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Article

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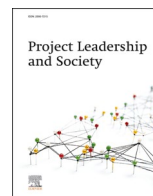
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Empirical Research Paper

Owner capabilities in project organizing: Managing disruptions on infrastructure projects

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ABSTRACT

Megaprojects are large-scale, complex initiatives that often encounter major disruptions during their life cycle. These disruptions have the potential to seriously impair the viability of the megaprojects. They may also cause severe damage to the economy in the region where they are emerging. To overcome disruptions, and to enhance their delivery performance, the strategic management concept of dynamic capabilities is being increasingly applied. In the context of megaproject owners, there is a need to understand what capabilities are required and how they are developed in the face of disruptions.

Drawing upon longitudinal data over a period spanning 50 years for three megaprojects in the urban development (metro rail) domain, this study examines key disruptions that may influence the development of owner capabilities. Specifically, this study identifies four project capabilities: i) a strategic capability to continuously engage with, and manage external stakeholders, ii) a strategic capability to preserve value and transform the delivery process, iii) a governance capability to enhance organizational resilience, and iv) a commercial capability to manage knowledge and partnerships. Given that disruptions are repetitive in nature, owners would need these project capabilities to overcome disruptions.

1. Introduction

Megaprojects are large-scale, complex, and politically sensitive initiatives involving many actors with competing interests and values (Ninan et al., 2019; van Marrewijk et al., 2008). Globally, a vast majority of megaprojects have experienced disruptions that have adversely impacted their outcomes. In the context of this study, a disruption is an interruption in ongoing work whose impact on the delivery threatens the viability of the project. Disruptions are typically caused by protests, strikes, technical roadblocks, accidents, bankruptcies of contractors, natural calamities, and similar undesirable events. A disruption may occur repetitively on a project; the underlying cause for the disruption may be similar (experienced earlier by the project) or entirely different. Further, disruptions may be caused by internal or external factors, and may be intentional or unintentional (Coombs, 1995).

Disruptions often cause delays in delivery. They also cause cost overruns, diluted benefits, negative publicity and ultimately result in their failure (Shenoy and Mahanty, 2021). If not managed properly, these disruptions may not just seriously impair the viability of megaprojects, but may also cause economic instability in the region where

they are emerging (Lehtonen, 2019). Organizations would, therefore, need capabilities to quickly recover from disruptions.

Strategic management scholars have established that organizations rely on their capabilities to deliver superior sustainable performance (Helfat et al., 2007; Teece, 2009; Teece et al., 1997). Therefore, current research in strategic management has increasingly focused on the development of capabilities. At a fundamental level, organizations have capabilities to deploy resources to *make a living* (Winter, 2003). These are referred to as *ordinary* or *zero-order* capabilities. At a higher level are capabilities that allow the ordinary capabilities to change. These capabilities are referred to as *dynamic capabilities* that “integrate, build, and reconfigure internal and external competencies to address rapidly changing environments” (Teece et al., 1997). This study posits that organizations would need new capabilities to overcome disruptions.

Megaproject development involves several stakeholders; however, there are three key actors: i) suppliers (project-based firms), ii) projects and programs, and iii) owners and operators (Gulino et al., 2020; Winch, 2014; Winch and Leiringer, 2016). These actors have their own distinct needs and, therefore, distinct capabilities. While suppliers focus on project deliverables, the owners and operators aim to enhance

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operational benefits. Past literature on project management has focused on project output and its delivery aspects. However, for a project to be considered successful, the benefits of its deliverables must be realized. For this to happen, owners' capabilities would need to be studied (Gulino et al., 2020). Therefore, scholars in project organizing (Gulino et al., 2020) are now shifting focus to capability development from the owner's perspective.

This study investigates the development of project capabilities from an owner's perspective. This study seeks to extend the project capabilities framework developed by Winch and Leiringer (2016) to account for disruptions. Specifically, this study aims to answer the following research questions.

[RQ1] What owner capabilities are required to overcome mega-project disruptions?

[RQ2] How are these owner capabilities developed in the context of disruptions?

Practitioners and academics may benefit from the answers to these questions, as they would get new insights into megaproject disruptions and related owner capabilities. This can help them prepare better to overcome those disruptions and assure successful outcomes. In this study, we investigate only disruptions that result in significant delays, cost-overruns, diluted benefits, and negative publicity.

The article is structured as follows: Section 2 describes the key actors and their roles in megaproject development. Specifically, the owner capabilities in project organizing will be analyzed, followed by an analysis of owner capability development in the face of disruptions. Section 3 details the research methods as well as the multiple cases studied, along with the data collection and analysis methods. The owner capabilities that emerge are then examined. This is followed by an analysis in the light of the existing framework on project capability development. The final section describes the key contributions of this study, its limitations, and suggestions for future research.

2. Literature review

2.1. Owners, suppliers, and projects and programs

Organizations generate business income by providing services to their customers. When an organization wishes to enhance their ability to deliver services to their customers, they make strategic decisions to invest in projects. While the organizations' core business relates to offering services to their customers, they occasionally invest in projects to enhance delivery of their services (Winch, 2014). In the context of project organizing, these organizations are referred to as owners and operators ('owners').

The owners do not normally undertake the projects themselves; they hire project-based firms ('suppliers') that provide project-related services (Winch and Leiringer, 2016). The owners engage the suppliers through temporary organizational arrangements ('projects and programs') to achieve their strategic intent (Winch, 2014). Each of these organizations – owner, supplier, and the temporary project and program – have a specific role. While the owner's role is to identify the right project for investment, and to integrate the new asset and operate it, the supplier's role is to deliver the asset on schedule and within budget, and thus contribute to the owners' strategic requirement. Each organization thus has a distinct role and, therefore, would need distinct capabilities. A few capabilities would be routine, but to be successful, some of the capabilities may need to undergo changes.

2.2. A framework for owner capabilities in project organizing

Capabilities are a collection of individual competencies and resources that can lead to the achievement of the goals of an organization. Capabilities are "an organization's ability to mobilize, deploy and

combine resources that it either owns or has access to" (Leiringer and Zhang, 2021). At the fundamental level, organizations have capabilities to deploy resources to *make a living*. These are referred to as ordinary capabilities, i.e., the capabilities required to achieve technical efficiency and to enable an organization to *do things right* (Teece, 2014, p. 331). An organization's ordinary capabilities are sufficient to achieve competitive advantage, but only until conditions change. (Teece, 2014, p. 331). When conditions change, the organization will need capabilities that allow ordinary capabilities to change. These capabilities are referred to as dynamic capabilities. These capabilities are about *doing the right things at the right time*. A dynamic capability is the "capacity of an organization to purposefully create, extend, or modify its resource base." (Helfat et al., 2007). In the face of adversity, a capability – ordinary or dynamic – can be exploited to produce desirable outcomes (Teece, 2014).

Past literature in megaproject development has focused on activities of suppliers (project-based firms) rather than owners. It has now been established that owner capabilities are key to successful project organizing (Cha et al., 2018; Gulino et al., 2020). In the context of projects, operational and dynamic capabilities are more intertwined (Zerjav et al., 2018). Project capabilities are required to reconfigure and adapt to changes in the project environment (Zerjav et al., 2018).

Morris and Hough (1987) emphasised the need for a *strong owner* to successfully deliver projects. Addressing this call, Winch and Leiringer (2016) developed a framework for owner project capabilities, which they defined as: "the dynamic capabilities required by the owner organization for the acquisition of infrastructure assets in order to extend or improve its operational capabilities" (p. 272). The framework provided insights into the capabilities required by strong owner in the context of transportation projects. They identified three areas of capabilities. The first set of capabilities are *strategic capabilities*. This is a key responsibility of the owner organization, requiring identification of the right investment from several competing proposals. In addition, the owner would require capabilities to develop a mission statement, raise funds for the project, and for stakeholder management. Finally, the owner would also need portfolio management capabilities to ensure the projects are aligned with the organization's strategic goals (Stordy et al., 2021; Winch and Leiringer, 2016). The second set of capabilities – *commercial capabilities* – are required to interact with their suppliers. This includes capabilities to break the project scope into work packages. The owner would also require capabilities for relational and contract management. The third set of capabilities are the *governance capabilities* that underpin the relationships between the owner and the project. These capabilities include coordination capabilities, assurance capabilities and capabilities to integrate new assets with operations (Winch and Leiringer, 2016; Zhang et al., 2023). The owners may acquire an appropriate mix of these three capabilities either endogenously through organizational learning, or exogenously through partnerships (Winch and Leiringer, 2016).

In social infrastructure projects, the end-user acquires a central role. A project would be considered successful only when the users' needs are taken care of. Owners may also need *transformational capabilities* – consisting of capabilities of collaboration, innovation, project-led learning, and having a user-driven mindset capabilities – to succeed (Gulino et al., 2020). To ensure transformation, an organization would need to ensure realization of the benefits of the projects implemented. Owners would, therefore, also need *project backend capabilities* that are essential to ensure realization of benefits. These capabilities include employee training, knowledge transfer and operational governance capabilities (Cha et al., 2018).

Like the social infrastructure projects, owners engaged in building economic infrastructure (e.g., transportation) would need to shift their focus from being asset owners to service providers, i.e., more focus on the end-customer. In addition, keeping the asset integration in mind, they would need to articulate the voice of the operations and focus on value delivery (Maytorena-Sanchez and Winch, 2022).

2.3. Disruptions and owner capability development

While capability development in predictable conditions focus on exploitation of operating routines, the same in uncertain scenarios depends on exploration or modification of existing operating routines (Adam et al., 2020; Davies, A., Dodgson, M., and Gann, 2017; Davies and Brady, 2016). Conflicts arise during land acquisition due to disagreements between the project on one hand, and the landowners, squatters/encroachers, environmentalists, and social and religious groups – collectively referred to as project affected people (PAPs) - on the other hand. In a conflict situation, PAPs often become mobilized to ensure their interests are realized. Such conflicts may result in a disruption of the project. In the context of an owner, projects should actively engage PAPs by establishing public outreach activities to ensure the regional acceptability (Denicol et al., 2020) of the project. Owners would need capabilities to influence external stakeholders (Ninan et al., 2019), to build trust (Ninan et al., 2023) and to implement appropriate conflict resolution strategies (Thomas and Kilmann, 1974). Owners may need appropriate coping strategies to overcome crises that result in disruptions (Iftikhar et al., 2021). Some coping strategies may be general (e.g., communication, coordination) while others (e.g., negotiation) may be contingent to a type of disruption.

Organizations may need operational capabilities to comply with political requirements and expectations for the purpose of maintaining or creating value (Oliver and Holzinger, 2016). Organizations may also take actions to mobilize support to advance their interests. Opportunities may arise in the form of changes to policies and regulations. A politically aware organization may not only quickly comply with the new regulation but may also set new standards and create barriers to entry for future competition. This would require the organization to have dynamic political capabilities (Oliver and Holzinger, 2016).

Natural calamities may disrupt the project and its supply chain. Owners would need the capability to quickly restore capacity and continuously adapt to changes (Geambasu, 2011) caused by such calamities. This may require not just skills but also behaviors. There is increasing evidence of megaproject citizenship behavior (MCB) – a voluntary, extra-role behavior amongst stakeholders – being deployed to recover from disruptions and improving resiliency (Morkan et al., 2023; Yang et al., 2021). Creating an awareness of collective mindfulness within stakeholders may also improve project resiliency (Wang et al., 2021). In situations where a disruption has already occurred, there are limits to what an owner can do. Owners would need the capability to identify their limits of management; disruptions that are beyond their control must be escalated to the governance level (Iftikhar et al., 2021).

Benefits of the project are realized when the developed assets are integrated with operations. Disruptions may occur during the transition from project to operations (Zerjav et al., 2018). In the context of an owner, projects would need to learn from the previous decisions made, respond to the external environmental factors by adapting their project capabilities, and develop new routines to improvise and maintain their capabilities in the face of uncertainty. Establishing an operations strategy group is another suggestion to develop new capabilities (Maytor-ena-Sanchez and Winch, 2022).

As can be seen from the discussion, a vast majority of literature has focused on developing capabilities under stable conditions. As in the past, megaprojects will face disruptions. They may encounter resistance from the community or may have to contend with differing technical opinions. They may face an uncertain situation due to, say bankruptcy of a supplier, or encounter a technical issue that they never expected. Owners will, therefore, require capabilities to overcome such situations quickly. However, this topic within the spectrum of project organizing is under-researched. This article attempts to identify owner project capabilities from the perspective of disruptions. The focus on developing economies and a multiple-case study approach are additional dimensions of this study.

3. Methodology

3.1. Research design

This study used a multiple case study methodology (Eisenhardt, 1989b; Yin, 2009). The case study method is especially beneficial when there is a need to understand a detailed phenomenon (Iftikhar et al., 2021). In addition to answering the open-ended, or “how” type of research questions (McKnight, 2012; Pettigrew, 1990), this methodology provides a stronger base for theory building (Yin, 2009). It enables exploring theoretical tensions and use the findings to develop more encompassing theories (Poole and van de Ven, 1989). They also enable comparisons and yield more robust and generalizable theory (Eisenhardt and Graebner, 2007).

A “case”, in this study, is a metro rail megaproject being constructed and operated by an owner. Three case studies were used; all the cases were from the same domain. Megaprojects from disparate domains (e.g., airport construction, nuclear power plant construction, ship building etc.) will have variations. The use of multiple cases from a single domain enables control for such extraneous variations (Eisenhardt, 1989a). Comparison of the three cases enabled drawing insights and the reasoning for development (or the lack) of project capabilities. Fig. 1 illustrates the research design for this study, which attempts to connect the research questions to the data.

3.2. Selection of cases

The following criteria were used to screen and select the cases from ten available cases for this study (Yin, 2003).

- Unit of analysis: Because the study focused on disruptions and responses to disruptions, a disruptive event was identified as the unit of analysis.
- Exemplary outcomes: Disruptive events are a function of the length of the metro rail network. Only those owners that had completed construction of 40 km with another 40 km under construction were considered for the study. Preliminary screening showed that three of the 10 cases met this criterion.
- Coverage: To emphasize different economic conditions and cultures, a criterion was set to include cases from different regions of the country.
- Data availability: The availability of data was also a key factor in the selection of cases for this study. Preliminary screening revealed availability of sufficient data related to research questions for selected cases.

The characteristics of the cases selected for this study are listed in Table 1.

3.3. Data sources

This study utilized publicly available data on megaprojects between 1972 and 2022. The data was analyzed using ATLAS.ti (web version) qualitative analysis software that had text data mining capabilities.

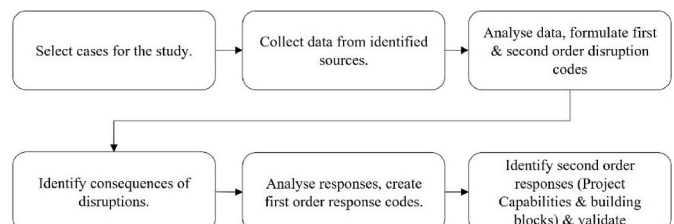


Fig. 1. Research design.

Table 1
Characteristics of cases.

Project/ Owner Code	Governance	Project Owner	Project Status (in Kilometers)	Average Daily Ridership	Disruptions Encountered
M1	Special Purpose Vehicle (SPV) with equal stake of the union and state governments.	Ministry of the Housing and Urban Development, operating through the SPV	Operationalized: 72 Under Construction: 98	0.7 million	1. Land acquisition 2. Technical issues during tunnel boring 3. Stoppage of work as well as operational during the pandemic
M2	SPV with equal stake of the union and state governments.	Ministry of the Housing and Urban Development, operating through the SPV. A small section of the network was implemented in partnership with a private concessionaire	Operationalized: 350 Under Construction: 65	6.8 million	1. Land acquisition 2. Intra-organizational interference 3. Accidents 4. Stoppage of work as well as operational during the pandemic
M3	Initially work was carried out under the supervision of the Indian railways. Later (in 2008) a SPV was created with equal stake between the union and state government; In 2012, the state government withdrew from the project and all its shares were transferred to the ministry of railways.	Ministry of the Housing and Urban Development, operating through the SPV	Operationalized: 48 Under Construction: 48	0.65 million	1. Lack of support from government in land acquisition; ownership changes 2. Accidents/Technical issues 3. Funding issues

Image and audio files were analyzed separately.

Archival data was key to this study as no other data source could offer such visibility into the disruptions of megaprojects in the past fifty years. Because of their considerable social and economic impact, the media has increasingly shown interest in the development of megaprojects (Ninan, 2020; Oswald et al., 2018). News articles and press releases are available in the public domain. Data contained in these digital sources is generated without the intervention of researchers (Silverman, 2006). Parliamentarians always want to know the status of megaprojects due to the large investments made by the government. Parliamentary notes are based on questions asked by members of the parliament and responses given by the ministers in-charge and are on record. These digital sources of data – news articles, parliamentary notes, press releases etc. - do not carry any biases. Data compiled from digital sources are, therefore, a great source for research. This study, used qualitative and quantitative data from archival sources, including the following:

1. Historical annual reports, detailed project reports, environmental assessment reports and the social impact assessment reports of the megaprojects under study to learn about implementation plans as well as disruptions and responses.

Annual reports of megaprojects contain valuable information including achievements and plans. Attention was focused on the director’s report and the chairman’s letter, both of which are an integral part of every annual report. These reports are publicly available. Detailed project reports as well as the environmental and social impact reports for the projects under study are also available in the public domain.

2. Audit reports of the comptroller and auditor general (CAG) as well as the public accounts committee (PAC) of India.

In certain cases, megaproject owners may selectively provide partial information, especially about adverse events over the past year. Since

this study is about disruptions and adverse events, the CAG and the PAC reports were also used to identify such information. All reports referred to in this study are publicly available.

3. Press releases, news reports published by global news agencies, web portals dedicated to megaprojects as well as similar local sources.

News reports published by reputed agencies were an important source for this study. News items from Thomson-Reuters, Bloomberg, and local publications such as Economic Times, Deccan Herald News Service (DHNS) and Times News Network (TNN) were also reviewed as part of this study. Web portals that are dedicated to metro rail projects in the country (e.g., themetrorailgu.com, metrorailnews.in) were also a source for data for this study. All these news articles may be accessed from the respective archives/web portals.

4. Debates as well as the questions raised by members of upper and lower houses of the Indian parliament,

Electronic notes of the debates in the parliament as well as the questions raised by members in the Indian parliament, along with the answers provided by the minister in-charge of the department owning the megaproject were quite useful to identify the responses to disruptions. The questions and answers are available on the websites of the upper and lower houses of the Indian parliament (<https://eparlib.nic.in/>).

Table 2 summarizes the data sources used for analysis.

3.4. Data analysis

Data analysis was carried out over two stages using the Gioia method (Gioia et al., 2013). Coding was performed for disruptions as well as for responses. The coding strategy comprised of reviewing the archival data and moving from a data-centric to developing a theory-centric construct (phrases). For the data on disruptions, sixteen first-order codes (theory-free) were identified. Next, the first-order codes were mapped to a

Table 2
Summary of data sources.

Data source and types of documents	Number of documents		
	M1	M2	M3
Annual Reports, Newsletters, Detailed Project Reports, Environmental Assessment Reports, Social Impact Reports	41	31	14
Audit Reports (Performance) and Public Account Committee Reports. (Some of the reports contained information about all the three cases)	3	6	3
Press Releases, News articles, articles published on web portals dedicated to megaprojects, research reports and related articles.	105	184	46
Parliamentary notes (<i>Lok Sabha</i> debates), answers to questions raised in the parliament, Standing Committee reports, Report of the Ministry of Housing and Urban Development and the Ministry of Railways, and the Bills, Acts and Policies relevant to the projects.	27	130	62

second-order disruption code. The methodology required a comparison of the first-order codes with terms found in theory/literature to create second-order constructs. However, in order to get better insights of different types of disruptions and corresponding owner capabilities, the first-order disruption codes were mapped to disruption categories based on the guidelines specified by Coombs (1995). All the disruptions were thus organized into an orthogonal matrix of four categories using two dimensions of Attribution theory– i) source, and ii) purpose. While the source can help locate the origin of an adverse event, the purpose could provide more insights into the controllability of such events. The source may be internal or external and the purpose may be intentional or unintentional. The disruption categories formed the second-order constructs for this study. The second-order codes are theoretical in nature (McKnight, 2012) and help in explaining patterns in data. The four categories of disruptions were.

- a) Intentional disruptions caused by external factors.
- b) Intentional disruptions caused by internal factors.
- c) Unintentional disruptions caused by external factors.
- d) Unintentional disruptions caused by internal factors.

The data structure for disruptions resulting from data analysis at the end of first stage is shown in Fig. 2. Table 3 shows the number of instances of disruptions found in the data.

The second stage of data analysis involved coding the responses to disruptions encountered by the projects. A term (keyword) that closely represented the owners’ actions (response) to a disruption was identified from the archival data. For instance, owners conducted outreach activities, such as street plays and publishing newsletters, to communicate the purpose and benefits of the project to public. A first-order response code, *building trust*, was assigned to these activities. This process was repeated for all disruptions. Next, the first-order response codes were reviewed, and a capability theory-centric response code was identified by iterating between literature and data. Similar theory-centric response codes were aggregated to obtain a second-order response code. For instance, *building trust* was related to a theory-centric response code named *engaging stakeholders*. Similarly, *resolving conflicts* and *influencing policy* were associated with another theory-centric response code named *managing stakeholders*. Thus, *building trust*, *resolving conflicts* and *influencing policy* – all first-order response codes - were aggregated under a second-order response code named *engage and manage stakeholders*. The second-order responses (i.e., *engage and manage stakeholders*) were the **project capabilities** while *building trust*, *resolving conflicts* and *influencing policy* were the **building blocks**, or a set of sub-capabilities, that comprise the project capability. A typical architecture of the project capabilities and its building blocks (McKnight, 2012) is shown in Fig. 3. One project capability was thus identified for each of the four disruption categories.

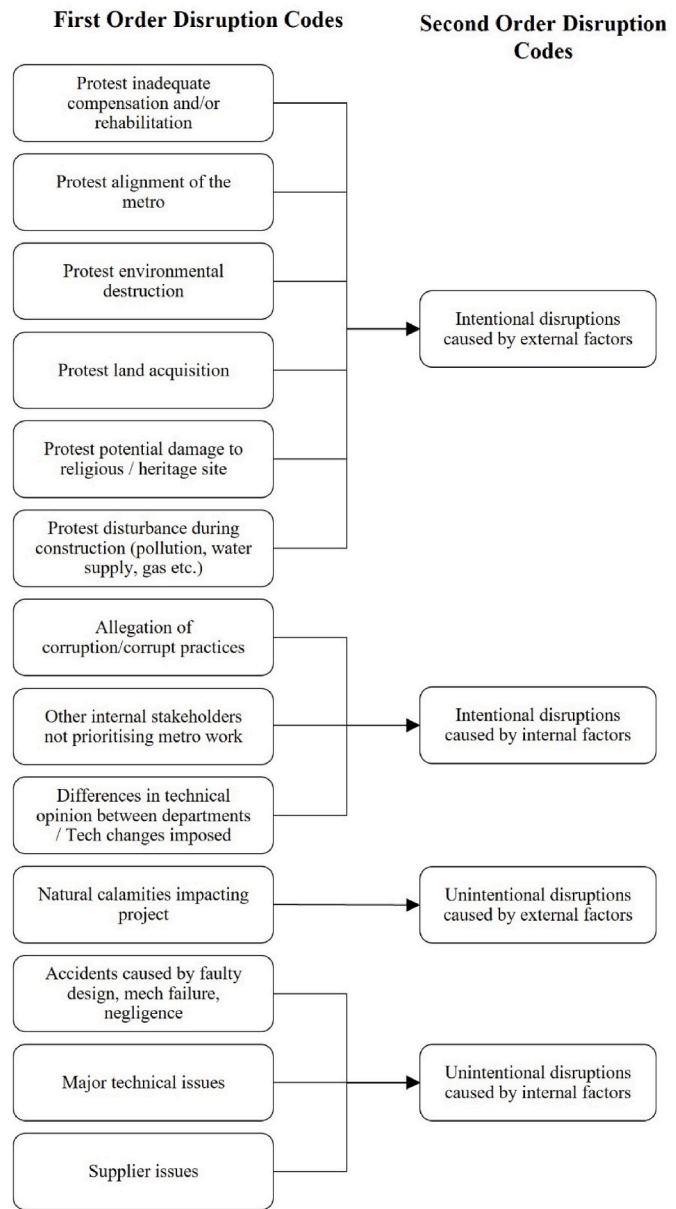


Fig. 2. Data structure for disruptions.

Table 3
Disruptions - first order code count.

First order code	Instances
Inadequate compensation and/or rehabilitation	4
Protest against alignment	8
Protest environmental destruction	9
Protest land acquisition	20
Protest damage to religious/heritage sites	7
Protest disturbance (noise, vibrations, air pollution etc.) due to construction	6
Protest corruption	4
Other departments/stakeholders not prioritizing metro work	23
Differences in technical opinion/Technical changes imposed	12
Natural calamities (Flooding, pandemic etc.)	8
Accidents (caused by negligence, faulty design, mechanical failure etc.)	16
Technical issues	9
Supplier issues	6

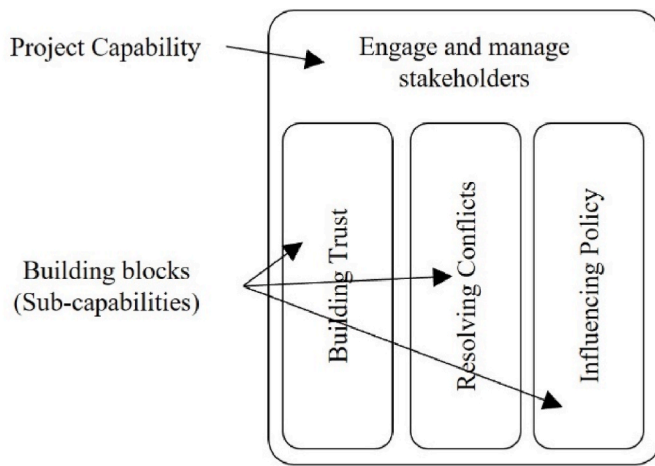


Fig. 3. A typical project capability architecture.

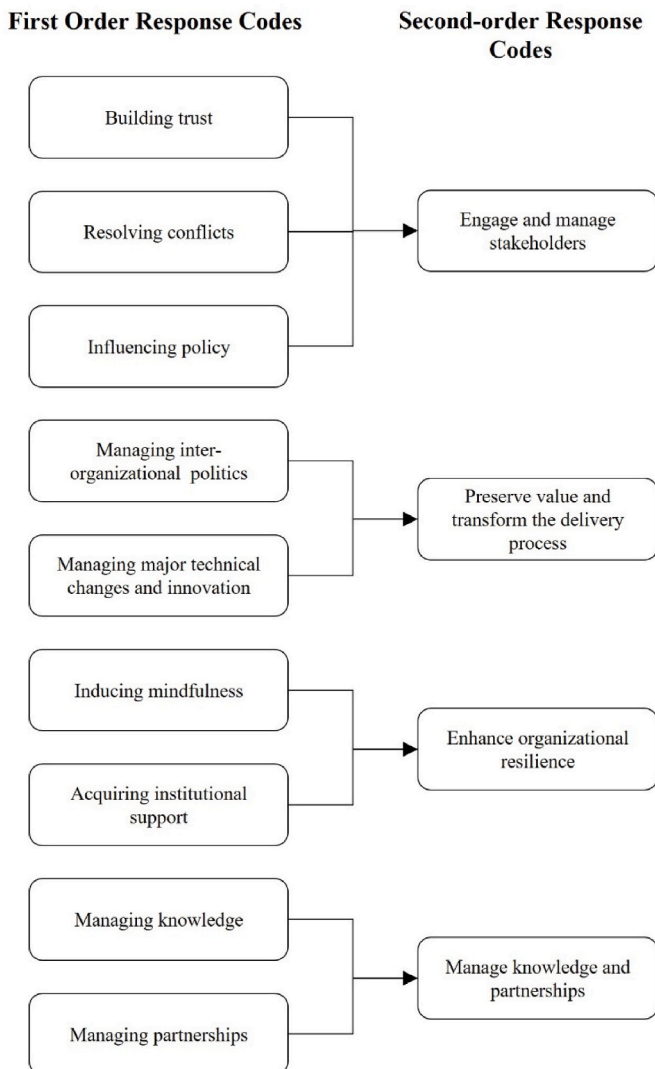


Fig. 4. Data structure for responses.

The link between the first- and the second-order disruptions as well as response codes were validated by discussing the practical implications of the emergent theory. Fig. 4 shows the data structure for responses.

4. Findings

4.1. Intentional disruptions caused by external factors and identified responses

This type of disruption was caused due to protests by external stakeholders. The community was resisting the project for various reasons. Specifically, in India, where the study is set, land acquisition is a state subject and is governed by local regulations (for instance, the Karnataka Industrial Areas Development Act, 1966). The role of an owner includes surveying the land and handing over the list of properties (public and private) to the revenue department of the state government, which then acquired the land and transferred it to the owner. Post the transfer, the owner awards the agreed compensation to the project-affected people (PAP).

Conflicts and disagreements have almost always been encountered land acquisition. Conflicts have also been encountered during construction, i.e., residents in the neighborhood have complained about excessive noise during construction. Despite having no direct role in the process, the project owner would need to engage with the PAPs, build trust with them, resolve conflicts, and monitor their rehabilitation/resettlement. In other words, the owner would need to have the project capability to *engage and manage stakeholders*. From the archival data, it was also possible to identify the building blocks of this project capability: i) building trust, ii) resolving conflicts and iii) influencing (development and/or amendment) of policies. The building blocks of this project capability are described in detail below.

4.1.1. Building trust

The owners of M1 set up a committee to assess fair compensation for those that would be losing land. The committee had wide-ranging discussions with members of the public and real estate agents to arrive at a formula to estimate compensation. Disbursement of compensation was also conducted in a transparent manner, which enhanced trust between M1 and the stakeholders. During the later stages of the project, there was continuous discussion between the M1 team, the investors, and the PAPs. These visible actions – setting up a committee, arriving at a formula to compute compensation, overseeing actual disbursement of compensation, one-on-one meetings with project affected people, public consultation on the project etc. – resulted in building trust between the owners of M1 and the stakeholders. The team also conducted walk-through meetings as part of their confidence building strategy. To quote the Due Diligence cum Resettlement Report in Sep 2020,

“A walk-through informal group consultation was conducted during site visits along the alignment stations and at affected locations During discussions, the project proposals (alignment and proposed stations); benefits of the project; impact and resettlement benefits; grievance redressal details and role of administration; etc. were explained to get their opinion and wider public input from among the public and affected public.”

The leadership team of M2 had implemented a long-distance railway project and had experience in dealing with land acquisition issues. Initially, the need to acquire private land was minimal. Yet the owners of M2 proactively engaged the public – using street plays and other sensitization programs - to understand their requirements. A task force was set up to deal with land acquisition issues. Where private land acquisition was necessitated, the task force met and negotiated with the landowners directly. When all other options failed, the task force pursued legal options in getting access to land quickly. The political class and the bureaucracy were fully committed and supportive of M2 and

they publicly referred to it as a role model for other government organizations to follow. The owners of M2 also built an excellent relationship with the media. The public relations officer regularly informed the public on the happenings in the project via the media. Positive messages went out to the public and this helped in building trust. To quote an ethnographic researcher (Onishi, 2016),

“... the media could have ... unearthed, and reported negative stories. ... they had to acquire land, demolish ..., and build the infrastructure these incidents could have been taken up as a story that deserved public attention. So why did it not happen?”

M3 was one of the oldest megaprojects in the region and was initially run by a central government department that had no experience in constructing metro rail. Also, with little political backing, the production of trust took a long time and, consequently, they could not acquire land early in the project. This was one of the reasons for the long duration required to implement the first phase of the metro system.

In summary, trust is a key success factor in situations that require interactions with members of civil society. The archival data showed that M1 and M2 continuously engaged external stakeholders to build trust. The teams listened to the grievances of the stakeholders, showing empathy. The leadership of M1 setup an independent committee that came up with a logic for fair compensation for land acquisition, which was accepted by a vast majority of the external stakeholders. They also ensured the compensation was distributed transparently. On the other hand, M2 engaged with the public using street plays informing them about the project and its benefits. The team negotiated directly with the landowners. There was a face to each negotiation, and this showed authenticity. M1 and M2 were able to build trust; however, there was no evidence in the archival data to show the presence of trust drivers in M3, which explains the reason why they were unable to acquire the land required and had to ultimately realign the railway line.

4.1.2. Resolving conflicts

M1 encountered conflicts during land acquisition and used multiple strategies to resolve them. People that had encroached on government land illegally were persuaded by political leaders to relocate elsewhere. Legal landowners were convinced by M1 team members to opt for market-based compensation. To facilitate fair compensation, M1 set up a land committee that was tasked to estimate the fair value of land. To quote the Due Diligence cum Resettlement Report dated Sep 2020 of one of the investors of M1 in the context of public consultations,

“The main questions raised by the stakeholders was with reference to the ongoing demolition work and request for assistance to help the school which is along the alignment. The design, which was earlier impacting the school was changed to protect the school. The change of design to protect the school, at the request of the community, through consultation, addressing any grievances, such as removal of demolished debris blocking access due to construction activity reflect that meaningful consultations have been carried out in this section.”

There was also evidence of stakeholder requirements being integrated into the overall megaproject requirements, such as restricting the cutter speed of the tunnel boring machine (TBM), while boring beneath residential buildings to reduce vibrations.

M2 also encountered several conflicts with external stakeholders, most of which were related to land acquisition (private property owners and those with religious, heritage, and political structures). The legal framework for land acquisition, promulgated in the year 1894, was grossly inadequate. To overcome the legal inadequacies, the M2 team setup a task force with clear definition of role and objectives and allocated sufficient resources for acquiring land. The task force worked aggressively with the Chief Secretary of the state and resolved all the conflicts using multiple strategies, which included the use of persuasive yet firm arguments to acquire land, being accommodative in some situations, and in some other situations, arriving at a compromise solution

by identifying an alternative location for resettlement or rehabilitation. The team also agreed to plant saplings to compensate for felling trees. The use of different strategies enabled M2 acquire land as early as possible and start construction.

Team M2 was being constructed in a city that had a rich archaeological history. There were concerns that the safety and the aesthetics of the archaeological monuments in different parts of the city would be disturbed. In response to a list of queries raised by a key stakeholder, the union minister for urban development, in his address to the parliament on the May 2, 2000, stated that a central agency was asked to do an impact study of all the monuments in the city. The minister further assured the parliament that the emergence of the metro rail will not disturb the monuments. To quote the minister,

“... after conducting detailed studies has advised that with the type of MRTS structures near the monuments and the methodology to be used for their construction, there would be no adverse effect on the safety of these monuments. Besides, the MRTS structures are being got designed by prominent architects to ensure that aesthetics of the monuments are not disturbed. In fact, these structures will meld well with the prevailing architecture of the area and enhance the ambience.”

With regards to acquisition of land, M3 did not show urgency that was shown by M1 and M2. Like in other parts of the country, land acquisition was a state government subject, and the best action taken by M3 was to organize meetings between the Chief Minister, the Chief Secretary of the state and the Union Minister for Urban Development. Team M3 were not able persuade the state government to hand over the private land that was critical for the development of the metro, nor did they obtain any commitment from the State Government for a date by which they would be handed over the land. To quote the Standing Committee Report on Urban Development of Oct 2015, presented to the Indian Parliament,

“The Committee became aware that this project was sanctioned by Govt. of India on 30th July 2008 at an estimated cost of Rs. 4676 crores. The Committee are distressed to note that physical and financial progress of this project is only 36.5%.”

In summary, the owner will need to exhibit appropriate behaviors to ensure early resolution of conflicts with external stakeholders. M1 and M2 used these behaviors to ensure this, and were, therefore, able to deliver their work closer to the agreed schedule. Persuasive arguments and political pressure. Agreeing to relocate religious structures and change the design to protect a school, persuading people to opt for market-based compensation, rehabilitating displaced people, committing to take care of the archaeological monuments, and planting saplings to compensate for felling trees were a few owner responses to resolve conflicts. Legal options were avoided and used only when all other options failed. On the other hand, team M3 avoided confronting the state government and was unable to acquire resources for the project.

4.1.3. Influencing policy

Having experienced the difficulties in implementing the project requirements, team M2 was able to provide feedback during the development of the *Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR Act, 2013)* to effectively manage expectations of the external stakeholders. M1 was able to define their own compensation and resettlement package which included compensation based on market value of the land as well as a 100% solatium if the landowner agreed to handover the property - referred to as a consent award, or a 30% solatium in other cases, referred to as the normal award. The policy was first developed and approved by the local (state) government in 2007, and later revised in 2019, and has seen several land acquisition related issues being resolved.

As the oldest megaproject in the country, M3, which was being executed by the national railways, experienced several difficulties in the phases of initiation, design and execution. The government of India

decided to create an authority that would oversee the execution of metro rail projects. To quote the then union minister for railways during a debate in the parliament on July 26, 1978,

“... ..., it was found necessary that we should go ahead with the metro railway scheme and beginning has already been made certain provisions of Act of 1894 are not adequate to meet with the requirements of construction of metro railway Keeping in view all these future prospects, we have to formulate a legislation. We have to define what is the competent authority before whom the claims can be (p)referred.”

The Metro Railways Act (1978) was first notified in Feb 1979 and was relevant only to M3 at that time. However, it has since then been amended multiple times and incorporated policies to remove difficulties experienced during construction as well as operations of M1 and M2, balancing it with meeting external stakeholder needs, such as the social impact assessment clause.

To summarize, policy development and megaproject development are conducted in parallel in developing countries. Policy-making is a very complex process that involves co-creating a vision, mobilizing support for (a specific) cause, and managing opposition. From the narrative above, it can be observed that both M1 and M2 were able to influence policy from their respective governments. The vision was articulated clearly to all the team members, and they had excellent relationship with the political class (support and managing opposition). However, in the case of M3, except for the amendment to the Metro Railways Act (1978), there was no factual evidence of M3 influencing any law to facilitate speedy construction of megaprojects.

A comparison of the building blocks of the project capability in engaging and managing stakeholders comprising building trust, resolving conflicts and influencing policy are as shown in Table 4.

4.2. Intentional disruptions caused by internal factors and identified responses

Intra-organizational politics and technical/regulatory changes imposed on the megaproject comprise these disruptions. Owners would need to work with several other organizations to achieve project goals. To preserve the value of the work performed, the owner would need to influence individuals and departments in those organizations. The owner would also need to be innovative to implement changes (such as changes to the design) to avoid delays and reduce costs. The owner

Table 4
Engaging and managing stakeholders: building blocks.

Building Blocks	M1	M2	M3
Building trust	High: Land committee setup to decide fair compensation; transparent disbursement. The compensation policy continues to be in force as M1 expands its reach.	High: Several initiatives, legal options were used as last resort. Relationship with media was exploited to send out positive messages and create a good image.	Low: Too much reliance on government, most issues of land acquisition taken to court.
Resolving conflicts	High: Multiple strategies – compete, accommodate, collaborate and compromise	High: Multiple strategies used – compete, accommodate, collaborate and compromise	Medium: Avoided confrontation with the government as well as landowners.
Influencing policy	High: Setup land committee. Came up with a compensation formula that was enacted as law in the state	High: The Metro Railways Act, 1978 amended and is now applicable to the entire country.	Low: Initiated the development of a nation-wide policy; however, has shown less intent thereafter.

would also need capabilities to sense the requirements for future megaprojects, shape those requirements by influencing the development of new policies and transform the megaproject delivery process by setting new standards. In the context of this study, the owner would need to possess the project capability to preserve value and transform the delivery process. The building blocks of this project capability include i) managing inter-organizational politics, and ii) managing major technical changes and innovation.

4.2.1. Managing inter-organizational politics

The owner of M1 had to coordinate the shifting of public utilities (electricity distribution systems, water & sewerage systems, telecommunication systems etc.) with stakeholders in other organizations (internal stakeholders in this context) that were not quite motivated and did not prioritize the metro rail work. The owner of M1 responded by hiring retired employees of the public utilities to work with their former colleagues to get the work expedited. M1 also faced allegations of corruption from internal stakeholders in procurement of materials. The owners responded by establishing two policies: i) to prevent fraud and ii) to conceal the name of the whistle-blowers.

The owner of M2 had obtained commitments from the bureaucracy about minimal political interference in decision making. To quote an article published in *The Tribune* of Jan 2, 2005, that discussed the culture of the organization,

“... the financial powers were vested in the managing director. Also, the managing director was the last authority on tenders Even the Prime Minister bought a ticket for enjoying a ride on the Metro.”

Despite these commitments, M2 faced political headwinds. M2 was funded in part by an international sponsor and a precondition was the appointment of a team of experts (general consultant) that will help M2 in design, awarding of contracts and supervision of construction. A key minister in the union cabinet (an internal stakeholder) raised an issue over a lack of transparency in the award of the contract for the general consultant. The owner of M2 successfully managed the internal politics by handing over all relevant documents to an empowered committee that was set up to resolve conflicts. Based on the facts and information provided by M2, the empowered committee – setup by the government to address intra-organizational issues - cleared the owner of M2 of any impropriety. The project was allowed to continue. In a detailed statement on the Dec 14, 1999, to the members of the parliament, the union minister for urban development said:

“... who are to fund part of the project cost, require International Competitive Bidding (ICB) procedure to be followed for items of work to be financed by them. Companies/consortium having requisite technical competence, bid-capacity, manpower resources, availability of plant, machinery and equipment, and financial soundness were prequalified for ... the items of work and invited to tender for them on design and construct basis. These companies/consortia happen to be foreign companies, mostly with Indian members ...”

In another instance, a key decision had to be made during the design: would the metro rail use a standard gauge or a broad gauge? M2 was governed under the Metro Railways Act (1978). This act allowed the Indian railways, which, at that time, had little experience in the construction of a metro rail, to be a significant partner in decision making. This impaired the decision-making capabilities of M2. The owner of M2 wanted a standard gauge because this would have allowed smaller turning radius, offered comparatively higher speed, allowed exploitation of advanced technology, and would have lowered overall cost/land requirements. The Indian Railways (an internal stakeholder), however, was responsible for overall safety of the railway operations, including the metro rail, in the country. They differed from the views of M2 and recommended broad gauge because that would allow its seamless integration with the mainline railways. Both sides made their representations to an empowered group of ministers. The empowered committee,

however, keeping the safety aspect in mind, ruled in favor of the recommendations made by the Indian Railways since the original proposal recommended a broad gauge. To quote the union minister for urban development, in his address in the parliament, on the Aug. 16, 2005,

“ ... decided to use broad gauge to enable the Indian Railways to provide necessary back stopping and infrastructure support for the project as well as considerations of interoperability and development of future dependence on indigenous capacity. However, this is not a general decision to be applicable for all metro rail systems in the country.”

While the initial phase of the metro was redesigned to run on a broad-gauge line, the owner of M2 sustained the pressure and made several fact-based presentations to key stakeholders. To ensure that the megaprojects in future did not encounter such issues, the owner of M2 lobbied hard to include the words “*after consultation with the State Government*” in Section 1 of the amended (Metro Railways Act, 2009) which, significantly changed the way metro rail projects were implemented in the country. Thus, the owner of M2 not only created and preserved value of the work performed till date and did not let the intra-organizational politics impact their work, but they also set standards for future projects in the country.

It is a norm that a senior person with several years of experience is usually appointed to the post of General Manager. The General Manager is responsible for making all key decisions. It is also expected that the General Manager’s tenure continues till the end of the project (or until completion of a significant milestone). On M3, however, since its initiation in 1969 till 1987, there were twelve General Managers appointed to execute M3. A recommendation was made by the owner of M3 to appoint a General Manager till the end of the project, as continuity of top management would help in expeditious execution. However, to quote a representative of the Railway Board as stated in the PAC report (1988–89),

“...the project had already taken in interminably long period and the reasons for this were not those which could have been solved merely by the continuation of the General Managers because the problems were such that even if a General Manager had continued, he could not have overcome these problems ...”

The work on M3 was stopped in Dec 2012 due to the inability of the local government to acquire land for the purpose. The government instead suggested a realignment of the metro rail. As per archival data, the owner of M3 initially raised concerns on the realignment stating that the change, nearly four years after the approval of the detailed project report, may take a toll on the completion of the project. They also indicated that the realignment would require them to negotiate additional funding requirements with the investors. After a while, however, the owner of M3 started justifying the realignment, suggesting that the realignment seemed to be a political decision rather than an engineering one. The owner of M3 was unable to effectively manage the political class. To quote the Secretary of the Ministry of Urban Development, in the report of the Standing Committee on Urban Development,

“I am aware that the delay has been on account of largely the difficulties in land acquisition and the State Government, perhaps, was not very helpful I am told. Now they are fully on board and things are moving.”

In another instance, the work on M3 was delayed by over 4 months due to the inability of the owners to convince the local traffic police to hand over a certain section of a road, which had extreme traffic during daytime. The inability of the owners to come up with feasible alternative solution (such as working during the nighttime, creating a temporary alternative route for daytime traffic etc.) and their inability to get the local politicians to influence the police resulted in a deadlock situation.

Observations from archival data indicate that owners of both M1 and M2 had built excellent relationships with the bureaucracy, the political class and other government institutions. They were, therefore, successful in overcoming issues that otherwise would have resulted in several

changes that would have impacted the project adversely. M1 applied anticipatory (hiring retired employees from utilities) and reactive political strategies (policies to prevent fraud) to overcome disruptions. The owner of M2 complied with the investors requirement of appointing a general consultant and did not budge under government pressure (defensive political strategy). They were able to influence the amendment of the Metro Railways Act (1978) which would shape the way metro railways in India would be built (proactive political strategy). They had obtained commitment from the bureaucracy of minimal political interference at the start of the project (defensive political strategy). They also worked towards obtaining a first mover advantage by recommending a standard gauge (anticipatory political strategy), which although did not succeed till the Metro Act was amended. The owner of M3, on the other hand, was not able to influence the political class to the extent required.

4.2.2. Managing major technical changes and innovation

M1 had to make a major change to the design of viaducts. A vast majority of viaducts are constructed between pillars that stand in the center with roads on either side. However, in one section, this design would have reduced the available road space considerably and would have created bottleneck in road traffic. The designers quickly made major changes in this section and used portal beam structures to avoid this problem. In another instance, the design for two elevated stations were also changed to be built at partially underground level to meet the requirements of local airport authorities. M1 demonstrated innovativeness in managing major changes to the project, which would have otherwise delayed the project and increased the costs significantly.

M2 put the gauge controversy behind them and started making major changes to implement the broad-gauge system, despite having pressed to implement the standard gauge. Effective change management helped M2 realize their delivery goals. One such major change was to build the superstructure and the tracks to board gauge specifications but mount standard gauge rolling stock since the orders for standard gauge rolling stock were already placed. While this innovation did not go well with the Research Design and Standards Organization (RDSO), which was responsible for approving the schedule of dimensions (SOD), it nevertheless met the M2 delivery targets. To quote the RDSO in their approval letter dated Dec. 17, 2004,

“... this is a unique situation where a wider gauge (i.e., BG) has been adopted and narrow stocks (body) has been mounted over BG. There is no ready-made SOD available for such type of mixed system Clearance can be given only provisionally.”

M3 had planned to use sheet piles for the underground (tunnel) section based on the advice given by the erstwhile Soviet Union (USSR) consultants, as well as constraints around funding and technology available then. The sheet piles were to be imported since they were not available locally in India. During construction, the engineers engaged on M3 realized that the sheet piling would not work since it was impossible to retrieve and reuse the sheets once they were laid. The inability to retrieve and reuse the sheets would increase the construction cost significantly. While another technology (diaphragm wall) was available, the leadership team of M3 took six years to decide to switch from sheet piling method to diaphragm wall technology. To borrow a quote from the PAC report (1988–89),

“... it was already known that sheet piles could not be used for supporting road decking over them and were also not capable of being integrated with the main boxes...they were found to be prone to lateral deformation causing damage to adjacent utilities and buildings. In spite of the knowledge of these shortcomings earlier, the Railways appear to have adopted this method as it was considered to be cheaper than the Diaphragm walling on the assumption that the sheet piles could be re-used according to the advice of USSR consultants obtained in 1971. Sadly enough, the Project Administration persisted with this method.”

The inability of M3 to manage this major change to technology and the lack of innovative capabilities delayed their project delivery by about six years.

The above narrative suggests that none of the megaprojects adopted a robust system for innovation and change management. However, the owners of M1 and M2 were able to manage major technical changes relatively better. M2 reacted well and implemented an innovative workaround to manage the gauge issue. M1 also reacted quickly to make design changes to the viaducts as well as to the stations near the airport to meet compliance requirements. On the other hand, M3 adopted a trial-and-error method in managing major technical changes, and their indecisiveness costed them several months.

Table 5 shows a comparative analysis of the building blocks of the project capability in preserving value and transforming the delivery process, comprising of managing inter-organizational politics and managing major technical changes and innovation.

4.3. Unintentional disruptions caused by external factors and identified responses

Unintentional disruptions caused by external factors include interruptions due to natural calamities, such as earthquakes, floods, and the pandemic. Organizations would need to ensure their employees are aware of and are focused on the current situation. When disruptions are severe and beyond their scope and control, the owners would need to work with the governmental agencies (e.g., the national disaster response force, or the NDRF) to cocreate solutions. In other words, the owner would need to have the project capability to *enhance organizational resiliency*, whose building blocks are: i) inducing mindfulness and ii) acquiring institutional support.

4.3.1. Inducing mindfulness

All the three megaprojects under study were under construction when the pandemic of 2020 struck in three waves. The first wave was in the period Jun–Oct 2020, a more serious second wave in the period Apr–Jul 2021, and a third one in the later part of 2021. Owners focused on the operational aspects. The data revealed that the owner’s business continuity teams dealt with designing systems from the end-user perspective. The owners expected the suppliers and their supply chain to manage disaster situation on their own. None of the megaprojects under study were prepared to manage the turmoil caused by the pandemic.

Table 5
Preserving value and transforming the delivery process: building blocks.

Building Blocks	M1	M2	M3
Managing inter-organizational politics	Medium: A few political management strategies applied	High: Used appropriate strategies – reactive, proactive, defensive, and anticipatory, depending on the situation, to good effect. Also set standards for future megaprojects in the country.	Low: Unable to apply appropriate strategic political strategies when required.
Managing major technical changes and innovation	Medium: Implemented technical changes based on need, collaborated with other stakeholders (civic and airport authorities).	Medium: Implemented a workaround to manage costs and delivery dates. Although not the best solution, it worked.	Low: Trial and error method used. Progress stopped when the experiment failed.

Construction work on M1 continued at a slower pace during the pandemic under strict testing protocols. Each day the body temperature of all the personnel at the construction sites would be monitored, and anyone with mild symptoms would be isolated. To quote an officer, as reported in a newspaper on the July 14, 2020,

“Every day before letting them to the work site, we conduct fever test and one of them was found having mild fever. Accordingly, we got him tested and he was found COVID positive,”

Shortly thereafter, about eighty construction workers tested positive for corona virus. All the workers were isolated and were treated, and the construction work was halted until after the team members were cleared wot work. The owner of M1 setup a temporary health care center to treat their personnel. To quote the chairman of M1 from the annual report of 2020–21,

“... established a 100 bedded COVID Care Centre (CCC) ..., with a view to provide dedicated COVID care facility for the employees ... as well as for the workers employed as contractors ... ”

On M2, new roles and responsibilities were quickly assigned to officers to monitor virus-related symptoms within the team. To quote the director of M2, as published in the annual report of 2020–21,

“The company’s engineers have been keeping a close watch at the sites to ensure all norms are followed. Further, at construction sites various measures viz. hands-free hand washing, creation of sanitization points, sanitization of common tools, installation of precaution related pictorial messages, ensuring availability of masks and thermal scanners at sites and nomination of dedicated marshals to monitor the implementation of Covid related measures at the sites, were adopted to keep the workforce safe.”

Team M3 tried to exploit the lockdown situation. The team members that tested negative after a 5-day quarantine would be sent to test the structural strength of the buildings in the vicinity of the construction sites. To quote a senior officer from M3, from a newspaper article of June 26, 2020,

“We started preparation almost three months ago and finally succeeded in making our construction site a Covid-free zone before resuming We had to quell fears among workers.”

Towards the beginning of 2021 when vaccination was introduced, the focus of all the megaprojects turned towards recovery. To quote the chairman of M1, from the annual report of 2020–21,

“... conducted vaccination drive on 27th May 2021 and on 25th June 2021 both for the employees as well as for workers of the contractors engaged in the construction of Metro Project. Around 8000 workers of the contractors including employees have been vaccinated ... ”

In summary, the narrative shows that while initially none of the owners were prepared to counter the impact of the pandemic, they were able to refocus their attention (a key factor of mindfulness) on their people, monitor their health, quarantine them to stop the spread of the virus, and restart when they recovered. Mindfulness is critical when an unintentional disruption caused by external factors is encountered. From the observations, all the megaprojects, while not being prepared initially, focused their immediate attention on implementing the safety guidelines. When a vaccine was available, they focused their attention on recovery and restarting of construction activities.

4.3.2. Acquiring institutional support

In some cases, the responses to severe disruptions may be beyond the scope of an individual project teams. In such cases, projects would need to acquire institutional support (i.e., from their local or state governments or any other institution).

In March 2020, a country-wide lockdown was announced by the central government and all construction was halted to prevent the spread of Covid-19 virus. The ministry of labor is responsible for the

general welfare of the construction workers. The ministry responded to the situation by directing all state governments to ensure direct transfer of money into the bank accounts of the construction workers. To quote a senior ministry official from the Standing Committee of the Labor ministry (2020–21),

“Advisory guidelines were issued on 24.03.2020 under Section – 60 of the Building and Other Construction Workers Act, 1996 to all the States/UTs Building and Other Construction Workers Welfare Boards to frame a scheme for transfer of adequate funds in the bank account of construction workers through direct benefit transfer (DBT mode) from the cess funds collected by the States/UTs.”

While many construction workers left the construction sites, a small number of workers continued to work on the project through the pandemic under strict protocols. This enabled the megaprojects reduce the delay. This would not have been possible without the support of the state and the central government’s support. M1 and M2 were special purpose vehicles and had representatives of the state and central government on their boards. It was easy for them to acquire such institutional support. M3 was driven by a central government department and did not face issues in acquiring support in this situation either.

In summary, when an unintentional high impact disruption occurs, the owners would need to influence the governments to ensure their work progresses. The presence of central government representatives (bureaucrats) on the boards of their organizations is therefore critical. Bureaucrats may also present innovative solutions to manage such situations. The owners would need to keep monitoring the environment for disruption signals and network with government representatives.

A comparison of the building blocks of the owner project capability in enhancing organizational resilience comprising of inducing mindfulness and acquiring institutional support is as shown in Table 6.

4.4. Unintentional disruptions caused by internal factors identified responses

Unintentional disruptions caused by internal factors include accidents resulting in injury or death of team members or public, technical problems encountered during execution as well as supplier bankruptcy. In such situations, the owners would be required to learn from the mistakes and ensure they are not repeated. In some cases, the owners may not have the required capability; they may have to partner with specialist organizations to get their work completed. In summary, the owner would need the project capability to *manage knowledge and partnerships*, whose building blocks are: (i) creating and managing knowledge, and (ii) managing partnerships.

4.4.1. Creating and managing knowledge

In the case of M1, an under-construction pillar collapsed during the construction that resulted in the death of two people, including a child. Construction work was ordered stopped. Prior to this accident, some road users reported seeing similar tilts of pillars elsewhere, but there were no accidents. To ensure there was no conflict of interest, a one-man inquiry team - a senior academician from a reputed technical institute – was asked to review the design of the pillars and identify the cause(s) of failure.

Table 6
Enhancing organizational resilience: building blocks.

Building Blocks	M1	M2	M3
Inducing mindfulness	Low: Not fully prepared to counter the pandemic initially. Roles and responsibilities assigned as an afterthought	Low: Not fully prepared to counter the pandemic initially. Roles and responsibilities assigned as an afterthought	Low: Not fully prepared to counter the pandemic
Acquiring institutional support	Low: The presence of government representatives on the board of the SPV helped acquire institutional support during the pandemic.	Low: The presence of government representatives on the board of the SPV helped acquire institutional support during the pandemic.	Low: The presence of government department officials helped acquire institutional support during the pandemic.

Team M1 participated in the root-cause analysis exercise, which revealed design deficiencies of piers that were taller than 12 m. A new 2-stage method of construction was devised to build tall (>12 m) piers. Work restarted after a review of all the tall piers that were constructed before the accident. The methods statement (standard operating procedure) was updated to reflect the decision made regarding construction of tall (>12 m) piers. The concept of toolkit meetings was introduced to educate workers on following safe construction practices.

To quote the senior academician, who was asked to study the reasons for the collapse of the pillar (reported in a newspaper on the Jan 11, 2023),

“Those incidents could have served as a good lesson and this accident could have been avoided. I am not sure what action they took during the time,”

M2 encountered several accidents during the execution (construction) phase that resulted in injuries and death. This was highlighted by a parliamentarian during a discussion on amending the [Metro Rail Act \(2009\)](#), on Feb 24, 2009,

“I am drawing the attention of the hon. minister as to how many accidents have occurred It had occurred on 28th August 2007, November 2007, 21st January 2008, 15th February 2008, 19th May 2008, May 23rd, 2008, 18th July 2008, August 2008, 4th September 2008, 30th September 2008, 8th October 2008, and 19th October 2008. These are the dates on which major accidents had occurred. So, seeing this we can say that the safety aspect is not taken care of”

To make things worse, M2 encountered yet another major accident in July 2009 during construction that resulted in injuries and deaths. Cranes were requisitioned to clear the debris; two of those cranes collapsed during the debris clearing operations resulting in further injuries. This led to an outrage with people questioning the safety protocols practiced by M2. A committee was setup to investigate the incident. The committee report suggested deficiency in the design of the pillars as well as in the strength of materials used. To quote a senior opposition leader in the parliament on July 28, 2009, while discussing the committee report,

“I have scrupulously listened to the statement of the hon. minister. There have been many more incidents after this incident. Even today there is news that in a number of pillars cracks have appeared. There have been accidents leading to death after this incident. It is a continuous process going on.”

Team M2 analyzed the root cause of the accidents, reviewed the standard operating procedures (SOP), and made changes to it. To prevent loss of life, a new hazard monitoring system that indicated the level of safety to workers was deployed at the construction sites. Street plays were conducted to spread safety awareness. Workers were also trained on the safety procedures.

M2 also faced technical issues during integration of project output with operations. Shortly after it was opened for operations, one of the sections of the metro was closed after cracks were discovered in the tension clamps. The initial diagnosis was that the clamps were of poor quality. The speed of the trains was reduced as a precautionary measure, and the failed clamps were replaced during non-operational hours;

however, the clamps continued to fail, prompting a temporary closure of the metro operations. After a series of tests with new tensions clamps, the speed of the trains was gradually increased and approval was finally obtained to run the trains at 120 kmph. A newsletter published on the website of M2 (in Sep 2023) articulates the experience of the engineers that were involved in resolving the problem:

"Before taking up this mammoth exercise, the efficacy of these clamps was checked on a kilometre-long trial track. Various measurements including vibration & stresses on rails were carried out using advanced instruments on this trial track before implementing the same on the main corridor. The estimated timeline for the completion of this task was 18 months. However, took the challenge and successfully ensured the completion of the work within just six months During the non-revenue hours, the Overhead Equipment (OHE) system was also made suitable for the movement of trains at 120 kmph."

M3 encountered repeated instances of land subsidence while tunneling an underground section that runs below a river. Buildings were damaged and residents evacuated when people discovered cracks on the walls of their residences, first in Aug 2019. Affected people were evacuated and accommodated in neighboring hotels. When the tunneling work restarted, M3 again encountered a land subsidence (in May 2022) requiring affected people to be shifted. A third instance of water seepage happened in Oct 2022, which caused the soil to sink by 6 mm. To quote a senior administrator of M3 from a newspaper article published on Oct 15, 2022,

"We had completed grouting the upper part of the cross-passage tunnel Work resumed on the lower half on October 12. After cement grouting wasn't effective, we started chemical grouting and till the early hours of Friday it appeared to have stiffened the soil. But around 3.30am water started seeping in and soon, water was gushing in at 200 L per minute. We continued the grouting work and managed to reduce the flow to 60 L per minute by evening."

In summary, megaprojects will need to develop the ability to create and manage knowledge. The observations from archival data lead us to believe that megaproject teams learnt from their mistakes and put in place remedial measures. However, there was little evidence of any attempt to diffuse the learnings between megaprojects or even between different sites within a megaproject. While the teams may have gained the experience (experience accumulation), the processes of knowledge articulation and codification is not yet institutionalized.

4.4.2. Managing partnerships

During the construction phase of M1, one of the TBMs encountered severe ground conditions. The tunneling face had a mix of hard granite, blocks of concrete and soil with high ground water levels. The work was more complex because of historical buildings overground and tunneling had to progress slowly. In such scenarios, the cutterhead would require regular, continuous interventions. The congested residential area overground also impeded the progress of grouting the unstable areas. Team M1 did not have sufficient knowledge of tunneling in such scenarios. It partnered with a global tunneling expert, whose scope included refurbishment of the broken cutterheads and undertaking the tunneling work. The tunneling expert used the resources available locally, including those from M1, to successfully complete the work. Coordination of the work – roles, responsibilities etc.- was entirely done by the experts as observed from the archival data.

M2 had the experience of implementing a metro rail elsewhere in the country and was, therefore, appointed consultants to M1. However, the two organizations did not communicate well. The relationship was severed when a long delay was encountered during the construction of an underground multi-level interchange. This was when a collaboration was most needed. To quote a senior administrator, as reported in a newspaper on the Aug 19, 2015,

"... fearing that the interchange would be the biggest deadlock, we had suggested an alternative, but it was rejected by the then MD. He was in a hurry to terminate the contract ..."

Partnership and collaboration were in-built in the funding contract of M2. As per the contract agreed with the financiers, work packages and contracts would be awarded to a consortium that had the highest technical rank (and not to the one that bids the lowest). Further, each contracting consortium – typically, a collection of foreign firms - would have an Indian partner. This agreement ensured that M2 team members learnt as they executed the project. In a different scenario, M2 had to collaborate with an international university to find reasons for fault in one of their operational lines.

One of the main contractors of M3 encountered financial problems due to non-receipt of funds for work performed on projects elsewhere. Instead of cancelling the contract, M3 worked with the primary contractor and ensured their work did not slow down. To quote the Public Accounts Committee report (88–89),

"... have lately been facing certain cash-flow problems, due to non-realisation of their dues from other projects in India and abroad. All possible efforts are being made to see that their work does not slow down on this account."

Being implemented in an old city, M3 also faced the usual situation of utility systems (water, sewage, electricity, and telephone) not matching the actual site layout. M3 team had to collaborate with the people from the utility agencies to get those transferred to another location/site.

In summary, coordination (allocation of roles/responsibilities) and communication (agreements) were key to managing work with external teams/organizations. When the partnerships worked well, the work progressed well, as in the case of M2. When partnerships were severed, the work suffered and caused enormous delays, as in the case of M1. The capability to manage a partnership depends on the ability to coordinate, communicate, and bond with all parties.

A comparison of the building blocks of the project capability in managing knowledge and partnerships, comprising of creating and managing knowledge as well as managing partnerships is shown in Table 7.

5. Discussion

This study identified four project capabilities that a strong owner may need to overcome disruptions. The findings of this study are discussed in the light of the strong owner framework developed by (Winch and Leiringer, 2016). This section also discusses how these owner project capabilities may be developed.

To overcome intentional disruptions caused by external factors, this study identified the necessity to maintain strong and continuous engagement with external stakeholders, primarily the people that would lose their land or those that would be displaced due to the project. The alignment of the metro rail is a strategic decision. The owner, to ensure the delivery of maximum benefits to the public, would want the alignment to cut across the city. This may require acquisition of land as well as properties owned by private parties. Land acquisition, as described in the case study setting, is a state government subject. To build the capability to acquire land, the owners of future megaprojects would need to set up a new team that consists of the following:

1. A nodal officer, who has intimate knowledge of the local land acquisition policies and regulations. Serving officers from the government revenue department would best fit the role.
2. A reputed real estate consultant, who has knowledge about the property values in the area where the megaproject is being planned. The consultant would be able to help evolve a formula to determine appropriate compensation for acquiring land.

Table 7
Managing knowledge and partnerships: building blocks.

Building Blocks	M1	M2	M3
Creating and managing knowledge	Low: Limited to accumulation of experience. Some efforts in articulation (training) and codification observed (revising standard operating procedures).	Low: Limited to accumulation of experience, but some efforts in articulation (training) and codification observed (revising standard operating procedures).	Low: Limited to accumulation of experience
Managing partnerships	Medium: Partners identified as an afterthought; in one case partnership was severed.	High: Partnership and collaboration in-built in contract with investors. Collaborations with specialist organizations to fix issues.	Medium: Partnering (bonding) with utility agencies, and the primary contractor when they (contractor) faced cash-flow issues.

3. A marketing team, that can conduct outreach activities and aggressively communicate the vision of the project to the public.

With the above competencies, the owner would be able to build trust amongst stakeholders, resolve conflicts quickly and provide feedback to local/central governments on land acquisition policies, which can smoothen the land acquisition process in future.

As can be seen from the discussion, land acquisition is not a core business of the owner. In the context of this study, the capability to *engage and manage stakeholders*, by definition, fits the description of an owner project capability in that it purposefully (to acquire land) extends the resource base (create a new team with roles defined above) to achieve their goals. This finding supports the theory by [Winch & Leiringer \(2016\)](#), who have identified stakeholder management as a strategic capability.

Intra-organizational politics and technical changes imposed on the project were the primary cause of intentional disruptions caused by internal factors. Findings from this study suggest that owners that built excellent relationships with the bureaucracy, the political class, the media, and other government institutions were successful in overcoming issues that, otherwise, would have resulted significant delays. Depending on the situation, owners applied a variety of political strategies – anticipatory, reactive, defensive, and proactive – to overcome intra-organizational political issues ([Oliver and Holzinger, 2016](#)). Some of the owners successfully preserved the value of work performed till date and did not allow the intra-organizational politics to adversely impact their delivery. The owners that did not confront political problems failed in meeting their project goals.

In certain other cases, the project would need to make changes (i.e., change to design) dictated by the ground conditions (i.e., not much space available for construction). The findings revealed that owners would need a robust change management system and a policy for innovation. These would also enable their capability to deliver their projects closer to schedule.

Strong owners would deploy their internal competencies to create value, resist political pressures, and adapt to the essential changes quickly. They thus preserve the value of work performed, and successfully prevent waste. The strong owners are also able to sense the need for future megaprojects, shape those by influencing the development of new policies and transform the megaproject delivery by setting new standards, as was observed in the case of M2. This owner project capability – *preserve value and transform the delivery process* – fits the definition of strategic capability. A few elements of this capability (i.e., project selection methods) has been discussed in [Winch and Leiringer \(2016\)](#).

The findings of this study revealed that none of the owners were able to manage the adverse impact of unintentional disruptions caused by external factors such as the pandemic. The owners had a dedicated team to coordinate disaster management related work led by a safety officer, whose role included the development and execution of safety plans. However, the safety team focused on just the commercial operations of the metro rail and the end-users ([District Disaster Management Authority, 2011](#)). It was assumed that the suppliers would be managing the project supply chain related disruptions. In the context of an owner, the resiliency must be dealt with at an organizational level ([Naderpajouh et al., 2020](#)). To develop resilience capabilities on the project as well, the

owner will need to renew the responsibilities of the team that oversees disruptions on the project and its supply chain (all tiers of suppliers). This study recommends that the owner redefine the roles and responsibilities of the safety team, and ensure the team clearly understands the scope of their work. The safety team would also need to facilitate behavioral training amongst all personnel to induce mindfulness and to create an awareness of MCB ([Yang et al., 2021](#)).

When disruptions are severe and beyond their scope and control, the safety team would need to coordinate relief work with governmental agencies (e.g., the national disaster response force, or the NDRF) to cocreate solutions. This will require the owner and the safety team to jointly identify the threshold beyond which they would requisition the involvement of external parties in the event of a severe disruption.

As can be seen, the capability to overcome unintentional-externally induced disruptions would call for making changes to the role, responsibilities, skills, and behaviors of people. In certain cases, the safety team would also need to coordinate relief and rescue work with external agencies thereby extending the resource base. This reconfiguration of the resource base required to *enhance organizational resilience* would fit the definition of an owner project capability. This could be classified as a governance capability since the owner would need to manage interfaces with the temporary project organization ([Winch and Leiringer, 2016](#)).

As more and more megaprojects get initiated, the owners would need the capability to create and manage knowledge, not just to perform routine work, but also to overcome disruptions. [Zollo and Winter \(2002\)](#) introduced the concept of deliberate learning, which included three components – i) accumulation of experience, ii) knowledge articulation, and iii) knowledge coding – in the evolution of dynamic capabilities of an organization. The capability to *create and manage knowledge* is closely related to deliberate learning. The three cases under study had low levels of deliberate learning. To address this concern, the government has set up a knowledge repository under the aegis of the I-Metro ([PRS Legislative Research, 2022](#)), whose mandate is to create a platform for sharing ideas across all metro rail projects in the country. Introduction of innovation champions ([Sergeeva and Zanello, 2018](#)) and encouraging open innovation capabilities ([Shenoy et al., 2023](#)) can also help owners resolve problems quickly and facilitate the delivery of projects closer to the scheduled date.

Megaprojects involve a lot of uncertainty, and in some situations the contractors may not be able to perform specified work. In such cases, it is best to involve partners with specialized skills that have executed similar work on other projects. As discussed in the findings section, the megaprojects that faced uncertain situations (for instance, M1, when it encountered hard rock and concrete blocks while tunneling a major interchange) were able to overcome the situation by employing experts. Owners would need specialized relationship management skills – coordination, communication and bonding – to manage such partners ([Schreiner et al., 2009](#)). Knowledge gained by working with experts will also need to be managed efficiently. While the capability to *manage partnerships* (e.g., relational management) has been identified as the commercial capability ([Winch and Leiringer, 2016](#)), this study extends the framework by including the capability to *manage knowledge* to it.

Table 8 summarizes the project capabilities identified in this study and relates it to the strong owner framework developed by [Winch and Leiringer \(2016\)](#).

Table 8
Summary of strong owner project capabilities identified in this study.

Project capability identified	Project capability description	Project capability type	Building blocks of project capability	Development of capabilities
Engage and manage stakeholders	To continuously engage with stakeholders, to build trust, to resolve conflicts and to influence development of new policies	Strategic	<ul style="list-style-type: none"> • Building trust • Resolving conflicts • Influencing policy 	<ul style="list-style-type: none"> • Setting up a team comprising of legal and property valuation experts for land acquisition • Communicating regularly with government, to provide feedback on policies • Setting up a team for outreach/ communication
Preserve value and transform the delivery process.	To comply with the requirements of the political environment, to sense need for future megaprojects, to shape and set new standards, to set higher barriers to entry	Strategic	<ul style="list-style-type: none"> • Managing inter-organizational politics • Managing major technical changes and innovation 	<ul style="list-style-type: none"> • Building strong relationships with government, bureaucracy, media, and other institutions • Applying appropriate political strategies to preserve value and prevent wastes • Developing and implementing a robust change management system • Developing and implementing a policy for innovation • Communicating regularly with the government and bureaucracy to create and implement new standards and shape future projects
Enhance organizational resilience	To focus attention on the current situation, to create awareness of behaviors required to enhance organizational resilience	Governance	<ul style="list-style-type: none"> • Inducing mindfulness • Acquiring institutional support 	<ul style="list-style-type: none"> • Redefining roles and responsibilities of the safety team • Organizing behavioral training amongst all personnel to induce mindfulness and to create an awareness of MCB • Defining threshold for escalating issues beyond control to acquire institutional support • Coordinating disaster management activities with external parties.
Manage knowledge and partnerships	To encourage continuous learning, creation, and dissemination of new knowledge; to manage relationships with partners	Commercial	<ul style="list-style-type: none"> • Creating and managing knowledge • Managing partnerships 	<ul style="list-style-type: none"> • Creating a central knowledge repository • Developing and implementing a policy for innovation: open innovation, innovation champions. • Developing relationship management skills

6. Conclusions

This study asked two research questions: (i) what capabilities would owners need to overcome disruptions, and (ii) how are owner capabilities developed in the context of disruptions. Based on archival data collated over a 50-year period, this study categorized disruptions into a two-dimensional orthogonal matrix using the source of disruption and the intention of disruption as dimensions. This study makes two key contributions. First, in the context of owners, this study has established that projects would need four capabilities to overcome disruptions: (i) a strategic capability to continuously engage with, and manage external stakeholders, (ii) a strategic capability to preserve value and transform the delivery process of future megaprojects by setting new standards, (iii) a governance capability to enhance organizational resilience, and (iv) a commercial capability to manage knowledge and partnerships. This study also identified the building blocks, or the sub-capabilities that comprise the project capability. Second, this study extends the project capabilities framework suggested by (Winch and Leiringer, 2016) and provides insights into additional project capabilities required by a strong owner from the perspective of disruptions. Practitioners and mega-project owners may use these findings to channel their resources to develop such dynamic capabilities to address persistent disruptions. This study is not without limitations. To enhance validity, the link between the first- and the second-order disruptions as well as response codes were discussed with disaster management experts in megaproject construction. Usage of multiple sources of data also enhanced the construct

validity. However, this study relied solely on the archival data; formal interviews with key stakeholders would have further enhanced the reliability of the results.

Another limitation may be the generalization of the results. This study utilized cases from the metro rail (urban infrastructure) domain. The result of this study may be more relevant to other metro rail projects, which require large parcels of land and involve overground and underground construction including tunnel boring, shifting of utilities, and integration of communication and signaling equipment. Construction of a network of roadways or megacities have similar characteristics, and therefore, the insights from this study may be applicable to those types of megaprojects. The results may not be generalized to megaprojects that do not require land or require heavy construction over or underground (e.g., building a naval aircraft carrier or building a spacecraft.)

In terms of future research, there is scope for improving the research methods, specifically to enhance validity. While this study has used multiple cases, there was hardly any evidence of collaboration between the projects. Further research related to this study could focus on collaboration and learning between projects and owners. Culture is an important factor in any study and the cases utilized for this study are from the Indian subcontinent. Future research may include cases from different regions.

Interest statement

The authors declare no conflict of interest.

CRedit authorship contribution statement

Dinesh Shenoy: Writing – review & editing, Writing – original draft, Software, Formal analysis, Data curation, Conceptualization. **Biswajit Mahanty:** Writing – review & editing, Supervision, Project administration, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data used is in the public domain. Quotations are embedded in the manuscript.

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