



Industry or civil society? Role of institutions in COVID-19 crisis management

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Abstract

India is suffering from the devastating impacts of COVID-19, raising health, economic and social challenges. The industrial sector, along with civil society, took remarkable initiative to manage the crisis. In this paper, we explore the condition necessary for motivating an industrial entity to adopt institutional role in ensuring the well-being of their employees and indirect beneficiaries, balancing the operational goals with social best practices, which may yield a mutually beneficial outcome through a game-theoretic framework. Using a dynamic game model, we find that the sub-game perfect Nash equilibrium outcome is to provide relief during crisis by industrial sector and civil societies when the authoritative power of the industry over the society is sufficiently large. Integration of the civil societies with the industrial sector relief measures would lead to enhancement of the overall welfare of the society. These results are supported by a case study of a power sector organization in the state of West Bengal, India where the industrial entity has successfully maintained a fine balance of controlling the spread of the disease and a stable production process. The institutional initiative in terms of integration of the civil society with industrial entity is also exemplary in contributing to crisis management.

Keywords Industrial sector · COVID-19 · Authoritative power · Civil society · Social welfare · Relief work

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1 Introduction

During Covid-19 pandemic India has gone through phases of lockdown, resulting in collapse of market operations and almost complete cessation of all major economic activities resulting in a severe jolt on the GDP growth, which stooped to the lowest in the last four decades at -7.3% (MoSPI 2021). The core industrial sector which contributes 26% of the GDP, contracted by 2.5% in June 2021 due to the second wave of the Covid-19 pandemic and the associated strict containment measures (MoSPI 2021). In these trying times, all economic activities hinge on optimizing tradeoffs between reducing contamination and maintaining regular economic activities, which is extremely difficult. To restore the economic stability, there is an ardent need for active involvement of industrial sector beyond the realms of profit maximization and align them with the institutional role (Chakraborty et al. 2004; Porter and Kramer 2011; Young and Makhija 2014; Kaur and Kaur 2020). Besides the government and industrial sector intervention, the activities by the institutional civil societies are showing an upward trend (Bailey 2020) to restore the economy. Related to the ‘Gandhian concept of trusteeship’, even in India we have observed people with steady income are swayed to part with their wealth to help the marginalized section of the society. Huge crowdfunding from big corporate houses and even small pensioners helped in running community kitchens and providing primary health care to COVID-19 patients through civil societies, religious communities or student wing of the opposition political parties (Dey and Chakravarty 2021). The activities by the civil societies have created higher societal expectations from the industrial sector as well (Yuen et al. 2021; Brechenmacher et al. 2020). Hence, the social responsibility of the industrial sector with active cooperation of civil society plays a crucial role in determining the rate of recovery for the economy from crisis (Bailey 2020; Della Porta 2020).

The market mechanism works well to establish a Pareto-efficient situation during usual times. However, during a crisis, the need for additional inventions and responsibilities intensifies (Madsen and Ulhøi 2021). The traditional institutional theory is finding its way by challenging the fundamental neoclassical premise of disentangling society from economics. Standard economic models suggest that a firm’s sole objective is profit maximization, but in reality, there also exists a quest for power and prestige and societal acknowledgement. The endogeneity of the industrial sector can be reinforced by some policy interventions, specifically during a crisis and hence affecting livelihood of people and society (Mukhopadhyay and Demand 2021). The strategies for achieving these goals are different for different industrial entities; for a few, it may not be vital or relevant. In today’s time, there is an immediate need for deeper understanding of the socially responsible industrial ideas in policymaking while persevering role of civil societies (Friedman 2007). The literature on incomplete contracts and behavioral economics provides the instruments to envision the firm-society interaction in the Arrow Debreu general equilibrium model (Arrow and Debreu 1954). For instance, the presence of norms of solidarity, cooperation benefits even further with the presence

of common intrinsic motivation and other regarding preferences. As suggested by Bowles and Carlin (2020), there is a need for considering and integrating the third dimension in the system-viz. the civil society. Therefore, the link between civil societies as the third pole to the policy space can't be ignored (Bailey 2020).

In India due to the COVID-19 crisis, market has taken a back seat and it has been left to the industrial sector to ensure the proper functioning of economic activities even after maintaining the COVID-19 protocols (Manna 2021). In this paper, we explore the conditions necessary for motivating an industrial entity to adopt appropriate measures in coordination with the civil society to ensure the well-being of their employees and indirect beneficiaries, yielding a mutually beneficial outcome in a game-theoretic framework. We find that the higher is the authoritative power of the industry over society (for instance in terms of maintaining brand image like TATA group), the more integrated will be the civil in welfare activities (Yuen et al. 2021). The actions are justified by the social 'welfare-maximizing' behaviour of the industrial entity in contrast to the 'profit maximization' behaviour. Therefore, during an economic crisis, the market fails and the social role of industrial sector multiplies by many folds.

Among the core industries of the economy, the power sector faced unforeseen shocks like huge contractions in factory orders, production and exports due to the unprecedented economic crisis caused by COVID-19. The resilience of the power sector has become critical during this time, as hospitals and residences (for home care) need to rely on stable power. However, the power plants were running at low capacity in the absence of industrial demand (IEA 2020) causing a paradoxical situation. The pandemic has therefore affected the generation mix and a steady, reliable power supply is a high priority for the economy during this crisis. However, to ensure steady reliable, affordable power supply, a continuous effective co-ordination of system operation and crisis management is required to develop the resilient power sector in India. We have, therefore, supported our theoretical finding with a case study of an industry in the power sector in the state of West Bengal, India, where the industrial entity has been able to maintain the delicate balance of controlling the disease spread and a stable production process. The industrial sector initiative in terms of integration of institutions like civil society and industry is also contributing to crisis management. In the theory of industrial sector, the social responsibility of an industrial entity are widely discussed, however, the implication of exercising authoritative power to increase the social welfare in a game-theoretic approach, substantiated by a shred of evidence is the unique aspect of the current study.

The rest of the paper is organized as follows. Section 2 assesses a theoretical model explaining the exercise of authoritative power to combat crisis. A case study from the power industry has been described in Sect. 3. Section 3 also explained the measures taken by the industrial entity and the implications of the case study in relation to the game-theoretical model. The final section provides concluding remarks on the aspect of crisis management by industrial units by exercising their authoritative power and integrated action plans with the civil society.

2 The social trust and crisis management: literature survey

Traditionally, the crisis management literature emphasized on the event's threat to socio-economic values, its redressal urgency and actions in accordance with the issues of uncertainty (Rosenthal et al. 1989; Boin et al. 2005). Consequently, crisis management studies looked beyond formal structures to establish the need for an efficient coordination between crisis management and civil protection (Boin and Bynander 2015; Christensen et al. 2016). Specifically, more recent crisis management studies have been analysing on how social capital including social trust, shared norms, networks, and other informal structures impact human actions (Kapucu 2006; Boin and Hart P't 2010). Also, the role of social capital is instrumental in establishing effective governance (Putman 1993, 2000) which is central to the idea of crisis management. Among other things, social trust and confidence in institutions show close association (Knack and Keefer 1997; Zmerli et al. 2007) where a low social trust can exacerbate the consequences of the crisis (Klinenberg 2015; Kye and Hwang 2020). From a broader perspective, confidence in institutions can fuel internal trust among the citizens, accelerating the process of controlling crisis situations and hence reducing transaction costs (North 1990; Fitzpatrick and Mileti 1994; Rothstein and Uslaner 2005).

Institutional trust enhanced effective and legitimate public administration lays out the fundamental structure which can induce individuals to trust each other more (Rothstein 2011). Without trust in the government or institutions, support for policy implementation becomes difficult, particularly where short-term sacrifices are demanded but long-term gains are not foreseeable, as in crisis situations (Lee 1998; OECD 2013). In a pandemic-like situation, the improvement in trust in the central and local bodies becomes even more crucial (Lee 2006; Van de Walle and Bouckaert 2003; Kye and Hwang 2020). Therefore, formation and dissolution of social trust have been of primary interest both for institutions and civilians, and existing literature has examined the trends, causes, and consequences of social trust and its relationship with institutional effectiveness (Coleman 1990; Dalton 2007; Delhey and Newton 2005; Fukuyama 1995; Knack and Keefer 1997; Moy and Scheufele 2000; Putnam 2000).

The institutional role in crisis management studies has however often been overlooked in identifying the differences in social trust and administrative cultures that may impact the effectiveness and legitimacy of institutions (Olsson 2009). Social trust often identified as a belief in the competence, honesty and benevolence of the other party (McKnight and Chervany 2000) is influenced by four major drivers viz., culture, institutional setting, economic and social outcomes, and performance of institutions (OECD 2013). The relationship between institutional performance and trust has been of particular interest to the administration of industrial entities because the role of trust has increasingly been identified as the potentially missing element for better crisis management and performance (Györfy 2018; James and Wooten 2010). The lesser-known issue is the extent of trust in institutions affecting post-crisis recovery of the industries. It is crucial to increase, or at least maintain, the level of trust in the institution by

using effective crisis management (James and Wooten 2010; Nakagawa and Shaw 2004).

3 The model

In this framework, we assume that there are two players in the system, viz., the industrial authority (A) and a civil society (S), who would provide relief work during a crisis like COVID-19 pandemic (*provider*) to the beneficiary (B) (*receiver*). Both A and S choose an optimal amount of relief amount depending upon their respective payoffs which are guided by the motivation of the relief providers. The benefit from participation in relief work are distinctively different among both the providers. When the industrial authority derives utility from the sense of empowerment by engaging in relief work (Galbraith 1973; Patterson and Clark 2020), civil societies indulge in these activities out of altruism (Forte 1997). Given this structural difference in the behavior of the two participating providers, industrial authority is assumed to be risk averse and civil societies are risk neutral in relief activities. Assuming constant marginal utility out of relief work, the beneficiaries are also risk-neutral in the model. The interaction between these agents helps to understand whether an integrated system between the industrial authority and the civil society is beneficial for the society or whether independent relief works conducted by both parties would be optimal. For that, we consider the following cases.

Case I: Only Industrial Authority (A) provides the relief work.

Under this situation, we assume that only A will provide relief to the society. Now, A can choose to provide relief of the amount $G \in [0, 1]$. Even if we assume that the entire amount of the relief does not reach the beneficiaries due to some leakage in the system, still αG reaches the beneficiaries, where $\alpha \leq 1$. This implies that there can be a leakage of $(1 - \alpha)G$ amount prevailing in the system. Subsequently, the leakage can also be interpreted as the cost of availing relief grants by the beneficiaries. For instance, often imprecise redistribution of the relief amount results in a partial reduction in the recipients of the relief. Assuming that the beneficiaries are risk neutral agent, the definitive form of their net utility function is

$$U_B(G) = \alpha G, \quad \text{where } \alpha \leq 1 \quad (1)$$

Since it is costly for A to provide the relief, we assume cost function as $C_A = \frac{G^2}{2}$, which exhibits constant increasing marginal cost.¹ Since, the authority's gain from relief activities accounts from its sense of empowerment accruing from the ability to exercise control beyond the industrial regime and perceived recognition by the society (Galbraith 1973) the utility from relief work is assumed to increase at a decreasing rate, denoted by $U_A = \sqrt{G}$, such that $\frac{\partial U_A}{\partial G} > 0$, $\frac{\partial^2 U_A}{\partial G^2} < 0$. The net payoff function from participation in the relief activity for A can be written as

¹ Constant marginal cost function to understand firm's behaviour is an standard assumption in the industrial organizational literature (for instance, see Besley and Ghatak 2008; Dey and Banerjee 2019 among others).

$$\pi_A = U_A(G) - C_A \quad (2)$$

Now, the objective of the authority would be to maximize the net payoff from relief, i.e.,

$$\max_{G \in [0,1]} \pi_A = \sqrt{G} - \frac{G^2}{2} \quad (3)$$

Taking the first order condition and setting it equal to zero ($\frac{\partial \pi_A}{\partial G} = 0$) we get, the optimal value of

$$G^* = 0.6. \quad (4)$$

Case II: Only Civil Society (S) provides the relief work.

In this sub-section, we assume that only S provides relief to the society. Let us assume that $C \in [0, 2]$ is the amount of relief provide by the civil society. The restriction on C is a technical assumption to ensure that the net payoff of S is non-negative. Similar to the situation in case I, even for community services, it is assumed that there would be same proportion of leakage or cost of accepting relief of $\alpha (\leq 1)$ for which only αC reaches the beneficiaries. Since, the civil society is risk neutral and altruist by nature, it is meaningful to assume utility of the civil society as say $U_S = C$ where, $\frac{\partial U_S}{\partial C} > 0$, $\frac{\partial^2 U_S}{\partial C^2} = 0$. However, the payoff of the recipient remains unchanged as before, $U_B(C) = \alpha C$. Put differently, if an individual is altruistic, the utility derived out of altruism is likely to remain unchanged at the marginal level, ensuring an increasing utility function at a constant rate. But the gain from the relief activity comes at a cost of $C_S = \frac{C^2}{2}$. Therefore the net payoff of the civil society from the relief activity is

$$\pi_S = U_S(C) - C_S \quad (5)$$

Therefore, the optimizing problem for the civil society would be as follows,

$$\max_{C \in [0,1]} \pi_S = C - \frac{C^2}{2} \quad (6)$$

Taking the first order condition and setting it equal to zero ($\frac{\partial \pi_S}{\partial C} = 0$) we get, the optimal value of

$$C^* = 1 \quad (7)$$

Comparing (4) and (7) we get that when only one out of the two agencies decides to provide relief during a crisis, the optimal action of civil society provides the relief amount of 1, greater than $G^* = 0.6$. Therefore, for B the payoff under case II is $U_B(C^*) = \alpha > U_B(G^*) = 0.6\alpha$.

Proposition 1 *Among the two relief providers, the industrial authority (A) and civil society (S), if either of the providers participates in relief provision to the society during a crisis, S outperforms A.*

Proof Provided in the discussion above.

Case III: *Both Industrial Authority (A) and Civil Society (S) provide relief to the society.*

In this case, we consider the situation when both providers are not playing a cooperative game but they are strategically interacting while choosing their ideal level of relief provision. A cooperative game would have been the first best situation as both the providers would have maximized their joint utility ensuring a better management of the provision for the society. However, often due to the practical difficulties of cooperation, such as information asymmetry about the activities (or the intent) of the industries and civil societies, cooperation may not be achievable. So, here we elaborate on the situation of non-cooperative game and consider a Stackelberg leader–follower framework to understand the optimal action for the providers and its impact on the beneficiaries.

First, we analyze the situation when A moves first and there is an integration in the actions chosen by both parties. In other words, due to the presence of strategic interaction, the utility of both parties is dependent on each other. We assume that the utility from relief activity for the S decreases with the increase in relief work provided by A such that,

$$\widetilde{U}_S = C(G) = \frac{C}{G}, \quad \text{where } G \in (0, 1] \quad (8)$$

Since the utility of S is accounted for by its altruist nature and related self-satisfaction (or warm glow), more provision from A diminishes the associated warm glow from the activity for S . On the other hand, for A more provision from S would imply lesser effort from A , which follows from the nature of their utility function in case I. Therefore, the authority's utility function will increase with the increase in C and there would be a partial substitution between C and G . Specifically,

$$\widetilde{U}_A = C(G)\sqrt{G} = \frac{C}{G}\sqrt{G} \quad (9)$$

Assuming that the cost structure remains unchanged, we proceed to solve the game using backward induction. We first find the optimal choice for the second mover, i.e., S . Since the S moves after observing the action of A , G is assumed to be given in the following optimization exercise.

$$\max_{C \in [0,1]} \widetilde{\pi}_S = C(G) - \frac{C^2}{2} = \frac{C}{G} - \frac{C^2}{2} \quad (10)$$

From the first order condition, we can derive the reaction function of S as

$$C^{**} = \frac{1}{G} \quad (11)$$

Now, A knows that S will follow its own reaction function which provides the maximum net payoff for S . Therefore, A will integrate the reaction function of S into its own optimization function as follows,

$$\max_G \widetilde{\pi}_A = C^{**} \sqrt{G} - \frac{G^2}{2} = \frac{1}{\sqrt{G}} - \frac{G^2}{2} = \frac{1}{\sqrt{G}} - \frac{G^2}{2} \quad (12)$$

The objective function of A is now a function of G only; A can choose the optimal value of $G^{**} = 0.76$. Substituting G^{**} in (6) we get $C^{**} = 1.31$.

Now, comparing all three cases, we observe that the relief provision is $G^{**} + C^{**} = 2.07$ units under case III, which is greater than both case I (0.6 units) and case II (1 unit).

Similarly, it can be shown that the optimal relief amount chosen are $G^{***} = 0.71$ and $C^{***} = 0.83$ for A and S respectively, when S moves first and A follows. This implies that utility for the beneficiaries under this situation will be for $U_B(G^{***} + C^{***}) = 1.54\alpha$ which is lower than the situation when A moves first in the non-cooperative equilibrium.

Proposition 2 *The societal welfare is maximum under the situation when the industrial authority moves first and the civil society follows while providing relief measures during a crisis.*

Proof Provided in the discussion above.

Even when the non-cooperative equilibrium is socially desirable the timing of the actions by the providers plays a crucial role. During the time of a crisis, the industrial authority can move first as they have the institutional set-up, from where the resource can be mobilized. The civil societies have limited funds to start with and need to gather funds before mobilizing the resources. However, access to funds does not ensure that A will take the lead in relief provision. In the following analysis, we explore when would A be willing to move first so that the socially optimum outcome is achieved. In this framework, we construct a dynamic game of complete information, where both providers are aware of each other's possible actions and payoff.

We assume that the A moves first. For both the agencies, the action sets the same denoted by $A_A = A_S = \{\text{relief, no relief}\}$. Now, A enjoys the power and recognition associated with the relief work (G). The relief provisions of S are often channelled through the organized setup established by A . This makes it more costly for A to manage the community-driven activities (C). Assuming that the cost of providing relief for both the players is zero, the payoff for A when both parties choose (relief, relief) is $G - C$. The utility of S also diminishes if A is proactive in provision of relief (as their actions are not scarce anymore) and their payoff is $C - G$. To fix ideas, we assume that the utility from getting recognition for A is low such that $G < C$. This can be explained by the fact that the citizen expects that the relief, in the philosophy of 'giving back to the society' is part of the duty of the organizational authority and hence the recognition is low. For simplicity, we have assumed that the utility of S from participating in relief programs is equal to the cost that they impose on A due to their action. If A chooses not to provide relief but S opts to provide relief then A loses the control over the society ($-G$), whereas the utility of S increase to $C + G$. If A only provides the relief, the payoff will be only G . The payoff of S for choosing

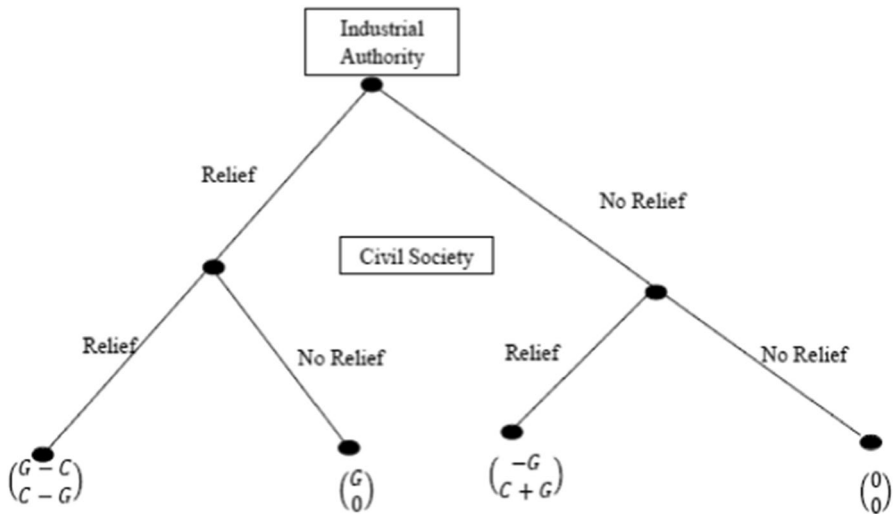


Fig. 1 Dynamic game between Industrial Authority and Civil Society during a crisis

‘no relief’ is zero. In the extreme situation, when both the players choose not to provide relief, the payoff for both are zero. We summarize the game with its payoff in the following extensive form representation in Fig. 1.

Now to find the sub-game perfect Nash equilibrium for this sequential move game, we use the method of backward induction. For S , it is best to choose relief when A choose relief since $C - G > 0$. Therefore, if A plays relief the game folds back and the payoff for A is certainly $G - C$. Similarly, when A plays ‘no relief’ the payoff is $-G$ as S will always play relief as $C + G > 0$. So, A will choose to provide relief if $G - C > -G$.

Proposition 3 *The sub-game Perfect Nash Equilibrium will be (relief, relief) only if $G > \frac{C}{2}$. Precisely, the industrial authority will choose to provide relief to the society in the time of a crisis only if the authoritative gain is sufficiently large.*

The above propositions can be substantiated and justified with an evidence from an industrial unit that successfully managed to continue its production process as well as managed the crisis by exercising its authoritative power and active cooperation from the community and public institutions.

4 A case study on power industry

Exemplary management of the crisis has been shown in one of the industries in the state of West Bengal, India. An intensive case study of a power plant has been provided, which lays out a thorough description, interpretation and understanding of strategies to manage the crisis by the power plant. To align our theoretical findings,

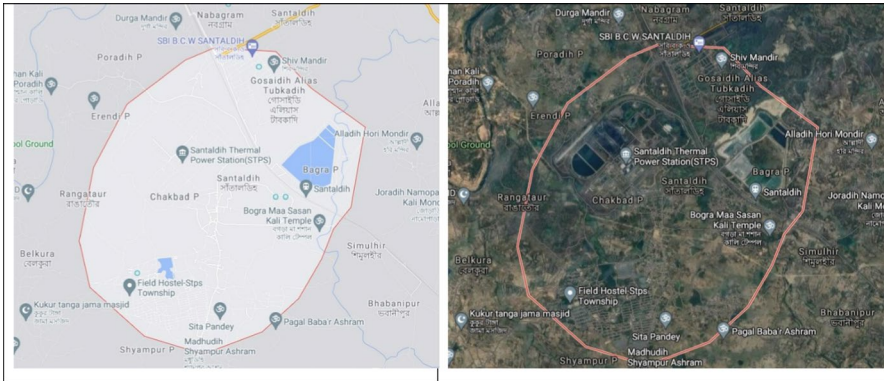


Fig. 2 Study area (The outlined area in the map is representing the Santaldih town centered by Santaldih Thermal Power Station at $23^{\circ}35'53''$ N $86^{\circ}28'26''$ E, in Purulia district in the Indian state of West Bengal). *Source:* Google map image taken on 24th July, 2021

data were gathered from the chosen power plant's company reports and through interaction with stakeholders from different levels of the case.

4.1 Study area

The study area is a government power generation plant at Santaldih in Purulia district in the Indian state of West Bengal. The township is built around 1975 to provide accommodation to the employees of the thermal power station (Santaldih Thermal Power Station (STPS) under West Bengal Power Development Corporation Limited (WBPDC)) under the government of West Bengal, India. The township is situated in a Community Development Block of Purulia district, which is one of the remotest and impoverished regions of the state of West Bengal, India. Despite its locational disadvantage (350 kms away from the Kolkata–Capital of the State West Bengal), the measures to combat the pandemic are commendable and worth sharing.

The industrial entity is a renowned power station with an installed capacity of 500 MW (with 2 units each of 250 MW). Around 700 permanent and 1500 contractual employees are engaged in this industry. The families of these employees reside in the township or in the adjoining villages. This industrial entity is 7 decades old establishment and the socio-economic development of the area is majorly centered in and around the power plant. The existence of this industrial entity has also helped to endear the trust of the entire community in and around Santaldih. Majority of the economic activities and livelihood of the localities are directly or indirectly dependent on the industrial entity; hence the industrial entity and its management's directives are exercised more effectively in this case. This is also the reason why the liability of the industrial entity has moved beyond the industrial revenue maximizing principle. Also, civil societies work in perfect coherence with the authority. It provides the utility of exercising authoritative power on the society making it an appropriate case to study (Fig. 2).

In order to prevent the spread of COVID-19, the authority of the industrial entity abided all the notifications issued by the state government as well as central government from time to time and implemented necessary preventive measures to combat the outbreak of COVID-19 without compromising productivity. However, apart from the government specified guidelines, the industrial entity initiated other measures to successfully manage the crisis which has been discussed in the following sections.

4.2 Power generation indicators

The domestic gross energy demand had been showing a fall of around 5% during 2001–2020 (IEA 2020; IFC 2020), the slowdown is further accentuated due to supply chain breakdown during COVID-19 pandemic. India saw one of the largest electricity demand destructions globally during pandemic as power demand fell by 28% up to the end of March 2020 (IEA 2020). Under the conditions of the strict lockdown, which started on 25 March 2020, power demand from hospitals, essential services and the residential sector was on the rise, while industrial demand and commercial activities dropped. By the end of August 2020, total power demand in India had not recovered to levels prior to Covid-19, according to the IEA (2020). However, the industrial entity, under this study, has been able to sustain their production reasonably at a stable position, exhibiting a fluctuation of only about – 7% compared to previous year, which stands well within the regular fluctuation range. The overall performance is depicted in the Table 1.

Structurally, power plants should run without interruption and electricity generation must continue. Due to lockdown, there are reasons for disruptions in the production process as it had to operate with low manpower. Yet, the power plant managed well the production fluctuation ensuring stabilized electricity generation as compared to the all-India power generation (Ministry of Power GoI 2021). In the above Fig. 3, it can be observed that from January, 2020 to July, 2021, the moving average of the generation is almost same, however, there are monthly fluctuations. The dotted line has shown the trend line and the actual generation is shown by the solid line in Fig. 3.

4.3 Measures to combat contamination

Indian experience in combating COVID-19 initiated in March 2020, with a very early stance of complete lockdown. The effect of complete lockdown had a hard blown on the economy and livelihood of the people (Dey and Chakravarty 2021), especially on the temporary workers from formal or informal job markets (Sharma 2020; Chandrasekhar and Ghosh 2020; Sharma and Mahendru 2020). The case has considered the crisis management as their utmost priority and managed the rate of contamination. The number of positive cases was limited and the severity of contamination had been less than 5%. Death due to COVID-19 only has been 1% within the township.

Table 1 Performance indicator of the case

Performance indicator	Generation (in MU)	PLF (in %)	Auxiliary consumption (in MU)	Auxiliary consumption (in %)	Specification oil consumption (in ml/kwh)	Forced outage (%)	Planned outage (%)
2019–2020	3693.57	84.11	304.72	8.25	0.9	1.07	5.82
2020–2021	3442	78.61	289	8.42	0.4	0.59	5.12

Source: WBPDCCL website

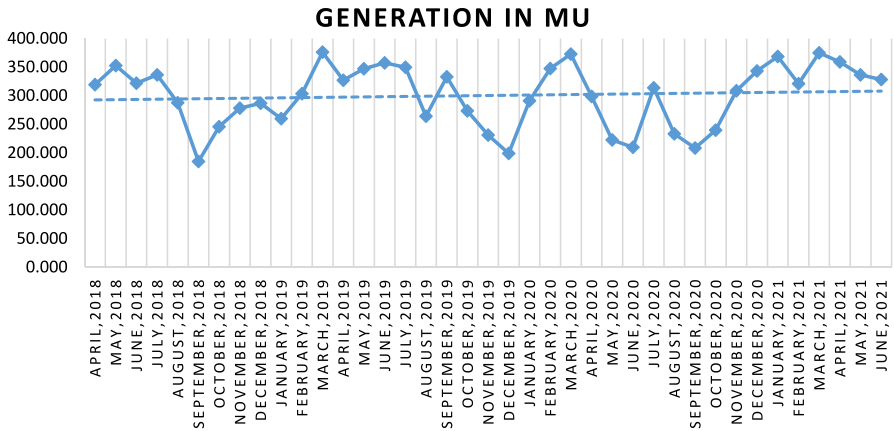


Fig. 3 Monthly generation during January, 2020–July, 2021. *Source:* STPS, WBPDC generation data, 2021

Like other operational industrial entity, the power plant had been taking precautions as per the mandate and the authority had been updating their measure with the WHO guidelines regularly. The medical officers along with the other officials, were continuously upgrading themselves with the protocols, medications and all necessary know-how. The information was disseminated on regular intervals via public announcements, distribution of pamphlets and even through online webinars. Validating the results from proposition 2, we find that the involvement of the local civil societies was very efficiently utilized by the industrial entity to empower the residents with the right information about updated preventive measures and contingent arrangements.

The major challenge of the authority has been striking a balance between the well-being of the employees and uninterrupted operation. Assimilation of workers in the plant is essential, but that would increase the exposure and might lead to an increase COVID-19 cases not only in the township but also among the localities. Therefore, the industrial entity took strict measures on the livelihood of the employees and their immediate family members. During the mandated unlock phase, the industrial entity maintained a restricted entry policy within the township. Employees' families had to register the reason for travel with the industrial entity so that a strict 14 days self-quarantine surveillance can be maintained by the authority and the medical unit once they return.

During the lockdown, the authority initiated a health status survey for the entire township, which included overall 1300 residential units where employees, contract workers and their families. The survey recognized the number of persons with various kinds of health issues (such as diabetes, high pressure, breathing trouble, etc.) to identify the vulnerability of township dwellers to COVID-19. This survey helped in planning out the possibilities of medical emergencies and equipping the hospital with the necessary infrastructure. The data generated out of the survey immensely helped in the preparedness of the authority. Interestingly, the civil society played a

crucial role in conducting the survey, convincing the locals as well as the employee families that the measures are for the well-being of the community and hence, helped in reinforcing the trust for the industrial authority. The resultant increased authoritative gain facilitated better management, as every concerned individual complied with the measure and accommodated with them. This observation goes in line with our result in proposition 2 that an integrated system is more welfare enhancing.

The industrial entity made additional effort to maintain the supply chain, not just for industrial production but also for the medical essentials. Timely procurement of PPEs and oxygen cylinders, maintaining medicine stock at the hospital, and providing on-call medical support from registered physicians were ensured. For instance, in early April 2020, the availability of sanitizers was limited even in the state capital, Kolkata, but the authority managed to procure them directly from the manufacturing companies. Additionally, a purchase order was placed with small MSME's and the stock-up problem was addressed by rationing all the essential.

4.4 Extended measures for the society

The COVID-19 measures were not exclusively restricted to the employees of the industrial entity. The adjoining villages were also beneficiaries of the relief measures. These actions were not only a part of their corporate social responsibilities but the safety of the localities would also limit the exposure of the employees, which will indirectly help the industrial entity in maintaining the man-hours required for production. Therefore, industrial measures went way beyond the mandated governmental protocols of operation. The authority had been taking all necessary steps to ensure that the people are prepared well to face the threat posed by the growing crisis during the pandemic. A well-integrated support from the employees and their family members, local residents, together with the authority has helped to control the spread of the virus in Santaldih.

To reduce the contamination from employees to local people, the authority emphasized on regular sanitization of those areas where people are bound to make a visit such as market, bank, ATM, panchayat office and medical units. Apart from the power plant and township area, the authority started the program for sanitization with the help of West Bengal Fire and Emergency Services in numerous offices and school campuses which are supposed to attract crowd at Santaldih and its nearby areas. Observing the successful implementation of measures for combating the disease by the industrial entity, the nearby coal washery plant and its township, Block Development Office (BDO), police station, panchayat samity office, land and land reforms office, health centres have requested the industrial entity for extending their support. In this way the industrial entity has exercised their authoritative power in these public spaces as well to limit the spread of the pandemic.

The economic condition of the nearby villages due to lockdown became vulnerable and the access to essentials like edible rations, masks and sanitizer were limited. The civil societies like employees club and associations initiated several programs in different phases with active support from the industrial entity to disseminate the essentials for the marginalized. The local police were also involved in the process to

ensure smooth distribution during the strict lockdown maintaining the all COVID-19 protocols.

Due to the locational disadvantage of the town, access to government health facilities and vaccination centres was also difficult. All the centres are far off and public transportation has lessened due to the pandemic, it was a challenge for the localities to reach the vaccination centres. The authority had set up vaccination camp within the township medical unit in association of a private hospital, where other than the employees and their families, vaccines were provided to localities at a minimum cost. These includes the household helpers, temporary workers, contractual drivers and shop keepers and many more.

The crucial phase for a power generation plant is overhauling, which demands more temporary and contractual labour for proper functioning and servicing of the machineries. This attracts workers to migrate to Santaldih from outside. Migration of labourers can increase infection transmission potential at the workplace and subsequently in township and its nearby areas. Special committees were formed to manage the protocols for this overhauling process under the COVID-19 restrictions. Accordingly, the industrial entity had prepared well in advance to keep the crisis at bay. It ensured allowing any worker to enter into the study area with appropriate medical reports. The industrial entity took initiative for medical tests free of cost with active collaboration with the District Magistrate and Chief Medical Officer of Health, Purulia. The authority arranged accommodation for the workers away from the residential area, in the safe houses/tents so that the social distance could be maintained even within the immigrant labourers. Similarly, vacant quarters have been furnished to isolate any employees who had been found with any symptoms of the virus.

In this extended social support, the industrial entity with appropriate authoritative power received an active support from civil societies including the employees and their family members, as expected from our result in proposition 3. Employees not only donated for relief funds, they also took initiatives to identify the issues related to livelihood of the people who are indirectly dependent on the power-plant and township, which were supposed to be addressed by the authority in support with the public institutions. The support to communities also creates a feeling of reciprocity (which is $\widetilde{U}_S = C(G) = C \cdot \frac{1}{G}$ in our model). People know that when in need, they may have the support of the community together with the industrial entity and public institutions, which can also explain the finding of proposition 1 clearly stating that the civil societies outperform the authority's action. The contribution to local communities also helps in generating the in-group identity and stretches the realms of altruism through the idea of 'giving back to the society'.

5 Conclusion

India had been suffering from the devastating impacts of COVID-19, raising health, economic and social challenges. The pandemic has compelled India to strengthen its ability to maintain security of supply, boost system flexibility and better integrate its authoritative power for effective preparedness in the case of socio-economic

crisis. It is also important to ensure the energy security through constant and reliable supply of electricity to the households, commercial and medical units during such crisis. The representative power generation units set an example how the industrial authority can provide support to the society in time of a crisis by exercising its authoritative power and with active cooperation with other institutions, which in turn can be mutually beneficial. The well-being of the society will ensure disease-free workforce leading to steady supply of resources maintaining productivity. The game theoretic model shows that the among authority and civil society, if either of the agency provides relief to the society during a crisis, civil society outperforms the industrial authority. Even assuming a percentage of leakage in the system, the societal welfare is maximum under the situation when the authority and the community both provides relief using a strategic interaction. However, the industrial authority will choose to provide relief to the society in time of a crisis only if the authoritative gain is sufficiently large. In this particular case, the industrial entity realizes the implicit cost of labour loss, productivity loss due to COVID-19. The implicit costs of ignoring the health issues of employees (for example the medical allowances bill) and their families can be a huge amount. The health of the temporary workers of the industrial entity is also important for the production performance because of the spiral nature of the disease. The oversight of this issue might have possible implications for the future business of the industrial entity (Madsen and Ulhøi 2021). This case study is a representative one and we can find similar evidences of other industrial entities operating in remote areas with a township. The success can be accounted for the authoritative control over the township and its associated areas. Wherever feasible, industrial entities should take the ‘management of this crisis’ as their utmost priority and successfully control the pandemic and maintain the production process by exercising their authoritative power.

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Declarations

Conflict of interest All conclusions and errors are the responsibilities of the authors and reflect their research analysis and do not reflect any other institutions’ viewpoint.

References

- Arrow KJ, Debreu G (1954) Existence of an equilibrium for a competitive economy. *Econometrica* 22:265–290

- Bailey K (2020) The empire of 'global civil society': corporations, NGOs, and international development. In: The global citizenship nexus. Routledge, pp 241–259
- Besley T, Ghatak M (2008) Status incentives. *Am Econ Rev* 98(2):206–211
- Boin A, Bynander F (2015) Explaining success and failure in crisis coordination. *Geogr Ann Ser B* 97(1):123–135
- Boin A, Hart P't (2010) Organising for effective emergency management: lessons from research. *Aust J Public Admin* 69(4):357–71
- Boin A, Hart P't, Stern E, Sundelius B (2005) The politics of crisis management. Cambridge University Press, Cambridge
- Bowles S, Carlin W (2020) Shrinking capitalism. *AEA Pap Proc* 110:372–377
- Brechenmacher S, Carothers T, Youngs R (2020) Civil society and the coronavirus: dynamism despite disruption. Carnegie Endowment for International Peace. https://carnegieendowment.org/files/Brechenmacher_Carothers_Youngs_Civil_Society.pdf
- Chakraborty SK, Kurien V, Singh J, Athreya M, Maira A, Aga A, Gupta AK, Khandwalla PN (2004) Management paradigms beyond profit maximization. *Vikalpa* 29(3):97–118
- Chandrasekhar C, Ghosh J (2020) Coronavirus: informal workers need greater support. <https://www.thehindubusinessline.com/opinion/columns/c-p-chandrasekhar/coronavirus-informal-workers-need-greater-support/article31143716.ece>. Accessed 4 Apr 2020
- Christensen T, Danielson OA, Lægrend P, Rykkja L (2016) Comparing coordination structures for crisis management in six countries. *Public Admin* 94(2):316–332
- Coleman JS (1990) Foundations of social theory. Harvard University Press, Cambridge
- Dalton RJ (2007) The social transformation of trust in government. *Int Rev Sociol* 15(1):133–154. <https://doi.org/10.1080/03906700500038819>
- Delhey J, Newton K (2005) Predicting cross-national levels of social trust: global pattern or Nordic exceptionalism? *Eur Sociol Rev* 21(4):311–327. <https://doi.org/10.1093/esr/jci022>
- Della Porta D (2020) Building bridges: social movements and civil society in times of crisis. *Volunt Int J Volunt Nonprofit Organ* 31(5):66
- Dey O, Banerjee S (2019) Incentive conscious' agents and moral hazard. *Indian Econ Rev* 54:149–169
- Dey O, Chakravarty D (2021) Trust and crisis management in India under COVID-19. *East Asia Forum*. <https://www.eastasiaforum.org/2021/07/22/trust-and-crisis-management-in-india-under-covid-19/>. Accessed 24 Oct 2022
- Fitzpatrick C, Mileti DS (1994) Public risk communication. In: Dynes RR, Tierney KJ (eds) Disasters, collective behavior, and social organization. University of Delaware Press, Newark, pp 73–75
- Forté JA (1997) Calling students to serve the homeless: a project to promote altruism and community service. *J Soc Work Educ* 33(1):151–166
- Friedman M (2007) The social responsibility of business is to increase its profits. In: Zimmerli WC, Holzinger M, Richter K (eds) Corporate ethics and corporate governance. Springer, Berlin, pp 173–178
- Fukuyama F (1995) Trust: the social virtues and the creation of prosperity. Free Press, New York
- Galbraith JK (1973) Power and the useful economist. *Am Econ Rev* 63(1):1–11
- Györfi D (2018) Trust and crisis management in the European Union: an institutional account of success and failure in program countries. Palgrave Macmillan, London
- International Energy Association (IEA) (2020) India needs a resilient power sector: Lessons from the Covid-19 crisis. <https://www.iea.org/commentaries/india-needs-a-resilient-power-sector-lessons-from-the-COVID-19-crisis>. Accessed 24 July 2021
- International Finance Corporation (IFC), World Bank Group (2020) The impact of COVID-19 on the power sector. https://www.ifc.org/wps/wcm/connect/f73f9cf3-3abd-4378-b5b6-c8eb8c4c1b45/IFC-COVID-19-PowerSector-final_web_rev.pdf?MOD=AJPERES&CVID=n9.04sQ. Accessed 24 July 2021
- James EH, Wooten LP (2010) Leading under pressure: From surviving to thriving before, during, and after a crisis. Routledge, New York
- Kapucu N (2006) Interagency communication networks during emergencies: boundary spanners in multi-agency coordination. *Am Rev Public Admin* 36(2):207–225
- Kaur G, Kaur C (2020) COVID-19 and the rise of the new experience economy. *FIIB Bus Rev* 9(4):239–248
- Klinenberg E (2015) Heat wave: a social autopsy of disaster in Chicago, 2nd edn. University of Chicago Press, Chicago
- Knack S, Keefer P (1997) Does social capital have an economic payoff?: a crosscountry investigation. *Q J Econ* 112(4):1251–1288
- Kye B, Hwang SJ (2020) Social trust in the midst of pandemic crisis: implications from COVID-19 of South Korea. *Res Soc Stratif Mob* 68:100523

- Lee J (1998) Democracy, social capital, and social trust. *Gyegan Sasang* 37:65–93
- Lee J (2006) Trust and civil society: comparative study of Korea and America. *Korean J Sociol* 40(5):61–98
- Madsen HL, Uhløi JP (2021) Sustainable visioning: re-framing strategic vision to enable a sustainable corporate transformation. *J Clean Prod* 288:1–12. <https://doi.org/10.1016/j.jclepro.2020.125602>
- Manna SS (2021) Restructuring state, society, and human development: projecting post-COVID pandemic equations. *COVID-19 Pandemic Trajectory in the Developing World* 145
- McKnight DH, Chervany NL (2000) What is trust? A conceptual analysis and an interdisciplinary model. In: *AMCIS 2000 Proceedings* 382
- Ministry of Power, Government of India (2021) Power sector at a glance all INDIA, 2021. <https://powermin.gov.in/en/content/power-sector-glance-all-india>. Accessed 24 July 2021
- Ministry of Statistics & Programme Implementation, Government of India (2021) Press note on provisional estimates of annual national income 2020–21 and quarterly estimates of gross domestic product for the fourth quarter (Q4) of 2020–21. https://mospi.gov.in/documents/213904/416359/Press%20Note_31-05-2021_m1622547951213.pdf/7140019f-69b7-974b-2d2d-7630c3b0768d. Accessed 24 July 2021
- Moy P, Scheufele DA (2000) Media effects on political and social trust. *J Mass Commun Q* 77(4):744–759. <https://doi.org/10.1177/107769900007700403>
- Mukhopadhyay A, Demand I (2021) Post-pandemic economic recovery: seven priorities for India. *ORF Occasional Papers*. Accessed 24 Oct 2022
- Nakagawa Y, Shaw R (2004) Social capital: a missing link to disaster recovery. *Int J Mass Emerg Disast* 22(1):5–34
- North DC (1990) *Institutions, institutional change and economic performance*. Cambridge University Press, Cambridge
- OECD (2013) *Trust in government, policy effectiveness and the governance agenda*. OECD. Government at a glance 2013. OECD Publishing, Paris, pp 19–37. https://doi.org/10.1787/gov_glance-2013-en. Accessed 24 Oct 2022
- Olsson S (ed) (2009) *Crisis management in the European Union*. Springer, Dordrecht
- Patterson A, Clark MA (2020) COVID-19 and power in global health. *Int J Health Policy Manag* 9(10):429
- Porter ME, Kramer MR (2011) Creating shared value. *Harv Bus Rev* 89(1–2):62–77
- Putnam R (2000) *Bowling alone: the collapse and revival of American community*. Simon & Schuster, New York
- Rosenthal U, Charles MT, Hart PT (eds) (1989) *Coping with crises: the management of disasters, riots, and terrorism*. Charles C. Thomas Publisher, London
- Rothstein B (2011) *The quality of government*. University of Chicago Press, Chicago
- Rothstein B, Uslaner E (2005) All for all: equality, corruption, and social trust. *World Politics* 58(1):41–72
- Sharma M (2020) Life, livelihood and lock down: the dilemma ahead. *Mainstream weekly*. <http://www.mainsstreamweekly.net/article9350.html>. Access 24 July 2021
- Sharma GD, Mahendru M (2020) Lives or livelihood: insights from locked-down India due to COVID19. *Soc Sci Hum Open* 2(1):100–136
- Van de Walle S, Bouckaert G (2003) Public service performance and trust in government: the problem of causality. *Int J Public Adm* 29(8–9):891–913. <https://doi.org/10.1081/PAD-120019352>
- Young SL, Makhija MV (2014) Firms' corporate social responsibility behavior: an integration of institutional and profit maximization approaches. *J Int Bus Stud* 45(6):670–698
- Yuen S, Cheng EW, Grépin KA, Fu KW, Yung KC, Yue RP (2021) A tale of two city-states: a comparison of the state-led vs civil society-led responses to COVID-19 in Singapore and Hong Kong. *Glob Public Health* 66:1–21
- Zmerli SK, Newton A, Montero JR (2007) Trust in people, confidence in political institutions, and satisfaction with democracy. In: van Deth W, Montero J, Westholm A (eds) *Citizenship and involvement in European democracies*. Routledge, New York, pp 35–65

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