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Grappling with Grand Crises: An Ecosystem Approach

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Abstract

Organizations are vulnerable to grand crises, such as pandemics, terrorism, and climate disasters that are complex and often require a crisis management ecosystem (CME) to address them. However, the nature and core features of CMEs have not received much attention in the crisis management literature. In this paper, we provide insights into the complexity of grand crises, and the core features of CMEs that are important to address them. We draw from the management literature on ecosystems and crisis resilience, and study CMEs that were used in the United States, Spain, and India to respond to the Covid-19 pandemic. We also discuss the contributions and implications of our paper for crisis management research and practice.

Keywords

change/transformation, resilience, structure, design and boundaries

Introduction

Sarah Kovoor-Misra

Organizations can be vulnerable to the devastation from highly complex "grand crises," such as the 9/11 terrorist attacks, the Covid-19 pandemic, and climate disasters. An organizational crisis is a threat to an organization's survival and goals (Kovoor-Misra, 2020). As organizational crises can vary in their severity and scale of impact, we refer to the more severe, complex crises as "grand crises" in this paper. In a grand crisis, multiple organizations are in crisis, the scale of impact is large, and complex crisis management systems with multilateral, interorganizational relationships are necessary to address their escalation and contain them. For instance, the Covid-19 pandemic disrupted numerous organizations economically and socially in many countries, it was a grave threat to human life, and its resolution required collaboration and multilateral, interorganizational relationships so that a vaccine could be developed and administered to a large population. As such, grand crises because of their grave threat levels, scale of impact, and complexity of resolution are a class of organizational crises that require more complex crisis management systems than those that address less severe crises.

Organizational crisis management research in the business management literature has advanced our knowledge of systems necessary for an individual organization in crisis (e.g., James & Wooten, 2010; Kovoor-Misra, 2020; Pearson & Clair, 1998). For instance, researchers suggest that organizational factors, such as crisis plans and teams, culture, leadership, identification, learning, and the dyadic positive relationships with stakeholders are crucial for effective crisis management (see Kovoor-Misra, 2020; Pearson & Clair, 1998). In addition, the field of public administration has studied interorganizational relationships primarily between various governmental agencies during crises, such as wildfires, hurricanes, and bombings (e.g., Curtis, 2018; Dinh et al., 2024; Moynihan, 2009). They focus on the role of crisis response networks that typically are centralized with an incident command leader who has largely dyadic relationships with network members. Predefined routines and roles enable these structures to execute during the urgency of these crises (Moynihan, 2009). However, research finds that crisis response networks tend to be slow to scale as the crisis escalates and spreads, coordination

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among an increasing number of actors becomes difficult, and new actors that are key for a specific crisis tend to be ignored (Curtis, 2018; Moynihan, 2009). The broader ecosystem and the role of multilateral, interorganizational relationships because of interdependencies that are critical during a grand crisis have tended to receive less research attention. Therefore, to capture the complexity of managing grand crises, we suggest that scholars take an ecosystem perspective and focus more broadly on the larger crisis management ecosystems (CMEs). These ecosystems can have nested within them crisis response networks and individual organizations in crisis. A focus on CMEs can provide a broader lens on crisis management efforts during a grand crisis, and provide insights into their core dimensions and features and the strategies that are required to address them. More recently, authors have focused on service (e.g., Fehrer & Bove, 2022) and innovation ecosystems (e.g., Sahasranamam & Soundararajan, 2022), in the context of a crisis. However, the larger CME where these subsystems are nested tends not to be addressed.

In this paper, we study the nature and core features of CMEs to broaden and extend research on organizational crises. We study CMEs by drawing on the management literature on ecosystems (e.g., Adner, 2017; Jacobides et al., 2018) and crisis resilience (e.g., Kovoor-Misra, 2020). We also study how countries, such as the United States, India, and Spain used CMEs to respond to the Covid-19 pandemic. The pandemic provides us with an extreme case to study CMEs. These extreme situations are important as they enable the phenomenon under study to be more clearly visible and can contribute to advancing theory (Eisenhardt, 1989). Below, I begin by providing an overview of some key crisis management and ecosystem concepts, and highlight the nature and core features of CMEs. Next, my co-authors discuss how these core features were present in the CMEs used by the United States, India, and Spain to contain the Covid-19 pandemic. Finally, I conclude the paper by discussing some commonalities and difference among these CMEs, and the contributions and implications of our paper for future research and practice.

The Nature of Crisis Management Ecosystems

An *organizational crisis* can *severely threaten* an organization's survival and/or goals, because it can result in a loss of human and/or environmental life, property, and financial resources; and tarnish an organization's reputation and brand (e.g., Kovoor-Misra, 2020). Further, exacerbating the *complexity* of crisis situations is that they also tend to be ambiguous and uncertain, in terms of their causes and the means to prevent and contain them (Pearson & Clair, 1998). Therefore, to address the severity of an organizational crisis, scholars suggest preparedness strategies before the crisis, containment efforts during a crisis, and recovery and growth mechanisms post-crisis that can also contribute to preparedness for future crises (Kovoor-Misra, 1995, 2020; Pearson & Mitroff, 1993). See Figure 1.

Scholars have sought to classify organizational crises using various typologies. For instance, Pearson and Mitroff (1993) classify organizational crises based on the factors (technical/economic or human/social) that caused the crisis, and whether they originated from a routine failure or deviance, such as a saboteur. In addition, Kovoor-Misra (1995) uses a multidimensional approach and classifies crises based on which dimension of the organization the cause of the crisis originated or which dimension of the organization is most severely impacted by it. In this framework, crises could be categorized as technological (e.g., oil spills), natural environmental (e.g., hurricanes), human and social (e.g., workplace violence), legal (e.g., lawsuits), economic (e.g., bankruptcies), and political/ethical (e.g., scandals). In this paper, since organizational crisis situations can also *vary in their complexity,* I differentiate between crises using this attribute. I focus on the *extent and reach of the crisis* and the *uncertainty* in the crisis situation. See Figure 2. For instance, a crisis can be limited to a single organization and its stakeholders, such as a workplace violence incident caused by a disgruntled employee. In other cases, multiple organizations can be in crisis at the same time, such as during a recession, pandemic, or a natural disaster that impacts a large region. In addition, complexity can also vary during a crisis because of varying degrees of uncertainty due to the severity of loss; the novelty and ambiguity associated with the cause, effects, and means of resolution; and the extent to which multiple, diverse organizations are required to collaborate to contain the threat. It is also important to note that crisis situations are dynamic and can escalate in their complexity over time. As a result, leaders need to recognize and track their severity and complexity and devise and expand structures and systems to address them, if necessary. For example, as a crisis expands beyond an organization's boundaries, crisis response networks of dyadic, interorganizational relationships can be activated. In situations that are even more complex, because multiple organizations are in crisis and diverse actors with multilateral relationships are required for its resolution, an ecosystem approach may be effective. In Figure 2, we depict how *grand crises* are in the upper right quadrant of complexity where multiple organizations are in crisis and uncertainty is high requiring multiple, multilateral, interorganizational relationships for their resolution. In these situations, an ecosystem approach is important to collectively address the shared threat and fate of multiple organizations.

The *organizational ecosystem* perspective is based on an *open systems* approach and is adapted from the biological sciences (Iansiti & Levien, 2004). In our discussion, we apply

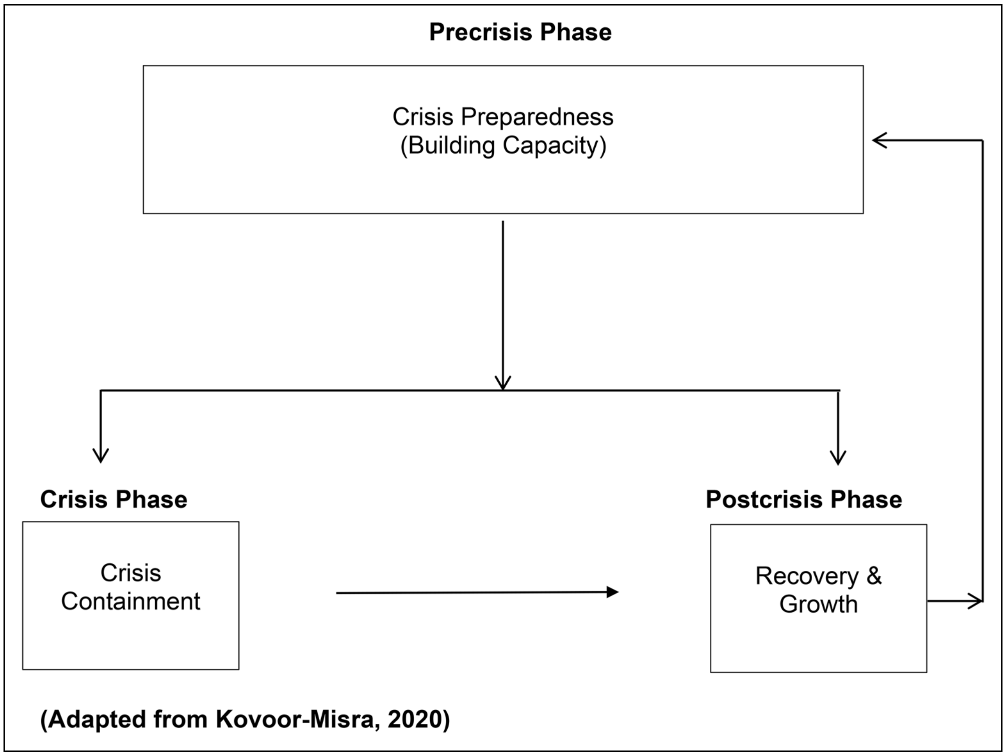

Figure 1. Phases of crisis management.

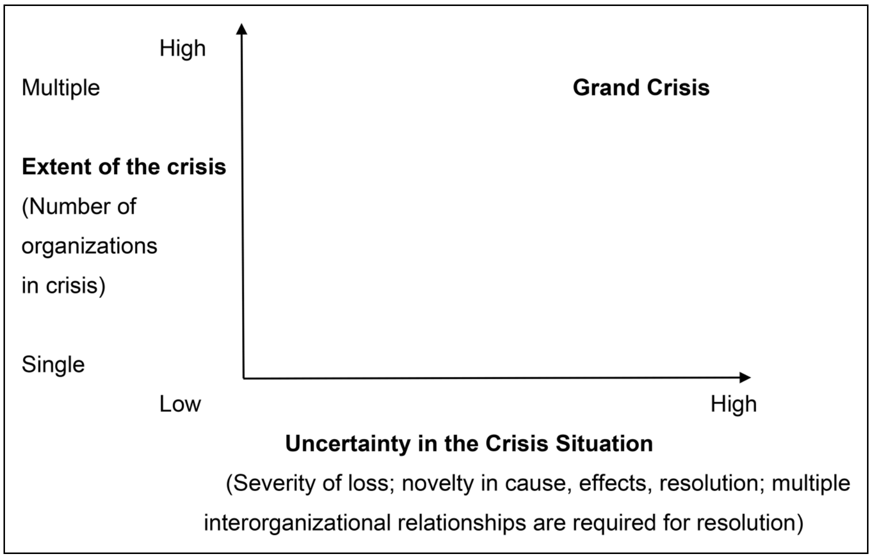

Figure 2. Grand crisis complexity.

the core features of organizational ecosystems that are discussed in the management literature (e.g., Adner, 2017; Jacobides et al., 2018) to describe CMEs, such as shared value propositions, structures, and dynamics. We also discuss the role of capacity as a dimension because it contributes to resilience that is necessary to contain and recover from a crisis, and is a key factor in the crisis management literature (e.g., Kovoor-Misra, 2020; Pearson & Mitroff, 1993). The core features of CME are summarized in Table 1 and discussed below.

Organizational ecosystems involve multiple organizations, with multilateral relationships between them because

Table 1. Core Features of Crisis Management Ecosystems.

Ecosystem dimension	Characteristics
Context and value proposition	Visible severe threat and shared fate because of threat to organizational goals, survival, life, and property Situational urgency and need for speed for resolution Clear situational value proposition to contain threat and contribute to social good
Structure	Diverse actors, with formal and informal, multilateral interorganizational relationships, and government as orchestrator. Prior institutional arrangements, roles, and responsibilities are adapted. New structures are created, if necessary.
Capacity	Resilience and resource capacity for urgent and quick response (resources, knowledge, structures)
Dynamics	Collaboration and/or competition. Coopetition is managed to address divergent political and economic interests.

of interdependencies, and a *shared value proposition* (see Adner, 2017; Jacobides et al., 2018; Shipilov & Gawer, 2020, for a review). The members of an ecosystem are interdependent and complement each other in terms of their contribution to their collective goals (Cobben et al., 2022). There are various *types of ecosystems* based on differences in their value proposition, and organizations can be members of multiple ecosystems. For instance, in non-crisis contexts, organizations may be part of business ecosystems that involve a number of organizations that share platforms around the value proposition of creating competitive advantage, such as Walmart and its various suppliers; or Microsoft and its diverse application developers (Iansiti & Levien, 2004). In addition, organizations may also be members of entrepreneurial ecosystems that are built around the value proposition of creating new ventures; innovation ecosystems that work on new products or services; knowledge ecosystems that seek to develop new knowledge on an issue; and service ecosystems that focus on providing complex services, such as healthcare (Cobben et al., 2022; Fehrer & Bove, 2022).

In a grand crisis context, organizations come together and create CMEs where the value proposition would be to contain the crisis and limit damage from present and future threats. Once there is consensus on the presence of a severe threat, the shared value proposition to contain the threat is clear and visible to all in a CME. In addition, because of the extreme threat, there often is *shared urgency* and the *need for speed* to work towards the value proposition in CMEs. This can result in heightened internal motivation among members of CMEs to resolve the situation, collaborate, and contain the crisis. Ecosystems are useful as they enable multiple organizations to rally around a shared value proposition, and this approach has advantages over going at it alone.

As open-system entities, ecosystems receive *inputs*, such as finances, information, or human resources from their external environments. These resources are used to create *outputs* in terms of products and services in response to external demands (Iansiti & Levien, 2004). In a CME, the outputs involve solutions (products, services, or processes) to prevent, prepare for, or contain a crisis and limit damage. To transform inputs into outputs, ecosystems have *structures* and boundaries and multiple actors have specific roles based on their contribution to the value proposition, and multilateral relationships between them as they perform certain activities. For the ecosystem to function effectively there needs to be alignment, in terms of a shared understanding of roles, activities, and the transfer of activities between actors (Adner, 2017). In addition, in terms of governance, the actors can be centrally coordinated or it can be decentralized and distributed (Jacobides et al., 2018; Olk & West, 2023; Shipilov & Gawer, 2020). In the case of CMEs, the actors can be diverse and include governmental agencies at the national, state, and local levels; and various business, nonprofit, university, and/or community organizations who can contribute to the crisis management effort. During a grand crisis, based on their legal powers or willingness to contribute to crisis management, the roles and responsibilities of each actor are based on previously specified responsibilities or are negotiated. The actors can have formalized contractual relationships with each other, such as between governmental agencies and pharmaceutical companies during the pandemic; or the relationships can be more informal, such as business organizations and citizens recognizing a need and contributing through donations or crowdsourcing.

Further, the ecosystem boundaries can be physical, symbolic, and social, and for its stability they need to be largely agreed upon by members. Internal boundaries, such as those between national, state, and local governments, could be based on legitimacy, status, and power dynamics that create a multi-layered system of levels that are hierarchically organized (Razmdoost et al., 2023). External boundaries enable the ecosystem to determine membership, provide an identity, protect its resources, and differentiate it from other ecosystems (Lamont & Molnar, 2002; Razmdoost et al., 2023). For instance, during the Covid-19 pandemic, national boundaries around CMEs became socially accepted and were evident in how statistics around the incidence and death rates associated with Covid-19 were reported. Therefore, CMEs can be large and have nested sub-ecosystems within them. For instance, in a large national ecosystem, sub-ecosystems can be present at the state or regional levels. In smaller nations, one would expect fewer layers within the CME.

It is also important to note that internal actors may be called upon to play the role of boundary spanners to coordinate between the various parts of the ecosystem and with external parties and ecosystems (e.g., Razmdoost et al., 2023). As a result, members of an ecosystem also interact with external parties as they strive to execute towards their value proposition, access resources, and influence other ecosystems. In addition, external parties may facilitate and coordinate the efforts of multiple ecosystems. For instance, during the Covid-19 pandemic, the World Health Organization and other organizations, such as the Coalition for Epidemic Preparedness Innovations (CEPI) played a facilitating role between various national ecosystems. In addition, internal and external actors may exert pressure to expand boundaries to access resources (Razmdoost et al., 2023). For example, during the Covid-19 pandemic, the World Health Organization repeatedly called upon richer countries to include poorer countries in their crisis containment efforts. Therefore, the permeability or openness of boundaries impacts access to resource inputs and relationships with internal and external actors (Faraj et al., 2011). Further, ecosystems may vary in fluidity and form (Razmdoost et al., 2023), as boundaries shift and membership changes based on the demands to fulfill the value proposition.

The Covid-19 pandemic highlights the global dimension often associated with a grand crisis. There were international actors, such as the WHO in the environment of most national crisis management ecosystems. In addition, there were also large global businesses, such as various pharmaceutical companies (e.g., Moderna and Pfizer) who were key actors during crisis management. Consistent with classifications used in strategy research (e.g., Mithani et al., 2021), we classify a global business as an internal actor if it is headquartered in the focal country being discussed. The rationale for this criteria is that typically the top managers of a company are present in these locations, it is the seat of important decisions, and it is often the principal place of business. We categorize the business as an external actor if it is not headquartered in the country, even though they may have operations within that country.

The extent to which ecosystems can fulfill their value proposition and adapt to external demands is also dependent on their *capacity*. This capacity can be cognitive, which is the extent to which members have the necessary knowledge and skills to fulfill their roles; structural, where the system can organize and coordinate between internal and external actors; and resource-based, in terms of having sufficient access to internal and external resources (e.g., financial, informational, human, technological) (Iansiti & Levien, 2004; Kotsopoulos et al., 2022; Razmdoost et al., 2023; Sahasranamam & Soundararajan, 2022).

In the case of CMEs, the capacity to also be resilient, agile, and transformative is critical to be able to address the urgency and the need for speed that is associated with a grand crisis (Fehrer & Bove, 2022; Sahasranamam & Soundararajan, 2022). This resilience capacity involves balancing change and efficiency, and can be built into the ecosystem before a crisis. The ecosystems need capacity in the form of adaptable structures, routines, and resources, such as crisis teams, plans, procedures, and technology to be able to respond with speed to the urgency in the crisis situation. For instance, hospitals and medical clinics had to quickly adapt at the local levels and new structures, such as Operation Warp Speed were created at the national level in the USA during the pandemic (GAO, 2021). To enable such agility and resilience, CMEs require leaders and actors with the requisite knowledge and skills; resilient, innovative, and transformative cultures; and positive relationships with multiple actors. Further, post-crisis the ecosystem needs to recover, learn from the experience, and make the necessary changes to prevent future occurrences or address future grand crises (see Brodie et al., 2021; Fehrer & Bove, 2022; Kovoor-Misra, 2020). In some instances, an established CME may not exist because the grand crisis is novel. This was the experience for the United States during the Covid-19 pandemic. In these cases, actors rely on existing institutional, financial, and leadership resources to speedily build ecosystems during crisis management.

In addition, the *dynamics* among members of an ecosystem and other external entities can also affect the ecosystem's performance. These dynamics can be complex and collaborative around the shared value proposition, or they can be competitive as member interests can also diverge (Adner, 2017; Siegel et al., 1990; Shipilov & Gawer, 2020). During crisis management, collaborative dynamics can center around the sharing of resources, creation of routines, and the development of innovations necessary to stem the crisis and contribute to the social good. However, competitive dynamics could also be present as members protect their economic and/or political self-interests in the situation and are opportunistic, as was present among the pharmaceutical companies (e.g., Pfizer, Moderna, and Johnson & Johnson) who sought to be first to create an FDA-approved Covid-19 vaccine. Competitive dynamics can also be evident between diverse national, state, and local governmental agencies as they jockey for political power. Further, collaborative and competitive dynamics could be around sensemaking and sensegiving, as members seek to address the ambiguity in the crisis and shape the narrative associated with the cause of the crisis, the actors and their roles (victims and villains), and the solutions that can contain the threat (Kovoor-Misra, 2020). Therefore, managing coopetition which is the simultaneous presence of competition and collaboration between actors with a shared value proposition is crucial (Gynawali & Charleton, 2018). The orchestrators and actors need to moderate, balance, and negotiate the intensity of competition and collaboration in these relationships so that it is not a barrier to value creation (Gynawali & Charleton, 2018).

Next, we illustrate the importance of CMEs in addressing grand crises by providing examples from the United States, India and Spain as they sought to stem the Covid-19 pandemic. These examples, highlight the core features of CMEs (context, value proposition, structure, capacity, and dynamics) that were used to contain the crisis. In addition, the authors also analyze in greater depth the features that played a critical role in these national ecosystems, and some contextual differences that resulted in variations. The authors and country cases that follow include:

1. Shanthi Gopalakrishnan describes the CME in the United States and highlights how a relatively new ecosystem needed to be established, and some of the collaborative, competitive, and coopetition dynamics that occurred.
2. Sreevas Sahasranamam discusses the CME in India, and the role of prior ecosystem capacity, in particular.
3. Ana Perez-Luno and Barbara Larrañeta provide insights into the ecosystem in Spain and highlight the ecosystem structure and the strong role of governmental agencies in coordinating activities.

The USA Crisis Management Ecosystem: The Role of Ecosystem Dynamics

Shanthi Gopalakrishnan

The Covid-19 pandemic created an enormous public health and economic crisis in the United States. The pandemic disrupted lives, pushed the hospital system to its capacity, and caused an economic meltdown (Lauren et al., 2020). In 2019, the USA had a population of 328.3 million (US Census Bureau, 2019), and a GDP of $ 21.38 trillion (Datatopics, 2019). In 2020, 110 public firms in a variety of industries, such as retail, restaurant, entertainment, travel, and hospitality, with a combined asset value of $292.7 billion filed for bankruptcy (Jones Day Newsletter, 2021). By the end of 2023, the deaths had surpassed 1.16 million (CDC Covid Data Tracker, 2024) making the Covid-19 pandemic to be one of the most severe US disasters by death toll (McKeever, 2021).

A crisis of this magnitude posed a unique and *severe threat* to the United States and called for a *coordinated*, and *speedy* response from multiple players across many levels to combat and contain it. Fortunately, the collective effort of internal and external actors resulted in the creation of a crisis management ecosystem (CME) and the development of a range of products, services, and processes to stem the pandemic. They included Covid-19 vaccines, drugs to reduce the effect of the virus (e.g., Remdesvir), products to contain the pandemic, such as ventilators and personal protective equipment (PPE), temporary hospitals, and virtual services, and processes for infection tracking, contact tracing, and vaccine distribution and administration. All of these outputs demonstrate how the CME collaboratively and ingeniously used resources to create products and services to meet the demands of the situation (Iansiti & Levien, 2004). Unlike some of the CMEs in Asia where they had prior experiences with pandemics, the USA had to largely *create a CME* to stem the novel Covid-19 pandemic. In this section, I provide insights into the nature of the ecosystem and discuss how it shared many of the core features of CMEs that are summarized in Table 1. Due to the contextual significance of ecosystem dynamics and because they were a source of strength and disruption, I particularly highlight their role in the ecosystem as actors sought to address a novel virus and fulfill the *value proposition* of containing the pandemic.

The US CME was *structured* by *multiple levels* and various *formal and informal actors*, and the *governmental agencies acted as orchestrators* to coordinate and direct activities between them. At the national level, the actors included the White House, Congress, and Federal agencies such as the Biomedical Advanced Research and Development Authority (BARDA), Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), National Institute of Health (NIH), and Operation Warp Speed (OWS) that was created to address the pandemic. OWS was a public–private partnership initiated by the US government to facilitate and accelerate the development, manufacturing, and distribution of Covid-19 vaccines, therapeutics, and diagnostics (GAO, 2021). It was funded by monies from the CARES Act (Coronavirus Aid, Relief, and Economic Security). OWS became one of the key orchestrating agencies that engaged with US pharmaceutical companies such as Moderna, Pfizer, and J&J in their pursuit of developing Covid-19 vaccines and other therapeutics. Regionally, state governments, universities, non-profits, and other academic, and community groups were also involved in testing and tracking the infection, and distributing and administering vaccines once they were developed.

External to the US CME, were global actors that were coordinators and aggregators of resources, information, and knowledge. For instance, the World Health Organization (WHO) provided information and guidance about the management and containment of the pandemic. In addition, the Center for Epidemic Preparedness (CEPI), which was launched in 2017 to address several viruses known to have epidemic potential, such as MERS, Ebola, and Zika also played a role (Ball, 2021). CEPI used its accumulated institutional knowledge from these earlier infectious diseases to partly fund the work on the COVID-19 vaccine of Moderna in the USA, and Oxford vaccines in the UK. Finally, the Global Alliance of Vaccine Immunization (GAVI) played a significant role in the global access and use of vaccines, and the US government was also a key member in this effort. In addition, the internal and external *boundaries* of the US CME were relatively permeable and enabled internal actors to identify with the larger collective, provided a basis for differentiating the ecosystem from others (Gulati et al., 2012), and allowed the flow of information and resources within and across the ecosystem.

One of the strengths of the US CME was its *capacity* that was available and built up before the pandemic. Even though the USA was not prepared for the Covid-19 virus, this built-up resource capacity enabled it to quickly establish a CME and access technologies and processes that eventually helped contain the virus. For instance, the USA was ranked # 3 in the 2019, Global Innovation Index rankings, in terms of the stability of its political, regulatory, and business *institutions* and environment (WIPO, 2019a). The institutional actors that I previously discussed enabled the CME to take action. Also, the USA invested heavily in *R&D spending* and *university-industry collaborations*. For instance, the US government invested $15.3 billion through BARDA (Biomedical Research and Development Authority) in HIV research programs. As a result, *knowledge repositories* had already been built and could be applied to other infectious diseases (Ball, 2021; Harris, 2022). In addition, a highly *qualified and trained labor force* created the requisite knowledge and *innovation capacity* within the country. Further, having large US *pharma companies* such as Pfizer, J&J, and Eli-Lilly was valuable. Aided by OWS, they were able to increase their R&D expenditures and their speed of product development in 2020 and 2021 to address the pandemic. The impact of this institutional and resource capacity was reflected in the speed at which the vaccine candidates entered phase 1 trials. It took just 63 days after China shared the genetic code of the Covid-19 virus (Shaferhoff et al., 2020). Also, the first human was vaccinated 12 months after the discovery of the virus. Next, I highlight the role of ecosystem dynamics because of their contextual significance. They were both a source of strength and disruption in the US CME.

Ecosystem Dynamics

The dynamcs in the CME were both collaborative and competitive and occurred formally and informally within the system. They were *primarily collaborative* and a source of strength around vaccine development and distribution, ventilator design and development, and the development of PPE. When competitors cooperate, *coopetition* is evident (Gynawali & Charleton, 2018), such as in the alliances among pharmaceutical companies who worked together on specific platforms for vaccine development. Coopetition between these companies was also largely managed by the alliances between them and OWS. Collaborative arrangements occurred in the ecosystem through formal alliances, informal consortia, and crowdsourcing arrangements. For instance, there were multilateral alliances that involved external agencies, such as CEPI and GAVI, where the USA was one of the members. CEPI established a global network of labs to centralize testing and enable the comparison of immunological responses generated by COVID-19 vaccines (Kumar et al., 2021). GAVI the vaccine alliance organization, was an independent public–private partnership that aimed to expand the global access and use of vaccines. The US government was one of its top donors, providing almost $3.1 billion out of its total of $23 billion in 2020. In addition, alliances with formal arrangements were established within the USA, that facilitated collaboration and provided knowledge and financial resources to the pharma companies and state governments. Such arrangements allowed partners to share risks and resources (Gulati, 1998; Gulati et al., 2000). One such partnership was between OWS and the pharmaceutical companies to accelerate the development, manufacture, and distribution of the Covid-19 vaccines. These public–private alliances resulted in the awarding of contracts to six companies (through a multilateral alliance) and in supporting three different vaccination platforms (GAO, 2021). Of the six companies, Janssen and Astra Zeneca were involved in the live-vector platform; Sanofi-GSK and Novavax were associated with the protein-based platform; and Pfizer and Moderna had the mRNA platform. Four of these companies (Janssen Pharmaceutical, a subsidiary of Johnson & Johnson, Astra Zeneca, Sanofi, and Moderna) received over $2.7 billion in government funding to help reduce the scientific, manufacturing, and marketing risks of vaccine creation and distribution. Astra-Zeneca (HQ Cambridge, UK) and Sanofi (HQ Paris, France) were the two non-US headquartered companies that received funding from OWS. The non-US companies were funded primarily to diversify the vaccine platforms that were being worked on (GAO, 2021). Pfizer chose not to take any funding from the government. Through the funding, the government underwrote pre-clinical trials, human testing, some of the manufacturing costs, and the market risks through advance purchase commitments. Pfizer, Moderna, Novavax, and Johnson & Johnson (all US-headquartered companies) had their vaccines approved for the US market (GAO, 2021).

The Pfizer and the Moderna vaccines were the most widely used in the USA and were both granted emergency authorization for use in December, 2020 (Lovelace, 2020). However, there were differences in how these companies accessed the key technologies to develop the vaccine. Pfizer collaborated through an alliance with BioNTech, a German company to access the mRNA technology. In contrast, Moderna had experience working with the mRNA vaccine before Covid-19 and was well-positioned to use its pre-existing internal knowledge

(McKinsey Report, 2021). Once the vaccination received FDA approval, the non-profits and state governments played a key role in their distribution.

Besides the formal collaborations around vaccine development and distribution, there were also informal, temporary collaborations between manufacturing and medical device companies to produce ventilators. These collaborations allowed quick data sharing and the use of complementary skills to produce the required end products (Liu et al., 2022). The Defense Production Act allowed US companies to repurpose their manufacturing capacity to solve the supply shortage of ventilators. One such collaboration was between Ford, GE Healthcare, and Airon Corporation. GE licensed a simplified ventilator design from Airon Corporation, and Ford produced ventilators based on that design (Ford Media Report, 2020). Similarly, General Motors (GM) retooled its Indiana plant and partnered with Ventec Life Systems bringing together GM's manufacturing expertise in making precision electrical components with Ventec's respiratory care expertise (Chandler, 2020). GM also converted its Warren, Michigan plant to produce 50,000 masks and collaborated with the state government and local suppliers to distribute them. During severe shortages in the heat of the crisis, these collaborations hastened the product development and manufacture of much needed products to treat patients.

Further, informal, temporary academic collaborations also occurred between professors within Johns Hopkins Berman Institute of Ethics and academics from other Universities, such as Stanford University. They worked together to release a comprehensive report to help local and state governments, technology developers, and business and institutional leaders make responsible decisions around the use of digital contact tracing technology (DCTT), such as smartphone apps and other tools to fight Covid-19. Building on that, universities like Eastern Washington University partnered with local health agencies like Spokane Regional Health District (SPRD) to implement a contact tracing training program (Line et al., 2022).

Finally, citizen groups informally collaborated, mobilized resources, and responded at a local level to the pandemic. These groups are important as they tend to be perceived as legitimate and trustworthy by those who want to contribute resources, and by local officials because they are locals affected by the crisis (Shepherd & Williams, 2019). Diverse groups of citizens, which consisted of do-it-yourself hobbyists, engineers, artisans, hackers, and small business owners with varying degrees of expertise in design, prototyping, digital and traditional fabrication, came together informally and used crowdsourcing to produce medical supplies, such as face shields, cloth masks, disposable gowns, and surgical caps (Browder et al., 2023). These temporary informal alliances among individuals and groups are important as they filled the gaps in the official response structures (Mittermaier et al., 2022).

In contrast, *competitive dynamics* were evident among various actors with respect to *sensemaking and sense-giving* about the "what," "why," "who," and "how" of the crisis and the strategies for its containment (Kovoor-Misra, 2020). Such sensemaking and sense-giving dynamics are socially constructed processes where individuals and groups, based on their predisposition, social networks, and cultural contexts, create different meanings and contrary narratives about their environment to enable action (Christianson & Barton, 2021). Also, at times certain groups or individuals create false or alternative narratives that are more emotionally palatable (Mikkelson et al., 2020). The pandemic resulted in competitive dynamics and competing narratives about the cause and the nature of the pandemic, how to contain the pandemic, and whether social distancing and vaccinations were effective as a means of containment. These competing narratives increased the complexity of the available alternatives and made it harder to agree on solutions. For example, governors of conservative states wanted to lift the lockdowns much earlier than some of the more populous liberal states because they believed that the lockdowns were severely detrimental to their states' economies. Also, some governors questioned the need to use masks and the degree of the infectiousness of the COVID-19 virus. There were also competing interpretations about the effectiveness of mask-wearing, social distancing, vaccinations, and lockdowns, which created confusion in the public's minds. As a result, the sensemaking and sense-giving efforts of different politicians, governmental agencies, medical professionals, and social media celebrities created competing narratives about effective crisis management. The competing narratives and the *messy, visible, and public negotiation* of how to address the crisis among different groups (conservative and liberal states and citizen groups) challenged the alignment of roles and activities around the value proposition (Adner, 2017) for containing the crisis.

In *conclusion*, the Covid-19 crisis within the USA was severe, and executing on a shared value proposition to stem the pandemic was a complex process. Like other CMEs, many diverse actors from the public and private sectors, universities, and citizen groups came together and participated in the ecosystem to contain the pandemic. These formal and informal actors had to work together and build capacity in the throes of the crisis, and the OWS was a central player in providing direction and orchestrating the movement of key financial and medcal resources. Since the value proposition of containing the crisis was met, on May 11, 2023, the Biden administration announced that the emergency phase of containing the virus was over (White House, 2023). Therefore, there was no need to continue the ongoing activity and complexity of the CME. However, many of its outputs such as vaccines, PPE, and testing continue to have *longevity*, as even though the pandemic is contained the virus persists and continues to infect citizens.

The Indian Crisis Management Ecosystem: The Role of Ecosystem Capacity

Sreevas Sahasranamam

In 2019, India's GDP was estimated at USD 2.8 billion (IMF, 2024) with a population of over 1.32 billion people (Ceicdata, 2024). In 2019, Global Innovation Index rankings, India placed 52nd out of 129 countries, first among Central and Southern Asian countries, and fourth amongst lower middle-income economies (WIPO, 2019b). The COVID-19 pandemic had a marked impact on India, particularly the Delta wave of the virus in the spring of 2021. India reported its first positive case of COVID-19 on January 30, 2020, and by the end of 2023 there were 533,000 deaths (Datacommons, 2024; WHO, 2023). In addition, the pandemic also had a significant impact on economic activity with the GDP dropping by 7.3% during the 2020–21 financial year (Dhingra & Ghatak, 2022). There was great urgency within the country to address these threats and contain the crisis. This section discusses how the Indian crisis management ecosystem (CME) responded to the pandemic. It provides insights into how this ecosystem shares many of the core characteristics of CMEs that were summarized in Table 1, some of its unique features, and how its prior capacity and experiences, in particular, contributed to its effectiveness.

The Indian CME was eco-centric, rather than firm-centric (Sahasranamam & Soundararajan, 2022), and the shared *value proposition* of containing the COVID-19 pandemic shaped the ecosystem and led to its organization. For instance, the first positive case of COVID-19 was reported in the state of Kerala on January 30, 2020 (Andrews et al., 2020). This early detection of a COVID-19-positive case happened because the state health department had issued a COVID-19 alert by January 18 to screen international passengers coming into the state. Soon after, on February 4, the state government declared the COVID-19 threat a state disaster (The Times of India, 2020), which triggered the state's health infrastructure to become prepared for tracking, isolating, and treating patients.

A key characteristic of the Indian CME *structure* was the presence of *diverse actors*, with both *formal and informal* relationships around the shared value proposition of crisis response. It involved the government at the national and state levels playing a critical regulatory and facilitation role, complemented by civil society organizations and volunteering actors coming to the fore to offer key solutions to contain the crisis. While the relationships between government and pharmaceutical companies involved formal ties, civil society actors, IT professionals, and volunteers worked together following the approach of open source communities, which have largely informal ties. The central government took a dominant role in vaccine manufacturing and distribution by joining the COVID-19 Vaccine Global Access Facility (COVAX) in July 2020, and establishing a National Expert Group on Vaccine Administration for COVID-19 in August 2020 (Pathak & Philo Magdalene, 2022). COVAX was an international alliance created by the World Health Organization (WHO) to facilitate the procurement of vaccines through the Global Alliance for Vaccines and Immunization (GAVI). India also supported the Developing Countries Vaccine Manufacturers Network (DCVMN), a platform that allowed organizations from developing countries to come together and share technical information and best practices around vaccine manufacturing and distribution. This included key vaccine manufacturers from India such as the Serum Institute of India (SII), Bharat Biotech, Zydus Cadila, Gennova Biopharmaceuticals, and Biological E (BEL) (Pathak & Philo Magdalene, 2022).

Another characteristic feature of the Indian CME was the *dynamics* of collaboration. There were *some coopetition* behaviors between state governments initially towards achieving zero COVID cases and showcasing them as models, but the presence of a strong *national government* and their initiation of regular meetings between state health departments paved the way for *more collaboration* between them. Since there were permeable *boundaries*, different actors came together to realize the shared value proposition. While in non-crisis times, government, industry, civil society, and academia—the quadruple helix of an ecosystem (Carayannis & Campbell, 2009) —worked largely in their silos, during the COVID-19 pandemic these boundaries became more permeable allowing for greater cross-sector collaboration (Sahasranamam, 2020). For example, multidisciplinary teams of open-source community volunteers, doctors, mathematicians, startup founders, and bureaucrats worked together in the creation of digital dashboards for tracking COVID cases (e.g., CoronaSafe Network) and in the creation of vaccination tracking portals (e.g., CoWIN). War rooms and digital dashboards were set up in government offices and volunteers were offered the space and resource support to develop digital tools. The above discussion has outlined the context, value proposition, structure, and dynamics of the Indian CME. Next, I build on this and highlight the most striking CME dimension in the Indian context, which was ecosystem capacity.

Ecosystem Capacity

Broadly two capacities in the Indian CME enabled it to respond with agility to the COVID-19 pandemic, namely cognitive and structural capacity. The *cognitive capacity* of the ecosystem include the knowledge, skills, and expertise it possesses (de Vasconcelos Gomes et al., 2018). The COVID-19 pandemic fundamentally posed medical/scientific and operational challenges for India. The medical challenges included finding a vaccine and having sufficient doctors to treat the infected; and the operational challenges included addressing the load on the healthcare system in terms of managing beds, oxygen, and ambulances, and the process of testing and tracking the infected.

The Indian CME had cognitive capacity in pharmaceuticals and software that enabled it to respond to these pandemic challenges. The Indian ecosystem had strong competence in large-scale drug manufacturing and relatively good competence in new drug formation and biotechnology. These capacities were present in the ecosystem for historical reasons aided by patent regulations. During the 1970–1995 period in India, only process patents were offered for food, medicine, drugs, and substances produced by chemical processes (Pradhan, 2007). This weaker patent regime that did not offer product patents on drugs, allowed for reverse engineering in drug formulation and development. This led to expertise in the development of generic drugs alongside the creation of infrastructure for large-scale drug manufacturing. As a result, the number of pharmaceutical firms in India rose from 2,257 in 1970 to over 23,000 by 2005 (Haley & Haley, 2012). Post 1995, after India became a signatory to TRIPS, these domestic pharmaceutical firms had to transition from protection based on process patents to developing product patents. The industry responded to the new patent regime through greater R&D investments and by developing new drug development capabilities (Sahasranamam et al., 2019). By 2013, the Indian pharmaceutical industry became the world's third-largest, in terms of value (Horner, 2014). This cognitive capacity in pharmaceuticals both in terms of manufacturing at scale and drug formulation, enabled the Indian CME to adapt and respond to the needs of the COVID-19 pandemic. For instance, the Serum Institute of India (SII) mass manufactured the COVID-19 vaccine developed by the University of Oxford's Jenner Institute and AstraZeneca, and exported it to over 90 countries globally (The Hindu Business Line, 2022). This was also the most commonly used vaccine in India and constituted over 75% of the doses (Statista, 2023a). In addition, Bharat Biotech developed an indigenous Covid-19 vaccine (COVAXCIN) in collaboration with the Indian Council of Medical Research (ICMR) —National Institute of Virology (NIV), and an intranasal Covid vaccine called iNCOVACC that was exported to eight countries (Bharat Biotech, 2022; The Hindu Business Line, 2022).

The cognitive capacity in software development largely emanated from the private sector (e.g., Infosys, Tata Consultancy Services), and the presence of foreign multinational subsidiaries in India (e.g., Accenture). In the 1980s, the Indian IT industry started with the export of relatively lower-end services, such as data feeding. Subsequently, the industry transitioned to onsite projects and went up the value and quality ladder to offshore development, niche products, and software consultancy by the early 2000s. Subsequently, in the 2008–2022 period, this IT expertise fueled digital entrepreneurship in e-commerce, Software-as-a-Service (SaaS), and other consumer technologies (e.g., Flipkart, Oyo, Ola, Freshworks), while strengthening the industry's presence in global software consultancy. As a result, the industry crossed $200 Bn in total revenue in 2022 (NASSCOM, 2022), and India ranked 3rd in the number of startup unicorns worldwide (Statista, 2023b). This cognitive capacity in software development enabled the CME to innovate and develop digital solutions to tackle the operational challenges of the COVID-19 pandemic. This included the creation of Coronasafe Network, an open-source digital public good created by volunteers that offered patient monitoring, ambulance management, and oxygen cylinder management (Coronasafe Network, 2020). A similar open-source initiative supported the creation of Digital Infrastructure for Verifiable Open Credentialing (DIVOC), a digital public good that enabled India to digitally orchestrate large-scale COVID-19 vaccinations. This was subsequently used by other countries like Sri Lanka, Indonesia, and the Philippines (DIVOC, 2022).

In contrast, *structural capacity* stems from socially constructed ways of doing things (Scott, 1992), such as routines, structural arrangements, and rules of engagement. However, since crises often are sudden occurrences, with high uncertainty, information asymmetry, and limited response time (Majchrzak et al., 2007), routines to respond to the situation may be missing or underdeveloped (Rush et al., 2021). Fortunately, in responding to the COVID-19 pandemic, the Indian CME could rely on *routines developed from responding to other crises*, and they had institutions that could play the role of *boundary spanners*. For instance, the state of Kerala had developed a routine for contact tracing and isolating patients during an earlier outbreak of the Nipah epidemic (Sahasranamam, 2021). This was subsequently implemented at international airports during the COVID-19 pandemic. Similarly, multiple Indian states had regular outbreaks of Swine flu and other influenza viruses. The protocols and routines developed for these crises also helped responsiveness to COVID-19. Through regular meetings between state and national governments, there was cross-learning of protocols and routines, some of which were adopted nationally. Similarly, there was a familiarity in the rules of engagement between civil society actors/volunteers and with the government that emanated from past instances of working together during a crisis. For example, many volunteers who developed the Coronasafe Network had worked together in the past as a team to develop the digital response to floods in Kerala in 2018. This involved them working with the government to create a digital solution to identify and support flood victims. Such instances of prior experience ensured mutual trust and understanding among the volunteers and with the government (Sahasranamam & Soundararajan, 2022).

In addition, the presence of *institutions* that could play the role of boundary spanners was important in the Indian CME. They helped mitigate issues that are often present during a crisis, such as the irrelevance of existing authority and communication structures (Majchrzak et al., 2007), and lack of coordination and organizing experience (Shepherd & Williams, 2014; Williams et al., 2017). Institutions such as startups, incubators, and non-profit think tanks filled the void, fostered innovation, and coordinated the activities between volunteers, government, and other relevant stakeholders. For instance, a startup founder who was previously the head of a state government incubator played the boundary spanner role in coordinating the volunteer community with the state government's response during the development of the Coronasafe Network (Sahasranamam & Soundararajan, 2022). While in the case of DIVOC, a non-profit think tank played a similar boundary spanner role.

Therefore, the cognitive and structural capacity within the Indian CME fostered *innovation and agility* in responding to the COVID-19 pandemic. They allowed the ecosystem actors to utilize their existing domain of experience and knowledge, and apply it to this new crisis. They reduced the gap and distance between existing knowledge and the new knowledge required to address the pandemic and fostered local rather than distant search for knowledge that is important for agility (Afuah & Tucci, 2012). Once the Covid-19 crisis was contained, the shared value proposition was no longer salient. However, the instances of prior capacity built through past crisis events (e.g., Nipah epidemic, floods) coming to the fore in the response to the COVID pandemic, highlighting that capacity may become *latent and dormant* within the system once a grand crisis has passed, but it can be reactivated during future threats. In certain regions of India, where the ecosystem capacity was backed by the legitimacy of the government and their political will, there was stronger evidence of latent capacity. In addition, some of the products developed by the CME such as the Coronasafe Network and DIVOC have lived beyond the peak crisis to become part of the UN Digital Public Goods and continue to be used in intensive care and vaccination credentialing, respectively.

In conclusion, the Indian CME played an important role both domestically and internationally in containing the COVID-19 pandemic. It can be characterized as an eco-centric ecosystem where the shared value proposition and urgency of the COVID response influenced the activities, actors, and resources. Both formal and informal relationships shaped the collaborative behaviors between actors in the ecosystem. The solutions developed for tackling the pandemic were created by multidisciplinary teams which included doctors, scientists, IT professionals, and student volunteers. India exported vaccines co-developed with multilateral partners to over 90 countries and digital public goods created by the ecosystem, such as DIVOC, were used in neighboring Southeast Asian countries for vaccination management. The key ecosystem characteristic that made the Indian CME effective was its prior cognitive and structural capacity.

The Spanish Crisis Management Ecosystem: The Role of Ecosystem Structure

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In 2019, Spain a developed social market economy had a GDP of 1.39 billion (World Bank, 2024) and was ranked 29th in the Global Innovation Index (WIPO, 2021). Unfortunately, it was one of the countries hardest hit by the coronavirus, in terms of number of deaths. In a population of over 47 million inhabitants (INE, 2024) there were over 121,000 deaths by 2023 (Datosmacro, 2023). Within the first six months of the outbreak, the unemployment rate rose to 16.13%, over 200,000 businesses disappeared (one in six), and 320,000 freelancers (10% of the total) terminated their activity, overall resulting in a negative growth of −11.32% in GDP for 2020 (World Bank, 2022). The novelty of the virus and the delay in recognizing the severity of the threat (March 14, 2020) exacerbated the situation.

However, the Spanish crisis management ecosystem (CME) had some strengths that it used to its advantage once the crisis was perceived as being *urgent*. For instance, over time it was able to orchestrate resources and actions to contain the *severe threat* generated by the COVID-19 pandemic. In addition, the Spanish vaccination strategy against COVID-19 was internationally recognized for being able to achieve vaccination coverage for almost 95% of the population 12 years and older, and reach almost 100% in many age groups within a short time frame of over one year (from the end of December 2020 to the first of March 2022) (Ministerio de Sanidad, 2023). In this section, we highlight how the structure of the Spanish CME that was characterized by the strong role of governmental agencies and permeable boundaries, enabled access to external resources and contributed to its success. In addition, we discuss how prior institutional capacity in pharmaceuticals and research centers, and collaborative dynamics between actors contributed to its effectiveness. Our analysis and discussion suggests that the Spanish CME shared many of the core features that were summarized in Table 1. However, some contextual factors, such as the prior experience with crisis built capacity and contributed to its effectiveness. We begin by highlighting the structure of the Spanish CME.

Ecosystem Structure

The Spanish CME was *structured* as an open system with *actors* at multiple levels/subsystems (Adner, 2017). These actors were *diverse* and both *formally* and *informally* connected. Some of the internal actors included the Spanish national government and its Ministry of Health and the Ministry of Industry, business organizations, and pharmaceutical firms in particular, research centers in universities and hospitals, non-profit organizations, volunteers, and the general population that strictly adhered to the new norms that were created. The *national government acted as a strong facilitator and orchestrator* of the ecosystem rallying these multiple actors around the *shared value proposition* of containing the pandemic. Spain was governed during the pandemic—and still today—by Prime Minister Pedro Sanchez, who belongs to the PSOE (Spanish socialist worker's party), and has been leading the Government since June 2018. In addition, Spain is also decentralized and governed by regional governments, and it has external influences as it is part of the European Union. The Spanish Ministry of Health was responsible for regulating containment measures in the worst months of the pandemic while the Ministry of Industry distributed economic aid, using the Carlos III subsidies along with other public and private initiatives to promote R&D on COVID-19 related health issues. Also, the government relied on external actors, such as the Global Alliance for Vaccines and Immunization (GAVI), and the COVID-19 Vaccine Global Access Facility (COVAX) an international alliance created by the World Health Organization (WHO) to enable the procurement of COVID-19 vaccines. Finally, the Spanish government linked internal and external actors and participated in the negotiations and subsequent distribution of funds under the umbrella of the Next Generation EU. This was an exceptional recovery instrument that temporarily activated funds within the EU countries.

Unfortunately, no Spanish pharmaceutical firm was able to move quickly enough to produce a new Covid-19 vaccine. For instance, the vaccine developed by Hipra never received authorization from the European Medicines Agency. However, several Spanish pharmaceutical companies (e.g., Rovi, Zendal Group, Reig Jofre, Insud Pharma) established formal collaborations with international companies such as Moderna, Johnson & Johnson, and AstraZeneca to provide facilities, supply chain, and workflows to meet the huge internal demand for vaccines, and they committed to manufacture and distribute vaccines for its use in the EU countries. While COVAX was the umbrella instrument for such collaborations, the Spanish pharmaceutical firms took the lead in the negotiations. In addition, other private companies, such as Fundación la Caixa and Fundación BBVA provided funds for R&D around mitigating factors for the pandemic. Also, Spanish research centers and universities provided important insights into the virus, and the efficacy of vaccines that were shared in international repositories. Finally, the hospitals were pivotal in taking care of the sick and in containing the virus.

A particularly relevant and unique aspect of the Spanish CME structure were its permeable *boundaries*. The Spanish CME had clear physical, symbolic, social, and political ecosystem boundaries (Razmdoost et al., 2023). Even more, these boundaries were remarkably permeable as it was nested in a multi-layered system of hierarchically organized levels (Spain within EU). The permeability or openness of the Spanish boundaries facilitated access to resource inputs and relationships with internal and external actors (Faraj et al., 2011). This permeability of the ecosystem boundaries explains why ecosystem members widely used distant search when looking for crisis solutions. While ecosystem members were already used to distant search (Piezunka & Dahlander, 2015) when looking for solutions in prior crises, they commonly did so within the boundaries of the EU. In the COVID-19 crisis, because there was high demand for vaccines and scarcity, the search became even more distant reaching organizations beyond the EU to companies in the UK and the USA.

Other Core Features

In this section, we briefly discuss how other features of the CME, such as its dynamics and capacity also enabled it to fulfill the value proposition of containing the virus. A positive aspect of the Spanish CME were the *dynamics* between actors that were characterized by *high collaboration* and relatively *low competition*. Collaborative dynamics were present primarily between the national government, the private sector, universities, regional governments, and external actors. As we have discussed above, there were collaborations between Spanish pharmaceutical companies and those in the UK and the USA. There was *limited political competition* between the Spanish national government and regional and EU governments. The severity of the crisis, urgency, and the need for speed made actors come together to quickly find consensus on strategies and solutions. Such cooperative behaviors can be attributed to a number of factors. First, the Spanish *national government* took control of sensegiving, sensemaking, and the narrative (Christianson & Barton, 2021; Kovoor-Misra, 2020) about the causes, consequences, and most important solutions to contain the threat, rather than regional and international institutions. Such control facilitated the process for Spanish individuals, groups, and companies to follow governmental instructions. In addition, to ensure a coordinated effort, they also exercised control through the Ministry of Industry over the nature of agreements made by the Spanish pharmaceutical companies and other actors.

Second, there was also *prior shared experience* in Spain in seeking agreement and finding consensus. For instance, the migration crisis within the EU provided learning experiences and the economic recession of 2008–2013 provided opportunities to learn from failure. Thirdly, a *national culture* characterized by collectivism and high power distance (Hofstede et al., 1991) enabled the population to be remarkably cooperative towards governmental instructions. Spanish citizens are efficient at working together and collaborating towards a common goal. This collectivism was evident when the Spaniards rallied around and applauded health care workers from their balconies in the thick of the pandemic. In addition, Spanish citizens do not generally question authority and they accept their place in the hierarchy. This power distance was evident in their obedience to the severe and long-lasting mobility restrictions, as from March 15 to June 21, 2020 only exceptional circumstances permitted Spaniards to leave their homes. Overall, these cultural characteristics seemed to facilitate governmental efforts to keep people home during the lockdown and to swiftly implement the vaccination campaign.

Finally, an additional strength of the Spanish CME was its *capacity*. In our discussion above, we have highlighted the capacity provided by various institutions, such as national governments, research centers, universities, and hospitals. Also, the strong national culture, and lessons learned from prior crises. Here we will provide deeper insights into the capacity provided by the Spanish *pharmaceutical industry*. This industry is a major strategic sector of the Spanish economy. It has gained prominence over the last 25 years, becoming a major driver of the country's exports and private R&D investment. According to the 2019 National Accounts data, the pharmaceutical industry directly generated 6,846 million euros of gross value added (GVA), that is, 0.6% of the total Spanish economy (La Caixa Research, 2022). It is the eighth largest industrial sector in the country and generates 5% of the GVA of the manufacturing industry (Farmaindustria, 2021). Five big Spanish pharmaceutical companies used their prior experience and capacity and played a significant role. They included:

- Rovi, located in Madrid and Barcelona. Founded in 1946, the company operates in both Spain and Portugal, and is expanding internationally. Rovi specializes in producing multifunctional pharmaceutical products, and they signed an agreement with Moderna early in the pandemic to fill and finish its mRNA vaccines for markets outside the USA (Rovi, 2022).
- The Zendal Group, located in Galicia, was created in 2008. It collaborated with the Spanish National Research Council (CSIC) on two projects through its subsidiaries CZ Vaccines and Biofabri. It also signed an agreement with Novavax to handle the production of the Novavax shot antigen in the European Union. It is exclusively dedicated to the manufacturing and development of three SARS-CoV-2 vaccines (Landauro & Faus, 2021).
- The Reig Jofre company, that dates back to 1929, has four production centers in Spain and Sweden, as well as 177 business partners in more than 70 countries. The company's main activity is the manufacturing of vial packages of given sizes, which explains its partnership with Janssen (Johnson & Johnson's pharmaceutical company) to produce, package, and distribute its vaccine in Europe (Reig Jofre, 2020).
- Viralgen Vector Core, a Basque company established in 2017, was selected, together with the Basque Government, by Harvard University to be its manufacturing partner for the viral vector-based vaccine. According to Harvard, the company has become a meeting point for organizations experienced in biotechnology and life sciences. Viralgen's responsibility was to provide facilities, the supply chain, and workflows to meet the huge demand of viral particles, an essential vaccine component (SPRI Group, 2020).
- Insud Pharma, founded in 1977, signed an agreement with the University of Oxford to fill and package the AZD1222 viral vector vaccine manufactured by the British company AstraZeneca (Insud Pharma, 2021).

These five Spanish pharmaceutical firms were able to respond to the threat of the virus. They utilized their prior capacity and made agreements with US and UK firms in coordination with the national government. They played a key role in contributing to the Spanish CME.

In *conclusion*, the Spanish CME helped control the virus in the country, and significantly contributed to the COVID-19 vaccine industry during the pandemic. It was effective in being able to manage its population during lockdowns, run efficient vaccination campaigns, and produce and distribute most of the major COVID-19 vaccines in Europe. Its strong institutions, orchestration by the national government, a relatively mature pharmaceutical industry and collaborations with external parties, prior crisis experience, and a national culture of collectivism and high power distance all contributed to its responsiveness and effectiveness. Since the value proposition of containing the crisis was met, the CME is no longer active. However, some alliances persist as the pharmaceutical industry continues to maintain some of its international agreements and contribute to vaccine production under the supervision of the Ministry of Industry.

Wrapping Up: Contributions and Implications

Sarah Kovoor-Misra

The business management literature has advanced our knowledge of how an organization can prepare for, contain, recover, and change from a crisis. (e.g., Kovoor-Misra, 2020; Pearson & Clair, 1998). In addition, research in public administration provides insights into how crisis response networks, comprised largely of governmental agencies in dyadic relationships, can be used to coordinate during a crisis (e.g., Curtis, 2018; Moynihan, 2009). However, the larger crisis management ecosystem (CME) comprised of multilateral, interorganizational relationships that are necessary to address grand crises have received far less research attention. Therefore, this paper addresses this issue and provides insights into the nature of grand crises and the core features of CMEs. More specifically, our study contributes to the literature on (1) organizational crisis typologies and (2) organizational crisis management systems and structures. We relied on the literature on organizational ecosystems (e.g., Adner, 2017; Jacobides et al., 2018) and crisis resilience (e.g., Kovoor-Misra, 2020). We also studied how countries, such as the United States, India, and Spain used CMEs to respond to the Covid-19 pandemic. The pandemic provided us with an extreme case to study CMEs. These extreme situations enable the phenomenon under study to be more clearly visible and can contribute to advancing knowledge (Eisenhardt, 1989). In this section, I discuss the contributions of our paper and the implications for future research and practice. I begin by discussing our contributions to the literature on organizational crisis typologies.

Organizational Crisis Typologies

Crisis management scholars have sought to categorize varied forms of organizational crises. These typologies are important because they provide insights as to how crises may be similar or different, and can be managed. For instance, Pearson and Mitroff (1993) categorize crises based on the origin of their cause, such as technical/economic versus human/social and whether the cause was deviant or escalated from a routine failure. In addition, Kovoor-Misra (1995) developed a typology based on the dimension of the organization that may have triggered the crisis and/or was impacted by the crisis, such as economic (e.g., bankruptcies), human and social (e.g., workplace violence), ethical/political (e.g., scandals), technological (e.g., oil spills), and natural environmental (e.g., hurricanes).

In this paper, we suggest a typology based on the complexity of the crisis situation, as it is a key attribute of grand crises. Factors that contribute to crisis complexity that we highlight include the extent of the impact of the crisis, in terms of the number of organizations in crisis; and the uncertainty in the crisis situation (novelty, severity of loss, and the number of interorganizational relationships that are required for its resolution). We suggest that a grand crisis, relative to other less complex crises, is large in scale as multiple organizations are in crisis simultaneously. Further, there are high degrees of uncertainty because of the severity of the threat and the losses incurred in the situation, and ecosystems with multilateral, interorganizational relationships are necessary to address them. In addition, if the grand crisis is novel, there is ambiguity as to the cause and/or effects of the crisis. In these situations, new solutions are required and CMEs may need to be adapted or created to address them.

Our study used the Covid-19 pandemic as an example to highlight the scale and uncertainty that was present in this grand crisis. For instance, during the Covid-19 pandemic numerous organizations were in crisis simultaneously, and the pandemic took a severe toll economically, socially, and on human life. For example, by 2023, the USA experienced 1.16 million, Spain 121,000, and India over 533,000 Covid-19 deaths. Further, uncertainty during the pandemic was exacerbated as it was a novel virus and its effects and resolution were unknown. Due to the severity of the threat and the complexity of the situation, multiple, diverse organizations were required to work together in large national ecosystems to create new solutions, such as vaccines, drugs, and various products, services, and processes to contain the pandemic. The pandemic made visible the complexity of this threatening situation and the complex structures that were created for its resolution. Our discussion on the nature of grand crises provides insights into those crises that are highly complex. Therefore, crises differ not only on whether they are human and social, economic, technological, or natural disasters but these forms may also vary in the extent of their complexity. Future research can study other forms of grand crises that can occur because of terrorism, climate disasters, or other technological accidents to gain insights into other dimensions of complexity. Further, practitioners can use the complexity typology to assess the extent and uncertainty of the crisis that they are experiencing, as this analysis will have implications for the kinds of structures and systems that may be required. Next, I discuss our contributions to the literature on crisis management systems and structures.

Crisis Management Systems and Structures

The second contribution of our paper is to the literature on crisis management systems and structure. In this paper, we provide *insights into the core features of CMEs* that are critical during a grand crisis. First, based on the management literature on ecosystems (e.g., Adner, 2017; Jacobides et al., 2018) and crisis resilience (e.g., Kovoor-Misra, 2020), we specified some of *the core features of CMEs* that was summarized in Table 1. We suggested that CMEs, similar to other ecosystems, are multi-level, open systems with inputs and outputs; multiple organizations come together around a shared value proposition; they are structured by actors, activities, roles, and boundaries; members develop multilateral interorganizational relationships; collaboration is the basis of these relationships, but competition and coopetition can also occur and needs to be managed so that actors can execute on the value proposition; and the ecosystem needs capacity to respond quickly and contain the escalation and scale of a grand crisis.

We also provide additional insights into the core features of CMEs by examining the national CMEs that were used in the United States, India, and Spain during the Covid-19 pandemic. In this process, we provide an *international perspective* that tends to be less prevalent in crisis management research (Pearson et al., 2007). Table 2 summarizes the shared core features of these CMEs, and in italics I highlight

Table 2. CME Core Features – Similarities/Differences (Italicized) Between Countries.

USA	India	Spain
	Context	
Population of 328.3 million (2019), and over 1.16 million Covid-19 deaths by 2023 Severe threat and urgency	Population of 1.32 billion (2019), and over 533,000 Covid-19 deaths by 2023 Severe threat and urgency	Population of 47 million (2019), and over 121,000 Covid-19 deaths by 2023 Severe threat and urgency
	Value Proposition	
To contain the Covid-19 pandemic as quickly as possible and save lives	To contain the Covid-19 pandemic as quickly as possible and save lives	To contain the Covid-19 pandemic as quickly as possible and save lives
	Internal Structures	
Multiple levels and diverse internal actors with formal and informal, multilateral interorganizational relationships. National government played a key role as orchestrator	Multiple levels and diverse actors with formal and informal, multilateral interorganizational relationships. National government played a key role as orchestrator	Multiple levels and diverse actors with formal and informal, multilateral interorganizational relationships. National government played a key role as orchestrator
	External Structures	
Received inputs from various global actors (e.g., WHO)	Received inputs from various global actors (e.g., WHO and *Developing Countries Vaccine Manufacturers Network)*	Received inputs from various global actors (e.g., WHO and *European Union)*
	Dynamics	
Formal and informal collaborative dynamics *Competitive dynamics* between pharmaceutical companies and between governmental agencies *Coopetition managed by alliances and Operation Warp Speed*	Formal and informal collaborative dynamics *Relatively little competitive dynamics*. Some between state governments *Coopetition managed by national government*	Formal and informal collaborative dynamics *Limited competitive dynamics between governmental agencies and with EU*
	Capacity in 2019	
GDP of $ 21.38 trillion. Global Innovation Index ranking # 3. Strong capacity in large pharmaceuticals, and institutions. *Limited prior pandemic experience had built knowledge repositories on infectious diseases from HIV research*	GDP of 2.8 billion, Global Innovation Index ranking # 52, strong capacity in pharmaceuticals, software, and institutions *Prior experience with the Nipah epidemic and Swine flu and in collaborating over natural disasters*	GDP 1.39 billion, Global Innovation Index ranking # 29, strong manufacturing capacity in pharmaceuticals, received funding from EU. *Prior experience with the migrant crisis and 2008–2013 recession provided experience with consensus building*
	Outputs	
Created Covid-19 vaccines (Moderna, Pfizer & J&J), and drugs (e.g., Remdesvir) Manufactured vaccines for internal and external use Developed services and processes for infection treatment, contact tracing, and vaccine management	*Created a Covid-19 vaccine* (COVAXCIN) and intranasal vaccine (iNCOVACC) Manufactured vaccines for internal and external use Developed services and processes for infection treatment, contact tracing, and vaccine management	*Did not create a vaccine* Manufactured vaccines for internal and external use Developed services and processes for infection treatment, contact tracing, and vaccine management

some differences between them. These similarities and differences are discussed below.

We found that all three countries were in a grand crisis with *severe threat* and *urgency* to respond to them. There were high death rates, lockdowns were prescribed to reduce infection, and organizations, work, and life in general were disrupted. We also found that all three countries used CMEs to respond to the grand crisis. Third, we found some shared characteristics and a few differences in the core features of the CMEs. First, the three CMEs that we studied were all organized around the *value proposition* to contain the pandemic as quickly as possible to save lives. The second core feature was the CME *structure* that was characterized by *multiple levels* and organizations from *diverse societal sectors*, such as governmental agencies, the private sector, nonprofits, community organizations, universities, and external actors, such as the WHO and CEPI. India because of its status as a developing economy, was also associated with the Developing Countries Vaccine Manufacturers Network; while Spain as a member of the EU had other membership advantages and constraints. In addition, we found that the organizations in the CMEs were *existing institutions* such as the BARDA in the USA, or the Serum Institute in India that adapted their roles to respond to the new crisis, and *new structures* were also created, such as Operation Warp speed in the United States to respond to the pandemic. Further, the national government played a key role as *orchestrator* and facilitated vaccine creation or procurement in the USA, India, and Spain, while regional and local governments were more involved in vaccine distribution and contact tracing and treatment. The organizations also used *previously specified roles and relationships* to manage governance and determine tasks during the pandemic. For example, the federal, state and local governments in the USA had specific roles to play that were consistent with US constitutional law. In addition, nested within the larger CME were *sub-ecosystems* to address various aspects of the crisis, such as ecosystems at regional levels that were used for vaccine distribution and administration, innovation ecosystems (e.g., pharma companies and their affiliates to create vaccines in the USA), technology ecosystems (e.g., to develop tracking and tracing software in India), healthcare service ecosystems (e.g., health systems in states to help the sick in their regions), and manufacturing ecosystems (e.g., to manufacture vaccines in Spain and India). The various levels and these sub systems were connected to the larger CME by multilateral relationships and the shared value proposition of containing the common crisis.

The third core feature of the CMEs we studied was *relational dynamics.* We found that there were varying degrees of *collaboration, competition, and coopetition*. Collaborations occurred through formal alliances to aid vaccine creation, such as between Operation Warp Speed and the pharmaceutical companies in the USA, or between Spain and external actors to procure and manufacture the vaccines. Informal collaborations were also present, such as through crowdsourcing in the United States, or through boundary spanners who connected various entities in India. In addition, there were some competitive dynamics in the USA between the pharmaceutical companies as they sought to be first to market but coopetition was managed by Operation Warp Speed. Further, possibly because of the *polarization* in US politics and society at large (Carothers & O'Donohue, 2019), there were competitive dynamics between the national and state governments, and among citizen groups as to how to handle the crisis in the areas of vaccinations, lockdowns, and the use of PPE. We found that competitive dynamics were less prevalent during the pandemic in India and Spain.

A fourth core feature of the CMEs, was that ecosystem *capacity* contributed to ecosystem emergence and speed of response during the crisis. For example, *strong institutions* and financial resources in the United States and Spain, and *cognitive competencies* in technology and pharmaceuticals in India enabled the CMEs to respond to the threat of the crisis. *Inputs* from external actors also expanded capacity, such as information into all three ecosystems from the WHO and CEPI, and financial resources from the EU to Spain. A source of capacity that differed between the countries was their *prior experience* with pandemics. India could rely on prior routines because of their experiences with the Nipah virus and Swine flu. The USA derived some knowledge capacity from their HIV-related infectious disease research. On the other hand, Spain as a society had experiences in consensus building derived from overcoming crises, such as the 2007–2008 recession and the migrant crisis.

The final core feature of the CMEs was that they produced *outputs*. Both the USA and India were able to create a vaccine, and all three CMEs were able to use their capacity to manufacture vaccines not only for themselves but also for other countries. All three CMEs were also able to develop systems and processes that were effective for contact tracing, treatment, and vaccine administration. Therefore by 2023, all three CMEs called an end to the pandemic and successfully fulfilled their value proposition. However, due to ongoing infections from the Covid-19 virus on a smaller scale, some of the previously established alliances, such as those between pharmaceutical companies and governments or systems for contact tracing, such as the CoronaSafe Network in India are still in use.

Therefore, we found that the CMEs in the USA, India, and Spain shared a number of characteristics in their value proposition, structure, capacity, and dynamics. We found differences due to factors such as variations in the nature of their capacity, the prior experience with a crisis, and political and societal polarization. Future research can study the relationships between these core features and their contextual differences. For instance, does strong institutional and resource capacity or a shared value proposition moderate the relationship between polarization and competitive dynamics, as was found in the United States. In Spain, it appeared that their structure (e.g., permeable boundaries, national government), and capacity (EU resources and manufacturing ability) enabled them to build alliances with firms in the USA and UK and access the Covid-19 vaccine, even though they were unable to create one. Therefore, how CMEs compensate for deficiencies or dysfunctions in one area with strengths in another can be a fruitful area for future research. Also, future research can study these and other characteristics of CMEs in the context of other forms of grand crises that can be caused by wild fires, terrorism, or a recession. Such examination can provide additional insights into the size of ecosystems that are required and the role of diverse actors who are specific to the crisis situation.

Further, research on CMEs postcrisis can also be conducted (see Figure 1 for the phases of crisis management). Our paper focused on the crisis containment phase. Future studies can examine what happens to the CME once the threat has passed, in terms of dismantling structures, relationships, and processes, engaging in learning and building adequate capacity for future threats, and the barriers that can impede these activities. These aspects have been studied at the level of individual organizations in the management literature (e.g., Kovoor-Misra & Olk, 2015; Pearson & Mitroff, 1993). Research at the level of CMEs can provide additional insights into the structures and activities of CMEs over time.

In terms of practice, we suggest that as the crisis increases in complexity different structures and systems are required and leaders need to pay attention to the degree of escalation and its impact. Prior research has focused on crisis plans and teams at the level of the individual organization (e.g., Kovoor-Misra, 1995; Pearson & Mitroff, 1993) and crisis response networks and incident command centers for interorganizational relationships that tend to be dyadic (Curtis, 2018; Moynihan, 2009). We suggest that, during a grand crisis when multilateral, interorganizational relationships are necessary to address them, the CME may be a more effective structure.

In conclusion, we suggest that crisis management researchers zoom out and take a broader ecosystem perspective to capture the complexity of multilateral interorganizational structures, collaboration, and inventiveness during a grand crisis. In these situations, multiple, diverse, formal, and informal organizations come together in multilateral relationships and create new or adapted entities, as they grapple with severe threats. In this article, we provide insights into the complexity of grand crises and the core features of CMEs that were used during the Covid-19 pandemic.

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