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The Organizational Threat to Urban Public Safety in China: Exploring New Policy and Regulatory Directions to Achieve Greater Control over Organizational Accidents in Urban Environments

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Abstract

China is experiencing an unprecedented era of economic and social growth. This growth has spurned massive urbanization, resulting in the proliferation of major cities, with all the prosperity and threats that such development brings. Indeed, one does not have to look far to see the threats posed by organizational accidents to urban public safety in China. Such accidents highlight the tight coupling and interactive complexity present within urban environments. Analyzed from one angle, such accidents could be seen as inevitable. On the other hand, theories such as High Reliability Organizing and Resilience Engineering suggest that such accidents can be averted through fostering positive capacities. In this paper, these contemporary theories of accident causation and prevention are applied to the urban safety setting, with a focus on fostering a suite of capabilities across urban systems. Suggested areas of inquiry are suggested to advance the science and practice of urban public safety in China.

Keywords: Urban public safety; Safety culture; Disaster prevention

Introduction

On 12th August 2015, a series of explosions ripped through a container storage facility in the Port of Tianjin, killing 173 people and injuring 798 more. Eight additional explosions occurred as the resulting fires burned uncontrolled over the following three days. Over 6,000 local residents were displaced by the disaster, and over 17,000 apartments were damaged by the blast shockwaves and subsequent fires. In all, the event caused significant damage and disruption; not only to the company and its immediate subsidiaries, but also to the surrounding general public.

Urban public safety is a field of study and practice that concentrates on the prevention, mitigation, and recovery from large-scale disasters that affect cities [1]. Hazards that urban public safety is typically concerned with include natural disasters such as fire, flood, and earthquake, terrorism, crime, and traffic accidents [2]. However, less cited are the threats posed by industrial or organizational hazards, such as the one that was triggered in Tianjin Port in 2017.

Literature Review

An under-appreciation of organizational accidents within the debate and practice of urban public safety in China represents a serious omission. On the one hand, organizations are a significant threat to urban public safety. On the other hand, organizations are also a source of positive capacity, ultimately contributing to the resilience of the overall urban system in the face of threats, disruptions, and disturbances.

In this paper, I describe the nature of urban public safety in China, and outline the characteristics of urban environments that make them particularly susceptible to disruption from organizational accidents. I then describe the application of several theoretical perspectives on organizational safety that has relevance to the urban safety setting. Finally, I consider urban public safety from a systems control perspective; specifically, I outline how public safety institutions could leverage culture to enhance overall performance of urban public safety systems.

Urban public safety in China

Understanding the vulnerability of cities in China to major disasters is of the utmost importance for a number of reasons. China is no stranger to major disasters, with over 200 million people being affected by natural disasters alone each year [3]. Notwithstanding the potential immense loss of human life and chronic suffering of those immediately affected, there are a host of widespread economic, social, and moral impacts [4]. Recent widely-publicized events in China highlight the vulnerabilities within the oversight and control of public safety [5]. A short summary of recent noteworthy disasters includes the following:

- Tainted milk powder in Sanlu, resulting in the deaths of hundreds of infants in 2007-2008.
- Contamination of major water supplies following chemical spills in Songhuajiang in 2005.
- Mislabelling of exported chemicals by pharmaceutical companies in 2007.
- The 2017 Sichuan landslide.
- The 2008 'great earthquake' in Wenchuan.

On initial inspection of this list, some disasters appear to be 'man-made' whereas others are naturally occurring. Ultimately, it can be argued that all disasters have their roots in the endeavors or inactions of humankind, as blessed with hindsight; we can quickly identify failures and omissions in planning, design, construction, response, and recovery.

Perhaps because of the ubiquitous nature of natural disasters in China, urban public safety is primarily concerned with this domain

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[6]. Yet, organizational accidents present a 'clear and present danger' to urban environments as vividly evidenced by the Tianjin disaster and a host of other events in recent years. China's explosive economic growth has fuelled the urbanization of most of the country, transforming the nation into a world superpower and exponentially raising living standards for millions of people [5]. However, the cost of this expansion has been the colocation of major industrial parks alongside residential and recreational areas.

Colocation of industrial and residential areas within urban environments is frequent in China. Tianjin Port is located just 30 kilometers from Central Tianjin, a city with over 15 million people, or the fourth largest city in China. Satellite data provided by Planet Sky shows the violation of a 1km buffer zone from the epicenter of the blast site; residential areas, public thoroughfares, and public buildings were all co-located with hazardous chemical storage areas.

An excerpt from Zuo et al. vividly illustrates the threat that organizational accidents pose to urban public safety [7]:

"*There have been small blasts before," Xu said. "We all know it's dangerous but we never expected something this bad could happen. The factories also provide us with jobs and improve our situation." Xu said she had decided to move further out, but her father had remained in Wangshang, a village located just 1km from the park. Zhu Xiaoying, who is also from Wangshang, described the industrial park as a "time bomb" and said the government, had insisted on building it close to the residential area. "When the industrial park was built around 2007, I knew it was a time bomb. We voiced our opposition but it didn't work, so we moved far away," Zhu said. "Now something terrible has finally happened."*

It is clear that industrial accidents pose a clear threat to urban public safety. But why are urban environments susceptible to industrial accidents, and importantly, what can be done to avoid them?

The nature of urban environments

Cities exhibit tight coupling and interactive complexity. Tight coupling is exhibited when a system exhibits several properties. Cities tend to be tighter in their coupling because of interdependency, coordination requirements, and information flow. As compared to rural villages, cities are densely packed spaces, with high concentrations of people and infrastructure in relatively small areas. Entities within a system are often mutually dependent on each other to function; inhabitants rely on services like supermarkets for food, supermarkets in turn rely on other inhabitants for labor and logistics companies for supplies, suppliers in turn rely on a complex web of distribution and management entities.

Cities are also tightly coupled in the sense that information, and hence disruption, can spread quickly. Consider the recent spate of terrorist attacks across the globe. Information about the events choked news networks and often spreads faster than public safety organizations can respond, resulting in panic, confusion, and potentially further loss of property and life [8]. Exposure to terror-related media can cause secondary traumas among an urban population [9]. Information about even small and isolated events can propagate quickly throughout urban environments as the social networks are tight, low latency, and nodes have multiple inputs and outputs.

Colocation of industry with residential areas further increases the tightness of urban coupling. As rural farmland becomes subsumed by industrial growth and expansion, residents turn to the factories and facilities as a source of income. Co-located industrial facilities reduce the physical separation between living areas and production areas. Consequently, there is an erosion of the natural buffer or defenses that physical separation provides against the uncontrolled release of hazardous energies.

Cities are also interactively complex, which means interactions are non-linear and far more sophisticated than serial cause and effect models predict. Urban environments, and hence, urban public safety, are best viewed from a systems-thinking lens where a system is decomposed into multiple subsystems, and their effects modeled as a series of feedback loops [4]. This perspective highlights several features of interactive complexity in urban public safety settings, namely:

- Personnel specialization (representing the different and oftentimes niche functions provided by public safety institutions, such as fire, police, and ambulance services).
- Multiple control parameters with unanticipated interactions (there is no centralized 'public safety' authority, and multiple institutions can make decisions that clash or reinforce one another).
- Indirect information on processes and anomalies (information must pass up the chain from units on the ground to controllers operating at higher levels).

The tight coupling and interactive complexity of urban environments presents challenges to the achievement of acceptable levels of public safety. According to Perrow et al, major disasters are 'normal' or inevitable where there is tight coupling and interactive complexity. This pessimistic view suggests that such systems should either be (unhelpfully) abandoned, or alternatively, decoupled or made less complex. In the case of cities, perhaps a strategy designed to lessen coupling would be a wise choice. Increased scrutiny of organizational planning permission, laws and regulations related to industrial and residential zoning, and implementation of buffers may be viable strategies to reduce coupling between dangerous technologies and residential areas, as is currently the case in China today [10].

The reality of the situation in China is that the ship has already sailed. The urban system is already tightly coupled, and short of decommissioning billions of dollars of infrastructure or relocating residential areas away from danger, urban public safety must focus its energies on managing the current risk and preventing future uncontrolled risk exacerbation.

The law of requisite variety states that a system must have as many responses as its inputs demand; in other words, a system must be able to generate enough responses to at least equal the requirements of its operating environment. Systems can generate such responses through prescriptive means, attempting to anticipate and pre-specify all possible contingencies and provide instructions on how to respond [11]. Practically, such an approach is fraught with danger because it is an impossible task. A better strategy is to instead encourage subsystems within a broader system to exhibit self-organizing properties like decentralized decision-making, improvisation, and adaptation. Under this approach, the system is able to self-generate responses, meaning that the overall control structure and hierarchy becomes much simpler, and is instead specified by general operating principles rather than prescriptive action and process rules.

In urban public safety, the scale of the systems being managed is enormous. The current approach of regulation and enforcement in China, and indeed globally, has so far proved inadequate to ensure public safety. Strict rules and procedures are frequently circumvented or simply ignored, as the pressures and temptations of expansion and prosperity drive the system closer to the 'edge' of safe performance.

Counter pressures designed to push the system back from the unsafe zone are either weak and inconsistent, or reactive. What is needed is a control mechanism that balances the need for prevention of harm with the promotion of positive capacities for success. Culture is one way in which systems can be loosely governed; whereby regulators can still achieve their public safety objectives in the absence of a complex web of strict rules and effortful compliance regimes.

The duality of the urban public safety control problem

According to Rasmussen et al, safety is best represented as a control problem. In this sense, 'control' refers to having power or influence over the course of events. In urban public safety, this means exerting purposeful influence over both banal and exceptional safety-relevant circumstances (i.e., daily traffic incidents and extraordinary industrial disasters), and steering outcomes towards desired end states. Control can be exerted based on feed forward influences that take into account feedback from sensors that map current system state and operating parameters. In society, proactive control is typically achieved using top-down processes; at a macro level, regulations, laws, business incentives, and planning/design are examples of the types of activities that generate control, and hence, safer outcomes. Reactively, emergency services and specific implementation of laws by such services result in the containment and recovery of urban incidents [12].

From one perspective, urban public safety is primarily a prevention-oriented endeavor, in the sense that the ultimate goal is preventing, reducing, and perhaps even eliminating the occurrence of negative or loss events like accidents. Interventions and activities centering on prevention include public monitoring, use or threat of force by policing services, safety inspection regimes, and safety requirements. Such activities could be positioned as a means to encourage the fulfillment of duties and obligations, compliance, and risk-aversive behaviour among citizens [13].

Alternatively, urban public safety can contribute positively to the growth, prosperity, and overall flourishing of city environments through a promotion-based approach. For example, urban designers routinely combine aesthetic and functional principles that enhance the urban environment (and in so doing, contribute to positive psychological and behavioural states), as well as incorporating traditional safety mechanisms such as defenses against traffic incidents, terrorism, and stampedes [1]. Inherent within Chinese culture is an implicit focus on the role of physical space and design aesthetics, which can help to promote positive capacity in urban safety. Positive capacity interventions and design characteristics encourage promotion, whereby feelings of safety and security are supplanted by a desire to grow, develop, innovate, and strive towards the achievement of positive goals [13]. In this way, urban public safety can contribute to the development of positive capacity for resilience.

In reality, both control strategies are required. On the one hand, highly dangerous technologies and processes require techniques to ensure safety and reliability. Strategies including standardization, prescription, and reutilization are 'tried and true' ways to achieve public safety. Public policy informs the development and passing of legislation, which in turn results in detailed regulations, which further cascade down into codes of practice, standards, and certifications. Practically, organizations conduct audits and inspections to ensure compliance, which are supplemented by government enforcement regimes, albeit in a limited manner given the small ratio of inspectors to businesses.

An exclusive compliance-based approach produces diminishing returns in practice because its punitive nature drives secrecy and an adversarial relationship with system controllers [14]. In addition, prevention-focused initiatives are typically reactive in that they rely on a trial and error approach; laws and regulations are developed, cases are tested, and laws implemented. Such an approach is error-prone (legislation can produce intentional effects on public safety, such as the roofing insulation scandal in Australia) and has a long time lag.

Modern regulatory approaches seek to counter this problem through an emphasis on proactive and promotion-focused engagement activities [15]. Engagement activities are inherently promotion-focused as they typically include principle-based legislation (where organizations are given broad objectives or principles to achieve rather than compliance with specific requirements). Engagement also includes advisory and quasi-consulting services that businesses can access free of charge or at a very low cost. Examples from Australia include safety management system advice and leadership development programs [16].

Culture in a regulatory regime for urban public safety

Regulators in safety have dabbled in culture with mixed results. In Norway, the offshore petroleum regulator introduced a requirement for organizations to achieve a 'sound HSE culture', which departed from the traditional approach of accountability and compliance [17]. Although industry expressed concern about the breadth and ambiguity of the principles, overall the change was successful at driving greater attention on social factors and their role in driving safety outcomes in high hazard industries. It also changed the role and industry perception of the regulatory from 'command and control' to 'educate and engage'. This opens the door for regulators in urban public safety to improve outcomes for society through adopting a principle- and engagement-based approach.

Definitions of safety culture abound

Some definitions are all-inclusive, consisting of behaviour, structures, and systems [18], whereas others are more nuanced and intangible, consisting of 'deep-seated assumptions' and beliefs [19]. These definitions hint at two differing ontological approaches; functionalist (culture as something an organization 'has') and interpretivist (culture as something an organization is or does). Functionalist approaches have the advantage of being prescriptive and normative; offering a template against which organizations can be measured, monitored, and controlled. However, the interpretivist way of treating culture has been criticized as superficial, judgmental, and ultimately, unrealistic in its imposition of a homogenous framework of attitudes, values, and behaviour [20].

The functionalist approach overcomes these problems by suggesting culture is an emergent property of an organization. Culture is positioned as heterogeneous and dynamic, being shaped and reformed as people interact and make sense of their environment. The 'stable' component of culture refers to implicit social norms and conventions of behaviour, stories, aspirations, and deeper beliefs about what constitutes a hazard and how it should be controlled. These intangible components are shaped and reformed over time as new beliefs are introduced by people with power, beliefs are updated or challenged, and events produce transformational experiences that require an overhaul and refresh of the existing culture.

Discussion

Although the interpretivist view has been challenged for its impracticality (i.e., what can organizations and regulators do), a middle ground can be reached whereby the evaluative and normative flavor of a functionalist approach can be combined with the emergent and

nuanced nature of an interpretivist approach. For instance, safety culture could be defined as the assemblages of meaning around risk that shape safety-related decision-making and behaviour. Such a definition shifts the attention from culture as a 'thing' that can be bolted on or done to organizations, and towards developing a deep understanding of sense-making processes and outcomes of meaning in organizational settings. By adopting a functionalist approach to culture, and implementing in the urban public safety context, system controllers can exert a powerful yet 'soft' measure of control over high hazard organizations and indeed, the system itself.

Application of safety culture to urban public safety

Treating safety culture as patterns of meaning has a number of important implications for urban public safety. A core challenge faced by public safety institutions is information management. An effective urban public safety institution requires not only high volume and low latency information, but also high quality processing and sense-making. Public safety institutions are essentially decentralized, with multiple interdependent entities requiring mutual coordination, inter- and intra-organizational information sharing, and joint decision-making. Culture can act as a barrier or a facilitator of smooth operations between public safety institutions. Past experiences and stories regarding interactions between public safety organizations could impair cooperation, resulting in missed opportunities to share information and prevent major organizational accidents. As culture drives decision making around the development and implementation of structures and systems, an unhelpful cultural base between institutions could discourage the establishment of protocols that promote information sharing.

Moreover, public safety institutions need to be alert to increasing risk among organizations located close to residential areas and major public infrastructure. Internal organizational cultures that emphasize secrecy, denial, and confrontation with public safety authorities are likely to prevent the upwards flow of accurate information to inform risk identification and assessment. By engaging directly with industry in an engagement capacity, new cultural beliefs and norms will likely develop, fostering a culture of open reporting and participation in regulatory initiatives that promote safety. Public safety authorities should critically examine the punitive repercussions often dealt out to violations of legislation to balance retribution with restoration. Restorative justice emphasizes accountability through reparation, acknowledgement, and learning. Retributive justice emphasizes accountability through punishment, sanctions, and reinforcement of obligations. The former opens channels of information and ultimately uses less resources whereas the latter shuts down communication and hence requires intense resource allocation to uncover the true state of affairs within organizations (e.g., expensive regulatory 'blitzes' and oversight).

Mapping the safety culture of public safety institutions and their interactions with industry safety culture has the potential to reveal a slew of levers that could result in better informational management. Interviews and focus groups conducted with a range of public safety stakeholders, ranging from institutions like fire services and disaster response, through to industry, and finally, the general public, would identify patterns of meaning and opportunities to enhance culture in ways that improve the quality of information. Although such an endeavor would be effortful and involve deep consultation, it stands to provide a great deal of benefit to public safety institutions looking for ways to remove barriers to both the upwards and downwards flow of information.

Others have argued for a greater focus on safety culture in a public setting [6]. Education of citizens in risk management and basic safety science theories and expectations is likely to apply a bottom-up pressure on the public safety system and on high hazard organizations themselves who are operating in public spaces. Public opinion can act as a pressure gradient on the urban public safety system, providing upwards feedback to public safety institutions to update or refresh legislation, deny industrial development applications, and ramp up compliance inspections in response to perceived danger. An informed and educated society is able to make better decisions around risk and has more options available in terms of alternative employment (decreasing the reliance on high hazard industry as a source of income). Public safety education thus standards to act as a powerful system-level intervention that could shape the properties and behaviour of the entire Chinese public safety system [21].

Taken together, the above discussion highlights a number of specific research questions for public safety scholars to investigate in China:

- What barriers exist to the effective communication and transfer of risk-related information within and between public safety institutions?
- What is the effectiveness of public education in risk-related concepts on overall public safety system dynamics and performance?
- What opportunities do different stakeholders have to interact with each other about safety topics and what role does organizational culture play in facilitating or impeding the interpretation and action of such information?
- How effective is an engagement-based approach at improving public safety outcomes in contrast to a compliance-based approach?
- How could the culture of urban public safety across Chinese cities, in terms of the interplay between the general public, industry, and public safety institutions be mapped and modeled?

Conclusion

Across China, urbanization is exploding. Cities have increased in size exponentially in a short space of time. Such urbanization has resulted in great prosperity and advancement, and even improvements in public safety through establishment of disaster recovery, crime deterrents, and emergency response services. Yet, organizations are increasingly collocating with residents, enticed by local governments to bring prosperity to the area. Residents too are driven by the prospect of a stable income and a better life. However, this colocation of high hazard industries, coupled with poor organizational safety cultures, regulatory authorities that focus on top-down compliance and effortful (and ultimately impossible) inspection regimes, and system level drivers such as a desire for economic growth, foreign demand for exported products, and business development incentives present a dangerous combination of conditions that are cause for concern. Urban public safety can improve its reach and influence through considering the role of culture. Culture acts as a mechanism for system control at multiple levels; education of the general public provides bottom up pressure for safety; policy, regulation and regulatory strategy provides top down pressure for safety.

References

1. Cai K, Wang J (2009) Urban design based on public safety-Discussion on safety-based urban design. Front Arch and Civ Eng 3: 219-227.
2. Delucchi M, Kurani KS (2014) How to have sustainable transportation without making people drive less or give up suburban living. J Urban Plan Dev 140: 172.

3. ADRC (2019) Asian Disaster Reduction Centre: Hyogo Publications, Japan.
4. Yu D, Fang C (2017) The dynamics of public safety in cities: A case study of Shanghai from 2010 to 2025. Habitat Int 69: 104-113.
5. Wong C (2009) Rebuilding government for the 21st century: Can China incrementally reform the public sector? The China Quart 200: 929-952.
6. Lixin Y, Lingling G, Dong Z, Junxue Z, Zhanwu G (2012) An analysis on disasters management system in China. Nat Haz 60: 295-309.
7. Zuo M, Leng S, Zhang P (2019) 'I knew it was a time bomb': China chemical plant blast was not the first at industrial park. South china morning post, P.R. China.
8. Foa EB, Cahill SP, Boscarino JA, Hobfoll SE, Lahad M, et al. (2005) Social, psychological, and psychiatric interventions following terrorist attacks: Recommendations for practice and research. Neuropsychopharmacology 30: 1806.
9. Ben-Zur H, Gil S, Shamshins Y (2012) The relationship between exposure to terror through the media, coping strategies and resources and distress and secondary traumatization. Int J Stress Manage 19: 132.
10. Perrow C (2011) Normal accidents: Living with high risk technologies-Updated edition. Princeton university press, USA.
11. Dekker S (2017) The safety anarchist: Relying on human expertise and innovation, reducing bureaucracy and compliance. Routledge, UK.
12. Rasmussen J (1997) Risk management in a dynamic society: A modelling problem. Saf Sci 27: 183-213.
13. Casey T, Griffin MA, Flatau HH, Neal A (2017) Safety climate and culture: Integrating psychological and systems perspectives. J Occup Health Psychol 22: 341.
14. Battmann W, Klumb P (1993) Behavioural economics and compliance with safety regulations. Saf Sci 16: 35-46.
15. Almond P, Gray G (2017) Frontline safety: Understanding the workplace as a site of regulatory engagement. Law Policy 31: 5-29.
16. OIR (2019) Safety leadership at work program, Government of Australia.
17. Antonsen S, Nilsen M, Almklov PG (2017) Regulating the intangible. Searching for safety culture in the Norwegian petroleum industry. Saf Sci 92: 232-240.
18. 75-INSAG-4 (1991) Safety culture. Vienna: International Atomic Energy Agency, Austria.
19. Edwards JR, Davey J, Armstrong K (2013) Returning to the roots of culture: A review and re-conceptualisation of safety culture. Saf Sci 55: 70-80.
20. Dekker S (2019) Foundations of safety science: A century of understanding accidents and disasters. Routledge, UK.
21. Medium Corporation (2019) Planet Series: Tianjin Explosions Aftermath: Understanding risk in high-res. Medium, USA.