A Community-Based Emergency Response Management in Pasir Gudang, Johor: Theoretical Framework

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Abstract. Community-based emergency response management refers to a collaborative planning and engagement approach, which is designed to support communities and organizations in developing a safer, more resilient and sustainable future. That being mentioned, this study looked into the theoretical bases and practices in light of emergency response, apart from determining the functions of the community in line with emergency response. The primary goal of this study is to build a theoretical framework that enhances the functions of the community in times of emergency response. The mixed-method approach was adopted for data collection. The qualitative approach via interviews had been performed with organization and industry experts in Pasir Gudang, while the quantitative method was employed for the residents in Pasir Gudang. The theoretical framework embeds six elements of emergency response for the community to improve its emergency management. The identified community-based functions seemed to lack in activities, action, function, technique, knowledge, and skill. The proposed theoretical framework is bound to aid the management to comprehend the essence of community-based emergency response and to implement viable strategies in times of emergency.

1. Introduction
Pasir Gudang, being one of the biggest industrial cities, is located at the end east of the Johor Bahru District, Johor, Malaysia. It is known as a manufacturing center in Malaysia, a municipality region under the flagship zone of Iskandar Malaysia, and the third-largest province that has been envisaged to be a sustainable capital with worldwide stature in 2025 [1]. Due to rapid industrial development, the population at Pasir Gudang has been expected to escalate to 375,700, along with household population of 92,906 in year 2025 [2]. At present, Pasir Gudang is composed of 20 residential areas with the total households of 533,868, as tabulated in Table 1.
Table 1. Total households in Pasir Gudang (2013-2019).

| Year | Malay | Chinese | Indian | Others | Non-citizen | Total |
|------|-------|---------|--------|--------|-------------|-------|
| 2013 | 123,634 | 69,716  | 14,667 | 1,053  | 18,219      | 227,290 |
| 2014 | 124,826 | 69,826  | 14,814 | 1,120  | 21,160      | 231,700 |
| 2015 | 133,288 | 73,895  | 15,809 | 1,233  | 23,070      | 247,295 |
| 2016 | 192,645 | 106,248 | 22,759 | 1,801  | 34,007      | 357,470 |
| 2017 | 198,931 | 108,832 | 23,463 | 1,852  | 35,106      | 368,185 |
| 2018 | 268,005 | 145,290 | 31,333 | 2,510  | 47,184      | 494,322 |
| 2019 | 288,289 | 154,822 | 32,032 | 2,723  | 53,387      | 533,868 |

Pasir Gudang visions to be a "Renowned Prosperous City" [3]. The key industries are petrochemical, oleo-chemical, transportation and logistics, shipbuilding, electrical and electronics, food, metal, and oil palm storage. Most of these industries involve dangerous and hazardous substances. The increasing number in population, together with over 45 high-risk industries, seems to draw attention to a number of safety issues towards the surrounding communities. A scenario of emergency occurs due to major incidents involving hazardous materials, explosions, transportation accidents, uncontrollable fires, chemical spillage, or combinations thereof, resulting in injuries, evacuations, and fatalities. According to Perry and Lindell [4], without an effective emergency response management, the community is exposed to high risks with hundreds and thousands of lives at stake if an accident happens. Prior to emergency, the administrative and local communities must be equipped with community-based emergency-preparedness measures, as reflected in the management plans.

2. Community engagement for emergency response

For better engagement during emergency response, it is essential to educate the communities about their involvement in emergency management practice [5]. An effective emergency response practice reflects the willingness displayed by the community to get involved in emergency management. Such involvement points out a top-down transmission model, instead of a single-layer conversation line amongst all stakeholders [6]. [7] asserted that the partnership shared between communities and emergency management practitioners is training-obligated and regulation-driven emergency management processes.

Recent years have witnessed the adverse effects of fatal accidents, thus gearing up communities to organize effective emergency service activities [8]. As part of effective emergency management, the public is provided vital information in the form of advice, instructions, and warning [9]. Upon evaluation, the communities seem to display effective multi-agency coordination and response in times of emergency [10-12]. Recent studies have highlighted the exceptional leadership and operational roles portrayed by the engaging communities as part of emergency management practice in times of distress [13]. [14] emphasized on the significance of the existing activities led by community that gave a hand during calamities. It is certain that knowledge, values, practices, and response arrangements of the community may improve emergency response [15].

3. Theories relevance to emergency response

The nature of emergency response is one that is heavily practical. From the stance of practice, emergency response, as defined by [16], refers to actions taken in readiness for, during, and immediately after an emergency to ascertain that the impacts of emergencies are minimized. In light of academic, [17] explained response as the involvement of several agencies in the attempt of reducing the adverse impacts caused by unanticipated perturbation in a society that potentially threatens lives, assets, social values, and the environment.
Table 2 showcases that emergency response is composed of several activities that include a range of resources, various stakeholders at differing levels, and the affected communities. [18] and [19] had warned against making isolated empirical deductions or providing references that limit association with operations of emergency management, such as managing people, comprehending procedures, and mobilizing resources. Hence, the theories selected for this study had been based on their correlation and relevance to both functions and activities that enhance response.

| Emergency Management Phase | Activities | Actions | Functions |
|----------------------------|------------|---------|-----------|
| Response                   | Plan Implementation | Emergency declaration | Warning Messages |
|                            | Public information  | Inform Higher Authorities | Activate coordination centers |
| Registration and tracing   | Evacuation | Search and rescue | Mobilize resources |
| Damage assessment          |            |                     | Institute public health measures |
| Provide medical support    | Network Communication |                     | Provide immediate relief |

[20] claimed that several theories, namely broad perspectives, embryonic theories, micro theories, and normative theories, can be applied to identify emergency response in light of practitioners, along with their responsibilities during the response. [21], who had assessed a number of emergency response theories, namely decision, system, chaos, and management theories, depicted both the management of coordination of people, functions, and resources. The stated eight theories were employed to analyze emergency response and to identify gaps that exist in community-based emergency response. Table 3 describes emergency management and emergency response models.

Table 3. Emergency management and emergency response models.

| Classification of theory | Theory Title | Description |
|--------------------------|--------------|-------------|
| Normative theory          | Emergency management | This theory emphasizes on the application of preparedness concept for a response that involves the efforts of emergency managers and the development of operations plan of action during emergencies. |
| Perspectives theory       | Emergency management | This theory explains the actual problem that arises during the response phase and in emergency management. |
| Micro theory              | Emergency management | This theory explains prediction of human behavior on the effects of disasters. |
| Embryonic theory          | Emergency management | This theory initiates a framework conceptualized from elements derived from a real emergency response. |
| System theory             | Emergency management | This theory explains the integrative levels of elements |

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response within a system, the interplay between systems, and their elements in identifying their respective functions.

Management theory (F.W. Taylor, 1911)

Emergency response

This theory emphasizes on the measurement and specification of all organizational tasks. These tasks are standardized and organized based on hierarchy divisions to define the lines of authority and control.

Chaos theory (Henri Poincare, 1880)

Emergency response

This theory refers to a mathematical approach to study and predict the future behaviors of dynamic systems sensitive to initial settings. It has been adopted in philosophy, sociology, economics, and biology disciplines to depict issues stemming from the existing correlations in numerous social, organizational, and natural systems.

Decision theory (E.L. Lehmann, 1950)

Emergency response

This theory embeds rational concepts regarding decision making in adherence to design, intelligence, review, and choice.

3.1. System and management theory

The system theory elaborates the integrative levels of elements found in a system, the interplay found between the systems, and the elements based on their functions [22]. This theory is vital to comprehend organizational management based on parts that are unified to attain a certain objective [23]. The management theory reflects careful measurement and specification of organizational tasks that are organized by adhering to hierarchy, as well as by determining both control and authority [24]. Both system and management theories are essential in outlining emergency response procedures that demand exceptional correlation between activities and elements, aside from the implementation of the activities based on hierarchy of authority. The standard operating procedure (SOP), for example, is a set of official documentation that depicts decisions, policies, and actions for execution by emergency responders [25].

3.2. Chaos theory

The chaos theory, referring to a mathematical approach, predicts and studies the future attributes of systems sensitive to their initial settings [26]. Despite solely applicable to deterministic system [27], the chaos theory is used in philosophy, biology, and sociology domains to elaborate issues that stem from existing correlations in organizational, natural, and social systems [28]. Calamities are intricate events that adversely affect many aspects, such as security, public safety, legal and public affairs, communication, and coordination of organizations. The management theory is vital to attain the demanded coordination level, so as to manage effectively any emergency. Nevertheless, it is common for emergency management (at response stage) to incorporate various parties and organizations to interact in an interrelated manner [29].

3.3. Decision theory

The decision theory is composed of several rational concepts related to decision making in adherence to review, design, choice, and intelligence [30]. Stemming from time constriction and stressful condition during disasters, the rational decision models could become ineffective at the response stage in emergency management [31]. Both demands and obstacles noted at this stage have led to the application of various decision-making models to coordinate resources and implement plans to gain
effective response [32]. The Markov Decision Process (MDP) models can be applied within the context of management due to their attributes that emphasize on the response objective [33].

The MDP model, which offers mathematical framework, is impacted by both outcomes and conditions that are either controlled or random to deliver decision in times of disaster [34]. The process of making decision is essential to study numerous optimization issues [35]. The attributes of MDP, at the stage of emergency response, adhere to various related and real-time decision making to meet the response objective, as well as to manage the event evolving state and the actions of other agencies involved [36]. The primary objective of response is to hinder the adverse effects of any disaster on assets, people, nature, and other essentialities [37].

4. Development of a theoretical framework for community-based emergency response

A theoretical framework is the foundation of a study, mainly because a researcher can uncover all factors related to a problem from observations and readings. According to [38], a theory refers to a systematic and coherent formulation of concepts, models, and ideas used to construct meaning to explain, interpret, and model practice. Through a theoretical framework, researchers can integrate these factors logically to provide a scientific basis for research. [39] asserted that a theoretical framework refers to a conceptual model of how one makes logical sense of the correlation between certain factors related to the issue at hand.

[40] assessed the bases of emergency response by implementing several theories, for instance, management, system, chaos, and decision theories, in order to describe both management and coordination of functions, resources, and people. Such enhanced comprehension contributes to the domain of community-based emergency response. Based on the above theories, a theoretical framework was developed for community-based emergency response to display the relevance of the selected theories, as illustrated in Figure 1.

![Figure 1. The theoretical framework of community-based emergency response.](image-url)

5. Conclusion

Emergency response is indeed a critical phase in times of emergency. This paper, thus, assessed several emergency response theories to develop a theoretical framework for community-based emergency response in Pasir Gudang. Four theories were selected to evaluate the essence of emergency response, while six elements of emergency response were identified for the management to
implement viable and effective idea, so as to enhance the safety of the community during emergency events. It is better to be well-prepared and take appropriate measures in order to overcome any address impact on the community.

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