Research on enterprise epidemic Grid-based management from a fractal enterprise perspective

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Abstract. During the COVID-19, with the uncertainty of epidemic change and repetition, the environment of enterprises has become increasingly complex. How to reduce the huge impact of the epidemic on enterprise operations, enterprise epidemic management is very important. From the perspective of fractal enterprise management, this paper establishes a fractal structure model of enterprise epidemic management. Based on the similarity, it is divided into four modules: personnel & environment management fractal element, material management fractal element, data information management fractal element, and production management fractal element. It realizes the open communication of each fractal element in a goal-driven manner, and successfully implements the grid-base management of epidemic situation in enterprise operation. In grid-base management, according to the overall requirements of "Three Adheres", implement the staff management strategy of "Three Vertical, Three Horizontal and Three Inspection", adhere to the principle of "Three Independence", and explore the way to break the situation of normalized enterprise management of epidemic situation and prepared for the post-epidemic era in advance. At the same time, it also has a good reference significance for other emergency events.

Keywords: Epidemic prevention and control; Complexity; Fractal management; Grid-based management; Normalization of epidemic situation; Emergency

1 Introduction

Since the first discovery of Corona Virus Disease 2019 (COVID-19) in Wuhan in 2019, it has been almost three years. Efficiently balancing epidemic prevention and control with economic and social development has always been a key topic of concern in society. People's Daily has mentioned the requirement of "preventing the epidemic, stabilizing the economy, and ensuring safety in development" [1]. Therefore, it is particularly important to manage companies during the epidemic period. From a large number of news reports, we can see that companies have smoothly carried out production during the epidemic period. On the one hand, they need to solve the problem of labor, reduce the number of personnel infections, and ensure the safety of production sites without viral contamination. On the other hand, they need stable logistical support and

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continuous transportation capabilities. The enterprise system during the epidemic period is a non-linear and complex system. Fractal theory provides a new direction for the study of enterprise management [2,3]. From the perspective of fractal enterprise, the author conducted in-depth research on the grid-base management implemented in B workshop during closed-loop production, and put forward effective suggestions for enterprise epidemic prevention and control work. At the same time, it provides a reference for researchers engaged in management studies to further understand fractal enterprise theory and grid-base management, which has positive social significance [4].

2 Complexity Analysis of Enterprise Epidemic Management

2.1 Objective Complexity

The complexity of composition, involves the departments involved in the production of B workshop, including production, maintenance, logistics, third parties, and property management. In normal production, there are less than 2000 personnel directly involved, and all personnel are distributed around the relatively closed and dense production line. During the closed-loop production period, these personnel need a large amount of living materials, epidemic prevention materials, and a full range of living guarantees. The living materials involve dozens of types such as employee accommodation, washing, and catering. Epidemic prevention materials also include more than a dozen types such as masks, gloves, disinfectants, and test reagents. These factors combined make epidemic prevention management face enormous challenges in terms of scale and quantity. In addition to being large in scale, the complexity of composition is also reflected in the types of composition. From the beginning of the closed-loop production of employees, tracking the physical condition of employees is a very important task, during the epidemic period, there may be four types of cases that emerge one after another: confirmed cases, suspected cases, fever cases that cannot be ruled out for infection, and close contacts. At the same time, after being infected with the novel coronavirus, there is also a certain incubation period. Faced with the population composed of the above different types, on the one hand, it is necessary to reduce the opportunities for healthy employees and infected employees to come into contact, and reduce the risk of infection. On the other hand, it is necessary to quickly and accurately screen the above risk personnel and promptly control and treat them. The above factors have increased the complexity of objective composition[5,6].

2.2 Subjective complexity

During the period of epidemic control, the whole society is very strict about the management of the COVID-19 epidemic, the infected people are centrally treated, the close contact need to be centrally isolated, and other people who receive the flow of transfer also need to be isolated at home, so it can be said that the talk of "COVID-19" was scary, and the employees' awareness and preparation for "COVID-19" is still at the level of fear and inadequacy. At the same time, the workshop is also closed for a short

period of time due to the epidemic of foreign input. Although several rounds of comprehensive disinfection and cleaning have been carried out, employees have a certain resistance and uneasiness about returning to the production site, which has created a great obstacle to the quick resumption of work and production, and is the first problem that needs to be solved to reach the arrival rate smoothly[7] .

3 Fractal structure model and grid-based in Epidemics management

3.1 Fractal structure model

The management of the COVID-19 is an open and complex system, and the adoption of a fractal management model requires the division of the entire pandemic management system into different fractal units. Each fractal unit runs in a goal-driven manner, with self-similarity, self-organization, dynamic adjustment, simple and orderly structure [8,9,10].

In the process of pandemic prevention and control, B workshop of a company organized manpower and material resources to achieve rapid resumption of work and production in accordance with the company's overall objectives. They developed a fractal management model for pandemic management, as shown in Fig. 1. In the process of execution, B workshop adjusted and managed themselves based on their own characteristics and situations, designing many efficient pandemic prevention and control measures and mechanisms that fully leveraged their initiative and agility. During the fractal management process, the workshop maintained efficient and smooth flow of personnel information. In response to sudden outbreaks of the pandemic and personnel changes, they made effective responses, quick decisions, and ensured the dynamism and vitality of the entire management process. At the same time, in the pandemic prevention and control stage, B workshop simplified the management process, made full use of WeChat and its applets, set up groups, and directly conveyed relevant policy requirements to every frontline worker. The on-site situation was also mastered by all management levels through relevant means, and accurate responses were made by frontline managers guided by data analysis and outlier identification [11].

In the process of fractal management, B workshop accurately grasped the company's overall goals, fully exerted the autonomy, dynamism, and simplicity of the workshop, and achieved a low infection rate and rapid resumption of work and production in the workshop.

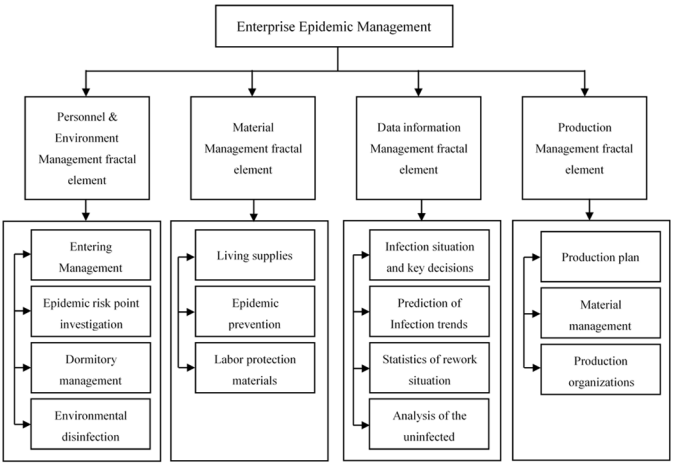

Fig. 1. Fractal structural model in COVID-19 management

3.2 Grid-based management

Grid-base management originated from the Internet and later applied the grid concept to the field of management. It has been widely used in urban management, market supervision, patrol and control, and other fields. The system structure of grid-base management ensures the smooth flow of information and realizes efficient and fast management due to its four characteristics of distribution and resource sharing, self-similarity, dynamicity, high scalability, autonomy, and management multiplicity [12,13,14].

In the process of the COVID-19 prevention and control, according to the physical and geographical attributes of the workshop, the workshop was divided into several grids for unified classification and naming, and a four-level management system was formulated, as shown in Fig. 2, namely "workshop-area-group-team". By dividing the grids, the responsible areas and persons of each grid were determined. The "three independence" principle was implemented within the grid area, which refers to independent work, independent eating, and independent rest, reducing the risk of cross-infection among personnel of different teams and facilitating rapid flow control in case of emergencies. At the same time, the past scattered information was quickly shared, making management more accurate and agile, and facilitating the formulation of targeted response plans. The high efficiency of grid-base management is fully reflected in the face of sudden pandemic situations that require quick decision-making by managers at all levels.

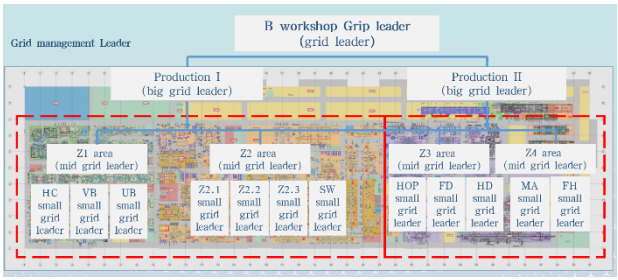

Fig. 2. Four-level grid-base management system in the workshop

4 Coping strategies for fractal enterprise epidemic management

In the concept of fractal enterprise management, all fractal elements have similar goals, and the overall goals have "consistency," while each goal can be achieved accurately. In the pandemic management process, B workshop divided each fractal element based on similarity, the specific response plan is decomposed layer by layer around the overall requirements of "three Adheres" to ensure the health and safety of all employees, to fight against the Epidemic, and to achieve annual production and operation target.

4.1 Personnel and Environmental Management

Personnel and environmental management are the difficulties in epidemic prevention and control. In the management process, the self-organizing characteristics of fractal enterprises are fully utilized, starting from the company's overall goals, based on the characteristics of the workshop, and self-adjusting and optimizing, implementing the "three vertical and three horizontal three inspection" personnel control policy. The three verticals refer to the three stages of "before arrival," "on duty," and "after work" of the process of resuming work and returning to the factory. The three horizontals refer to three different types of personnel involved in production. The three inspections refer to the three inspection contents, as shown in Fig. 3.

	Before work	On duty	After work
Production personnel on duty and preparation	1. regulations, nucleic acid 2. Self status confirmation 3. Preparation of personal belongings	1. Nucleic acid status check 2. Temperature measurement detection 3. Travel code check	1. Pre shift antigen testing 2. Nucleic acid testing during production 3. Temperature and detection in the morning and afternoon
Production support personnel On duty and preparation TSS, QM, Log.			
Third party service personnel On duty and preparation QM-DT/ Log.			

Fig. 3. Three vertical, three horizontal and three inspection personnel control strategy

During the process of returning to work on site, the first step is to prepare before entering the factory. Information screening is conducted for personnel returning to work. A small program is developed to collect information, including the name, employee number, shift, number of accounting tests and results, antigen test results, living conditions, health status of cohabitants, release from quarantine time, willingness to return to work, and other information for each employee. Contact tracing investigation is also conducted based on this information to calculate the number of returning employees who meet the criteria, and prepare for the entry to the factory.

Upon entry to the factory, each employee undergoes antigen testing according to the epidemic prevention requirements. If the antigen results are normal, the employee can proceed to the workshop. Before entering the workshop, the employee is provided with a "three-piece set of epidemic prevention" which includes rubber gloves, medical masks, and N95 masks, and is required to scan the QR code to complete the registration process.

After entry, a buffer zone system is implemented, which means that all new employees cannot immediately return to their respective workstations, but must go to the prepared "buffer zone" for a two-day isolation period. The main purpose is to prevent carriers of the virus from bringing it into the production site, causing environmental pollution, and triggering another outbreak. After two days of isolation, the corresponding team will arrange for a person to take the employee back to the corresponding grid area to carry out related production activities.

In addition, special disinfection and epidemic prevention measures are taken. A comprehensive risk point investigation is conducted for the previous outbreak area to identify epidemic risk points and create a hot spot map. High-frequency differentiated environmental disinfection and management are carried out in the hot spot areas, increasing the depth and frequency of disinfection, as shown in Fig. 4.

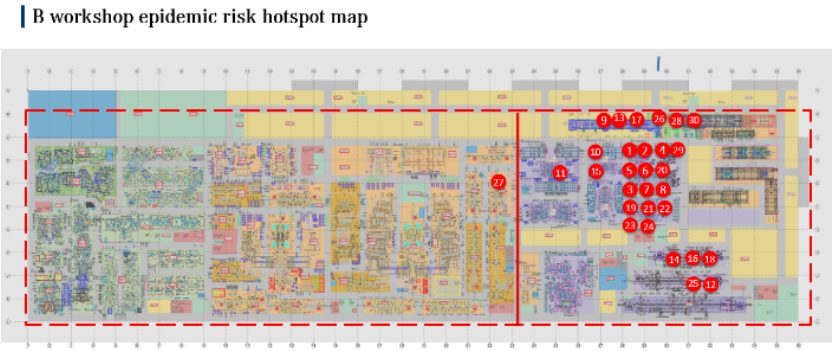

Fig. 4. Epidemic risk hotspot map

In the personnel and environmental management fractal elements, self-planning and autonomous management are encouraged, and their subjective initiative is fully utilized. For example, in grid areas, places such as restrooms, dining areas, smoking areas, and rest areas are the most prone to epidemic transmission. In response to these issues,

everyone works together to actively find epidemic prevention measures. In the restroom, touch-type faucets are replaced with induction-type faucets and separated, reducing the risk of cross-infection. At the same time, each small grid (team) is designated to use the faucet and restroom pit area range, with special identification and divided into zones and time periods for use. This not only reduces contact between different grids but also facilitates subsequent epidemiological investigations, as shown in Fig. 5. Ultraviolet lamps are used for deep cleaning in the restroom. In the dining area, the dining method within each grid is clearly defined, as well as the dining and drinking water locations for each person. In the accommodation area, the area is divided into zones according to the grid and managed with tents, which not only avoids clustered infections but also meets the requirements of employees for privacy. Special personnel are arranged to perform environmental cleaning before the start of each shift, after lunch, and after the end of the shift in the above-mentioned areas[15].

Fig. 5. Specialized Anti-epidemic Measures

4.2 Materials management

Epidemic prevention material management is a key guarantee for controlling the spread of the epidemic throughout the entire epidemic prevention process. During the epidemic, epidemic prevention materials are in short supply, and distribution and collection are extremely complex. To ensure the completion of the above tasks, information flow and management flattening are required in the fractal management process. Therefore, an efficient communication mechanism is established through the WeChat platform to ensure that each grid can receive material-related information in a timely manner, and the responsible person of each grid can also submit requirements to the material management department in a timely manner. At the same time, the management structure is simplified, and each grid area is divided into small grids as units, directly communicating with the material management department. The middle grid level and the large grid level only need information reporting, which improves problem-solving efficiency and enhances responsiveness. In actual implementation, in order to

accurately grasp the actual number of demand and avoid cross-infection during the process of receiving goods, each small grid adopts a non-contact method to establish a contact with the material management department through "online material application", and adopts the "grid centralized collection in different time slots" method, staggered time slots for small grids to directly collect, ensuring that epidemic prevention materials are timely and efficiently delivered to every employee's hand, while establishing a good material account book. The management of daily necessities mainly involves the accurate prediction of material data before resumption of work and the timely supply of new employees during the resumption of work.

4.3 Big Data Information Management

In the entire closed-loop production and epidemic prevention process, big data is fully utilized to improve the efficiency of data utilization, accurately statistics and analyze the situation in the workshop, and thus achieve accurate and rapid decision-making. A self-designed data statistics mini-program dynamically tracks the daily health status of employees. Based on related research on COVID-19 and the development trend of epidemic situation in the early stage of closed-loop production, it is predicted that about 90% of employees in the workshop will be infected in the end, and the number of infections will gradually decrease after it exceeds 60%. Through the analysis of this infection trend, the number of personnel in the workshop that can participate in production at different periods can be determined, so as to provide early data support for production planning[16].

In the process of predicting the development and peak of the epidemic situation with big data, the second week starting from the beginning of the closed-loop is the most severe week for epidemic infection. On the one hand, the epidemic prevention and control focus is adjusted in a timely manner to delay and flatten the infection peak, and on the other hand, personnel arrangements and training are prepared in advance. According to the analysis of production capacity bottlenecks, personnel are flexibly allocated when the epidemic peak comes to ensure that the overall output is not affected. Fig. 6 shows the comparison between the predicted development of the epidemic situation in the workshop and the actual infection situation.

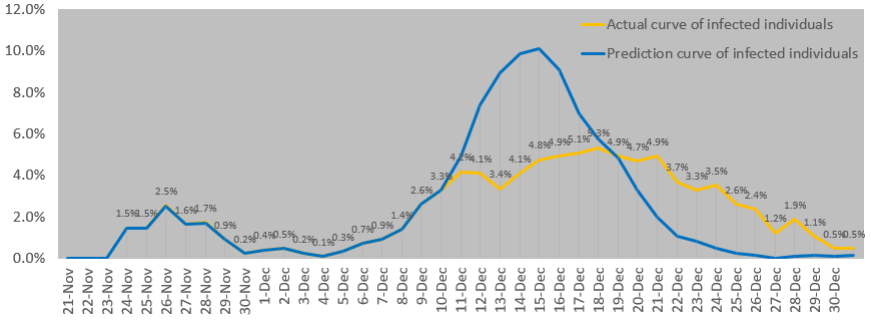

Fig. 6. Comparison between predicted and actual development of the epidemic in the workshop

At the same time, using big data information, daily updates on the number of positive cases and attendance status in the workshop can be obtained. This includes information on employees who have come to work, those who have tested negative but have not attended work, those who have tested positive but have not attended work for multiple days, and the number of positive and negative cases at the department level. This is illustrated in Fig. 7.

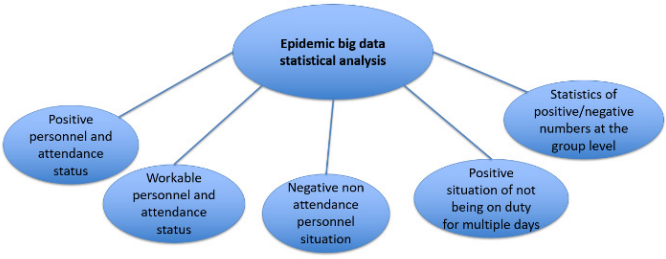

Fig. 7. shows the daily distribution of statistical results for big data information.

4.4 Production Management

Fractal enterprises have good dynamism and flexibility, and can respond effectively to the rapidly changing environment. In the process of enterprise epidemic management, the key is to maintain vitality. With vitality, different response measures can be taken according to real-time situations. For example, in the production management fractal element, according to the overall idea of parallel epidemic prevention and production protection, B workshop set the closed-loop production management plan in three stages.

The first stage is grid startup and single-shift opening, with a design time of one week, to ensure the completion of the entire closed-loop grid system and the smooth resumption of production lines. The important task in this stage is to identify and eliminate the risk of workshop epidemic transmission, establish the concept of closed-loop production grid-base management for employees, and smoothly execute the standard of grid-base management, bringing the entire production rhythm back to the track of epidemic prevention and resumption of work.

The second stage is the double-shift startup and rapid adjustment, with the key task of further increasing production capacity and restoring production capacity to the level before the epidemic. This stage is also the most difficult part of the entire plan. After switching from single shift to double shift, on the one hand, more employees need to be mobilized for closed-loop production, and on the other hand, as the number of people increases, the complexity of epidemic prevention materials, living materials, and grid-base management presents higher challenges. Therefore, at the beginning of the second stage, the workshop dynamically differentiated production and rest time according to the daily available workforce in each area and the production plan, and set a reasonable double-shift overlap time to jointly produce in case of severe personnel shortage, effectively ensuring the normal delivery of production capacity.

The third stage is the labor shortage and production capacity challenge. The biggest difficulty in this stage is how to solve the shortage of personnel caused by infection and how to ensure the continuous and stable production capacity. Therefore, based on the early big data analysis, the workshop predicted the trend of epidemic situation, evaluated the available production personnel in each time period, and timely adjusted the production plan, allocating personnel for timely supplementation. For example, during the peak of the epidemic, the bottleneck area caused by the lack of personnel was identified in time, and resources were tilted towards the bottleneck area, coordinating personnel from other non-bottleneck areas to overcome the difficulty of production capacity bottleneck, doing a good job in job skills training, and ensuring the overall quality and quantity of production plan in the workshop.

At the same time, according to the big data statistical results, the workshop dynamically tracked the recovery process of employees' return to work, actively mobilized the rehabilitation employees to return to work as soon as possible, and achieved a dynamic balance between the loss of production and the number of new employees participating in work, as shown in Fig. 8, which is the statistical and tracking of infection rate and recovery rate (predicted value) in the workshop production management process. Combining with the policy changes in the national epidemic management, corresponding adjustments were made in a timely manner[17].

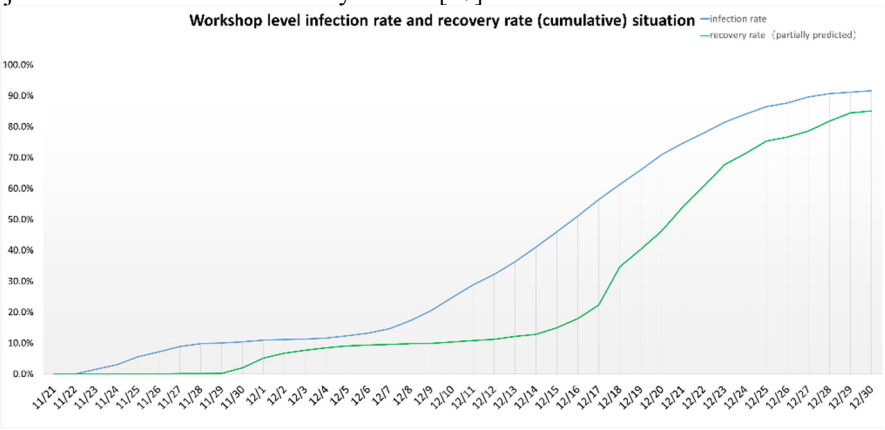

Fig. 8. tracks the infection and recovery rates (partially predicted).

5 Summary

The current epidemic prevention and control measures have entered a normalized stage. Only by coordinating epidemic prevention and control with economic and social development can we further promote the overall improvement of economic operations. This article focuses on epidemic prevention and control management in enterprises. From the perspective of fractal management, it first analyzes the complexity of epidemic management in enterprises. It mainly deconstructs the difficulties and challenges faced by enterprises in epidemic management from the two aspects of objective complexity and subjective complexity, and further expands on the objective complexity in terms of

compositional complexity, task complexity, and functional complexity. Based on the characteristics of the complex system of enterprise epidemic management, a fractal structure model of enterprise epidemic management is constructed. It is divided into personnel and environmental management fractal elements, material management fractal elements, data information management fractal elements, and production management fractal elements. The above ideas are applied in the practice of closed-loop production grid-base management of enterprises. By adopting relevant response measures and strategies, the orderly, safe, and efficient management of enterprise epidemic prevention and control is achieved, and the peak of epidemic infection is delayed and flattened. This explores new paths and methods for enterprise epidemic management and accumulates experience for enterprise epidemic management and other emergency incidents in the post-epidemic era.

At the same time, there is a need for further exploration and research on emergency management of sudden events during the enterprise epidemic management process and the sensitivity management of epidemic responses, in order to further improve the comprehensiveness and profundity of enterprise emergency management for sudden incidents.

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