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# Network Analysis of the Disaster Response Systems in the Waste Recycling Center

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**Abstract:** Since the process of waste recycling generates dust and flammable gas during fragmentation, there is always a risk of fire resulting therefrom, and fire does, in fact, frequently occur. However, research on disaster management at recycling facilities deals only with the problem of processing systems from a technical point of view, but it does not suggest concrete alternatives from a management point of view. Therefore, in this study, we analyzed the influence of the disaster response network of a waste recycling center at the organizational level based on the concept of the cognitive accuracy of a network when considering administrative aspects. Through this analysis, we confirmed that factors affecting the influence of the network exist, such that the entire network and the networks of different levels of position are different. We suggest that this can be improved by deploying members who perform formal tasks at the center of the network so that everyone can agree political approach.

**Keywords:** Waste Recycling System, Disaster Response, Network, Cognitive Accuracy

## 1. Introduction

South Korea, the Sewol ferry disaster acted as an opportunity to spread awareness that our society is facing risks, and this change of perception has led to the need for cooperation between sectors and organizations [1]. Accordingly, the Ministry of Public Safety and Security was newly established as a disaster management control tower, and this function is currently maintained by the Ministry of Public Administration and Security. In order to promote cooperation between organizations and institutions on the front line, hiring process has changed to include disaster management specialists, such as safety managers, within an organization [2]. However, large and small disasters still occur due to insufficient management, such as MERS, the COVID-19 pandemic, and repeated forest fires in Gangwon-do, South Korea, and damage is occurring and social anxiety is spreading due to the lack of cooperation and communication in the response processes [3,4].

This phenomenon can be seen prominently in the industrial field. In 2013, there were 5,267 cases of fire in industrial facilities, accounting for 12.9% of the total cases of fire in South Korea, and the damage amounted to about KRW 276.2 billion, accounting for 63.6% of the total monetary damage from cases of fire nationwide. In 2016, there were 5,503 cases of fire in industrial facilities, accounting for 12.7% of the total cases of fire, and the damage amounted to about KRW 221 billion, accounting for 52.6% of the total damage. The number of cases of fires at industrial facilities in 2020 was 5,217, accounting for 13.4% of the total cases of fire, and the damage amounted to about KRW 397.5 billion, accounting for 66.1% of the total damage. As such, there has been no significant change in the absolute number of cases of fire occurring in industrial facilities, and the monetary loss in the industrial field accounts for more than 50% of the total monetary loss from all fire accidents, highlighting the importance of disaster management for industrial facilities.

As the need for waste recycling gradually increases, interest in recycling waste is growing, and the amount of waste being recycled is also increasing. In the process of recycling waste, there is always a risk of fire due to chemicals and dust generated while shredding electronic products, such as refrigerators, and large and small fire accidents do, in fact, occur frequently [5,6]. However, disaster response in recycling workplaces is not actively discussed, and there is a need for the management of disasters, such as fires, that may occur in electronic product recycling centers. On the other hand, most of the research on the management of disasters, such as fire and explosion, at waste recycling centers has been approached from mechanical and technical points of view. A plan has been proposed for prevention and management by analyzing the problems of a recycling processing system based on the mechanism of dust and flammable gases from various organometallic compounds generated in the shredding process, causing fires and explosions due to overheating and friction heat in mechanical processes [5,7]. However, this approach has limitations in that it does not consider management aspects, such as organizational systems, in disaster response situations. Therefore, this study analyzes the disaster response network of an actual waste recycling center and aims to suggest a strategy to improve network influence within an organization at the managerial level.

## 2. Literature Review

### 2.1. Network for disaster management

Previous study presented the fundamental principles of networks, such as "unifying purpose," "independent members," and "multiple leaders." These principles could be applied to disaster management as well [8]. In other words, in order to achieve the common purpose of effective disaster management, a given task must be performed, and organizations participating in disaster management must select the best method to fit the given situation based on their independence and perform the task. Leaders participating in disaster management should fulfil a role in coordinating and promoting the overall work process [9]. From this aspect, another researcher suggested the necessity of establishing a private–public–industry–academia network in disaster response and its plan [10]. It was suggested that a regional autonomous prevention foundation should be designed as a network organization, and the operation models of the safety monitoring group, disaster prevention group, emergency response group, and recovery support group were suggested based on the regional private–public–industry–academia network. Meanwhile, another research group reviewed effective methods for establishing disaster management governance based on the subsidiarity principle. It was suggested that a private organization council should be activated to integrate and coordinate the private–public sector, which is not well defined in terms of disaster response and management [11].

On the other hand, the importance of network configuration and utilization began to emerge gradually [12]. Above research stated that traditional disaster management methods, such as reforming laws and systems and strengthening physical disaster prevention capabilities, will no longer guarantee the effectiveness of disaster management. Therefore, the role of the government should be reviewed and readjusted. In addition, it has been suggested that networks and network utilization capabilities should be improved to solve complex social problems. Also, a new approach, such as integrated management and network utilization, is necessary for establishing a disaster management system. In a similar vein, it was suggested that the resilience of the local community should be strengthened, such as through the promotion of community connection and communication [13]. A new opinion suggested that the cause of collaboration failure through the analysis of the Sewol ferry disaster was the nonuse of an integrated disaster management framework, the non-establishment of a network system for collaboration, and a lack of collaboration between private and public organizations. Based on this aspect, the conditions for establishing a successful collaboration network, such as the necessity of consensus on a goal, implementation of training related to the collaboration network, establishment of a more flexible

execution process, and related technology and human resource infrastructure, were presented [1].

### 2.2. Network effectiveness

Network governance has emerged for effective organizational operation and management. Subsequently, how to effectively manage a network, that is, the problem related to the effectiveness of the network, has emerged as a major issue [14]. One theoretical approach presented an analysis framework for evaluating network effectiveness by classifying analytic frame into three levels: local community, network, and individual participation group. It was suggested that the effectiveness of the network at the local community level could be determined through the evaluation of whether the local community is receiving appropriate services through the network and whether effective service delivery is taking place. The evaluation at the network level concerns whether the network is organized and can be continuously maintained. Indeed, they emphasized that although network evaluation is effective externally, the network effect when members leave the network decrease due to network configuration and maintenance costs, etc. In addition, it was suggested that the existence and degree of profit generated through the participation of individual groups in the network could be a motive for joining the network [15].

Based on the above effectiveness analysis framework, defined three types of network governance related to the role of network governance and network efficiency: "participant-governed networks" (PGNs), "lead organization–governed networks" (LOGNs), and "network administrative organization" (NAO). LOGNs have a single member that determines network-level activities. NAO indicates the presence of network activity management organization. In addition, they presented criteria for determining the effectiveness of network governance, such as trust, number of network participants, consensus on network goals, and network-level capabilities [16]. Studies have been conducted to measure the level of the network, such as the influence of the network, from the perspective of the composition and continuation of the organization of the network. In terms of the network perceived [17], it was suggested that the network perceived by an individual must match the actual network through the concept of "cognitive accuracy," meaning that the accuracy of an agent who can recognize an influential network is positively correlated with actual influence [18].

Perceived accuracy of a disaster network has a positive relationship with the centrality of each host institution by applying the concept of cognitive accuracy to the disaster network, which is used as an index to improve the efficiency of the network [19]. In connection with previous study, they analyzed how a regional disaster management network changed based on these concepts. As a result, it was suggested that network-leading organizations showed high levels of influence related to establishment and resources, and that political-based influence was related to the perceived influence of actors [20]. In addition, applied research implemented that based on the cognitive accuracy model [19], newly analyze how the influence of a private–public partnership disaster relief network in response to a local disaster is shown in the case of Suwon-si in South Korea [18]. Through this empirical analysis, it was suggested that the degree of influence of a current disaster response network can be grasped, and specific strategies to improve the influence of the network can be proposed.

### 2.3. Research purpose

Due to the unpredictability and complexity of disasters, the importance of network organization is emphasized in disaster response and management. However, there is no discussion of disaster response networks at recycling sites. In other words, in the recycling process of a waste recycling center, most of the studies approached from a technical point of view, only suggesting the necessity of discussing management aspects, such as the organizational system in disaster response, and empirical analysis related thereto is insufficient. Although communication within each organization needs to be smooth and active

for communication between organizations to occur interactively, most of the studies related to network effectiveness analyze networks between organizations in the region and analyze the influence of the level of networks within an organization. Thus, studies analyzing the influence of the level of the network within an organization have not been previously conducted. Accordingly, in this study, we analyze the influence of the network level in an organization and the administrative aspect by analyzing the disaster response network in a waste recycling center.

## 3. Method

### 3.1. Study area and design

This study conducted a questionnaire survey targeting 47 workers at a waste recycling center in Yongin-si, Gyeonggi-do, South Korea. We analyzed response data between two groups consisting of positions and members, not considering relationship data between members, so the results of the survey were derived through two-mode network analysis using UCINET analytical software. Two questions in the survey were designed to measure network efficiency. The first question was designed to measure the perceived network: "Who do you think should be contacted first when a disaster event occurs?" The second question was designed to measure the actual network: "Who do you actually contact first when a disaster event occurs?" The survey was designed to allow respondents to indicate only one person for each of the two questions. The 47 employees were sequentially assigned numbers from 1 to 47 accordance with the positions such as decision maker, general manager, and practitioners, respectively.

### 3.2. Methodology

Based on the concept of cognitive accuracy, the influence of a network within an organization can be measured by dividing it into three levels of position: decision makers, general managers, and practitioners. The cognitive accuracy of a network can be measured as a percentage of the perceived network that is within the actual network [19]. Meanwhile, the level of organization can be divided into positions and functions. However, the roles of managers and practitioners are often divided into positions in industrial sites. There is no significant difference in the role of disaster response due to the division of duties among practitioners. Therefore, in this study, the analysis was performed by dividing it into position levels. In network analysis, it is important to identify the most important actors. To do this, network analysis finds a network's centrality [21]. This can be measured in three ways: "degree centrality," which measures the degree of direct connection between actors; "closeness centrality," which measures the shortest path between two actors; and "betweenness centrality," which measures how long an actor is located between two other actors [22]. However, since direct connection between actors is most important for coping with disasters, this study only measured the degree centrality of the network [19].

## 4. Results

### 4.1. Characteristics of survey respondents

The survey showed that 34 out of the 47 workers at the waste recycling center in Yongin-si, Gyeonggi-do, responded, giving a 72.3% response rate. The characteristics of respondents, such as position, experience of disaster response, frequency of disaster response, and capability of disaster response, are shown in Table 1. As we will discuss in detail in the conclusion and discussion sections, the density of the whole network is generally low in this study. This may be a phenomenon due to the communication system in a disaster situation only being connected to a few members. Thus, in this study, rather than interpreting density as an absolute degree of cohesion, we identified which network connections were relatively well organized as a relative criterion between the perceived

network and the actual network, and between the whole network and the network for each position [18].

**Table 1.** Characteristics of survey respondents.

| Category | Contents | Frequency (Person) | Share (%) |
|---|---|---|---|
| Status | Decision maker | 3 | 8.8 |
| | General manager | 8 | 23.5 |
| | Practitioner | 23 | 67.6 |
| | Total | 34 | 100.0 |
| Disaster response experience | Have | 24 | 70.6 |
| | None | 10 | 29.4 |
| | Total | 34 | 100.0 |
| Frequency of disaster response (per year) | 1-2 times | 11 | 32.5 |
| | 3-4 times | 10 | 29.4 |
| | 5-6 times | 2 | 5.8 |
| | 7 or more times | 1 | 2.9 |
| | None | 10 | 29.4 |
| | Total | 34 | 100.0 |
| Disaster response capability | Have experiences and manageable well | 10 | 29.4 |
| | Have experience and manageable to some degree | 14 | 41.2 |
| | No experiences but know how to manage | 4 | 11.8 |
| | No experiences but manageable with help of superior | 5 | 14.7 |
| | No experiences and have no idea how to manage | 1 | 2.9 |
| | Total | 34 | 100.0 |

*4.2. Whole-network level*

The connection centrality of the perceived network in the waste recycling center was in the order of members nos. 2 (0.586), 5 (0.517), 1 (0.310), and 14 (0.241). It can be seen that a perceived network is formed around decision makers and safety and health managers. The connection centrality of the actual network also appeared in the same order as the perceived network, that is, members nos. 2 (0.483), 5 (0.448), 1 (0.241), and 14 (0.172); it can be seen that the actual network is also formed around decision makers and people in charge of safety and health management. The cognitive accuracy of the corresponding network is high, as in nos. 2 (0.765), 5 (0.857), 1 (0.778), and 14 (0.714). Through this, it can be seen that the degree of agreement between the perceived network and the actual network is high. However, the connection centrality for top-ranked members was lower in the actual network, and the density was also lower in the real network (0.043) than in the perceived network (0.047). It can be seen that, unlike the perceived network, which is concentrated on a specific member, the actual network is relatively widely distributed. The results of the waste recycling center network analysis are shown in Table 2 and Figure 1.

**Table 2.** Results of the Network Analysis in the Waste Recycling Center.

| Perceived Network | | | Actual Network | | | |
|---|---|---|---|---|---|---|
| No. | Department & Position | Degree | No. | Department & Position | Degree | Cognitive Accuracy |
| 2 | General Management, Manager | 0.586 | 2 | General Management, Manager | 0.483 | 0.765 |
| 5[1] | Production & Operation, Manager | 0.517 | 5[1] | Production & Operation, Manager | 0.448 | 0.857 |
| 1 | Representative Director | 0.310 | 1 | Representative Director | 0.241 | 0.778 |
| 14[1] | General Management, Assistant Section Manager | 0.241 | 14[1] | General Management, Assistant Section Manager | 0.172 | 0.714 |

| 9 | Production Management, Department Head | 0.172 | 9 | Production Management, Department Head | 0.172 | 0.800 |
| 3 | Technical Support, Manager | 0.138 | 3 | Technical Support, Manager | 0.138 | 0.667 |
| 11 | Production Management, Department Head | 0.103 | 11 | Production Management, Department Head | 0.103 | 1.000 |
| 12 | Production Management, Department Head | 0.069 | 10 | Production Management, Department Head | 0.069 | 0.000 |
| 4 | Technical Support, Chief | 0.034 | 12 | Production Management, Department Head | 0.069 | 1.000 |
| 13 | Technical Support, Assistant Section Manager | 0.034 | 4 | Technical Support, Chief | 0.034 | 1.000 |
| | | | 6 | General Management, Section Manager | 0.034 | 0.000 |
| | | | 13 | Technical Support, Assistant Section Manager | 0.034 | 1.000 |

[1] Safety and health management, manager.
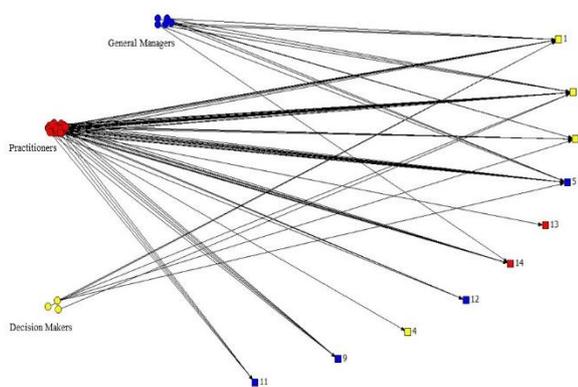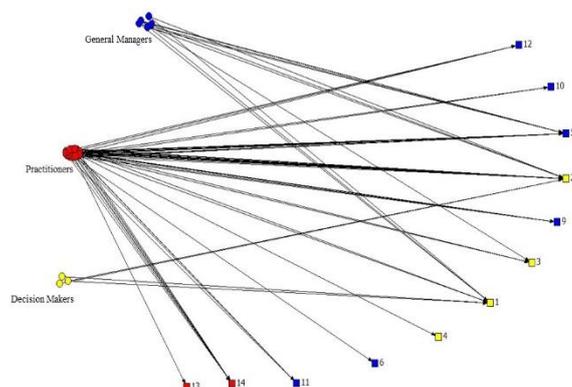


(**a**) Perceived network                          (**b**) Actual network

***Figure 1.*** *Network analysis results based on the whole-netwrok level comparing with perceived and actual network specifically: (**a**) Perceived network; (**b**) Actual network.*

*4.3. Network level of decision makers*

The connection centrality of the perceived network in the waste recycling center was found to be in the order of members nos. 1 (0.667), 2 (0.667), 3 (0.333), and 5 (0.333). This indicates that the perceived network has been established by decision makers. The connection centrality of the actual network was in the order of members nos. 1 (0.667) and 2 (0.667), indicating that the actual network is formed centered on the decision makers, similar to the perceived network. The cognitive accuracy of the network is formed with high values for members nos. 1 (1.000) and 2 (1.000). Through this, it can be seen that the degree of agreement between the perceived network and the actual network is high. However, the density of the network is lower in the actual network (0.028) than in the perceived network (0.043), so the perceived network is relatively widely distributed in the actual network rather than being focused on a specific member. The analytical results of the network focused on the decision makers in the waste recycling center are shown in Table 3.

**Table 3.** Results of the Network Analysis with Decision Makers' Level in the Waste Recycling Center.

| Perceived Network | | | Actual Network | | | |
|---|---|---|---|---|---|---|
| No. | Department & Position | Degree | No. | Department & Position | Degree | Cognitive Accuracy |

| No. | Department & Position | Degree | No. | Department & Position | Degree | Cognitive Accuracy |
|---|---|---|---|---|---|---|
| 1 | Representative Director | 0.667 | 1 | Representative Director | 0.667 | 1.000 |
| 2 | General Management, Manager | 0.667 | 2 | General Management, Manager | 0.667 | 1.000 |
| 3 | Technical Support, Manager | 0.333 | | | | |
| 5¹ | Production & Operation, Manager | 0.333 | | | | |

¹Safety and Health Management, Manager

### 4.4. Network level of general manager

The connection centrality of the perceived network by middle managers in the waste recycling center was found in the order of members nos. 1 (0.429), 2 (0.429), 5 (0.429), 3 (0.286), and 14 (0.143). This indicates that a perceived network was formed around decision makers and people in charge of safety and health management. On the other hand, the connection centrality of the actual network is shown as members nos. 5 (0.571), 1 (0.429), 2 (0.429), and 3 (0.143), indicating that the actual network is formed centered on the decision makers. This result indicates that the connection centrality of member no. 5, who is both a decision maker and a person in charge of safety and health management, features prominently. The cognitive accuracy of the network is high, such as members nos. 5 (1.000), 1 (1.000), 2 (0.667), and 3 (0.500). This result shows that the degree of agreement between the perceived network and the actual network is high. However, the density of the network is lower in the actual network (0.033) than in the perceived network (0.036), and the perceived network is relatively widely distributed in the actual network rather than being focused on a specific member. The analytical results of the network focused on the general managers in the waste recycling center are shown in Table 4.

**Table 4.** Results of the Network Analysis with General Managers' Level in the Waste Recycling Center.

| | Perceived Network | | | Actual Network | | |
|---|---|---|---|---|---|---|
| No. | Department & Position | Degree | No. | Department & Position | Degree | Cognitive Accuracy |
| 1 | Representative Director | 0.429 | 5¹ | Production & Operation, Manager | 0.571 | |
| 2 | General Management, Manager | 0.429 | 1 | Representative Director | 0.429 | 1.000 |
| 5¹ | Production & Operation, Manager | 0.429 | 2 | General Management, Manager | 0.429 | 0.667 |
| 3 | Technical Support, Manager | 0.286 | 3 | Technical Support, Manager | 0.143 | 0.500 |
| 14¹ | General Management, Assistant Section Manager | 0.143 | | | | |

¹Safety and Health Management, Manager

### 4.5. Network level of practitioners

The connection centrality of the perceived network by the practitioners in the waste recycling center was found in the order of members nos. 2 (0.632), 5 (0.579), 14 (0.316), and 9 (0.263). It can be seen that the perceived network is formed around the decision makers and safety and health management personnel. The connection centrality of the actual network also appeared in the same order as the perceived network, such as members nos. 2 (0.474), 5 (0.474), 14 (0.263), and 9 (0.263). This implies that the actual network is formed around decision makers and safety and health management personnel. The cognitive accuracy of the network was high, such as members nos. 2 (0.750), 5 (0.818), 14 (0.833), and 9 (0.800). Through this, it can be seen that the degree of agreement between the perceived network and the actual network is high. However, the value of the connection centrality of top-ranked members was lower in the actual network. The density was also lower in the actual network (0.048) than in the perceived network (0.052). This indicates that the actual network is relatively widely distributed. The analytical results of the network focused on the practitioners in the waste recycling center are shown in Table 5.

**Table 5.** Results of the Network Analysis with Practitioners' Level in the Waste Recycling Center.

| **Perceived Network** | | | **Actual Network** | | | |
|---|---|---|---|---|---|---|
| No. | Department & Position | Degree | No. | Department & Position | Degree | Cognitive Accuracy |
| 2 | General Management, Manager | 0.632 | 2 | General Management, Manager | 0.474 | 0.750 |
| 5[1] | Production & Operation, Manager | 0.579 | 51 | Production & Operation, Manager | 0.474 | 0.818 |
| 14[1] | General Management, Assistant Section Manager | 0.316 | 141 | General Management, Assistant Section Manager | 0.263 | 0.833 |
| 9 | Production Management, Department Head | 0.263 | 9 | Production Management, Department Head | 0.263 | 0.800 |
| 1 | Representative Director | 0.211 | 3 | Technical Support, Manager | 0.158 | 1.000 |
| 11 | Production Management, Department Head | 0.158 | 11 | Production Management, Department Head | 0.158 | 1.000 |
| 12 | Production Management, Department Head | 0.105 | 1 | Representative Director | 0.105 | 0.500 |
| 3 | Technical Support, Manager | 0.053 | 10 | Production Management, Department Head | 0.105 | 0.000 |
| 4 | Technical Support, Chief | 0.053 | 12 | Production Management, Department Head | 0.105 | 1.000 |
| 13 | Technical Support, Assistant Section Manager | 0.034 | 4 | Technical Support, Chief | 0.053 | 1.000 |
| | | | 6 | General Management, Section Manager | 0.053 | 0.000 |
| | | | 13 | Technical Support, Assistant Section Manager | 0.053 | 1.000 |

[1]Safety and Health Management, Manager

*4.6. Summary of analysis results*

The results of the network analysis are summarized in Table 6. Cognitive accuracies in all networks were ranged from 0.500 to 1.000. This indicated that in many cases, actual networks match well to perceived networks in terms of maximum 100% or minimum 50% of selectivity. This indicates that the degree of agreement between the perceived network and the actual network is generally high in the waste recycling center. The reasons for these results can be inferred as follows: The organization often faces large and small accidents, such as cases of fire and explosion, so there are a large number of members who have already experienced disaster response (24 members, 70.6%), and most of the members (28 members, 82.4%) knew how to deal with a disaster situation when it occurs. Therefore, it can be interpreted that the disaster response network functions smoothly in a disaster situation. However, unlike the results of the cognitive accuracy analysis in the network, the connection centralities between positions of the recycling center do not correspond with position. This will act as a factor that hinders the influence of the network.

In the whole network, the connection centrality of members no. 2 (leader in management team), no. 5 (leader in production management team and performer of safety/health management), and no. 1 (representative at center) was high. However, in the decision maker network, the connection centrality was high at members nos. 1 and 2. In the general manager network, the connection centrality was high for members nos. 1, 2, and 5, similar to the whole network. In particular, in the case of member no. 5, the centrality was higher in the actual network than in the perceived network. In the network of practitioners, the

connection centrality of members no. 2, no. 5, and no. 14 (leader in management team and performer of safety and health management) was found to be high. On the other hand, the connection centrality in the perceived network was higher than in the actual network. This means that the roles that the members who are perceived to play a central role in actual situations are somewhat insufficient. Also, in the case of member no. 14, another person in charge of safety and health management, the connection centrality was relatively lower than that of two leaders (members nos. 2 and 5), and the centrality in the actual network was significantly lower than the perceived network. This result indicates that the role of member no. 14 in charge of safety and health management will not be properly performed during a disaster event [2].

The density of the actual network is lower than that of the perceived network. This means that in the case of the perceived network, the connection relationships are relatively concentrated, but in the actual network, the degree of concentration is lower. On the other hand, the density of the practitioner network was higher than that of other networks [18]. In the case of practitioners, they face disaster situations with the recycling process directly; thus, the practitioner group has a greater concentration of connection centrality than other networks. In other words, there seems to be no particular problem when looking at the network in terms of members' cognitive accuracy, but the overall consistency of the network cannot be high based on position classification and network density.

Therefore, in order to secure network influence within the organization, it is necessary to reorganize the network configuration, centering on safety managers who perform official tasks in disaster management. A network should be formed around safety managers so that each position can have a consistent network system, and based on this, a network with aggregated connections can be developed. In order to make this suggestion possible, it will be necessary to grant related authority so that safety managers can actively and smoothly perform safety management tasks. In other words, safety managers should not only deliver their training, but also modify and supplement it to suit their working environment, and based on this, education and response system training should be led such that safety managers can function as the center of disaster response networks [18].

**Table 6.** Overall Results of the Network Analysis in the Waste Recycling Center.

| No. | Whole Network | | | Decision Makers' Level | | | General Managers' Level | | | Practitioners' Level | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Perceived | Actual | Cognitive Accuracy | Perceived | Actual | Cognitive Accuracy | Perceived | Actual | Cognitive Accuracy | Perceived | Actual | Cognitive Accuracy |
| 1 | 0.310 | 0.241 | 0.778 | 0.667 | 0.667 | 1.000 | 0.429 | 0.429 | 1.000 | 0.211 | 0.105 | 0.500 |
| 2 | 0.586 | 0.483 | 0.765 | 0.667 | 0.667 | 1.000 | 0.429 | 0.429 | 0.667 | 0.632 | 0.474 | 0.750 |
| 3 | 0.138 | 0.138 | 0.667 | 0.333 | | | 0.286 | 0.143 | 0.500 | 0.053 | 0.158 | 1.000 |
| 5[1] | 0.517 | 0.448 | 0.857 | 0.333 | | | 0.429 | 0.571 | 1.000 | 0.579 | 0.474 | 0.818 |
| 9 | 0.172 | 0.172 | 0.800 | | | | | | | 0.263 | 0.263 | 0.800 |
| 14[1] | 0.241 | 0.172 | 0.714 | | | | 0.143 | | | 0.316 | 0.263 | 0.833 |
| Density | 0.047 | 0.043 | | 0.043 | 0.028 | | 0.036 | 0.033 | | 0.052 | 0.048 | |

[1]Safety and Health Management, Manager

## 5. Conclusions and Limitations

In order to measure the network influence of waste recycling centers and suggest a network management strategy, analysis was conducted by position level based on the concept of cognitive accuracy, and even if the level of cognitive accuracy of individual members was high, there are factors that hinder network influence. In the case of the whole network, it was decision maker–centered, such as members nos. 1, 2, and 5; in the case of the decision maker network, such as members nos. 1 and 2, the configuration was centered on decision makers, but it showed a slightly different configuration from the

overall network. In the case of the general manager network, similar to the whole-network result, it showed a decision maker–centered configuration, such as members nos. 1, 2, and 5. On the other hand, in the network of practitioners, members nos. 2, 5, and 14, the connection centrality of safety and health managers was high, and it was developed in a different form from the other networks. As the density of the actual network was lower overall than the perceived network, it was found that the degree of concentration of the actual network was lower than that of the perceived network [18]. In addition, the density of the network of practitioners was higher than other networks and showed a greater aggregation of connections, which may reflect the characteristics of practitioners who must directly face disaster situations on the front line.

To establish the improvement strategy for factors that hinder the influence of the network within the organization, it will be necessary to reorganize the network configuration. This can be agreed upon by officially designating a person who in charge of disaster response and management. In other words, by forming a network centered on safety managers, the same network system for each position level can be established. Improvement could also begin by empowering safety managers to conduct active education and training. It is meaningful that this study found that the cognitive accuracy of the individual unit does not guarantee the power of the organization and that differences from the whole network exist and affect its power depending on the level of position of the network system in the organization. In other words, the strategy can be subdivided by considering not only cognitive accuracy but also position level in order to maximize network effectiveness within the organization.

Finally, in order to secure network effectiveness within the organization, the network structure should be reorganized around the safety and health management managers who perform official tasks in disaster management so that each position can have a matched network system. Based on this, the organization will be able to structure the network with cohesion. Thus, it is necessary to give safety and health management managers the relevant authority to actively and smoothly perform safety management tasks. However, this study stopped short of suggesting factors that impede the consistency of the network within the organization. In addition, there are limitations because this study has not been able to analyze factors, hindering the consistency of network, empirically and present detailed indicators and methods of measurement. Therefore, related research will also have to be carried out in the future.

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