Implementation and Evaluation of Pull-type Rationed Goods Request Framework

Yuta Seri[1] and Tomoyuki Ishida[2]

[1]Graduate School of Engineering, Fukuoka Institute of Technology, Japan

[2]Department of Information and Communication Engineering, Fukuoka Institute of Technology, Japan

Received: May 01, 2024; Revised: June 16, 2024; Accepted: July 18, 2024; Published: July 31, 2024

Abstract

In this study, we implemented and evaluated a pull-type rationed goods request framework. The proposed framework comprises three component systems. The first system is the individual rationed goods request system for disaster victims, which allows disaster victims to request personalized rationed goods. The second system is the individual rationed goods request system for informationally disadvantaged disaster victims, which allows informationally disadvantaged disaster victims, e.g., the elderly, to request personalized rationed goods using tablet terminals installed at evacuation centers. The third system is the individual rationed goods request management system for system administrators. This system allows system administrators to centrally manage information on rationed goods requested from the individual rationed goods request system for disaster victims and the individual rationed goods request system for informationally disadvantaged disaster victims. The proposed pull-type rationed goods request framework was evaluated using the system usability scale evaluation with 30 participants. In addition, the 30 subjects evaluated the operability, readability, functionality, and relevance of the proposed framework . The results demonstrate that the proposed framework received high marks in many items.

Keywords: Disaster Victims Support, Rationed Goods Request, Pull-Type Support, Web System.

1 Introduction

Natural disasters, e.g., torrential rains and typhoons, occur nearly every year in Japan due to its geography and location. For example, several recent largescale disasters include the Great East Japan Earthquake (March 2011) [1], the Kumamoto earthquake (April 2016) [2], the heavy rains of July 2018 [3], and the Noto earthquake (January 2024) [4]. Depending on the characteristics of a natural disaster, municipalities may issue evacuation orders or evacuation advisories to residents, leading to extended stays in evacuation centers. In principle, the procurement of supplies for evacuation centers is a municipal responsibility according to the Basic Act on Disaster Control Measures [5]. However, if it is difficult for a municipality to procure supplies, the prefectural governor will procure them upon request from the mayor of the municipality [6].

Based on past disasters, Okumura et al. [7] revealed that there are various issues in evacuation center management. Among these issues, it is difficult to quickly identify and ascertain the need for rationed goods. For example, the Great East Japan Earthquake, which occurred on March 11, 2011, caused severe damage in the Miyagi, Iwate, and Fukushima prefectures, and it was difficult to assess the need for supplies in these regions accurately due to damage to municipal government buildings and the disruption of communications infrastructure. Thus, a team specializing in rationed goods, companies, nonprofit organizations, and other supply providers anticipated the needs of the region and procured and shipped supplies. However, the relief supply needs of the region were not communicated effectively to the providers; thus, an insufficient amount

of supplies was shipped to the region. For example, a surplus of water and blankets were shipped; however, insufficient supplies of shoes and shampoo were received. This issue poses difficulties for disaster victims who cannot receive rationed goods. In addition, sorting and storing unnecessary supplies increases the workload of local government employees and volunteers, which can interfere with the execution of other tasks.

Twelve years have passed since the Great East Japan Earthquake, and telecommunications carriers and other organizations have been working to provide effective disaster relief across corporate boundaries, e.g., by offering free public wireless LAN services called "00000JAPAN" during disasters. Furthermore, communication services and environments have improved considerably by increasing the deployment of mobile power supply vehicles during disasters and creating an environment where communication terminals can be used at evacuation centers. As a result, it is possible to quickly identify the need for rationed goods by applications for supplies and various requests using information and communication technology systems [8].

The remainder of this paper is organized as follows. Related work is described in Section 2, and the purpose of this study is described in Section 3. The system configuration of the proposed pull-type rationed goods request system is discussed in Section 4, and the proposed system is described in detail in Section 5. Section 6 evaluates the proposed pull-type rationed goods request system. Finally, the paper is concluded in Section 7.

2 Related Work

Koesuma et al. [9] developed the dLOGIS logistics management system to realize efficient relief operations during disasters. The main screen of the dLOGIS application comprises five menus, i.e., disaster information, refugees, logistics needs, available logistics stock, and accepted logistics. The disaster information menu provides the latest disaster information entered by administrators and field coordinators, and the refugees menu provides the current status of refugees (including the number of refugees, family size, age, gender, and the number of pregnant refugees). The logistics needs menu provides refugees' needs for daily life, e.g., food, drinks, clothing, and toiletries. The available logistics stock menu provides logistics available at refugee camps and evacuation centers, and the accepted logistics menu provides logistics provided by various humanitarian organizations.

Usuda et al. [10] developed a shared information platform to share disaster response information and directly support the decision-making processes and activities of disaster response organizations. This platform makes it possible to recognize unified disaster situations quickly within the disaster response organizations.

Caragea et al. [11] developed the Enhanced Messaging for the Emergency Response Sector system, which uses machine learning to classify and aggregate tweets and text messages about earthquakes in Haiti. This system uses machine learning to classify important information posted on social media into 10 categories (medical emergency, people trapped, food shortage, water shortage, water sanitation, shelter needed, collapsed structure, food distribution, hospital/clinic services, and person news), thereby making it possible to deliver the information to the people who need it efficiently and effectively.

Kondaveti et al. [12] developed a decision support framework built on rapid information collection and resource tracking functionalities. This framework inputs the number of disaster victims and their current location (latitude and longitude), and it calculates the distance between the locations of all disaster victims using Euclidean distance as an index. Then, the victims are clustered based on the distance. This decision support framework facilitates efficient disaster response and optimal resource allocation.

Macit [13] developed the Integrated Disaster Management Systems framework, which allows disaster victims to select necessary relief supplies using a smartphone application and request them from an operation center when a disaster occurs. The operation center uses a supply chain management system to create an

optimal supply distribution plan based on the requests. Then, the shortest route from the disaster area to the nearest supply base is calculated using the Floyd–Warshall algorithm, and designated vehicles and personnel deliver the supplies using the shortest route. This integrated framework enables rapid disaster response and effective utilization of relief supplies.

Nwufoh et al. [14] developed the Emergency Alert Management System, which is designed to function in the event of an emergency situation, e.g., fires or accidents. This system can broadcast warning notifications to multiple devices simultaneously for targeted users.

Kosugi et al. [15] developed an improved version of the Disaster Information Tweeting System (DITS) and the Disaster Information Mapping System (DIMS) to collect and share accurate information quickly in the event of a disaster using Twitter (X). The DITS automatically adds user location information and appropriate hashtags to tweets, and it includes a function to save tweet information in a database. The DIMS maps tweets posted on the DITS. The improved version of this system has achieved accurate tweet mapping.

Ahmady et al. [16] developed a chatbot application to share disaster-related information in real time for foreigners living in Japan. This application uses the Telegram API to send and receive real-time information, and it provides real-time disaster information based on the user's current location and allows users to share disaster-related pictures.

Utsu et al. [17] developed the T-@npi safety confirmation system using Twitter (X). Users can check safety information via Twitter and T-@npi in the event of a disaster. This allows local government officials and rescue experts to relevant gather information quickly. In addition, the registered safety information is mapped onto an online map.

Pena-Caceres et al. [18] developed a chatbot to support citizens during emergencies and disasters. This chatbot system facilitates the transmission of various data, e.g., risk situations and rescue requests, through mutual communication between citizens and emergency management authorities.

Toraman et al. [19] developed an interactive tool that can recognize the situation of missing or trapped people and provide disaster relief for rescue and donation efforts. This system can collect tweets, classify tweets asking for help, and extract important entity tags. In addition, this system has a function to visualize the collected information on a map.

3 Research Objective

Many existing relief supply request systems calculate the expected amount of rationed goods automatically based on different types of information, e.g., gender, age, and family structure, and such systems are designed to be used by relief supply providers and local government staff. Other systems allow disaster victims to request needed rationed goods; however, such systems do not consider the digital divide. In addition, many relief supply request systems do not consider the provision of rationed goods according to the individual circumstances of disaster victims. Thus, we implement the following three systems to realize requests for rationed goods according to the individual requests of disaster victims.

3.1 Individual rationed goods request system for disaster victims

The individual rationed goods request system for disaster victims implements a function that allows disaster victims to issue requests for rationed goods to local government using smartphones according to their individual circumstances. In addition, this system allows disaster victims to view various information, e.g., the estimated arrival date of the requested rationed goods and notifications from local government agencies.

3.2 Individual rationed goods request system for informationally disadvantaged disaster victims

This system is designed for informationally disadvantaged people, e.g., the elderly. This system implements a function to request rationed goods from local government agencies using tablet terminals installed at evacuation centers. In addition, this system allows informationally disadvantaged disaster victims to view various information, e.g., the estimated arrival date of the requested supplies.

3.3 Individual rationed goods request management system for system administrators

This system implements a function that allows system administrators to centrally manage the information from the individual rationed goods request system for disaster victims and the individual rationed goods request system for informationally disadvantaged disaster victims. In addition, it has a function that allows system administrators to manage notifications to different evacuation centers.

These three systems realize the supply of rationed goods according to the individual circumstances of the disaster victims during disasters, and it realizes effective support according to the individual circumstances of each disaster victim at each evacuation center.

4 Pull-type Rationed Goods Request Framework Configuration

Figure 1 shows the configuration of the proposed framework. This framework comprises an disaster victim agent, an informationally disadvantaged disaster victim agent, a system administrator agent, an application server, and a database server.

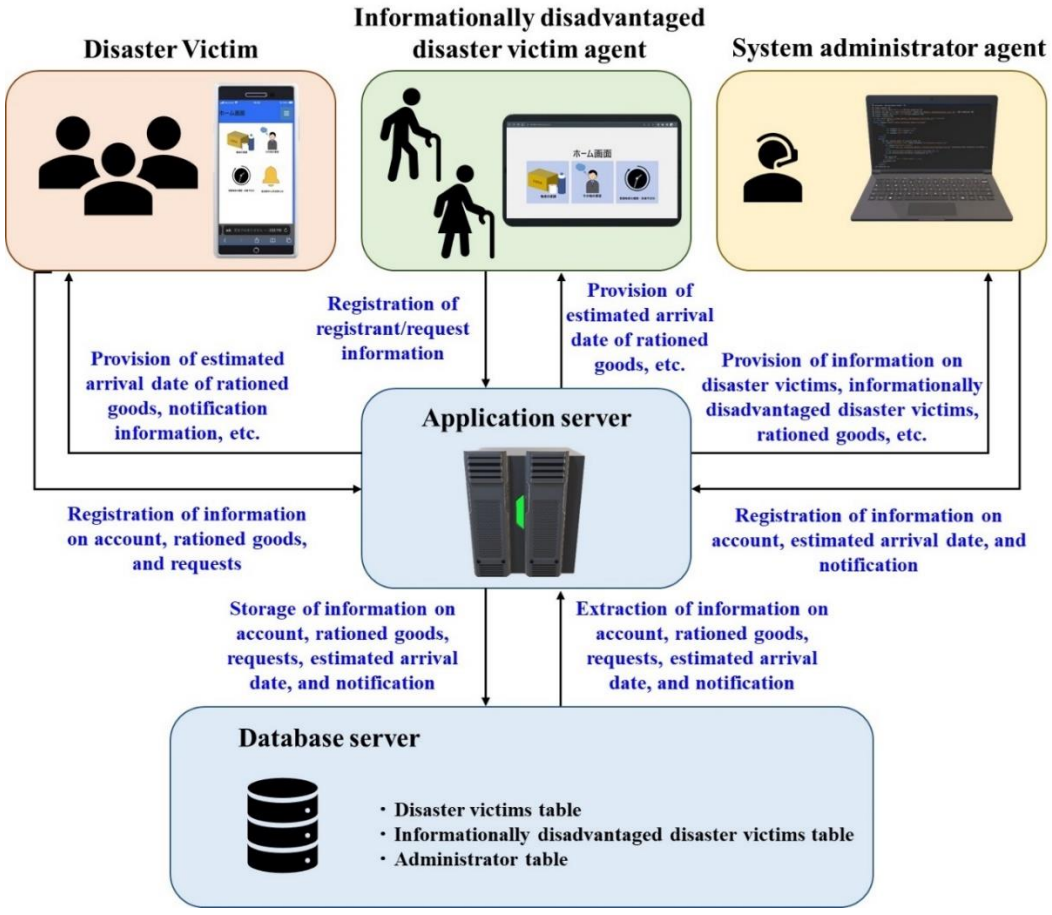


Figure 1. Configuration of proposed pull-type rationed goods request framework

4.1 Disaster victim agent

The disaster victim agent is assumed to be a disaster victim who can use an information terminal, e.g., a smartphone. The disaster victim agent registers their name, age, gender, evacuation center, e-mail address, and password using a QR code installed at the evacuation center. Once the user information has been registered, the disaster victim agent can register the rationed goods and other requests, view the relief supply history, view the estimated arrival date, and receive notifications from local government.

4.2 Informationally disadvantaged disaster victim agent

The informationally disadvantaged disaster victim agent is assumed to be an elderly person who does not use communication terminals regularly. Note that the system used by informationally disadvantaged disaster victim agents does not have a login function. Thus, the informationally disadvantaged disaster victim agent registers requests for rationed goods using large-screen tablet devices installed at an evacuation center. In addition, the informationally disadvantaged disaster victim agent can view the relief supply history and the estimated arrival date.

4.3 System administrator agent

The system administrator agent is assumed to be a local government employee who manages requests for rationed goods from the disaster victim and informationally disadvantaged disaster victim agents, and it sends the required information to evacuation centers. The system administrator agent receives the requests for rationed goods from the disaster victim and informationally disadvantaged disaster victim agents, and it requests orders from related parties according to the content of the rationed goods. In addition, the system administrator agent manages the estimated arrival date of the rationed goods and manages the information sent to the evacuation centers.

4.4 Application server

The application server accepts information and requests (account information, rationed goods information, other request information, and notification information to evacuation centers) sent from the disaster victim, informationally disadvantaged disaster victim, and system administrator agents, and it stores this information in the database server. In addition, the application server provides the information stored in the database server in response to requests from each agent.

4.5 Database server

The database server stores the information registered by the disaster victim, informationally disadvantaged disaster victim, and system administrator agents, e.g., account information, rationed goods information, other request information, and notification information.

5 Proposed Pull-type Rationed Goods Request Framework

5.1 Individual Rationed Goods Request System for Disaster Victims

The home screen is displayed when the user completes the login process or registers with the system. The home screen comprises a hamburger menu in the upper right corner of the screen, including “request for rationed goods,” “other requests,” “history of requested rationed goods and estimated arrival date,” and “notices from local government.”

When the user selects the “request for rationed goods” item on the home screen (Figure 2), the screen transitions to the rationed goods request form (Figure 3). Here, the label and drop-down menu for item 1 are displayed first. When the user selects the drop-down menu for item 1, the following options are displayed:

"medical/nursing supplies," "foods," "infant supplies," and "others." When the user selects "medical/nursing supplies" in item 1, the label and drop-down menu for item 2 are displayed. When the user selects the drop-down menu for item 2, the following options are displayed: "crutch," "wheelchair," "walking assist instrument," and "adult diaper." When the user selects "crutch" in item 2, the label and drop-down menu for item 3 are displayed. When the user selects the drop-down menu for item 3, the following options are displayed: "SS (121–137 cm)," "S (137–157 cm)," "M (157–178 cm)," and "L (178–198 cm)." When the user selects "M (157–178 cm)" in item 3, the "remarks" text box and "quantity" text box are displayed. When the user inputs information in the "remarks" (optional) and "quantity" text boxes and then clicks the "send" button, the application completion screen is displayed. Two seconds after the application completion screen is displayed, the screen returns to the home screen. Figure 4 shows a list of the rationed goods options.

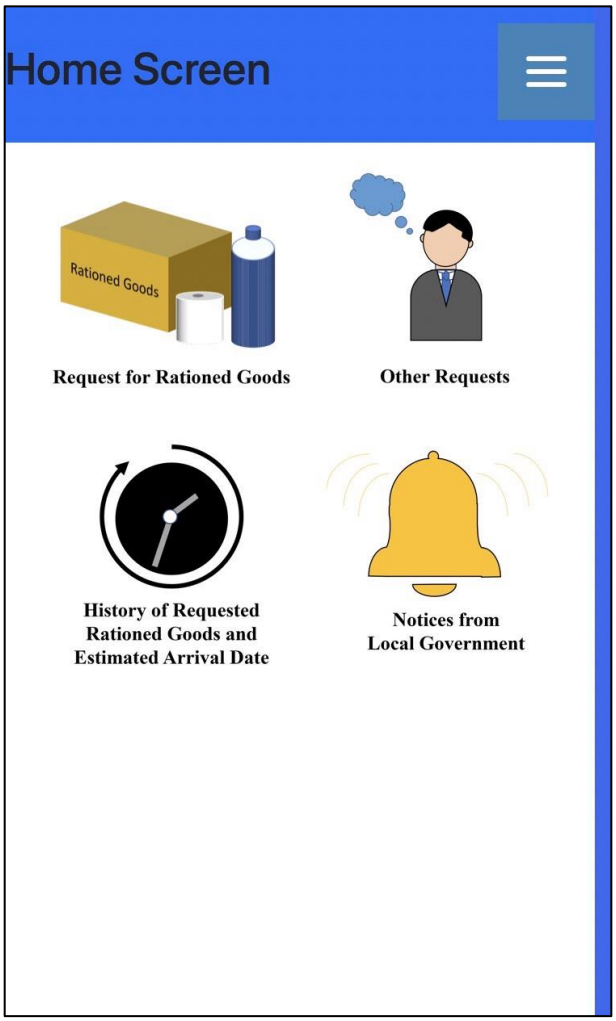


Figure 2. Home screen of the individual rationed goods request system for disaster victims

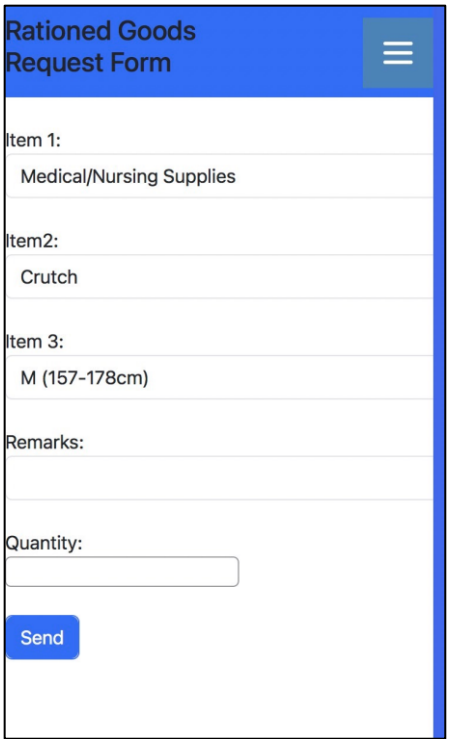


Figure 3. Request form for individual rationed goods

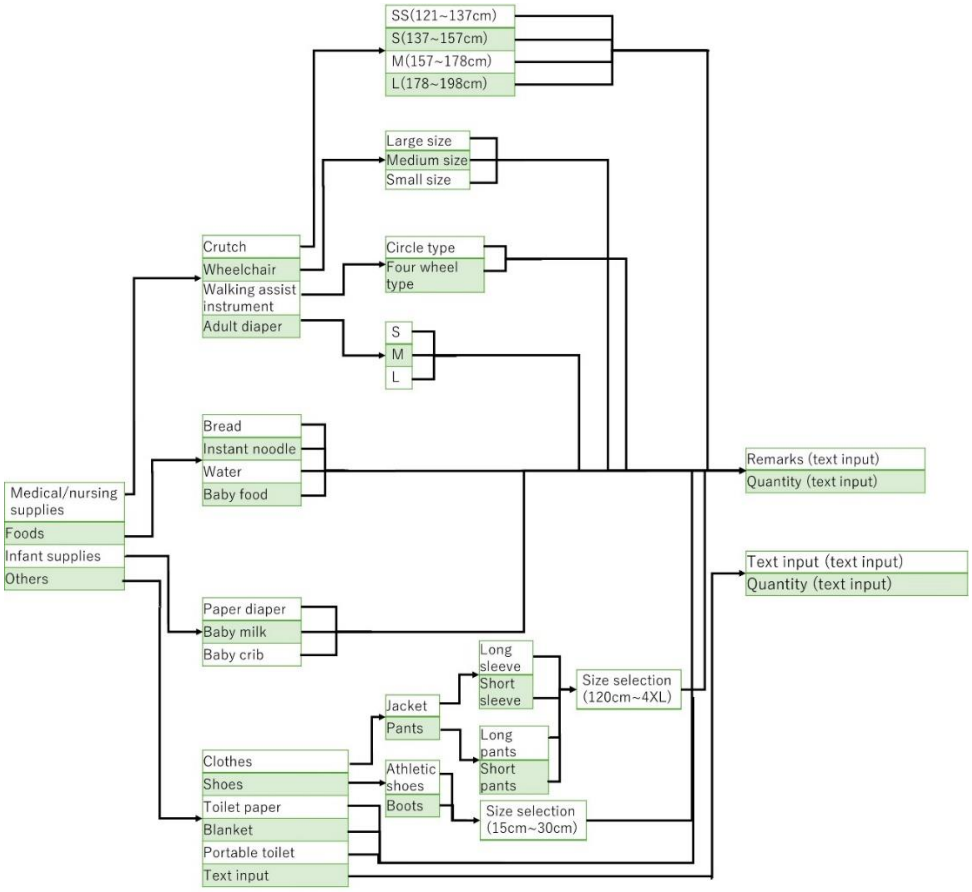


Figure 4. List of rationed goods options

When the user selects the “history of requested rationed goods and estimated arrival date” item on the home screen (Figure 2), the screen transitions to the rationed goods request history screen (Figure 5). Here, the users can check the requested item name, quantity, date and time, and estimated arrival date.

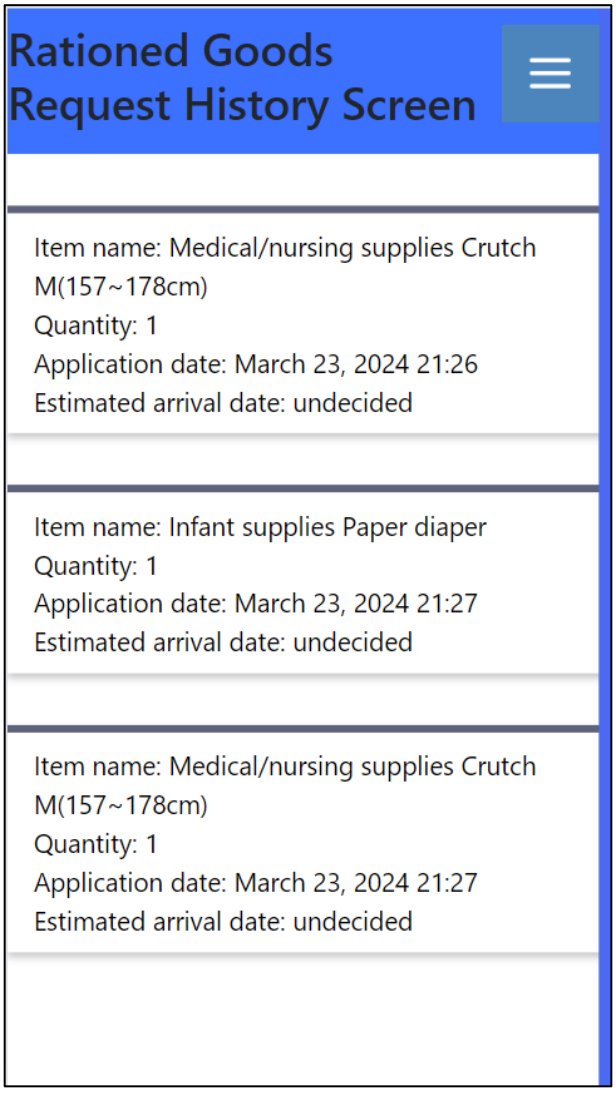


Figure 5. Rationed goods request history screen

When the user selects the “other requests” item on the home screen (Figure 2), the screen transitions to the other request form (Figure 6). Here, the users can input problems at evacuation centers and send requests to the local government. Two seconds after the user presses the send button and the application completion screen is displayed, the screen returns to the home screen.

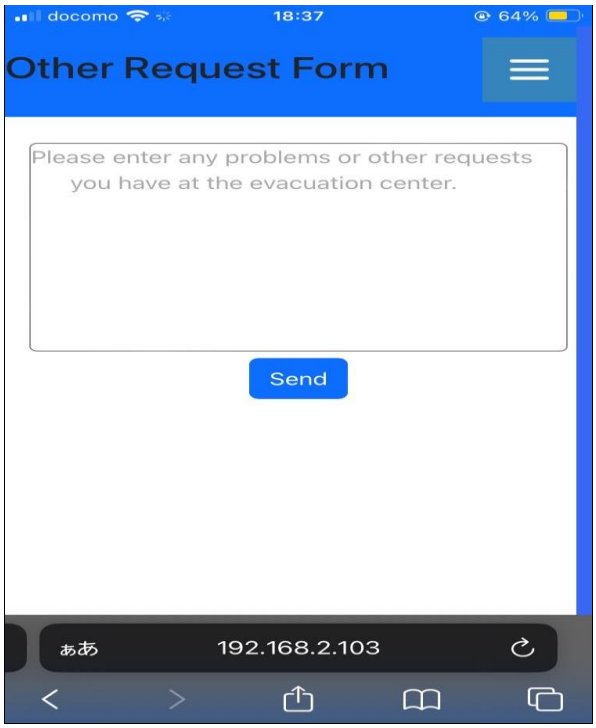


Figure 6. Other request form

When the user selects the “notices from local government” item on the home screen (Figure 2), the screen transitions to the notification screen from the local government (Figure 7). Here, a list of notifications comprising “title,” “contributor,” and “contribution date and time” is displayed.

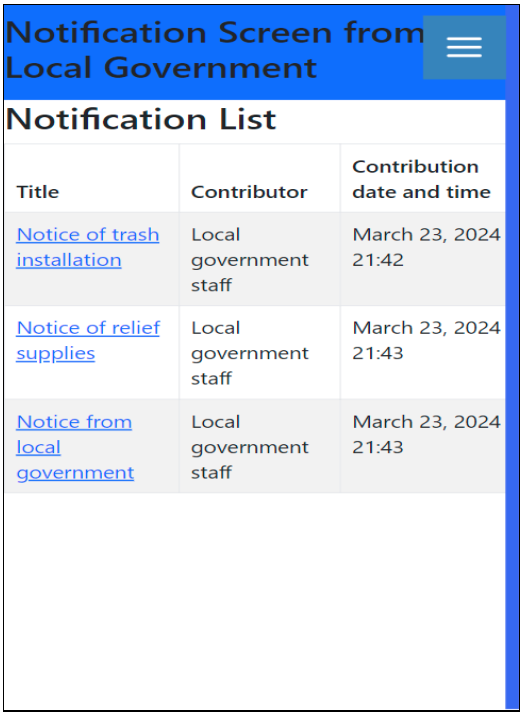


Figure 7. Notification screen from local government

6 Individual Rationed Goods Request System for Informationally Disadvantaged Disaster Victims

Figure 8 shows the home screen of the individual rationed goods request system for informationally disadvantaged disaster victims, which comprises the "request for rationed goods," "other requests," and "history of requested rationed goods and estimated arrival date" functions. When the user selects "request for rationed goods," the screen transitions to the rationed goods request form (Figure 9). Here, the user inputs and selects name, gender, date of birth, and evacuation center. When the user inputs and selects all items and clicks the "next" button, the buttons for "medical/nursing supplies," "foods," "infant supplies," and "others" are displayed (Figure 10). When the user selects the "medical/nursing supplies" button, the buttons for "crutch," "wheelchair," "walking assist instrument," and "adult diaper" are displayed (Figure 11).

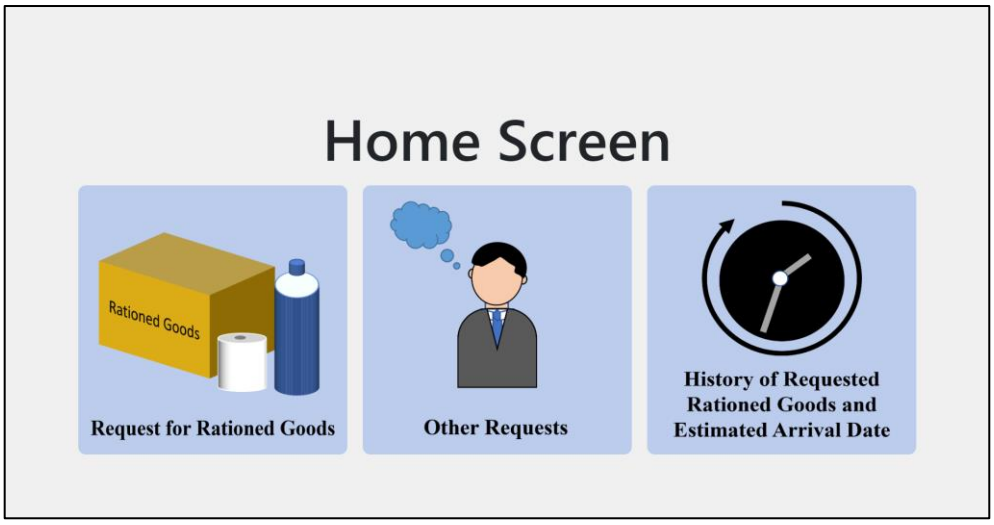


Figure 8. Home screen of the individual rationed goods request system for informationally disadvantaged disaster victims

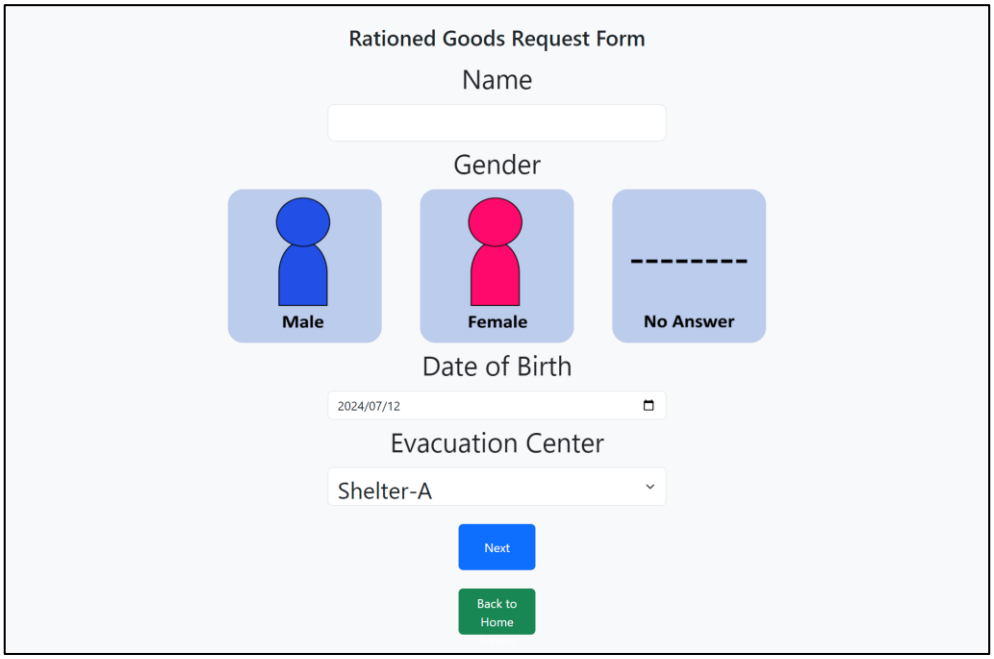


Figure 9. Rationed goods request form for informationally disadvantaged disaster victims

Figure 10. Rationed goods request form for informationally disadvantaged disaster victims (select rationed goods item)

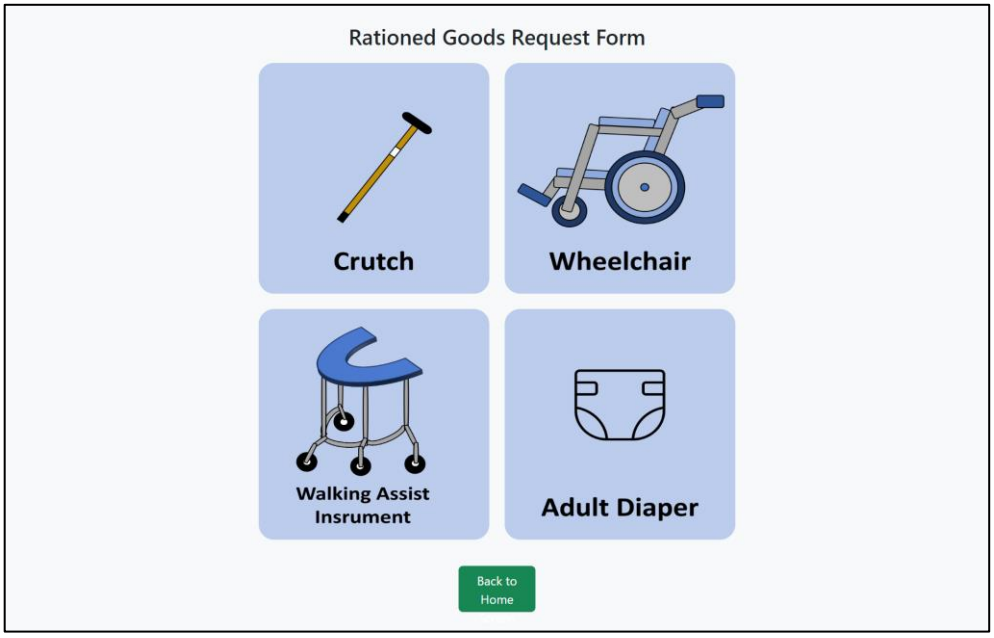


Figure 11. Rationed goods request form for informationally disadvantaged disaster victims (select medical/nursing supplies)

When the user selects the “other requests” button on the home screen (Figure 8), the screen transitions to the other request form, as shown in Figure 12. Here, when the user inputs their “name” and selects “evacuation center,” and then clicks the “next” button, the screen transitions to the other request form input screen (Figure 13). Here, the user can input problems at evacuation centers and send requests to local government. Two seconds after the user presses the send button and the application completion screen is displayed, the screen returns to the home screen.

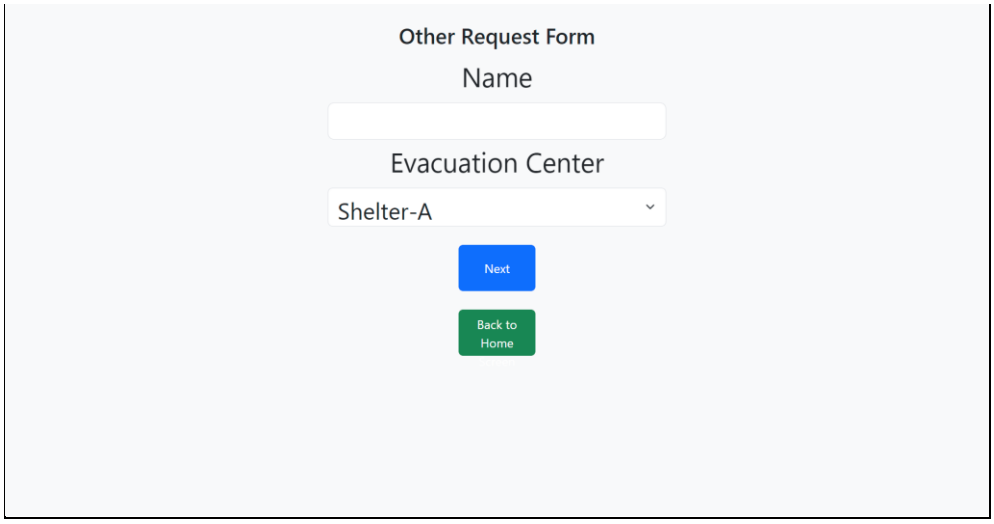


Figure 12. Other request form for informationally disadvantaged disaster victims

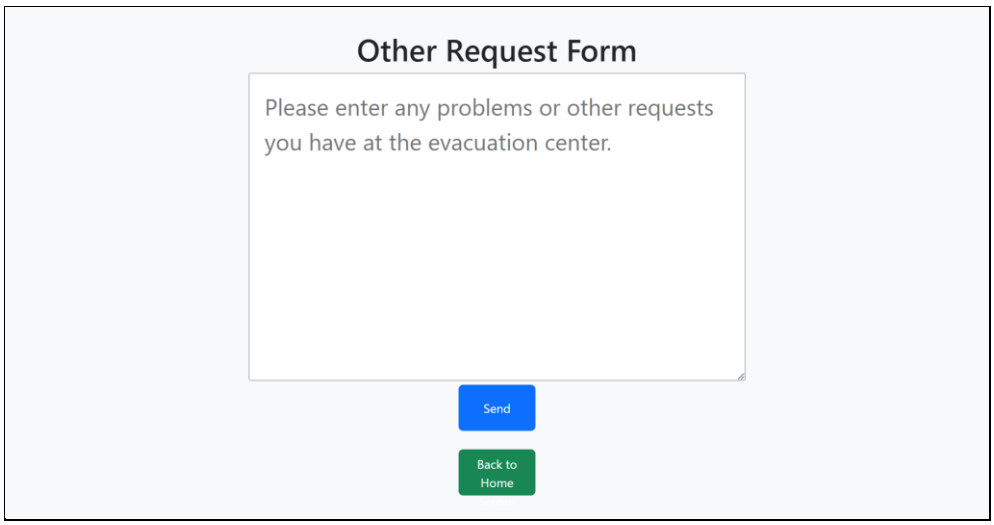


Figure 13. Other request form for informationally disadvantaged disaster victims

When the user selects the “history of requested rationed goods and estimated arrival date” button on the home screen (Figure 8), the screen transitions to the rationed goods request history screen (Figure 14). Here, the user inputs their name and date of birth. When the input name and date of birth information match the name and date of birth registered in the database, a list of rationed goods requested by the user, including the quantity, application date, and estimated arrival date, are displayed (Figure 15).

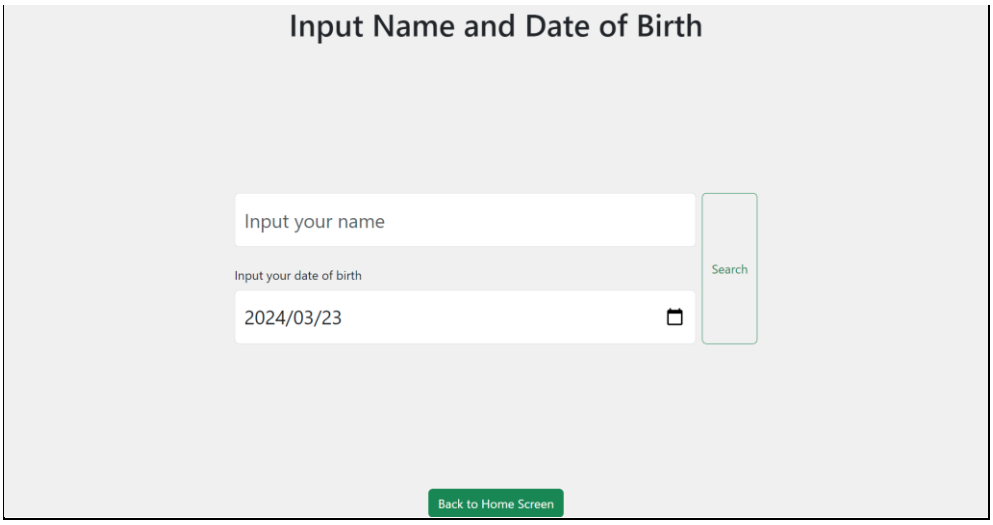


Figure 14. Rationed goods request history screen for informationally disadvantaged disaster victims

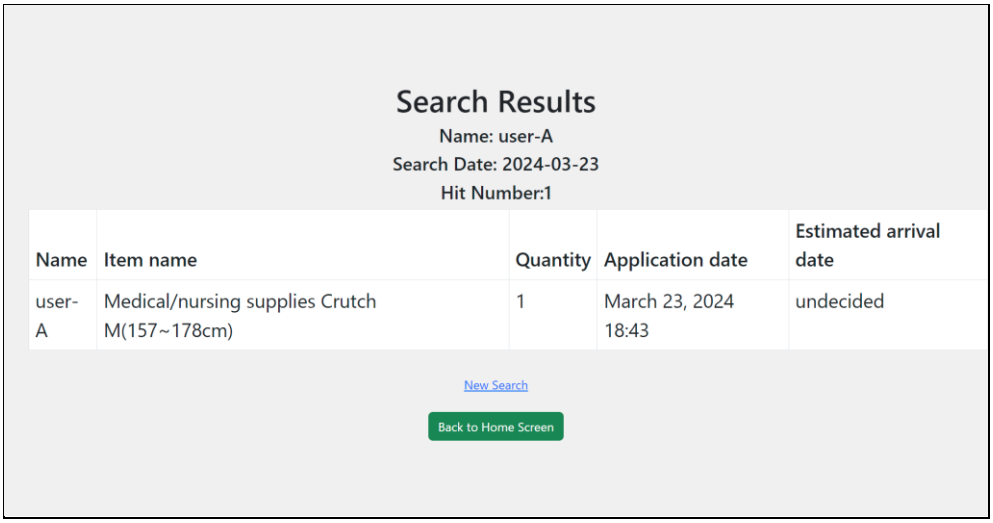


Figure 15. Rationed goods request history screen for informationally disadvantaged disaster victims

7 Individual Rationed Goods Request Management System for System Administrator

Figure 16 shows the home screen of the individual rationed goods request management system for system administrators. This screen comprises buttons for the “registration/correction/deletion of evacuation center,” “list of rationed goods requests for disaster victims,” “list of other requests for disaster victims,” “list of rationed goods requests for informationally disadvantaged disaster victims,” “list of other requests for informationally disadvantaged disaster victims,” and “notice from local government” functions.

Figure 16. Home screen of the individual rationed goods request management system for system administrators

When a system administrator selects the “registration/correction/deletion of evacuation center” button, the screen transitions to the evacuation center registration/correction/deletion screen (Figure 17). Here, the system administrator can check the list of registered evacuation centers.

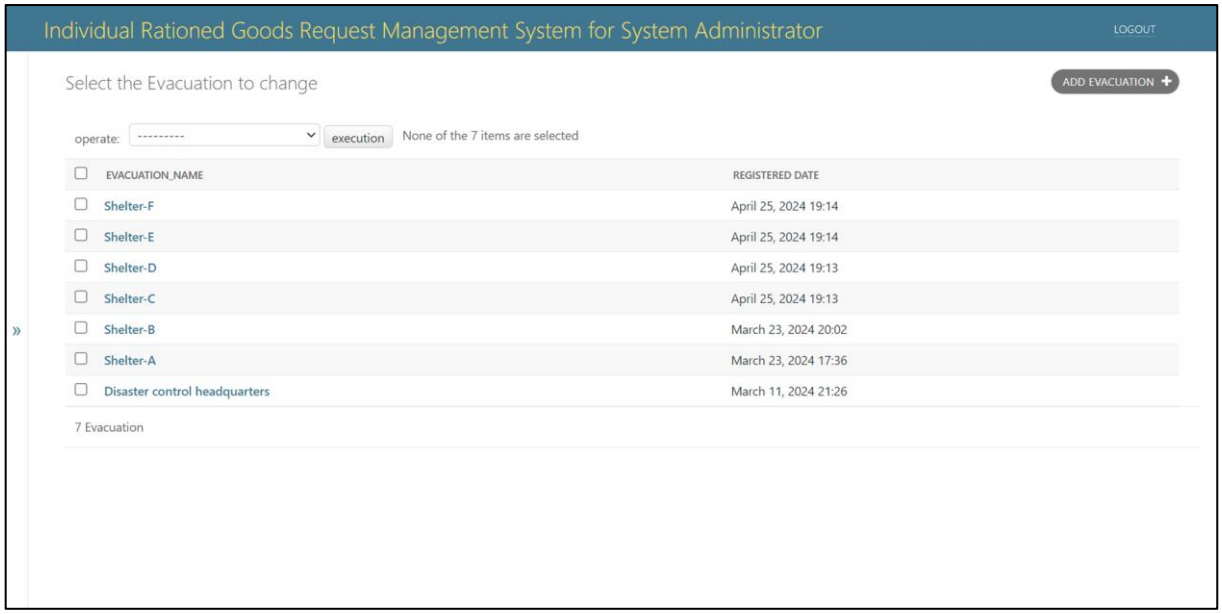


Figure 17. Evacuation center registration/correction/deletion screen

When the system administrator selects the “list of rationed goods requests for disaster victims” button on the home screen, the screen transitions to the rationed goods requests for disaster victims list confirmation screen (Figure 18). Here, the system administrator can check the list of rationed goods, including the quantity, name, age, application date, estimated arrival date, and evacuation center name. In addition, the system administrator can use the filter function to filter the results by name, application date, estimated arrival date, and evacuation center name.

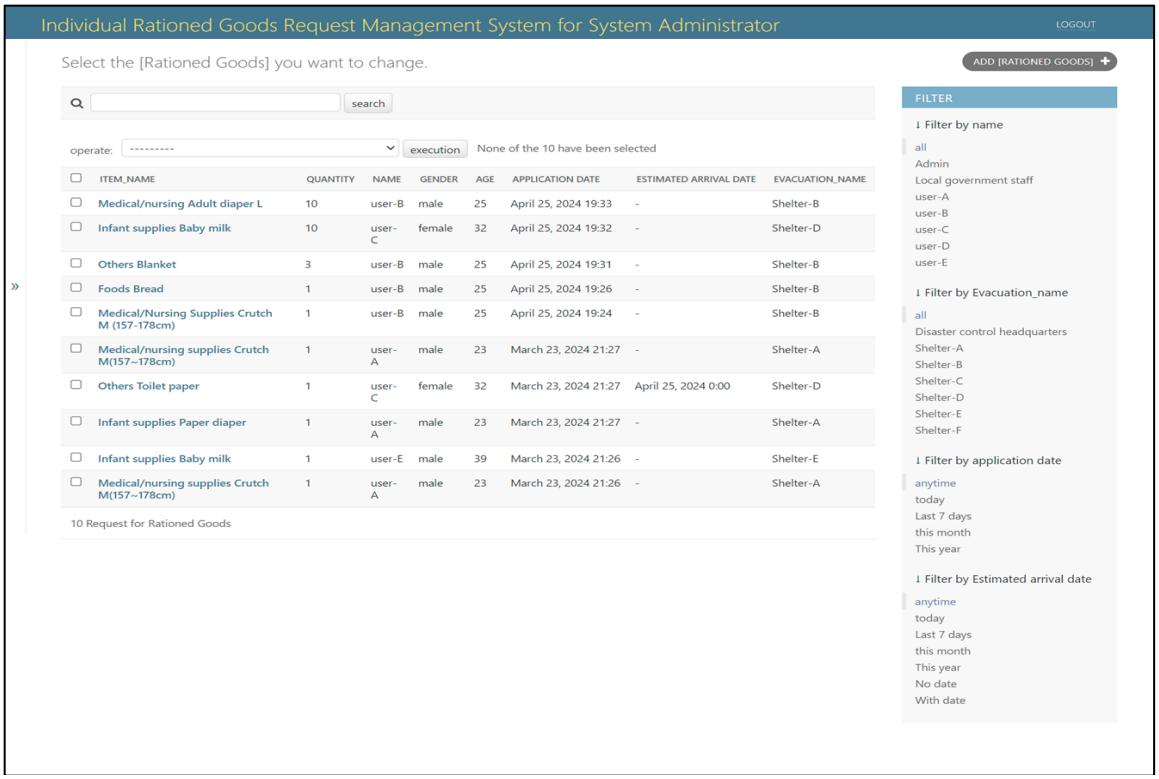


Figure 18. Rationed goods requests for disaster victims list confirmation screen

When the system administrator selects the “list of other requests for disaster victims” button on the home screen, the screen transitions to the other requests for disaster victims list confirmation screen (Figure 19). Here, the system administrator can check the other requests, name, application date, and evacuation center name requested by the disaster victims. In addition, the system administrator can filter the result by name, application date, and evacuation center name.

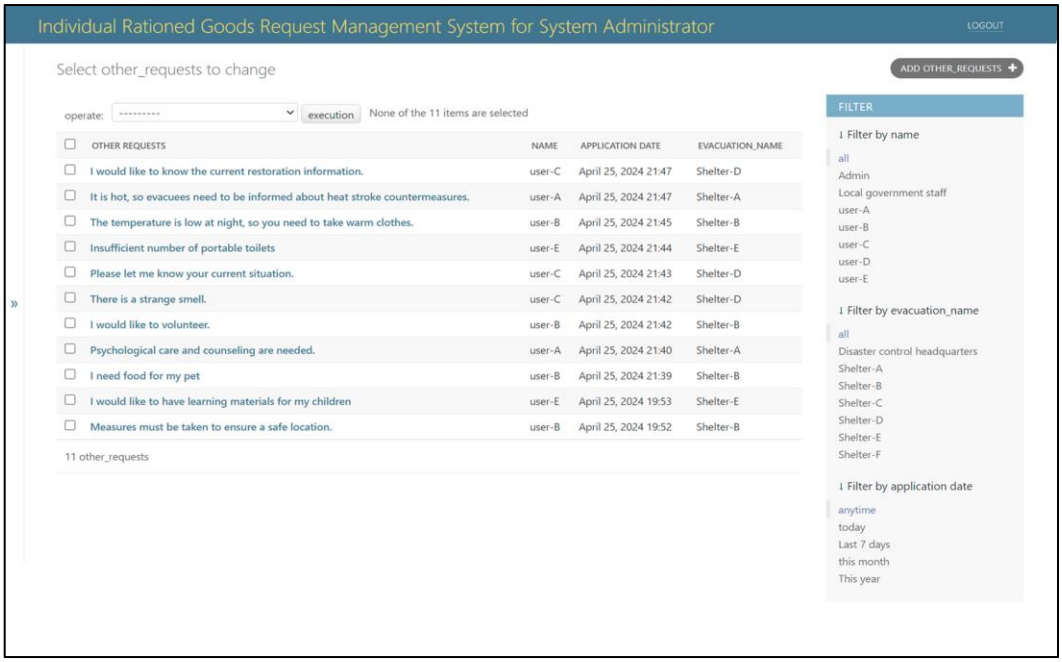


Figure 19. Other requests for disaster victims list confirmation screen

When the system administrator selects the “notice from local government” button on the home screen shown in Figure 16, the screen transitions to the notice from local government list confirmation screen (Figure 20). Here, the system administrator can check the title, notification content, contribution date and time, and the evacuation center name.

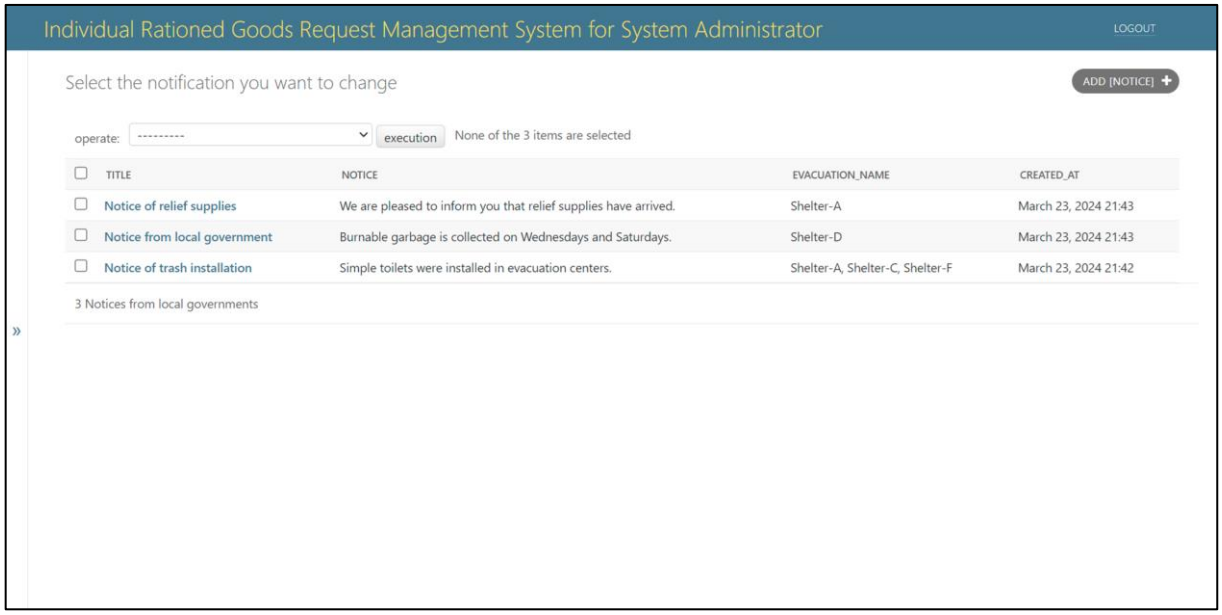


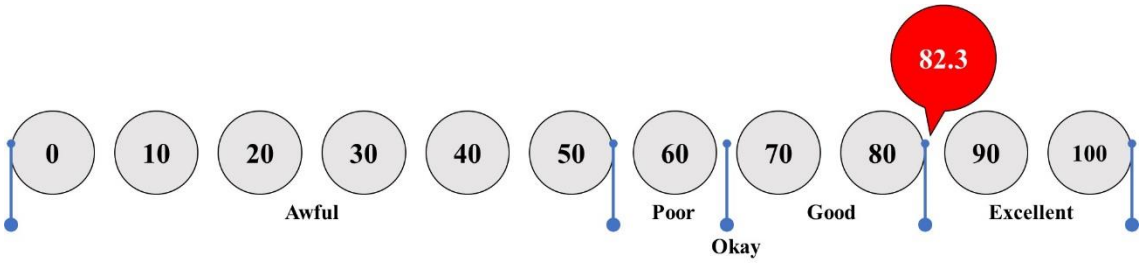
Figure 20. Notice from local government list confirmation screen

8 Evaluation of Proposed Pull-type Rationed Goods Request Framework

We performed a system usability scale (SUS) [20] evaluation with 30 subjects to evaluate the usability of the individual rationed goods request system for disaster victims, the individual rationed goods request system for informationally disadvantaged disaster victims, and the individual rationed goods request management system for system administrators. The SUS evaluation included 10 questions about system usability, and the subjects answered each question on a five-point scale. The SUS is a reliable tool to measure usability that was developed by John Brooke in 1986, and it is used to evaluate various products and services [14]. Note that a SUS score of 68 or higher is considered above average, and a score of 68 or less would be considered below average. In addition, in this study, the 30 participants evaluated each component system’s operability, readability, functionality, relevance, and effectiveness.

8.1 Evaluation of Individual Rationed Goods Request System for Disaster Victims

In terms of the individual rationed goods request system for disaster victims, the SUS score is shown in Figure 21, and the SUS item-classified score is shown in Figure 22. As can be seen, the average SUS score of the individual rationed goods request system for disaster victims was 82.3, which is greater than the standard average score of 68 points. However, for the item “I think that I would need the support of a technical person to be able to use this system,” the score was 62.5 points, which is less than the standard average score of 68 points. Thus, it is necessary to implement an operation guide function so disaster victims can use the corresponding individual rationed goods request system.



SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Poor
< 51	E	Awful

Figure 21. SUS scores of individual rationed goods request system for disaster victims (n = 30)

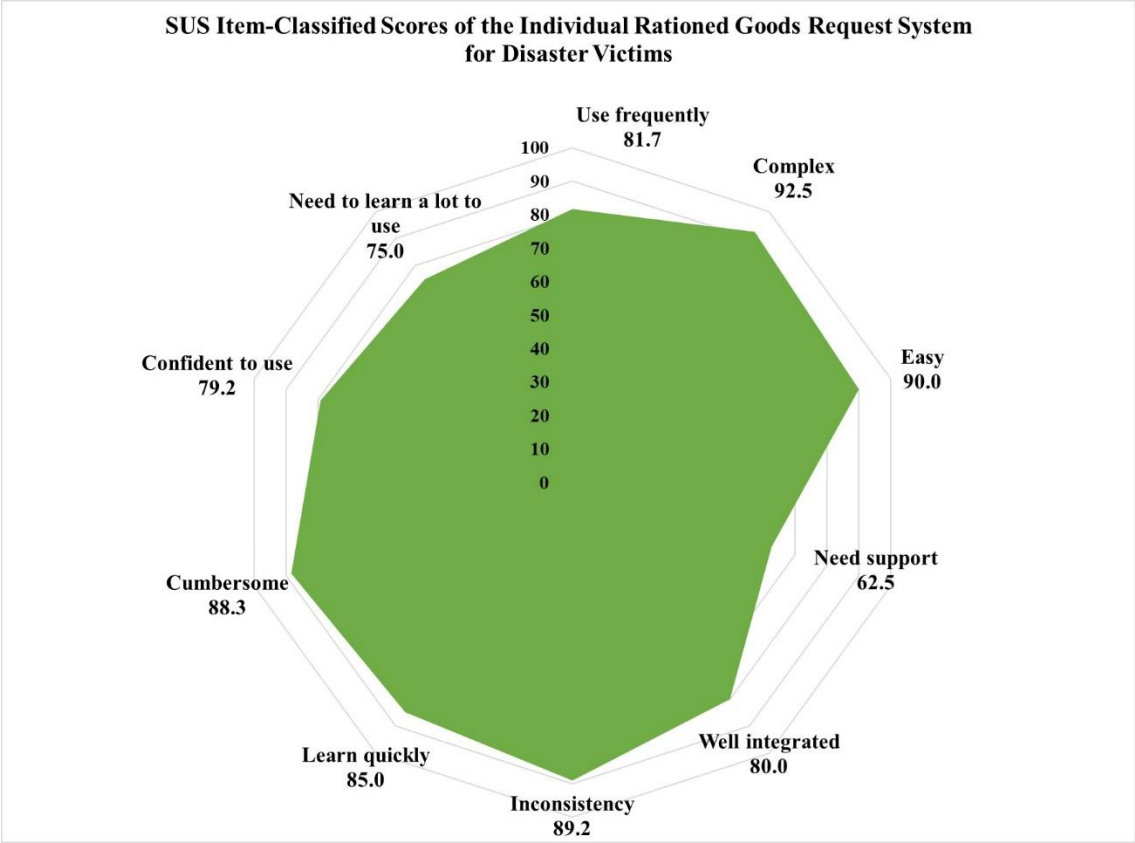


Figure 22. SUS item-classified scores of individual rationed goods request system for disaster victims (n = 30)

Figure 23 shows the evaluation results regarding the operability of the individual rationed goods request system for disaster victims. Here, 73% of the subjects answered “easy,” and 27% answered “somewhat easy,” which confirms the high operability of the individual rationed goods request system for disaster victims.

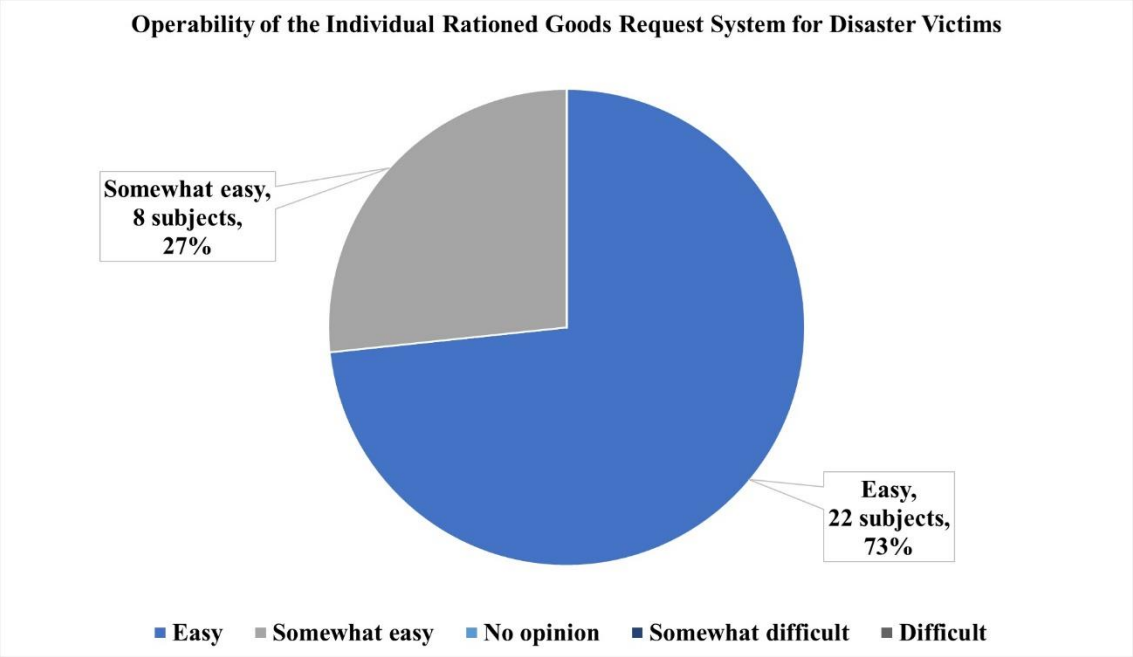


Figure 23. Operability of individual rationed goods request system for disaster victims (n = 30)

Figure 24 shows the evaluation results for the readability of the individual rationed goods request system for disaster victims. As shown, 80% of the subjects answered "easy to understand," and 17% answered "somewhat easy to understand." These results confirm the high readability of the individual rationed goods request system.

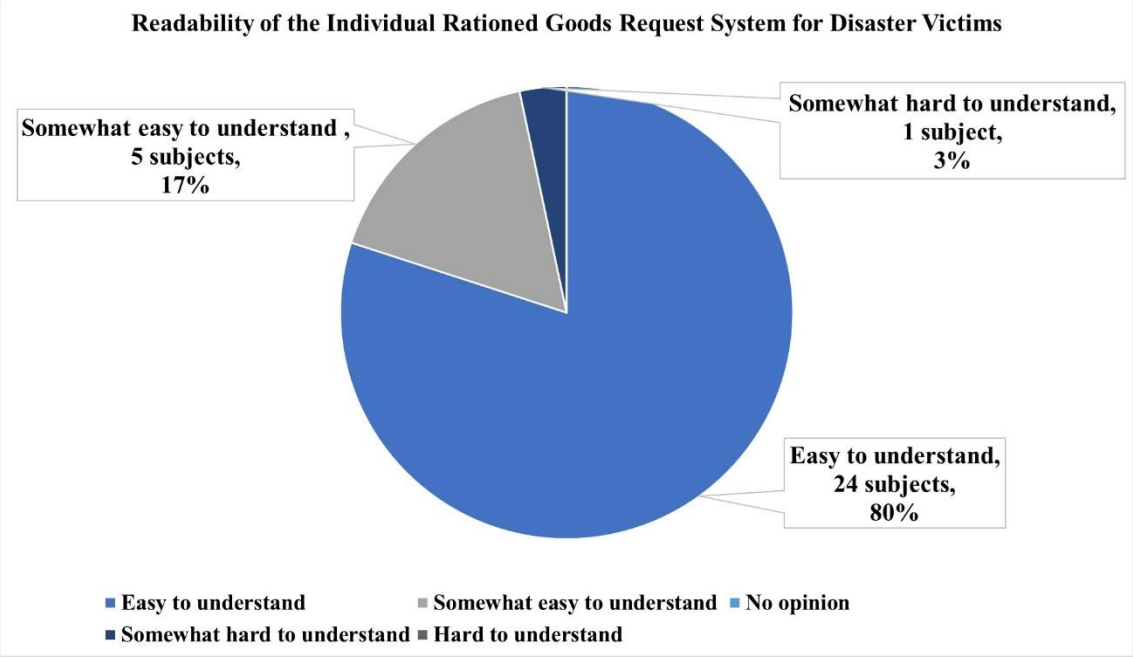


Figure 24. Readability of individual rationed goods request system for disaster victims (n = 30)

Figure 25 shows the evaluation results for the functionality of the individual rationed goods request system for disaster victims. Here, 67% of the subjects answered "satisfied," and 27% answered "somewhat satisfied," which confirms the high functionality of the individual rationed goods request system.

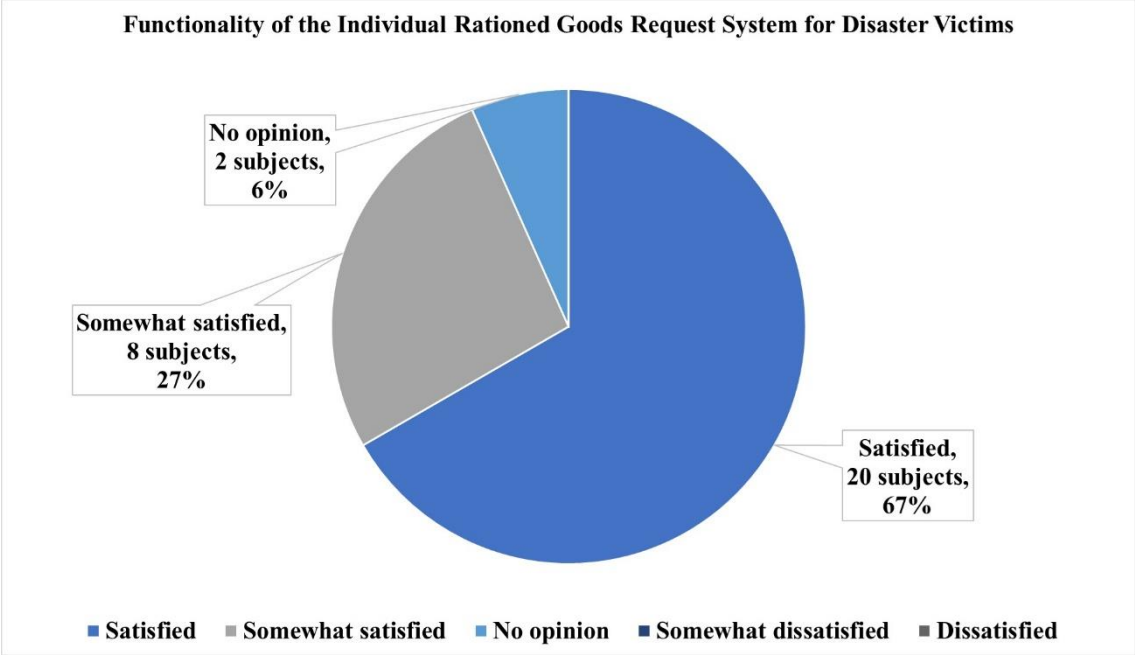


Figure 25. Readability of individual rationed goods request system for disaster victims (n = 30)

Figure 26 shows the evaluation results for the relevance of the individual rationed goods request system for disaster victims. As shown, 73% of the subjects answered "relevant," and 23% answered "somewhat relevant," and these results confirm the high relevance of the individual rationed goods request system.

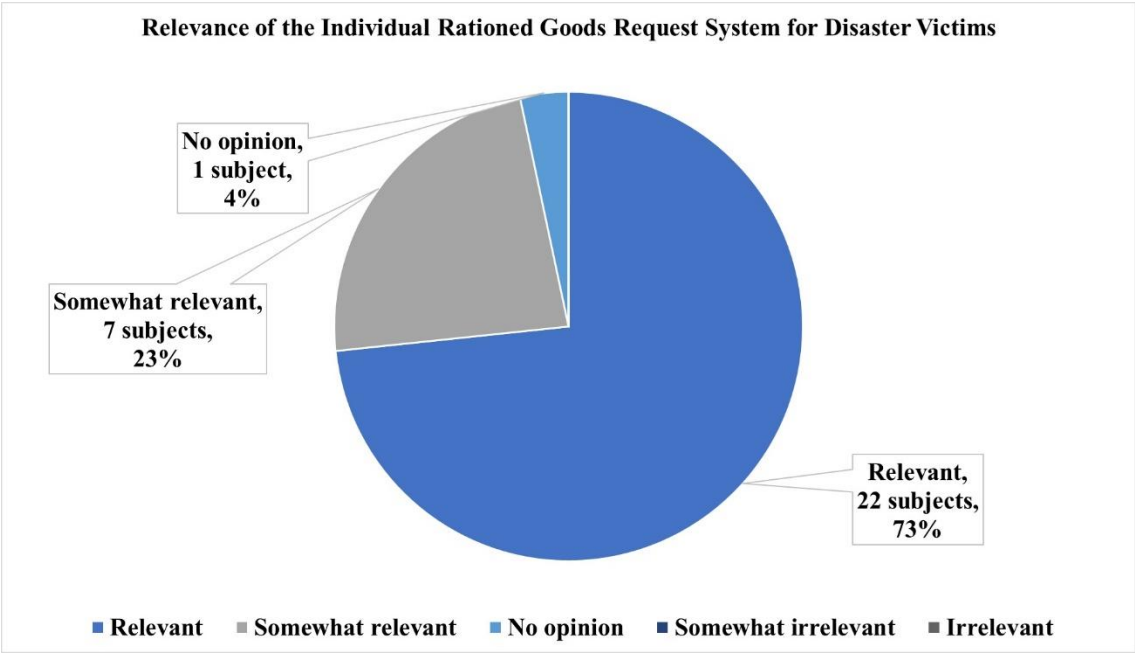


Figure 26. Relevance of the individual rationed goods request system for disaster victims (n = 30)

Figure 27 shows the evaluation results for the effectiveness of the individual rationed goods request system for disaster victims. Here, 63% of the subjects answered "effective," and 37% answered "somewhat effective," which confirms the high effectiveness of the individual rationed goods request system.

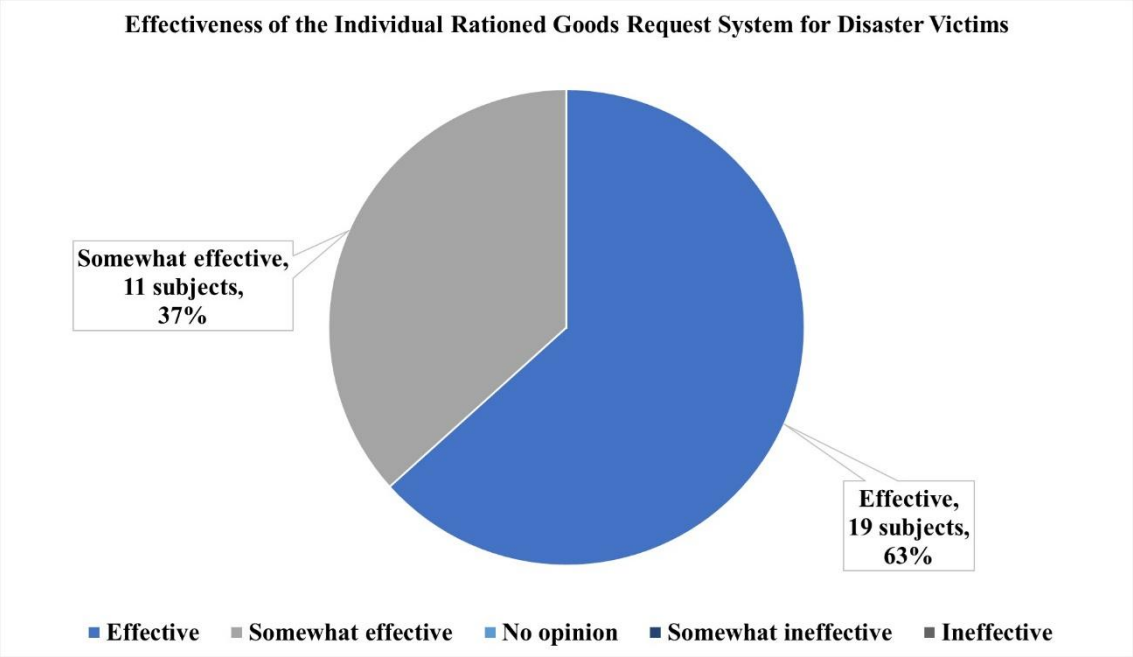
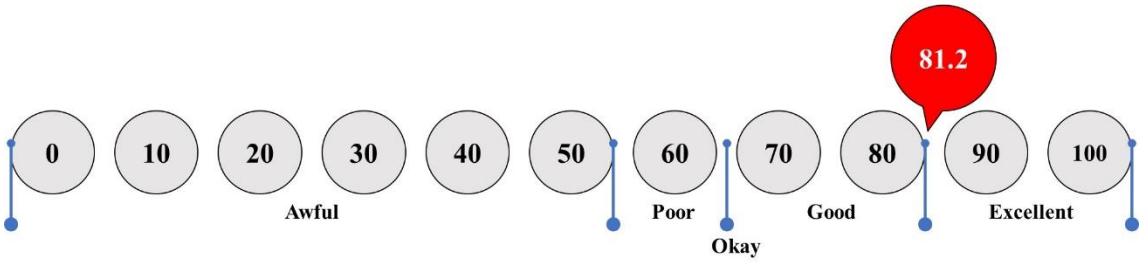


Figure 27. Effectiveness of individual rationed goods request system for disaster victims (n = 30)

8.2 Evaluation of Individual Rationed Goods Request System for Informationally Disadvantaged Disaster Victims

The SUS score for the individual rationed goods request system for informationally disadvantaged disaster victims is shown in Figure 28, and the SUS item-classified score is shown in Figure 29. As can be seen, the average SUS score of the individual rationed goods request system for informationally disadvantaged disaster victims was 81.2 points, which is greater than the standard average score of 68 points. However, for the item "I think that I would need the support of a technical person to be able to use this system," the score was 62.5 points, which is less than the standard average score of 68 points. Thus, it is necessary to implement an operation guide function so that informationally disadvantaged disaster victims can use the corresponding individual rationed goods request system effectively.



SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Poor
< 51	E	Awful

Figure 28. SUS scores of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

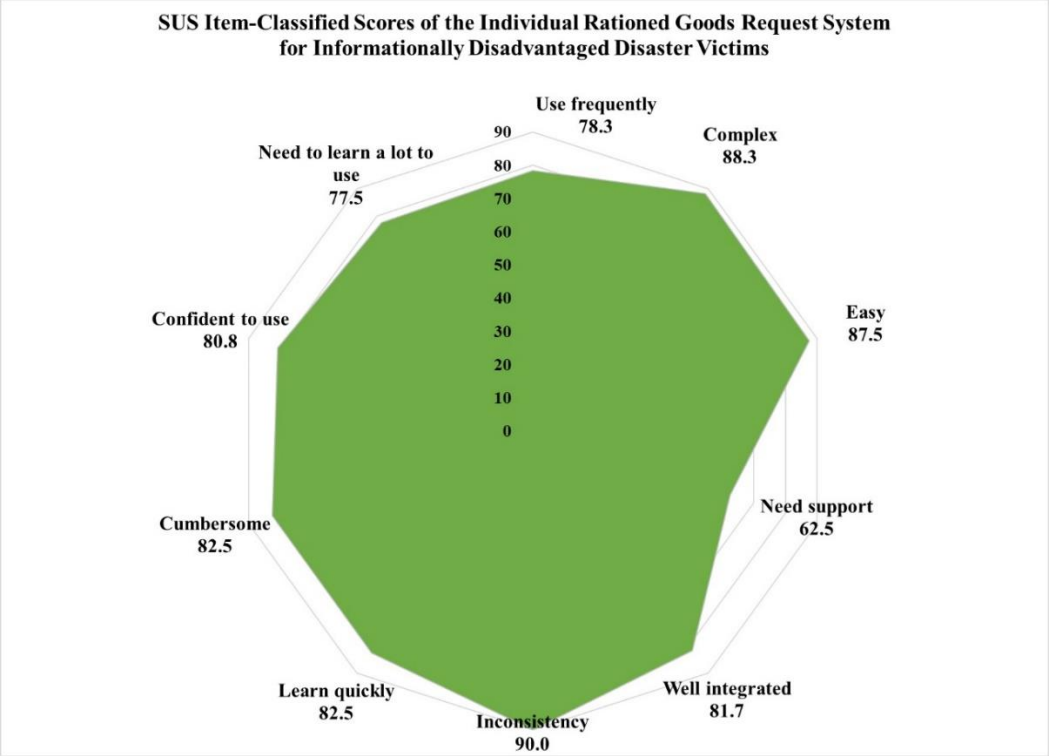


Figure 29. SUS item-classified scores of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

Figure 30 shows the evaluation results in terms of the operability of the individual rationed goods request system for informationally disadvantaged disaster victims. As shown, 70% of the subjects answered "easy," and 30% answered "somewhat easy." These results confirm the high operability of the individual rationed goods request system for informationally disadvantaged disaster victims.

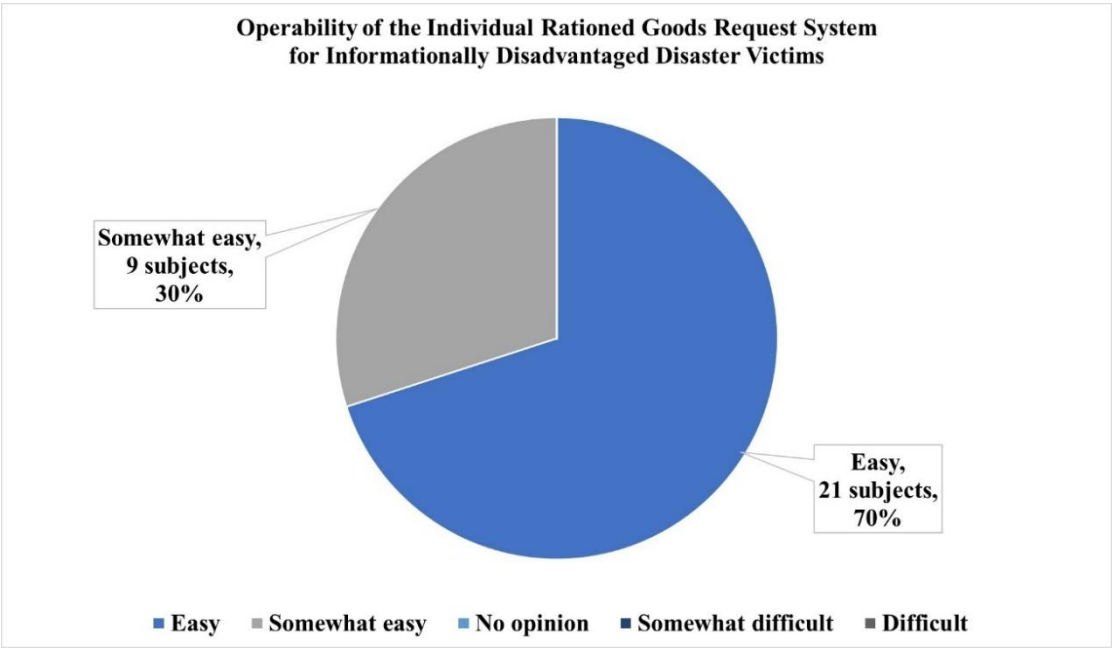


Figure 30. Operability of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

Figure 31 shows the evaluation results for the readability of the individual rationed goods request system for informationally disadvantaged disaster victims. Here, 60% of the subjects answered “easy to understand,” and 37% answered “somewhat easy to understand,” which confirms the high readability of the individual rationed goods request system for informationally disadvantaged disaster victims.

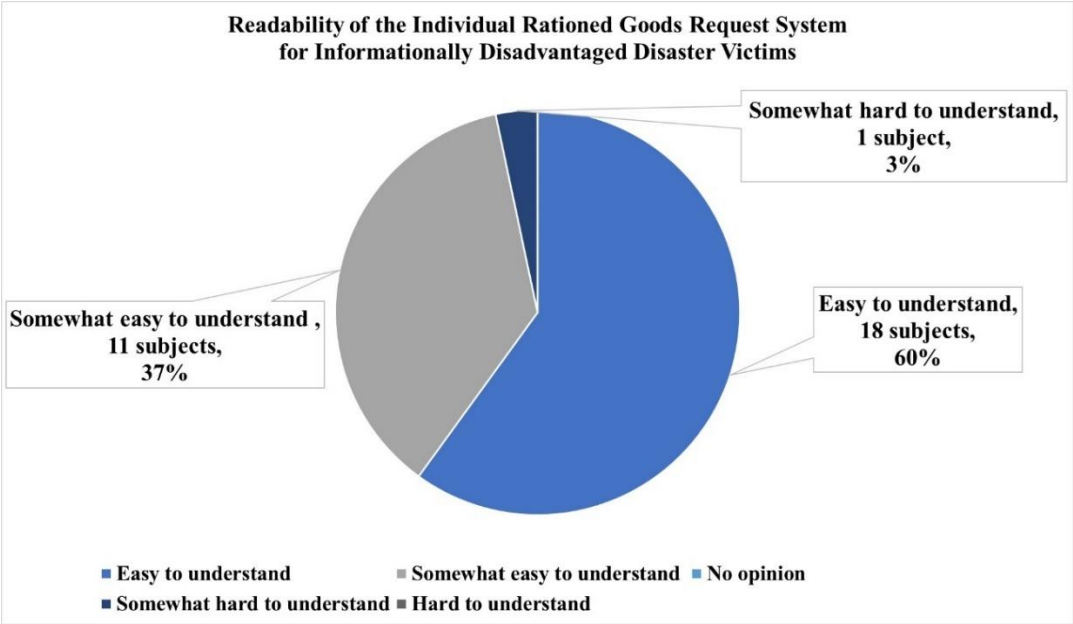


Figure 31. Readability of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

Figure 32 shows the evaluation results regarding the functionality of the individual rationed goods request system for informationally disadvantaged disaster victims. As can be seen, 67% of the subjects answered “satisfied,” and 27% answered “somewhat satisfied.” These results confirm the high functionality of the individual rationed goods request system for informationally disadvantaged disaster victims.

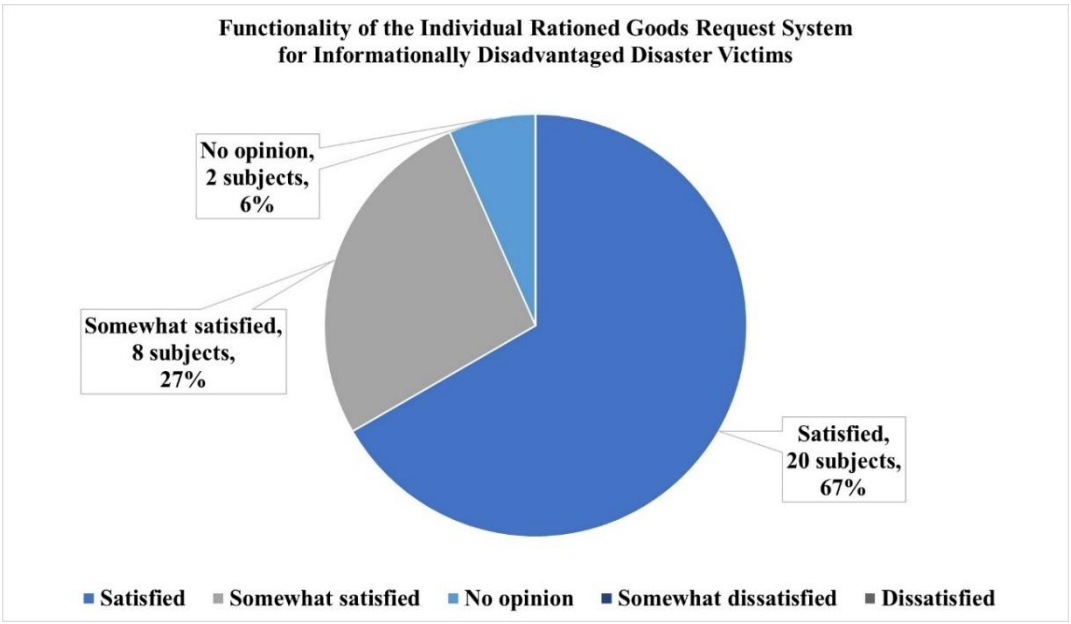


Figure 32. Functionality of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

Figure 33 shows the evaluation results in terms of the relevance of the individual rationed goods request system for informationally disadvantaged disaster victims. Here, 70% of the subjects answered "relevant," and 30% answered "somewhat relevant," thereby confirming the high relevance of the individual rationed goods request system for informationally disadvantaged disaster victims.

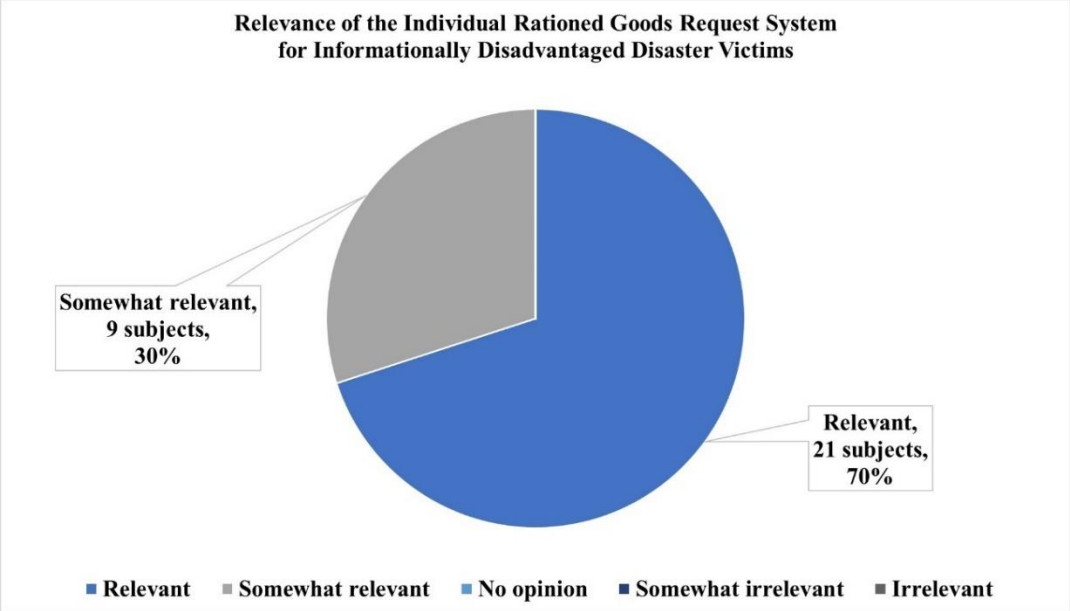


Figure 33. Relevance of individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

The evaluation results for the effectiveness of the individual rationed goods request system for informationally disadvantaged disaster victims are shown in Figure 34. Here, 80% of the subjects answered "effective," and 20% answered "somewhat effective," which confirms the high effectiveness of the individual rationed goods request system for informationally disadvantaged disaster victims.

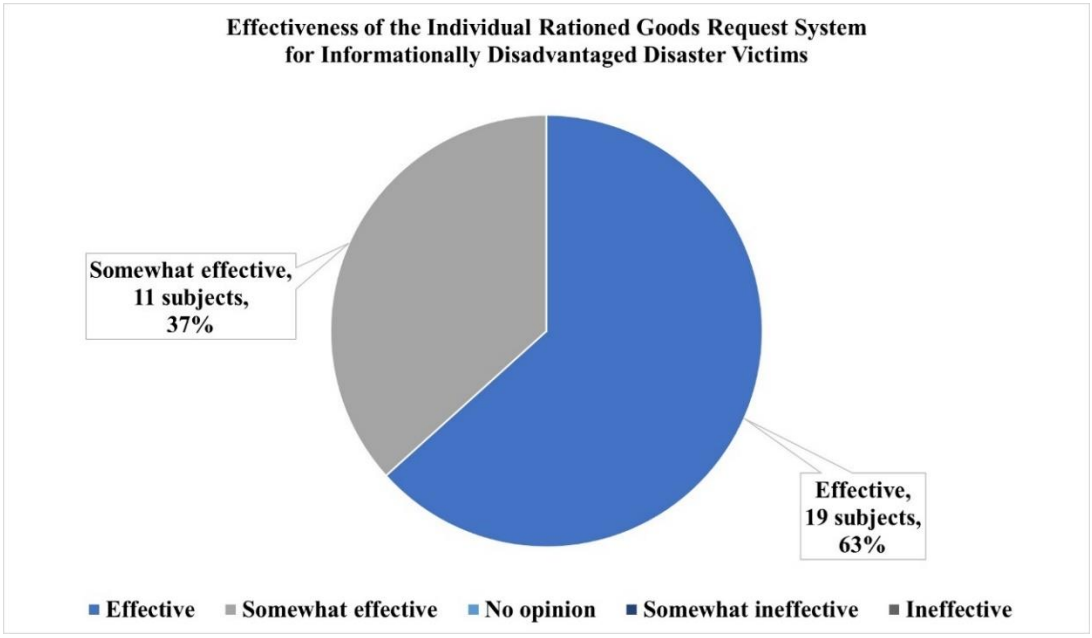
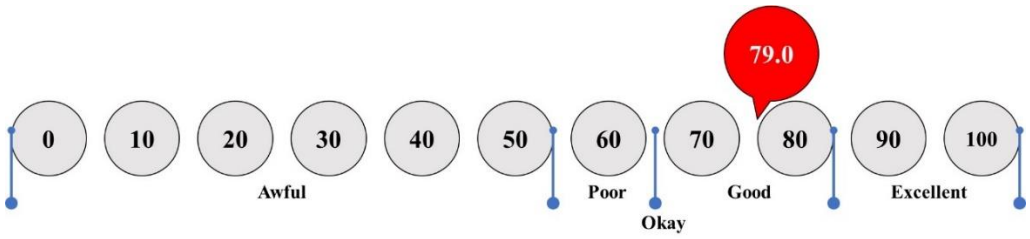


Figure 34. Effectiveness of the individual rationed goods request system for informationally disadvantaged disaster victims (n = 30)

8.3 Evaluation of Individual Rationed Goods Request Management System for System Administrators

The SUS score for the individual rationed goods request management system for system administrators is shown in Figure 35, and the SUS item-classified score is shown in Figure 36. As can be seen, the average SUS score of the individual rationed goods request management system for system administrators was 79 points, which is greater than the standard average score of 68 points. However, for the item "I think that I would need the support of a technical person to be able to use this system" the score was 52.8 points, which is less than the standard average score of 68 points. Thus, an operation guide function is required so that system administrator can use the system effectively.



SUS Score	Grade	Adjective Rating
> 80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Poor
< 51	E	Awful

Figure 35. SUS scores of individual rationed goods request management system for system administrators (n = 30)

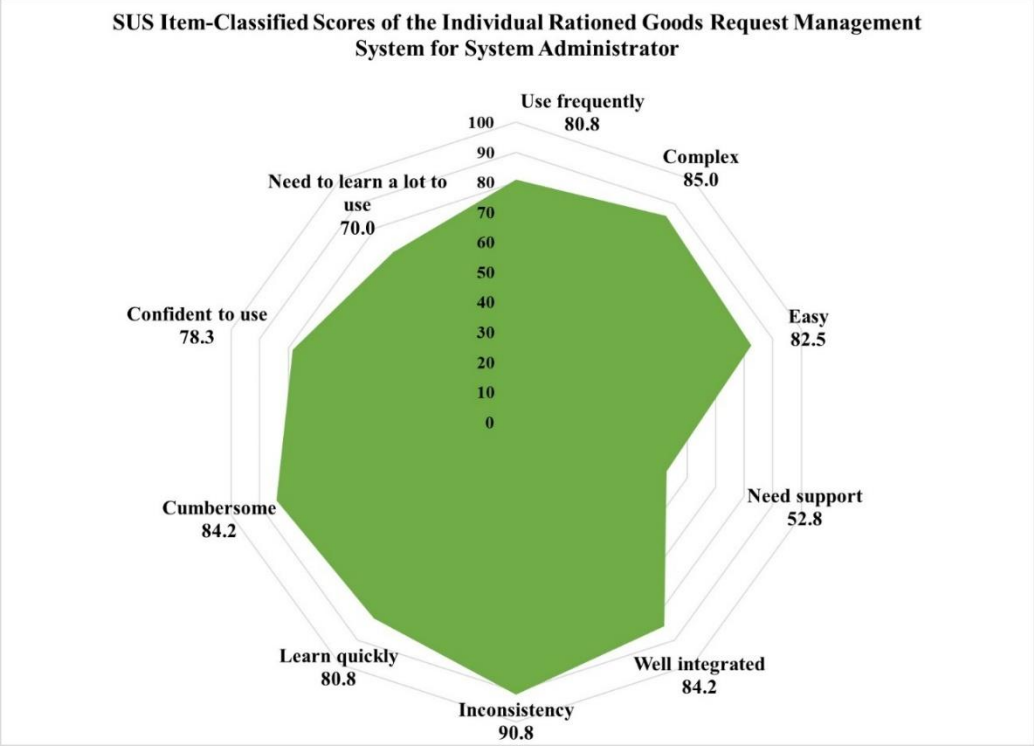


Figure 36. SUS item-classified scores of individual rationed goods request management system for system administrators (n = 30)

Figure 37 shows the evaluation results in terms of the operability of the individual rationed goods request management system for system administrators. As shown, 57% of the subjects answered “easy,” and 37% answered “somewhat easy.” These findings confirm the high operability of the individual rationed goods request management system for system administrators.

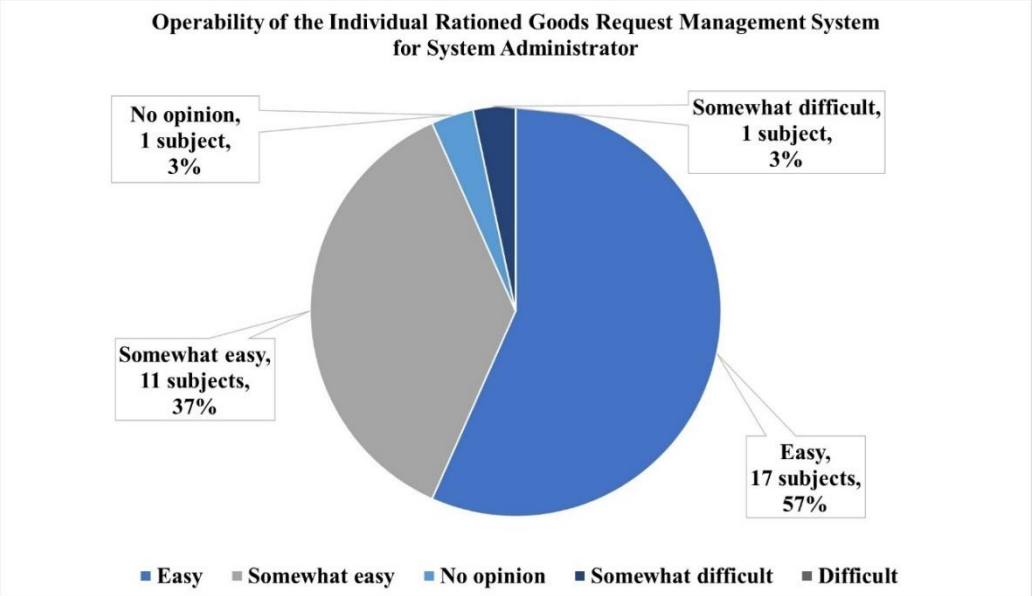


Figure 37. Operability of individual rationed goods request management system for system administrators (n = 30)

Figure 38 shows the evaluation results for the readability of the individual rationed goods request management system for system administrators. Here, 60% of the subjects answered “easy to understand,” and 30% answered “somewhat easy to understand,” thereby confirming the high readability of the individual rationed goods request management system for system administrators.

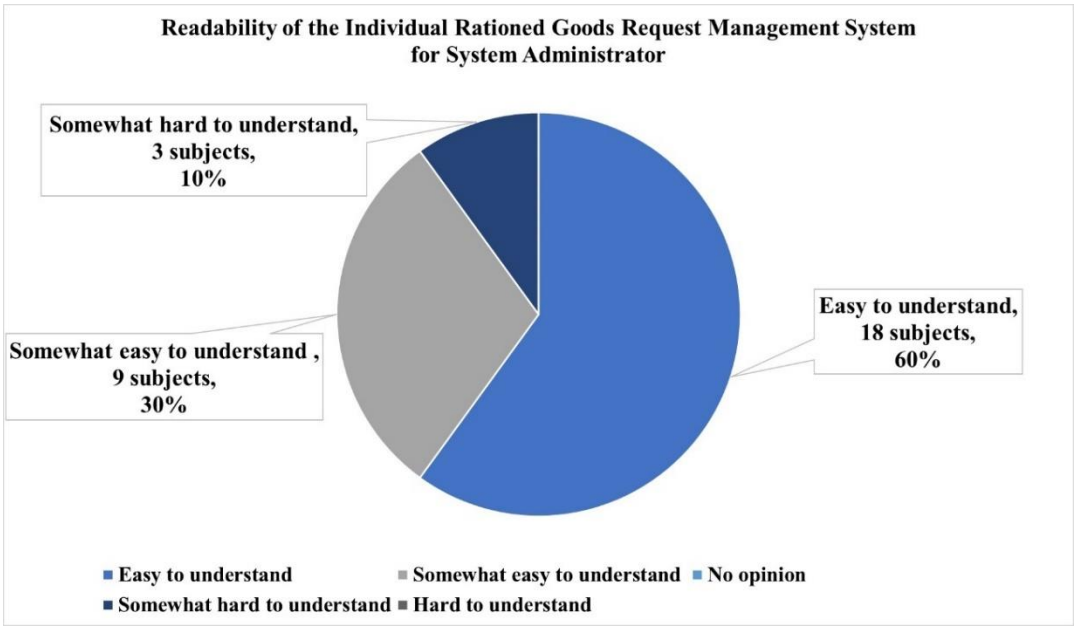


Figure 38. Readability of individual rationed goods request management system for system administrators (n = 30)

Figure 39 shows the evaluation results in terms of the functionality of the individual rationed goods request management system for system administrators. As can be seen, 60% of the subjects answered "satisfied," and 27% answered "somewhat satisfied," which confirms the high functionality of the individual rationed goods request management system for system administrators.

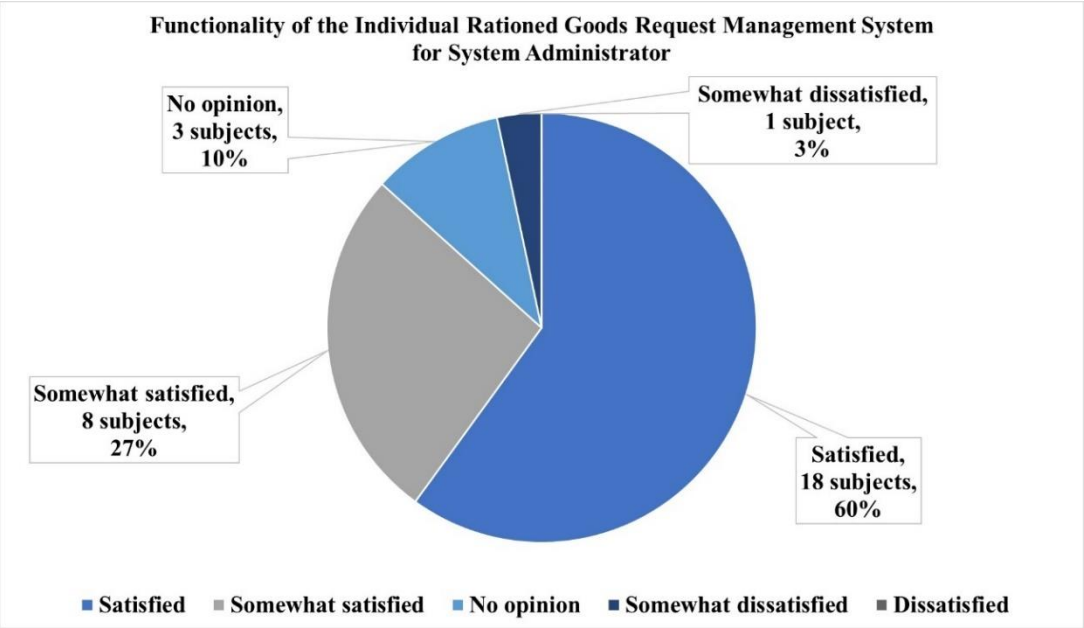


Figure 39. Functionality of the individual rationed goods request management system for system administrator (n = 30)

Figure 40 shows the evaluation results for the relevance of the individual rationed goods request management system for system administrators. As shown, 73% of the subjects answered "relevant," and 23% answered "somewhat relevant." These results verify the high relevance of the individual rationed goods request management system for system administrators.

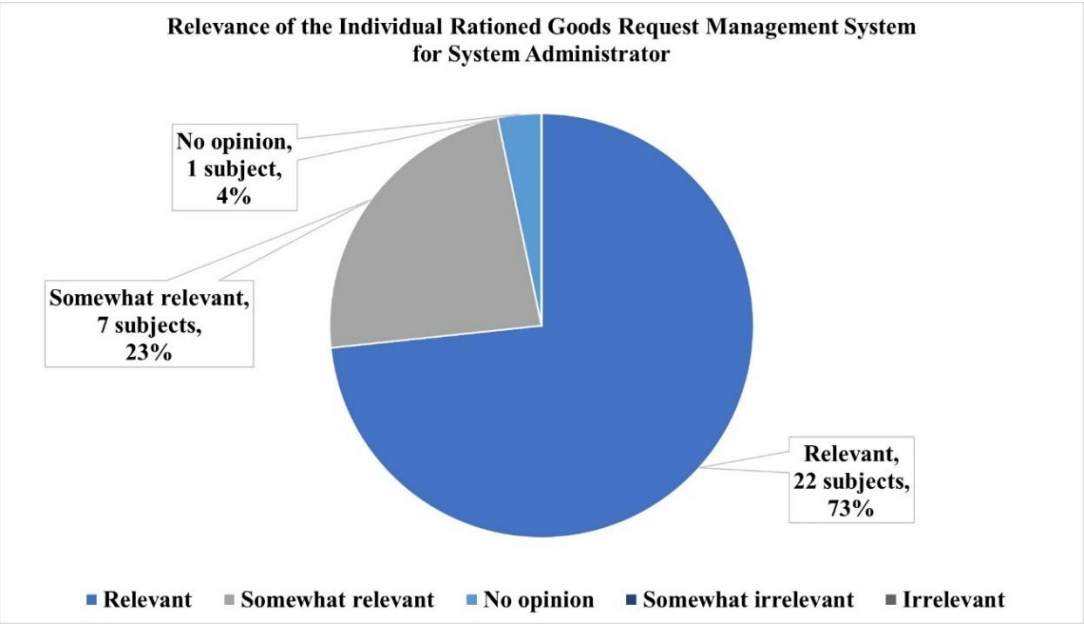


Figure 40. Relevance of individual rationed goods request management system for system administrators (n = 30)

Figure 41 shows the evaluation results regarding the effectiveness of the individual rationed goods request management system for system administrators. Here, 77% of the subjects answered “effective,” and 20% answered “somewhat effective,” thereby confirming the high effectiveness of the individual rationed goods request management system for system administrators.

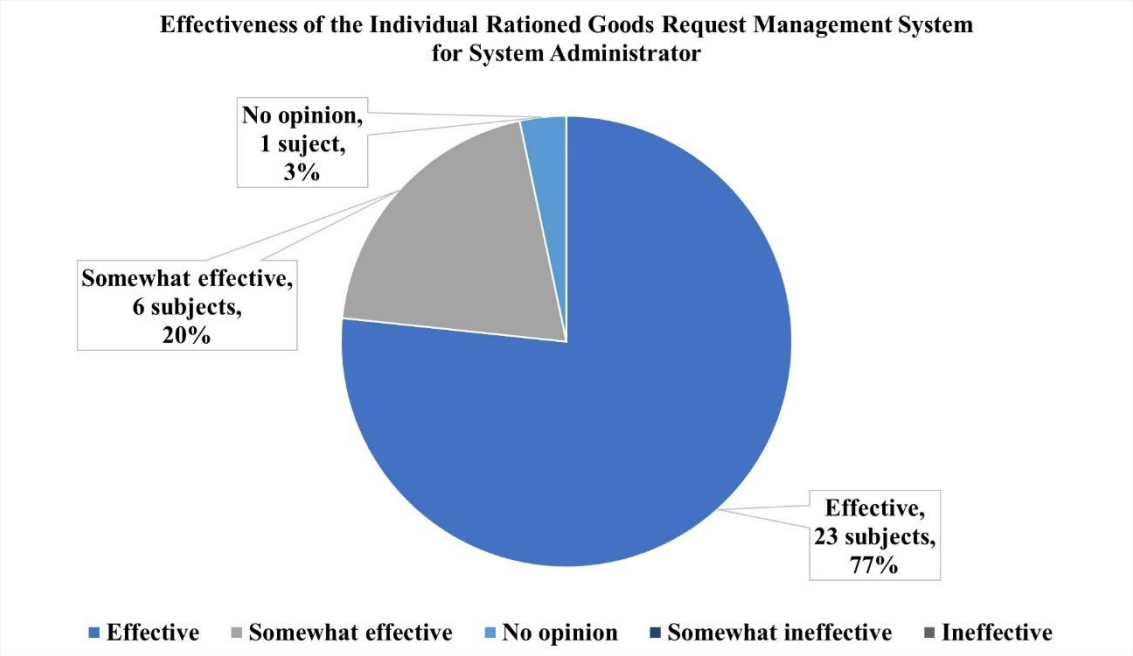


Figure 41. Effectiveness of the individual rationed goods request management system for system administrator (n = 30)

9 Conclusion

This paper has described the implementation and evaluation of a pull-type rationed goods request framework for long-term evacuations during natural disasters. The proposed framework comprises three complementary systems, i.e., the individual rationed goods request system for disaster victims, the individual rationed goods request system for informationally disadvantaged disaster victims, and the individual rationed goods request management system for system administrators. The individual rationed goods request system for disaster victims implements a function that allows disaster victims to personalized request rationed goods from local government agencies using smartphones. In addition, the individual rationed goods request system for informationally disadvantaged disaster victims allows informationally disadvantaged disaster victims, e.g., the elderly, to request specific rationed goods using tablet terminals installed at evacuation centers. Finally, the individual rationed goods request management system for system administrators allows administrators to centrally manage information from the individual rationed goods request system for disaster victims and individual rationed goods request system for informationally disadvantaged disaster victims.

Each component system of the proposed framework was evaluated using the SUS with 30 participants. In addition, the 30 participants evaluated the operability, readability, functionality, relevance, and effectiveness of each component system. We found that the proposed framework received high marks in many items. However, for all three systems, the score for the SUS item “I think that I would need the support of a technical person to be able to use this system” was less than the standard average scores. Thus, in the future, we plan to implement operation guide functions for each component system.

Acknowledgement

This paper is an extended version of the work [21] originally presented at the 18th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, Taichung, Taiwan, July 3-5, 2024.

References

[1] Japan Reconstruction Agency. Great East Japan Earthquake. https://www.reconstruction.go.jp/english/topics/GEJE/, [Online; Accessed in June 2024].

[2] Kato, A., kanamura, K., Hiyama, Y. (2016). The 2016 Kumamoto earthquake sequence. Proceedings of the Japan Academy, Series B, 92(8), 358-371. doi:10.2183/pjab.92.359

[3] Kawase, H., Imada, Y., Tsuguti, H., Nakaegawa, T., Seino, N., Murata, A., Takayabu, I. (2020). Bulletin of the American Meteorological Society, 101, S109-S114. doi:10.1175/BAMS-D-19-0173.1

[4] Japan Meteorological Agency. The 2024 Noto Peninsula Earthquake -Portal-. https://www.jma.go.jp/jma/en/2024_Noto_Peninsula_Earthquake/index.html, [Online; Accessed in June 2024].

[5] Japan Ministry of Justice. Basic Act on Disaster Management. https://www.japaneselawtranslation.go.jp/en/laws/view/3322/en, [Online; Accessed in June 2024].

[6] Cabinet Office, Government of Japan. Disaster Management in Japan. https://www.bousai.go.jp/1info/pdf/saigaipanf_e.pdf, [Online; Accessed in June 2024].

[7] Okumura, M., Bunphong, K., Okubo, K. (2012). Sequence Analysis of Needs for Relief Goods in Great East Japan Earthquake. Transport policy studies' review, 16(1), 59-67. doi:10.24639/tpsr.TPSR_16R_06

[8] NTT Broadband Platform, Inc. What is 00000JAPAN (Five Zero Japan)? -Public wireless LAN service in case of disaster or communication failure | Wi-Fi Column: Staying connected in Japan. https://www.ntt-bp.net/column/en/blog/2021/02/post-05.html [Online; Accessed in June 2024].

[9] Koesuma, S., Riantana, R., Siswanto, B., Purnomo, F. A, Lelono, S. (2017). dLOGIS: Disaster Logistics Information System. Journal of Physics: Conference Series, 909(1), 012007. dio:10.1088/1742-6596/909/1/012007

[10] Usuda, Y., Matsui, T., Deguchi, H., Hori, T., Suzuki, S. (2019). The Shared Information Platform for Disaster Management -The Research and Development Regarding Technologies for Utilization of Disaster Information-. Journal of Disaster Research, 14(2), 279-291. doi:10.20965/jdr.2019.p0279

[11] Caragea, C., McNeese, N., Jaiswal, A., Traylor, G., Kim, H. W., Mitra, P., Wu, D., Tapia, A. H., Giles, L., Jansen, B. J., Yen, J. (2011). Classifying Text Messages for the Haiti Earthquake. In Proc. of the 8th International Conference on Information Systems for Crisis Response and Management (pp.1-10), Lisbon, Portugal, May 2011.

[12] Kondaveti, R., Ganz, A. (2009). Decision support system for resource allocation in disaster management. In Proc. of the 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (pp.3425-3428), MN, USA, September 2009. doi:10.1109/IEMBS.2009.5332498

[13] Macit, R. (2019). INTEGRATED DISASTER MANAGEMENT SYSTEMS (IDMS): A PROPOSAL DECISION-MAKING SUPPLY CHAIN MODEL USING MOBILE INFORMATION TECHNOLOGY. Journal of Modern Technology and Engineering, 4(2), 89-108.

[14] Nwufoh, C. V., Olanrewaju, O. T., Johnson, O. A. (2022). Implementation of an Institution Based Emergency Alert Management System. International Journal of Engineering Inventions, 11(3), 609-618.

[15] Kosugi, M., Utsu, K., Tajima, S. Tornita, M., Kajita, Y., Yamamoto, Y., Uchida, O. (2017). Improvement of Twitter-based Disaster-related Information Sharing System. In Proc. of the 4th International Conference on Information and Communication Technologies for Disaster Management (pp.1-7), Munster, Germany, December 2017. doi:10.1109/ICT-DM.2017.8275693.

[16] Ahmady, S. E., Uchida, O. (2020). Telegram-Based Chatbot Application for Foreign People in Japan to Share Disaster-Related Information in Real-Time. In Proc. of the 2020 5th International Conference on Computing, Communications and Systems (pp.177-181), Shanghai, China, May 2020. doi:10.1109/ICCCS49078.2020.9118510.

[17] Utsu, K., Abe, M., Nishikawa, S., Uchida, O. (2020). Twitter-Based Safety Confirmation System for Disaster Situations. Future Internet, 12(1):14, pp.1-16. doi:10.3390/fi12010014

[18] Pena-Caceres, O., Tavara-Ramos, A., Correa-Calle, T., More-More, M. (2024). Integral Chatbot Solution for Efficient Incident Management and Emergency or Disaster Response: Optimizing Communication and Coordination. TEM Journal, 13(1), 50-61, doi:10.18421/TEM131-05.

[19] Toraman, C., Kucukkaya, I. E., Ozcelik, O., Sahin, U. (2023), Tweets Under the Rubble: Detection of Messages Calling for Help in Earthquake Disaster. arXiv preprint arXiv:2302.13403. doi:10.48550/arXiv.2302.13403.
[20] Usability.gov. System Usability Scale (SUS) | Usability.gov. https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html, [Online; Accessed in June 2024].
[21] Seri, Y., Ishida, T. (2024). Pull-type Relief Supplies Request System for Long-term Evacuation Support. In Proc. of the 18th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (pp.1-8), Taichung, Taiwan, July, 2024.

Author's Biography

Yuta Seri received the B.S. degree in Fukuoka Institute of Technology in 2024. Currently he is taking a master's course at Graduate School of Engineering, Fukuoka Institute of Technology. His research interests include Web Application System, Disaster Management System, Regional Disaster Prevention, Decision Support System, and Crisis Management.

Tomoyuki Ishida received the B.S. and M.S. degrees in Software and Information science from Iwate Prefectural University in 2004 and 2006, and Ph.D. degrees in the same University in 2010. Currently he is a professor in Department of Information and Communication Engineering, Fukuoka Institute of Technology, Japan. His research interests include Web Geographic Information System for local governments, Disaster Management System, Safety Confirmation System, Regional Disaster Prevention Planning, Virtual Reality and Tele-Immersion. He is a member of Virtual Reality Society of Japan (VRSJ), Information Processing Society of Japan (IPSJ) and Visualization Society of Japan (VSJ).