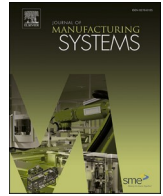




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New IT driven rapid manufacturing for emergency response

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ABSTRACT

COVID-19, which is rampant around the world, has seriously disrupted people's normal work and living. To respond to public urgent needs such as COVID-19, emergency supplies are essential. However, due to the special requirements of supplies, when an emergency occurs, the supply reserve mostly cannot cope with the high demand. Given the importance of emergency supplies in public emergencies, rapid response manufacturing of emergency supplies is a necessity. The faster emergency supplies and facilities are manufactured, the more likely the pandemic can be controlled and the more human lives are saved. Besides, new generation information technology represented by cloud computing, IoT, big data, AI, etc. is rapidly developing and can be widely used to address such situations. Therefore, rapid response manufacturing enabled by New IT is presented to quickly meet emergency demands. And some policy suggestions are presented.

1. Introduction

As of November 15, 2020, there have been more than 53 million confirmed cases of COVID-19 worldwide and nearly 1.3 million deaths [1]. The pandemic shows no signs of improvement. Currently, the global COVID-19 pandemic has begun to rebound. The pandemic is a critical challenge to the health and safety of the general public, the medical staff and systems [2], as well as emergency response worldwide. Facing the pressure brought by the pandemic, countries around the world have to adopt various methods to prevent the spread of the virus and make up for losses [3]. Manufacturing is the basic industry of the national economy. Therefore, manufacturing is most important in the process of responding to the COVID-19 pandemic. The manufacturing speed and quantity of emergency supplies (e.g., medical supplies and equipment, daily necessities, etc.) closely affect the effectiveness of pandemic prevention and control.

At the beginning of the COVID-19 outbreak, due to the rapid proliferation, the shortage of medical supplies became a pressing issue in society. For example, the shortage of masks and protective clothing, which are effective protective tools to prevent the spread of viruses, has become a worldwide phenomenon [4]. In addition, with the rapid increase in the number of infected cases, the pandemic created huge demand for relevant medical resources and personal protective equipment [5], resulting in acute shortages of medical resources such as test kits,

ventilators, face masks, safety goggles and protective clothing [6]. From this phenomenon, it can be concluded that rapid response manufacturing of specific emergency supplies is very important for public emergencies.

The sudden outbreak of the COVID-19 pandemic has brought great challenges to the manufacturing industry. Poor supply of raw materials, insufficient supply of skilled labor, and low efficiency of logistics and transportation, have become bottlenecks for the production of emergency supplies. For example, as for the supply chain, the interruption or disruption of materials has a direct impact on the supply of raw materials [7]. On the one hand, due to social isolation and the frequent and severe lockdowns across the globe, the supply chain system faced extreme disruption [5], resulting in a shortage of raw materials and key components. On the other hand, due to the surge in demand, raw material supply has become tense. Although the company may have stocked up raw materials in advance, after many days of suspension, if the raw materials cannot be replenished, production can grind to a halt. At the manufacturing end, the restriction of personnel movement, as well as active and passive isolation poses a very serious challenge to follow production schedules. Due to the shortage of labor, the production capacity of some enterprises cannot be recovered quickly [8]. In addition, due to lack of flexibility, some companies cannot adjust production capacity quickly to respond to changes in demand.

With the development and changes of the pandemic, the new

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generation information technologies (New IT) and smart manufacturing are playing an increasingly important role and value to cope with the above challenges [8,9]. Smart manufacturing can effectively improve production capacity and efficiency. At the same time, New IT can provide more powerful support for management and decision-making. The production challenges and rapid update of market demand brought by the global pandemic have put forward flexible requirements for manufacturing. The production line in the future will inevitably be characterized with highly efficient, flexibility and agile responsiveness to cater to the rapid changes in the external environment, especially for global events like the COVID-19. Therefore, rapid response manufacturing enabled by New IT is presented to address demand fluctuations. Regardless of the optimized configuration, high-efficiency and automated production of medical supplies during the pandemic prevention and control period, and the rapid recovery of production capacity and after the enterprise resumes work, they all leverage on the powerful assistance of the New IT driven rapid response manufacturing.

The rest of this paper is organized as follows. Section 2 presents a brief overview of public emergencies and their requirements. Section 3 analyzes the production characteristics of emergency supplies. Section 4 analyzed the impact of COVID-19 on manufacturing. Section 5 presents the New IT Enabled rapid Manufacturing. Some policy suggestions are presented in Sections 6. Finally, Section 7 draws the conclusions.

2. Public emergencies and their requirements

Currently, the global impact of COVID-19 virus has seriously disrupted the production and lives of people [8]. According to the process

and natural impacts, the public emergencies could fall into the following categories, as shown in Fig. 1.

2.1. The categories of public emergencies

2.1.1. Public health emergency

It mainly includes outbreaks of pandemic [10] (e.g., COVID-19, Middle East Respiratory Syndrome (MERS), SARS, H1N1, smallpox, pestis, etc.), animal pandemics (e.g., foot-and-mouth disease [11], avian influenza [12], swine influenza [13], etc.), group unexplained diseases, and other events that seriously affect public health and life safety. For example, with the outbreak of COVID-19, the demand for heavily used medical resources such as masks, protective clothing, ventilators, and temporary hospitals has exploded. As a result, imbalance between supply and demand could cause a humanitarian crisis [14].

2.1.2. Natural disasters

It mainly includes earthquake, tsunami, volcano eruptions, meteorological disasters (e.g., typhoon, hurricanes, tornado, El Nino, La Nina, flood and drought, etc.), geological disasters (e.g., landslide, debris flow, surface collapse, etc.), biological disasters (e.g., locust plagues, fall armyworm (spodoptera frugiperda), etc.), and so on [15]. For example, when a major earthquake occurs, especially in a mountainous area or a city with a large population (e.g., the earthquake in Haiti), the demand for relief supplies suddenly increases (such as disaster relief tents, food, medicine, temporary hospitals, disinfection supplies, etc.). If emergency supplies are not provided in time, the pandemic and associated diseases may occur after the wake of the massive disaster.

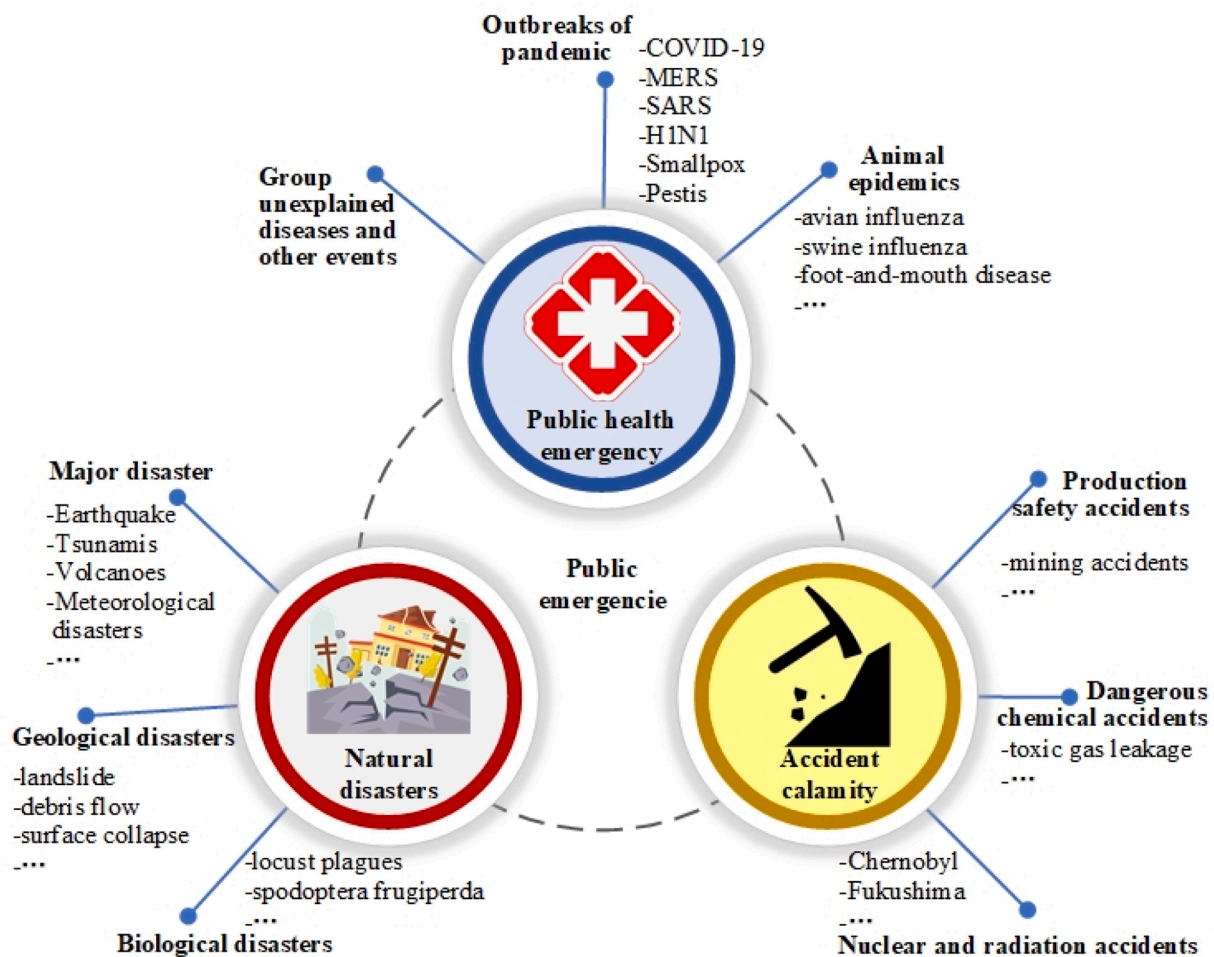


Fig. 1. The public emergencies.

2.1.3. Accident calamity

It mainly includes all kinds of production safety accidents (e.g., mining accidents), dangerous chemical accidents (e.g., toxic gas leakage), nuclear and radiation accidents (e.g., Chernobyl and Fukushima), and environmental pollution, etc. This type of accident is closely related to the lives and safety of the people, which has to be prevented at all costs. However, once an accident occurs, emergency rescue must be carried out as soon as possible to reduce the loss of lives and properties. When human lives are in danger, top priority should be accorded, which requires emergency supplies to be provided as soon as possible.

According to a comprehensive analysis, the emergency supplies used in most of the public emergencies mainly fall into the following two classes. (1) **Medical supplies**: It refers to the supplies which protect life, such as masks, first-aid medication, sanitizer, protective clothing, ventilators, oxygen machine, temporary hospitals, etc. (2) **Basic supplies**: It mainly provides supplies for the livelihood, including food, bedding and clothing, cooking oil and water, and fuel, etc.

At the same time, these emergency supplies have the following characteristics which are hard to meet.

2.2. The characteristics of emergency supplies

2.2.1. Peak demand

Because of the abrupt emergency events, the demand for emergency supplies could show explosive growth. For example, after the outbreak of the COVID-19 pandemic, masks have instantly become the most urgently needed pandemic prevention materials. As peak demand exceeds daily demand, there is a shortage of emergency supplies.

2.2.2. Uncertainty

Due to the unpredictability of the emergency events, including time of occurrence, intensity of impact, etc., the amount of emergency supplies, the mode of distribution and transportation, etc. cannot be determined early.

2.2.3. Irreplaceability

Some emergency supplies are specific supplies which are activated in a particular environment. For example, the vaccine used after the outbreak cannot be replaced with other materials.

2.2.4. Hoarding

Because of panic, people would stock up on vast emergency supplies. For example, when COVID-19 became serious, people stock up food, which has caused imbalance between supply and demand.

2.2.5. Urgency

Some new emergency products are needed in large quantities and great urgency. For example, when COVID-19 erupts, the test kit needs to be rapidly developed and mass-produced.

2.2.6. Severity of consequences

If emergency requirement resources are not supplied in time, the situation would worsen, leading to social instability. For example, after an earthquake or a nuclear leak, infectious diseases could occur if they are not responded to in a timely manner, resulting in high casualties.

Therefore, existing daily products need to be manufactured and supplied quickly when public emergency events occur.

3. Production characteristics of emergency supplies

On account of the characteristics of the above-mentioned public emergencies and emergency supplies, the timely, adequate and safe supply is very critical. For example, in response to COVID-19 pandemic, adequate medical supply is an important guarantee for the overall success of pandemic prevention and control. However, reliance on physical reserves alone cannot meet the needs of emergency response, especially

in the early stage, which is also the most critical period to control the public emergencies. In addition, the production of emergency supplies is basically event-driven. Unstable and uncertain demands lead to instability and uncertainty of production of emergency supplies. As a result, when a public emergency occurs, the production of emergency supplies cannot meet the demand. In the face of increasingly complex and uncertain public safety risks, especially the sudden occurrence of major infectious disease and unexplained mass disease emergencies, the production of emergency supplies should have the following characteristics:

3.1. Urgent large-scale

In the face of public emergencies, especially pandemics, the first reaction of people is to take personal protective measures. However, due to the lack of corresponding reserves in normal times, the supply of related emergency supplies would have a large-scale shortage in supply. Therefore, the production of emergency supplies should be fast and in large quantities. For example, after the outbreak of the COVID-19 virus, the demands for medical supplies such as masks, ethanol for disinfection, gloves, etc., have skyrocketed.

3.2. Rapid response

Emergency supplies must be delivered to those in need as soon as possible. When the time limit is exceeded, it could cause significant damage. Therefore, the production of emergency supplies must be fast. On the one hand, the production potential of the enterprise must be maximised quickly to produce a large number of emergency supplies. Raw materials or parts must be supplied quickly to ensure smooth production. Moreover, relevant enterprises should quickly adjust the production line structure to convert into emergency supplies production.

3.3. High-quality

Products quality is the most important concern in the production of emergency supplies. Without reliable product quality, high-level emergency response would not be guaranteed. Especially for food and medical emergency supplies, low quality may cause casualties. Therefore, the production of emergency supplies must focus on the product quality.

3.4. Safety

Safety is the fundamental requirement of emergency supplies production. Because emergency supplies production pursues high speed, it is necessary to ensure production safety in order to ensure no accidents. For example, to cope with COVID-19, relevant enterprises maximize their production capacity to produce a high volume of emergency supplies. As a result, the original production schedule is disrupted, which could pose a challenge to safe production. Especially for items such as the disinfection and protection products like alcohol and hydrogen peroxide are dangerous chemicals. There are very stringent tests for safe production operation. The production of emergency supplies must be highly emphasized in terms of safety, otherwise not only the emergency response cannot be satisfied, it will also cause additional damages.

Based on the above characteristics, under the situation of severe and complex events prevention and control, the production of emergency supplies faces the following challenges, as depicted in Fig. 2:

- (1) **The contradiction between general overcapacity in normal and insufficient capacity in emergency response**: To prepare for pandemic prevention and control as well as future responses to similar events, it is necessary to build production capacity reserve of emergency supplies. Investment in fixed assets of enterprises for emergency production capacity expansion creates overcapacity. The normal demand for emergency supplies is only

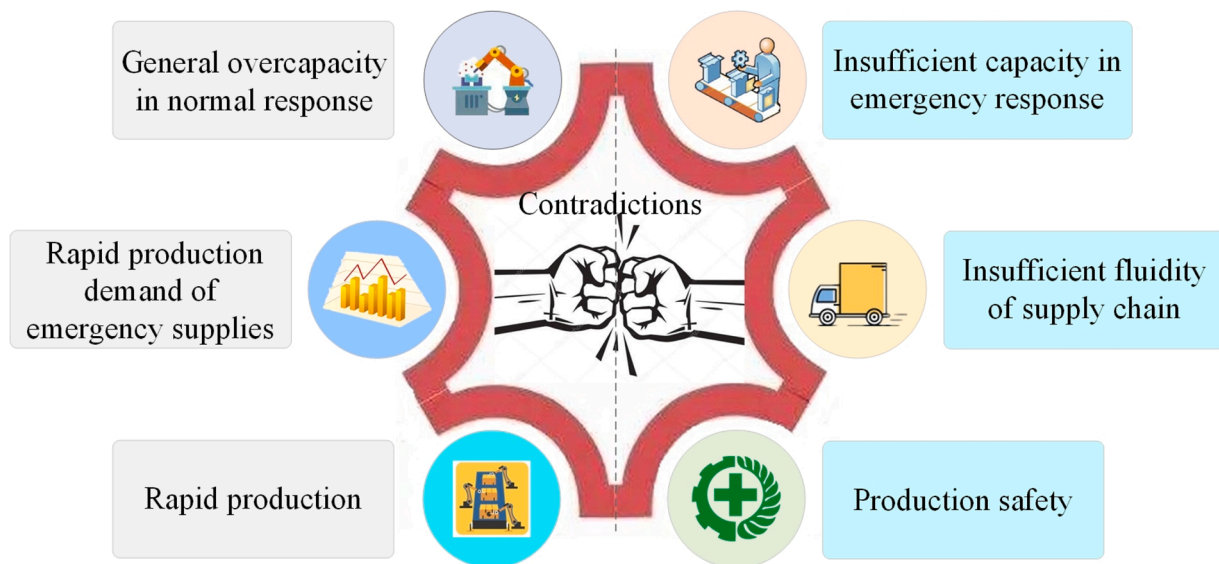


Fig. 2. The contradictions in production of emergency supplies.

a small fraction of all production capacity. However, when a public emergency event occurs, the production capacity for emergency supplies will not be able to meet all the needs.

- (2) **The contradiction between the rapid production demand of emergency supplies and the insufficient fluidity of supply chain:** In general, the supply chain is established for normal production. The supply of raw materials and spare parts is generally prepared in accordance with normal demand. But when a public emergency event occurs, the demand and orders for emergency supplies would explode. As a result, due to the insufficient fluidity of supply chain, the production capacity reserves are difficult to fully play out, resulting in the constraints of production of emergency products.
- (3) **The contradiction between the rapid production and the production safety:** In response to the need for rapid production of emergency supplies, some enterprises would change their production structure to produce the required emergency supplies. Because these enterprises usually do not produce these products, so the safety of production is an important issue to pay attention to.

To cope with these challenges, the production of emergency supplies should continuously improve reliability, stability, safety and environmental adaptability, and develop towards standardization, automation, intelligence, service, combination of emergency and general purpose products. The integration and development of new generation of information technology (New IT) represented by the IoT, big data, cloud computing, artificial intelligence (AI), digital twins, etc., has spawned a series of new products, new applications and new models, which has greatly promoted the transformation and upgrading of the industry, and has had a major impact on manufacturing industry. Driven by New IT, the rapid manufacturing of emergency supplies provides new and effective ways for the above challenges. New IT enabled rapid manufacturing could satisfy the needs of standardization, automation, intelligence, service, combination of emergency and general purpose products.

4. The impact of COVID-19 on manufacturing

At the beginning of the COVID-19 outbreak, the normal operation of manufacturing enterprises was disrupted because of lack of preparation. In addition, as the pandemic continues to spread, the global pandemic inevitably has had a great impact on the future development of the

manufacturing industry. At present, the COVID-19 pandemic is still continuing. Because of its long duration and wide range of influence, problems such as difficulty in resuming work, tight material allocation, and service delays have also caused the manufacturing industry to face many challenges.

The manufacturing is a huge and complex system, including multiple links from material supply, logistics and transportation, manufacturing plants, and end users, etc. Each link and the supporting unit of the manufacturing industry are mutually coordinated and restricted. Any problem in any link would have a major impact on the manufacturing industry. For example, a part or even a process could affect the production of the entire product. Currently, the pandemic has had the following effects on the manufacturing industry. On the material supply side: due to the low rate of resuming work and opening of the material market caused by the pandemic, manufacturing companies that need upstream raw materials and parts are facing supply chain disruption challenge [16]. It is directly manifested as insufficient supply of raw materials, auxiliary parts, accessories, parts, equipment, fuel, etc., which restricts the production and operation of manufacturing enterprises. In terms of logistics and transportation: the logistics and transportation network that supports the transportation of upstream material and the distribution of downstream products has been severely affected. The prevention and control of the pandemic has affected the logistics of road, railway and air transportation, resulting in delay of goods transportation. On the manufacturing side: because the pandemic prevention and control measures (e.g., isolation and restrictions on the movement of people, etc [17].) have affected the personnel activities, coupled with the impact of logistics, the manufacturing capacity has been affected by the supply of raw materials and labor shortages. In addition, regular disinfection and the use of anti-pandemic equipment slow down the pace of production and reduce labor efficiency. In the end, the pandemic has also affected the market, leading to a decline in overall market demand and causing survival difficulties for manufacturing companies.

At the same time, the pandemic also exposed some problems in the manufacturing industry. First of all, during the pandemic, the overall supply chain monitoring and response plan lacked transparency, which caused difficulties for timely response and dispatch in emergency logistics. The reason is that the digitization of the supply chain is not perfect, and the application of digitization is not widespread in the entire supply chain. In addition, a large number of manufacturing companies are unable to rationally arrange production due to their rigid dependence on the supply chain, leading to many problems such as overstocking, insufficient output, and late delivery, etc. Moreover, the

problems of resource and information isolated islands in manufacturing enterprises have not been fundamentally changed for a long time, leading to the unsmooth resource sharing and collaboration across industries and enterprises. On the other hand, some companies have insufficient automation and flexibility. Due to insufficient automation, there is insufficient production capacity due to worker isolation and movement restrictions. Due to insufficient flexibility, some manufacturing companies have very poor adaptability. For example, during pandemic, when protective products such as medical masks, protective clothing, and goggles were not produced in time and could not keep up with demand, some companies quickly adjusted their production lines to produce pandemic prevention materials. And some companies went bankrupt due to insufficient flexibility.

Based on the above, the pandemic places the following demands for the manufacturing industry. Based on the high requirements of the epidemic on logistics response, the commonality and versatility of logistics need to be paid attention to. At the same time, logistics is also required to have certain flexibility to achieve the expansion of logistics capacity in a relatively short time. In addition, digital management platform of logistics is increasingly needed to quickly, timely and transparently understand changes in logistics status. The digital platform can optimize supplier channels and improve the timeliness and accuracy of supply chain data to provide an accurate data basis for decision-making when a crisis comes. On the other hand, manufacturing companies should pay more attention to promoting the application of flexible automated production lines and smart factories to promote automation and flexible production, reduce dependence on labor, and better respond to labor fluctuations [18]. Manufacturing companies should have the ability to produce a variety of products to increase the company's production line utilization.

How should manufacturing companies respond to the challenges, impacts and demands caused by the pandemic? The rise of a new round of technological and industrial revolutions has provided significant opportunities for the development competitive landscape of the manufacturing industry [19]. Digital technologies have the capability of providing better solutions during the COVID-19 pandemic and post-COVID era [20]. Through the integration of digital technology, network technology and AI technology, the internal and external data chains of the enterprise can be connected to each other, which can help the manufacturing enterprise to truly gain insight into data from all aspects and form an efficient collaborative system to assist managers in decision-making [21]. Digital technology, network technology and AI technology can help manufacturing companies improve employee collaboration efficiency, increase production and operation transparency, improve quality and efficiency, respond more efficiently to fluctuations in market demand, shorten the time to market for new products, and achieve product innovation.

5. New IT enabled rapid manufacturing

At present, the preparation of emergency supplies is mostly for replenishing physical reserves. However, it is not possible for the physical reserves to meet all the emergency supplies needs, regardless of the size or structure of the reserves. As a necessary supplement, production capacity reserve can effectively make up for the shortage of physical reserves. Therefore, it is necessary to unify production, reserves, purchase and other links to form a dynamic reserve system. In the normal production and living environment, the production and supply of these emergency supplies can be allocated according to market resources. If an emergency event occurs, a combination mechanism must be used to meet the "peak demand" for emergency medical supplies. New IT driven rapid manufacturing is a potentially effective approach to meet public emergency requirements. The word of "New" represents the innovations and latest development in information technologies. Compared with the traditional information technology, the essence of "New IT" can be viewed as intelligence technology. The core elements of

traditional IT are network, computing, storage, infrastructure, operating system, and system software, which mainly are used as tools to improve business efficiency. However, the core elements of New IT are cloud computing, Internet of Things (IoT), big data, 5 G, and artificial intelligence (AI), etc. [19] With the powerful abilities of data acquisition, transmission, analysis and decision-making, New IT can enable the launch time of new services faster, the system more reliable and stable, and the operation and maintenance of system more intelligent. Therefore, New IT can cope with the challenges posed by the COVID-19 pandemic.

With the deep integration of new technologies such as information and communication technology, new materials, artificial intelligence, and big data with traditional industries, the emergency industry will usher in unprecedented opportunities in new technologies, new products, new formats, and new models. Under the guidance of New IT, rapid manufacturing would involve the following aspects (Fig. 3).

5.1. New IT driven new emergency supplies design

Most emergency products are products that are often used in various disasters and pandemics, which have been included in the catalogue of emergency supplies by the government. However, emergency events are happening more frequently, the scope of influence is getting larger, and the types of emergency events are refreshed (for example, COVID-19), which puts forward new requirements for the types and functions of emergency supplies. The types and functions of emergency supplies need to change with emergency events, which demand new designs which must first fully consider the environment of the users. Furthermore, human behavior is also an indispensable and important link for the functional design of emergency supplies [22]. In New IT area, the design is New IT-driven. The environmental factors and the behavior data of the user are obtained and analyzed through the IoT, big data and artificial intelligence to improve the capacity for the designers to translate user voices into product features and quality requirements [21]. After the design, the design scheme is virtually verified using digital twin. With the virtual models reflecting both the designer's intent and the practical constraints, digital twin could enable the verification and iterative optimization of design scheme to identify design fault and take rapid improvement [23]. As a result, New IT driven emergency supplies design can make the design and development of emergency supplies an efficient and flexible process, which only can ensure the design level, but also shorten the design and development cycle while saving costs.

5.2. New IT driven emergency supplies rapid manufacturing

The rapid manufacturing of emergency supplies is first to quickly maximize the production capacity of the production shop-floor in the shortest time to produce enough emergency supplies. On the other hand, the rapid manufacturing of emergency supplies is to transform the existing production line into an emergency supplies production line to make up for the shortage of emergency supplies manufacturing. For the maximizing of the production capacity, data-driven is a good method, in which accurate and real-time data collection and analysis is the prerequisite for obtaining accurate insights [21]. New IT provides technical support for improving the production efficiency of the factory and unleash hidden capacity potential. IoT, cloud computing, big data, AI, digital twin, and other New IT can integrate data from all emergency events for more efficient joint processing and analysis [24], so that manufacturing companies can develop optimal manufacturing solutions to achieve rapid manufacturing of emergency supplies under the situation of rapidly changing emergency events. Besides, advance technologies like AI, 5 G, digital twin, etc. also can improve the flexibility and functionality of manufacturing devices such as robots [2]. With the support of New IT, production scheduling is optimally executed. Production tasks can be reasonably allocated according to the capabilities of

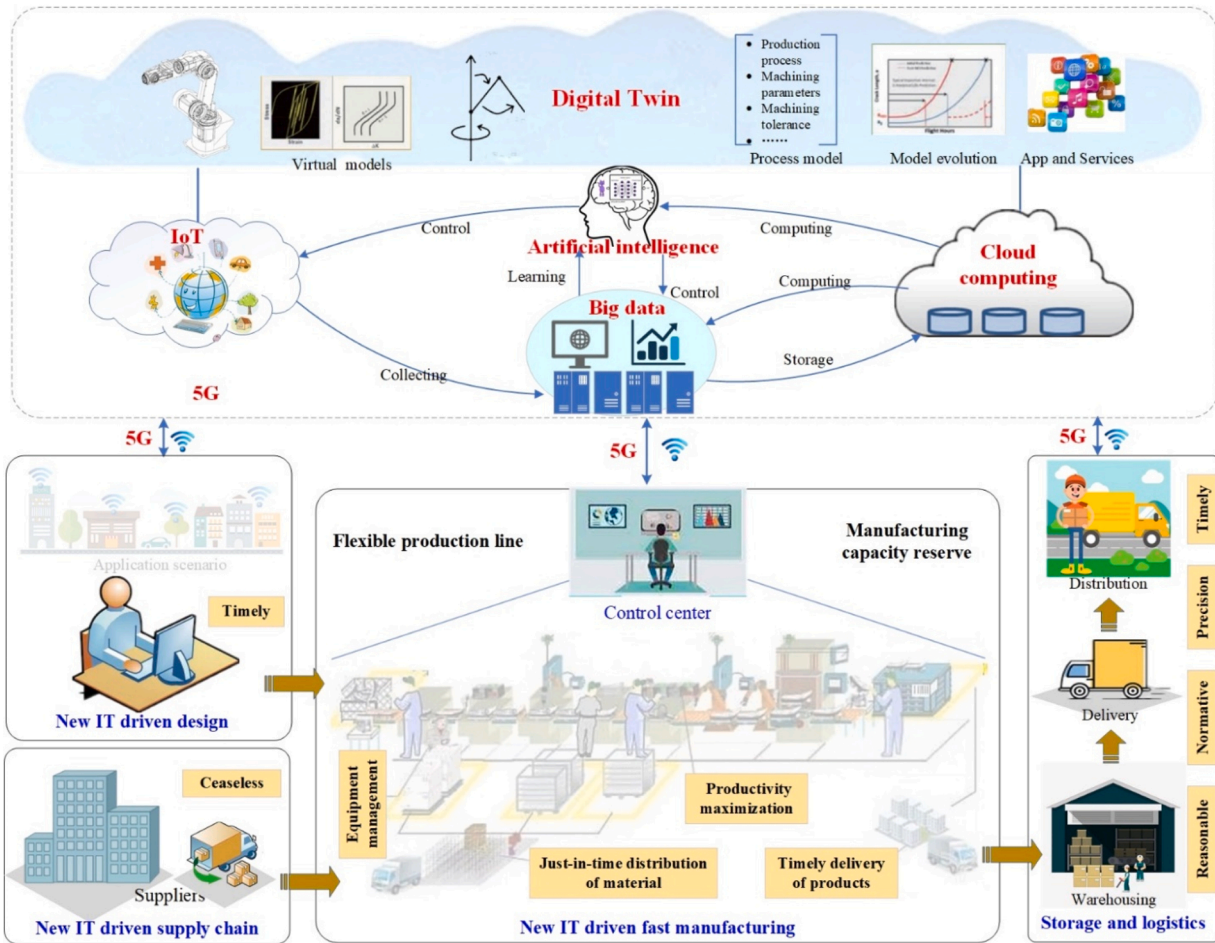


Fig. 3. New IT enable rapid manufacturing of emergency supplies.

the shop-floor and production line, ensuring the orderly production and timely delivery of products. For example, various parts should be manufactured in which production line, and what timing sequence should be followed between different production lines, etc. In addition, during the manufacturing process, New IT guarantees smooth and accurate shop-floor logistics. For example, from the material requirements of the production line, to the delivery of the material, and then to the distribution of the material, New IT-driven decision-making and control can select the optimal distribution route and complete the on-site distribution in the most suitable cycle, ensuring the smooth and rapid manufacturing. Moreover, by collecting various information about equipment, production and management on the production line, New IT can help manufacturers understand the status in real time. Once an exception occurs, the fault can be dealt with in a timely manner, reducing downtime events and ensuring the production capacity. On the other hand, New IT can help manufacturers design production capacity reserve. The production capacity reserve is to establish and improve the compatibility of productivity, which can quickly carry out production conversion to meet special needs under emergency conditions. The production capacity reserve should be considered and designed when the production line is designed and built. The design and verification of the hidden manufacturing capacity of the production line can be driven by New IT. By virtually running the hidden manufacturing capacity of the production line, all the expected functions of the production capacity reserve can be simulated to verify whether the design meets all the requirements, such as shop-floor layout, equipment configuration, material handling, buffer capacity, etc. Lastly, to ensure the rapid manufacturing of emergency supplies, the rapid supply of the supply chain is also a necessary condition. In the New IT-driven supply chain,

the process of purchasing raw materials, converting them into intermediate products and finished products, and selling finished products to users is monitored and controlled in real time. New IT-driven supply chain can effectively integrate suppliers, manufacturers, warehouses and stores. With New IT including IoT, Big data, cloud computing, AI, digital twin, etc., raw materials, intermediate products, and produced products can be sent to the right place in the right quantity, at the right time, and thus achieve the rapid manufacturing of emergency supplies without interruption.

5.3. New IT driven emergency supplies storage and logistics

New IT-driven storage and logistics for emergency supplies manages and monitors the procurement, storage, transportation, and distribution of emergency supplies. New IT-driven storage and logistics can monitor the entire process of emergency supplies in real time through IoT technology, big data technology, artificial intelligence technology, visualization technology, etc., and grasp the latest developments. According to the nature and impact range of the emergency events, New IT-driven storage and logistics make a preliminary demand analysis of the emergency supplies demands. And according to the specific conditions of distribution, varieties, specifications, etc. of emergency supplies, New IT-driven storage and logistics decided the emergency supplies reserves, release, etc. After an emergency event occurs, New IT-driven storage and logistics organizes transportation and distribution, and reaches the hands of those who need them. In all processes from the collection, storage, to distribution of emergency supplies, all information is collected, analyzed, and managed by New IT. New IT also provides an optimized model for the dispatch, transportation, and distribution of

emergency supplies, and provides intellectual support for the decision-making of the command organization, so that emergency supplies can be delivered to the demanders in the fastest and safest way in the shortest time.

6. Some suggestions

6.1. Production line function reservation

When new production lines and workshops are designed and constructed, the enterprises should take into account the production functions of emergency products. Reconfigurable manufacturing systems can satisfy this requirement, which not only produce high-quality products at low cost, but also allow for rapid response to market changes and consumer needs [25]. When an emergency event occurs, they can quickly transform their functions to produce emergency supplies in response to the calls for emergency production. For example, in the outbreak of COVID-19, many auto companies in China such as GAC, BYD, and Changan adjusted the production equipment to produce masks.

6.2. Improve relevant standards

The empirical, on-site response could lead to chaotic and inefficient situations in responding to emergencies events. Therefore, the mandatory standards for emergency supplies and emergency production should be improved. These standards include production, variety, specification, quantity, time, update, quality and cost standards, may stimulate the enthusiasm of individuals, enterprises and countries in emergency supplies production and regulate their behavior. In addition, the standards of various countries should be interoperable and compatible. For example, the protective effect of KN-95 mask and N-95 mask is the same, which should be compatible.

6.3. Improve laws and regulations

The formulation and improvement of laws could ensure that there are laws to be followed for emergency supplies reserve, emergency production, government procurement, storage and rotation, dispensing and transferring, requisition and compensation, etc. For example, the laws can stipulate the products directories included in the list of emergency supplies, the reserve threshold for these products and productivity threshold for emergency production. In addition, Tax relief and fiscal subsidy policies can be formulated to encourage enterprises and social organizations to produce emergency supplies and stock up on emergency supplies. Emergency supplies production capacity reserve, enterprise agent storage and other policies are also necessary.

6.4. Establish data and information sharing platform

Emergency supplies are related to the safety of life and property, which need to be monitored by the full name. The information sharing platform is used to collect and store the dynamic and static information of the entire process of emergency supplies production from demand, financing, storage, transportation, distribution to consumption. The information sharing platform is necessary for transparent supply and demand data, reasonable distribution to prevent social discontent and panic. For example, WHO has set up an online platform where clinicians can share anonymous patient data.

6.5. Improve the unified emergency supplies support system

The unified emergency supplies support system can guarantee the centralized management, unified allocation, peacetime service, emergency response in time of disaster, economy and efficiency of emergency supplies. Therefore, it is necessary to improve the relevant working

mechanism and contingency plans of the unified emergency supplies support system.

6.6. Global collaboration

Specialization, marketization and large-scale global collaboration are necessary to ensure emergency production and supply capacity. Especially in the case of the COVID-19 pandemic, global collaboration is key to fighting the pandemic

6.7. Improve the risk-sharing mechanism and promote insurance for major emergencies

The variety of insurance should be enriched to provide insurance for the personal safety of emergency personnel. The coverage of commercial medical insurance should be extended to cover more people and reduce the losses of enterprise and individuals.

7. Conclusion

The COVID-19 pandemic has caused a huge impact on the world. Under the pandemic, problems such as difficulty in resuming work, tight material allocation, and service delays have also made the manufacturing industry face many challenges in restoring production capacity. New IT can greatly reduce the time and cost of information exchange between enterprises through standardization and digitization. With its advantages in the information convergence, optimized scheduling, distributed collaboration, remote services, etc., New IT plays an important role in the production of medical protection materials and the precise allocation of emergency supplies. Driven by New IT, the rapid manufacturing of emergency supplies is presented to quickly meet emergencies demands.

Declaration of Competing Interest

The authors report no declarations of interest.

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