

Likewise, the main role of government departments is to partake and execute missions from the command center and coordinate between departments and also collaborate with non-government organizations (NGO), which, in the relief works, are mainly responsible for mobilizing donations and volunteers' arrangement jobs.

4. RESULT AND DISCUSSION

The proposed PWebSDSS integrated the DSS, GIS, and Internet (Web) environment, and aims to realize the main goal of sustainable economic development in modern urban management. By adopting the proposed PWebSDSS, the assisting role of the DSS for municipal authorities and organizations in urban management is optimized by introducing GIS, which can solve the drawback that the DSS cannot take spatial-temporal data into account. Meanwhile, the Web technology enabled the possibility of the participatory/collaborative urban management mode, in which both experts & non-experts, authorities & citizens can be involved in realizing a more effective, accurate, and democratic urban management. The proposed PWebSDSS in this study is designed for involving all aspects of urban management participants in peacetime, which can be transformed into a disaster management tool when dealing with a disaster situation.

Because it has been found that the functions of a usual urban management system are overlapping with the components of DM. Apart from the participatory capabilities above, one of the important benefits of the platform is that it has kept the whole development capabilities as other usual webpages, which enables the possibility and the easiness to develop new modules based on the different focus and interests of the decision-makes, By this integration way, the value and efficiency of the urban management process can be improved, the capacity of dealing with disaster situations of the city can be enhanced, and the development cost also can be reduced.

The overall conceptual design of the proposed PWebSDSS for regular urban management and disaster management sub-systems in urban areas can be seen in Figure 6 (a) and Figure 6 (b), respectively. The detailed functional design of the PWebSDSS for regular urban management and the sub-system for DM in urban areas is shown in Figure 7.

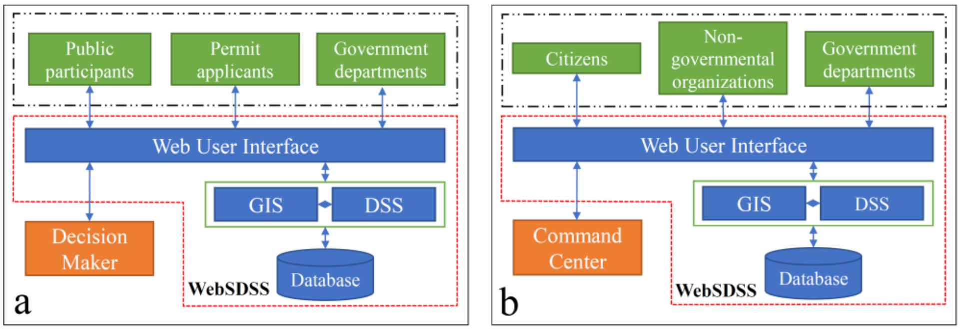

Figure 6. The overall conceptual design of the PWebSDSS for regular urban management (a) and disaster management in urban areas (b)

However, there are also some foreseeable drawbacks of the study. For example, since the system is intended for use by people in developing countries that have a complex political, social, and economic environment, the network facilities may be deficient in some of these areas, or the communication system may go out of operation when a devastating disaster strikes such as tsunami and earthquake. While our platform strongly relies on Internet accessibility, it may be not applicable in some cases. On the other hand, because some people in developing countries may not be able to utilize electronic products or are unfamiliar with GIS technology, system functionality, and interface design should be given great attention. The interface must be designed in a visually appealing and user-friendly manner, and the functionality should be straightaway. In addition, the government officers from these countries may also be unskilled in using computer programs, a short-term centralism training is also important. The protection of users' privacy and their private data is also an important part that cannot be ignored since the database of the platform could store large amounts of users' information.

Presently, the proposed PWebSDSS is still a concept production that is being summarized and developed from the literature review concerning DSS, SDSS, Urban Management, Disaster Management, and Urban Resilience. The laws and regulations, policies, as well as cultural differences among countries can also determine the practical application effect of the concept. Thus, further studies that focus on practical application are also crucial.

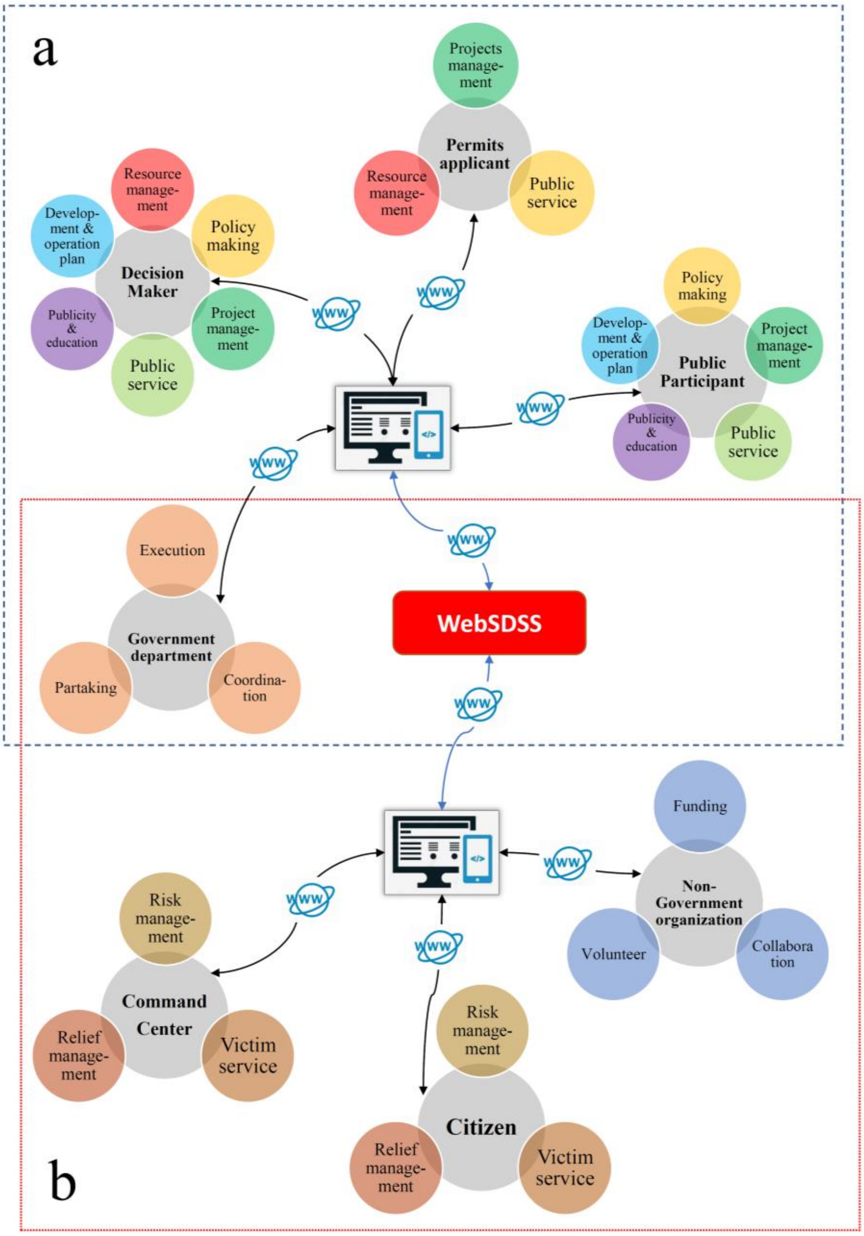

Figure 7. The detailed functional design of PWebSDSS for urban management (a), and the sub-system for disaster management (DM) in urban areas (b)

5. CONCLUSION

Our study reviewed the literature in the field of decision-making analysis and combed the evolution progress from the original non-spatial DSS to the spatial-temporal data supported and Web-based SDSS. Elaborated on each of their roles in the domain and their application area. Analyzed their innate inability and the benefits of each progression. Then we studied the concept of urban management and explored the possibility and the benefits of the participatory/collaborative urban management mode. We also reviewed the concept and content of DM and its relationship with urban management.

It was found that the typical SDSS has been criticized for not being able to solve complicated decision-making problems, engage various stakeholders, or democratize the planning process effectively, while the adoption of the proposed PWebSDSS of the study could optimize and facilitate the management process of urban areas that are rapidly developing, and a growing number of populations are involved, and facilitate an interactive, open, democratic, communicative, group-based, and informed deliberation process.

It was also found that the participatory urban management and the DM that involve proactive participation of citizens are somehow linked, and their functions are overlapped, which enabled their integration possibility. Thus, we believe the proposed PWebSDSS can be used as a regular urban management tool in peacetime and can be updated to a dual system when the DM elements are added. By this integration means, the city governance performance, and its capacity and resilience to disaster can be improved by adopting this concept.

We also believe this integrated participatory urban management platform has but is not limited to the following benefits:

- Experts & non-experts involving
- Authorities & citizens involving
- Urban & disaster management integrated
- Democratic
- Flexible in development
- Cost-saving

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