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On the Synchronisation of Activities During Construction Projects

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12.1. Introduction

When the achievement of a shared goal depends on the collaboration of multiple individuals or organisations, the synchronisation of activities carried out by the participants is often of crucial concern. For example, the outcomes of work carried out by teams of medical professionals working in emergency rooms, members of jazz orchestras, special weapons and tactics officers, or Olympic athletes running a 400-m relay are highly dependent on the individual participants' ability to work together, seamlessly synchronising the interdependent activities carried out by members of the team.

Construction projects are inter-organisational arrangements established to complete a large network of tasks characterised by complex interdependencies. At a practical level, subcontracting is used to distribute tasks to heterogeneous firms assuming diverse roles, such as the main contractor, subcontractor, and supplier of components. To minimise the time wasted on waiting for other firms to complete their tasks, it is crucial that such interdependent activities remain synchronised throughout the course of the project. However, construction projects are characterised by a variety of problems, including poor activity–duration estimates, logistical problems, quality problems, and scarcity of competent human resources, that frequently result in missed deadlines (Chan and Kumaraswamy 1997; Assaf and Al-Hejji 2006). Due to task interdependencies, problems encountered in a specific task frequently hinder the progress of other firms completing other tasks. To counter this, the resourcing and scheduling of tasks often need to be continuously adjusted by the organisations involved in the construction project. This process of organising is complex and dynamic and spans across organisational boundaries. Consequently, the coordination of

interdependent tasks is often suboptimal, unfavourably affecting project performance as well as quality of outputs. In some projects, delays cascade and spread uncontrollably across organisational boundaries.

This chapter focuses on the synchronisation of activities in inter-organisational construction projects. First, drawing on prior literature, I discuss the types of task interdependencies exhibited by such projects and how they are generally managed. Next, relying on interviews I have carried out with project professionals, I elaborate on the processes by which the synchronisation of interdependent activities is lost and restored. I then discuss how the synchronisation of activities is associated with performance outcomes at the level of both construction projects as a whole and the individual organisational participants. Towards the end of this chapter, I examine factors that support the ability of individual organisations and the entire inter-organisational project network to maintain synchronisation over the course of the project and practices/strategies project managers use to restore synchronisation.

12.2. Synchronisation of Activities in Construction Projects

12.2.1. Task Interdependencies and Synchronisation

Determining how to achieve and maintain the synchronisation of interdependent tasks in production processes involving multiple actors represents a core challenge of organising such processes, whether they are intra- or inter-organisational in nature. Here, ‘synchronisation’ refers to the timing and coordination of interdependent tasks in a manner that reduces the amount of non-productive working time (for example, time wasted on waiting for another task to be completed or on the rescheduling of activities). In production operations, interdependencies between tasks may be pooled, sequential, or reciprocal in nature (Thompson 1967; Donaldson 2001). In pooled interdependence, two or more actors make a distinct contribution to a shared goal. A job shop is a frequently discussed example of a production process with pooled interdependence (Galbraith 1973). In this case, each

worker can rather independently concentrate on their tasks, such as the assembly of products produced in the shop. No coordination between individual workers is typically necessary, but the outputs of all the workers contribute to the organisation's goals. In construction projects, supply chains for materials typically required in construction work (such as concrete and wood) exhibit pooled interdependencies, and exceptionally high demand or disruptions in supply can reduce the availability of critical materials.

In sequential interdependence, the output of one task serves as the input of another. In manufacturing environments, sequential interdependencies frequently characterise production lines and bottlenecks in batch processes (Woodward 1965). It has been argued that in the construction industry, the traditional production process is a classic case of the sequential interdependence of work (Winch 1989). The efficiency of projects involving a high number of sequentially interdependent tasks is supported by the detailed planning of schedules and resources and the order in which activities are to be carried out. This issue lies at the heart of project-management research. Reciprocal interdependence, in which the resources and actions of participants working on a task may affect the resources or actions of other participants, is both the most complex form of interdependence and the most difficult to coordinate (Galbraith 1973; Walker 2007). In construction projects, both the design and installation of various interdependent systems, such as electrical, heating, and ventilation, frequently require ongoing coordination and adjustment from several participating individuals or organisations. Although similar to sequential interdependencies, reciprocal interdependencies can also be partially coordinated by sophisticated planning techniques, the possible interactions are simply too numerous for such techniques to fully address the problem (Tushman and Nadler 1978). In addition, Tushman and Nadler (1978) suggested mutual adjustment as a means for further alleviating the problem of reciprocal interdependence. In mutual adjustment, any involved actor may introduce new information related to the coordination of the task in question at any time. As such, mutual adjustment closely resonates with the dynamic and process-oriented ways of organising discussed in

modern organisation theory. Finally, the challenges associated to reciprocal interdependence may also be tackled by the adoption of modularity in both organizational interfaces as well as product structures, as they have been argued to reduce the cost and difficulty of coordination (Sanchez and Mahoney 1996). Table 12.1 summarises the management of task interdependencies in construction projects.

12.2.2. Synchronisation of Activities in Temporary Organising

Although synchronisation is important to any productive task, its importance seems paramount in temporary organising, because time is by definition a scarce resource and generous safety margins cannot be incorporated into individual tasks to facilitate synchronisation (Lundin and Söderholm 1995). In addition, by contrast with process-based industries – such as petrochemical production and manufacturing-oriented industries with relatively stable supply chains as found in automotive production – the construction industry and other project-based industries are characterised by highly unique deliverables (Mandják and Veres 1998). Consequently, the chains of activities required to produce a construction project's deliverables are also highly unique. In addition, the inter-organisational networks of participating firms are established separately for each project (Hellgren and Stjernberg 1995), so the networks frequently include firms that have never worked together and, thus, have not developed effective ways to synchronise their production activities (Eccles 1981). The first meetings held at the start of the project have been argued to have a particularly central role for the coordination of activities, as behavioural pattens and assumptions guiding work emerge during them and become shared by the team members (Gersick 1988).

Construction projects are established for a specific purpose, like the construction of a shopping centre. Such projects involve the creation of a temporary project network, which ceases to exist immediately when the project is completed (or which is abandoned when

projects fail). There are no guarantees that organisations participating in a specific construction project will be selected for subsequent projects, which means that the organisations must deal with a high degree of uncertainty regarding future opportunities, that is, a very limited shadow of the future. It can be assumed that under this condition, the actors involved in construction projects may be less concerned about the synchronisation of tasks across the project organisation than are organisational actors in a more stable network structure, such as that associated with automobile manufacturing (Dyer 1997) and apparel manufacturing (Uzzi 1997). However, previous research has shown that despite a limited view of the future, construction projects are often characterised by a high degree of structural embeddedness because many of the participating firms may have worked with each other in the past (Eccles 1981). Some of the participating actors may, thus, have developed shared practices and routines for working together effectively and maintaining or restoring the synchronisation of activities.

12.3. Processes by Which Synchronisation Is Lost and Restored

How is the synchronisation of interdependent activities in construction projects lost? A project manager discussed the progress of work in a technical area:

We were supposed to carry out our work as we had done in the previous project together, but then it turned out that these subcontractors were so late, and they were missing all kinds of installations. And then when they started doing the installation work, and they managed to burn the paint so that it looked really bad. We had just started our work when the [client's] inspectors arrived and stopped our work. For a while, it was very unclear how we should proceed. (Project manager)

This example highlights that under the condition of task interdependence, the problems faced by one organisation can give rise to problems for another. As the project manager went on to explain, the desynchronisation process can be contagious:

It was as a snowball would have been rolling down a hill. Any area I went to inspect, somebody was saying to me that ‘we cannot finish this area as we are lacking the ordered furniture’! (Project manager)

So, was the bottleneck the [main contractor's] factory? (The author)

Absolutely. They had a lot of overlapping project deliveries at that time. (Project manager)

Figure 12.1 illustrates the process of losing the synchronisation of activities in an inter-organisational project. At t1, the interdependent tasks carried out by two organisations (A and B) are slightly desynchronised because A's work has fallen behind schedule, consequently slowing down B's work. At t2, the activities of the two organisations have become severely desynchronised, and B's work must be completely stopped until A completes its work. At t3, C's activities have become severely desynchronised with those of B.

The process of desynchronisation is often gradual, and it is difficult to identify a specific point in time when it begins; however, the point when work must be stopped is typically documented as stoppage and may have unfavourable consequences defined in the project contract for at least one of the involved parties. Severe desynchronisation does not always follow slight desynchronisation. Instead, either A or B, or both actors jointly, may deploy various measures to restore synchronisation, such as securing an additional workforce to speed up task completion. But how do organisations restore the synchronisation of tasks in inter-organisational projects? According to interviews carried out by the author, the measures adopted by organisations can be categorised as either inward-oriented or outward-oriented approaches. Inward-oriented actions aim to cushion the internal activities of the affected organisation from adverse conditions in its inter-organisational environment, whereas outward-oriented actions aim to influence the actions of organisations with which the affected organisation engages in interdependent tasks. A project manager discussed an inward-oriented approach:

The pace of the project has increased during September and October, resulting in additional work for us. There are many instances during which we have to make sure that the [subcontractor] actually has 15 men working … as it claims. We have to take additional measures to verify that this is actually the case. (Project manager)

So, would it be correct to ensure that the need to monitor the work of [the subcontractor] has increased in recent times? (The author)

Yes, and clearly so. (Project manager)

In this example, the project manager had decided to devote additional resources to monitoring the progress of the delayed subcontractor to ensure that timely information regarding the subcontractor's progress would be available as a basis for making project-related decisions in the future. A project manager representing a client organisation discussed an example of the outward-oriented approach:

I have asked them to redo all welds, but they have not complied. They are stating that this will incur additional costs. We have paid [the main contractor] once, but we have paid for quality work. Working with heavy steel is very different from working with light steel. They just did not understand that.

Furthermore, depending on the degree of desynchronisation (slight or severe) and the responses available to the actor, approaches to responding to desynchronisation events aim either to mitigate the event's harmful effects or to avoid the effects altogether. Figure 12.2 highlights the four types of approaches that may be available to project actors.

Firms may combine various inward- and outward-oriented approaches in their efforts to restore the synchronisation of tasks. A nascent stream of literature is devoted to uncovering the responses of actors when the synchronisation of tasks has been lost. Hällgren and Maaninen-Olsson (2005) showed that actors may search for information, change the composition of the project organisation, and engage in additional communication to restore the synchronisation of activities. More recently, Söderholm (2008) has demonstrated that

project actors may apply detachment strategies and renegotiate the conditions under which tasks are carried out. Drawing on the Manhattan Project, Lenfle and Loch (2010) emphasised the importance of improvising and learning-by-doing in projects for which following the traditional logic of sequential task completion poses significant difficulties. The author's interviews with project professionals revealed the following mechanisms:

- Increased monitoring of another actor
- Increased quality-assurance efforts
- Use of subtle pressure to convince another actor
- Use of coercive (e.g. contract-based) power to convince another actor
- Rescheduling of activities
- Reallocation of resources/allocation of additional resources
- Imposing monetary penalties for being late
- Replacing another involved actor (termination of contract)
- Reallocation of responsibilities between involved actors
- Agreeing upon joint operating practices with another actor
- Using own resources to support another actor's task progress (helping another actor)
- Changing the project scope
- Assigning own resources to less critical tasks (slowing down own work)

The approaches as well as the patterns of using multiple approaches to complement each other are diverse, most likely limited only by creativity of individuals working with construction projects.

12.4. Performance Implications of Desynchronisation

Maintaining the synchronisation of the supply of materials has been linked to the success of manufacturing firms (Das and Goyal 1989). In a supply chain context, Cao and Zhang (2011) identified a relation between inter-organisational synchronisation and production output. In the context of project-based organising, Brusoni and Prencipe (2001) described ‘achieving

technological and organisational synchronisation' as a key role of the systems integrator firm, which is responsible for the delivery as a whole, and Dvir and Lechler (2004) demonstrated evidence of a relation between project changes and project success. Accordingly, the dynamic and inter-organisational process of organising how task interdependencies are managed and desynchronisation is responded to plays a highly central role in determining the performance of construction projects. In the context of construction, organising occurs at both the level of individual organisations (Pitsis et al. 2003) and across organisational boundaries (Sydow and Braun 2018). As this is the case, performance implications of desynchronisation need to be discussed separately from the perspective of individual firms and the project as a whole.

From the perspective of an individual firm, most of the implications of desynchronisation are unfavourable. Tasks often need to be rescheduled to accommodate interdependent tasks running behind schedule. Rescheduling always consumes resources and may be highly problematic, particularly if the affected tasks are situated on the critical path of the project. Resources used in projects are also typically time-delimited and may not be available – at least not without an increase in price – to cater to the revised schedule. In construction projects, the reallocation of resources is particularly challenging under periods of high demand, when resources are scarce. An organisation falling behind schedule may also suffer reputational damage, which could diminish its opportunities to be selected for forthcoming projects. Further financial damage may occur due to penalties for missing deadlines specified in contractual agreements. Importantly, not all implications of desynchronisation are unfavourable from the perspective of an individual firm. If it becomes evident that a specific firm is falling behind and cannot meet its obligations, the client may need to redistribute the work originally allocated to this firm. The client may, for example, establish subcontracting relationships with additional firms to secure the resources needed to get the project back on track. In these kinds of situations, the time pressure for securing resources is often considerable, and some of the subcontractors may be able to take

advantage of this situation by increasing their prices. Moreover, a firm may benefit from desynchronisation when it lacks resources in the short term but can secure them in a cost-efficient manner at a later time. A firm struggling to meet its deadlines may be relieved to discover that other actors are falling behind and taking the blame for slowing down the project.

For a construction project as a whole, the implications of desynchronisation are predominantly unfavourable. Although an individual firm that is falling behind schedule may occasionally be able to catch up at its own cost, delays in critical tasks frequently cascade throughout the project organisation. A project task situated on the critical path can delay the entire project regardless of its scope. Some factors are external to project operations. As an indicator of this, during the COVID-19 pandemic, the global automotive industry suffered from a shortage of critical microchips, most of them less than €100 in value, resulting in temporary shutdowns of entire factories and the downgrading of production estimates for 2021 by hundreds of thousands of vehicles. To take another example, the United Kingdom experienced a reduced availability of lorry drivers following Brexit. This shortage compromised the availability of critical materials on construction sites throughout the country. Even when synchronisation can be restored without stopping the entire project, the costs of rescheduling tasks and reallocating the resources of multiple organisations unfavourably affect the performance of the project organisation.

Furthermore, instances of desynchronisation and who is responsible for it (and recovery) may foster an atmosphere of internal blaming and shaming, which could further hinder the flow of information and productivity. Although the desynchronisation of activities can often be remedied when sufficient (financial) resources are available, a more attractive option may be to scale down the project's scope. For example, ventilation equipment that cannot be acquired on time may be replaced with equipment with reduced performance specifications, or time may be cut from surface finishing, negatively influencing the aesthetic properties of the constructed building. Another problem related to desynchronisation is that it increases

time pressure, potentially leading to suboptimal decisions and even mistakes in the construction process. Although increased time pressure may facilitate inter-organisational problem-solving and creativity, which could lead to innovations in working practices and technical details, it can be concluded that desynchronisation is very harmful for both productivity and the outcomes of construction projects. Table 12.2 summarises the performance implications of desynchronisation.

12.5. Factors Associated with Synchronisation in Construction Projects

Multiple factors at the organisational, project, and institutional levels influence a construction project's vulnerability to desynchronisation events. Drawing from the development of the Polaris missile system, Sapolsky (1972) introduced the use of parallel tasks, fallback strategies, and decentralisation as practices that can be used to reduce the risk of desynchronisation. Parallel tasks have been used in military development projects, such as the Manhattan Project (Lenfle and Loch 2010). This method reduces the project's susceptibility to losing synchronisation, because a failing task can simply be abandoned and replaced by a parallel task that is proceeding as planned; however, in the low-margin construction sector, the use of parallel tasks is rare due to its cost implications. Fallback strategies rely on the option of reducing the outcome's scope (for example, by removing planned features) if it becomes evident during the execution of the work that the original scope cannot be fully met by the current organisation. Finally, the decentralisation of authority increases the number of independent channels of communication available to the organisation, enabling actors to work out problems quickly and autonomously instead of bringing them to the attention of a centralised decision-making body. The decentralisation of control can be achieved through a number of practices. For example, Davies et al. (2009) discussed the widespread use of cross-functional teams in the construction of the Heathrow T5 terminal. Concentrating on intra-organisational new-product-development projects, Hoegl

and Weinkauf (2005) verified the importance of two additional coordination mechanisms: project structuring and support and team interface management. The former mechanism involves the development of product integrity by achieving integration among various teams working on different modules in the project, whereas the latter mechanism involves inter-team communication and integration prior to freezing the project design.

The governance structure used in any construction project plays a central role in maintaining synchronisation, because it aims to align the interests and practices of organisational actors participating in the project (Ahola et al. 2014). This is accomplished by formulating shared rules and principles that are to be followed by the project actors. Some of these are included in project contracts, and some emerge during the course of the project as part of the continuous organising and self-organising that takes place amongst participating actors. As an example of a contractually defined rule, parties may agree on mechanisms for sharing bonuses paid to the project team or penalties payable by the project team. Project contracts also define the responsibilities of the participating organisations, which can range from very sharply defined to highly overlapping. If the responsibilities for project outcomes are at least partially shared across organisational boundaries, maintaining synchronisation becomes an issue of joint concern for the contracting parties. As an example of a principle that emerged during project execution, Ahola et al. (2017) discuss how the main contractor began to offer its subcontractors training related to welding highly specialised metal alloys to support them in maintaining the project schedule.

The roles of intangible and less formal elements, such as the project culture, are also significant. If the culture encourages actors to engage in filing claims and other types of zero-sum games that characterise construction in many parts of the world, motivating organisations to maintain synchronisation may be a very difficult problem. Instead, some actors may purposefully seek to desynchronise project activities for their gain at the cost of the productivity of the project as a whole. Generally, organisations that have worked together in the past and have established routines for collaboration are less likely to resort to

opportunistic behaviour than are actors with no shared history (Eccles 1981; Sydow and Staber 2002).

Individuals occupying central roles in the project's organisation are highly important for maintaining synchronisation as well. Generally, persons working for the construction project should have a positive view of teamwork and mutual gains. Key individuals working on the project can be co-located to further enhance collaboration across organisational boundaries (Walker et al. 2017). It is vital that key persons possess sufficient decision-making power to negotiate agreements with other organisations included in the construction project – and that they do so in a flexible manner, as the need arises and without seeking approval from their superiors for every proposal they make. Advocates of a strict, hierarchical chain of command and treating subcontractors as mere servants are likely to have a negative influence on the motivation of the inter-organisational project team to maintain synchronisation.

The project-management tools used in the construction project also influence the actor's ability to maintain the synchronisation of activities. The tools used should allow real-time task-completion data and communication to flow across the entire network of organisations involved in the project. Preferably, programmes used for scheduling and progress monitoring should be harmonised throughout the project's organisation. The use of diverse and rich communication applications is likely to facilitate effective communication across organisational boundaries, although with the cost that an official record of all communication and inter-organisational agreements is likely to become impossible to create and maintain. Table 12.3 provides a summary of factors associated with the frequency of desynchronisation events in construction projects.

12.6. Conclusion

In this chapter, I have described how the activities of organisations linked by interdependent activities can become desynchronised during a construction project and how synchronisation can be restored. I argue that although some individual firms may benefit from desynchronisation and may even seek to achieve it, its effects are in most cases highly

unfavourable for individual firms and especially for the construction project as a whole. Desynchronisation gives rise to disagreements and zero-sum games between firms participating in the construction project, wasting valuable project resources, risking the timely completion of the project and possibly undermining the functionality and quality of the project's deliverables. Because this is the case, devoting considerable effort to reducing the frequency of desynchronisation events at the level of both individual firms and the construction-project organisation as a whole makes good business sense.

Although many factors seem to relate to a construction project's vulnerability to desynchronisation events, two factors seem to play a particularly central role: attitudes and abilities of individual persons and the governance structure of the project. These factors are crucial as they influence the processes of organising and self-organising at both organisational and inter-organisational levels. Maintaining the synchronisation of tasks spanning organisational boundaries calls for open and ongoing communication and the willingness and ability to seek solutions that benefit the project as a whole. When problems arise, the joint intent of decision-makers must be finding the optimal solutions rather than identifying the parties responsible for the problem or the parties that will shoulder the costs of remedying it. In other words, key decision-makers must have a collaborative mindset and be granted enough leeway by their parent organisations to act accordingly. A collaborative orientation of decision-makers fosters the development of trust, which in turn facilitates the implementation of the project (Smyth and Edkins 2007). When a construction project is troubled, it is simply devastating for team morale to hear the project manager say the following words: ‘I know this would be the right thing to do, but there is no way my supervisor would allow it’.

The governance structure of the project, which consists of both formal mechanisms, such as contractual agreements, and informal mechanisms, such as trust and informal gatherings of the project team, influences the processes of organising by establishing the rules that guide processes of organising across the entire inter-organisational project organisation. A key

purpose of the governance structure is to ensure that the interests of the members of the inter-organisational project organisation are aligned and that all the members of the organisation benefit from the project's success or face harmful consequences if the project fails. As such, an important function of project governance is to recognise the need for continuous organising and create room for positive contributions, while trying to eliminate self-interested and other dysfunctional elements of organising. Regarding positive contributions, providing support for self-organising and mutual adjustment plays a particularly central role, as these processes are key for managing reciprocal task interdependencies crossing organisational boundaries. In practice, the project governance structure sets the limits in which these processes may operate. Formal governance mechanisms providing direction to purchasing practices in the project are also of importance. While arrangements for gain and pain sharing are likely to support task coordination, the use of lump-sum-based purchasing supports optimising at the level of a single organisation instead of the project as a whole. A governance structure tailored to the project can mitigate desynchronisation in two ways. First, it can reduce the frequency with which desynchronisation events occur. Second, when such events occur, it can ensure that all actors are motivated and able to engage in actions required to restore the project's synchronisation.

Previous studies of the delivery of complex projects (Brusoni and Prencipe 2001; Hobday et al. 2005) have highlighted the central role of the systems integrator firm – typically the main contractor in a construction project – in achieving technical as well as organisational integration. Although I do not question this, I argue that the synchronisation of activities across organisational boundaries cannot become the sole responsibility of a single organisation, even one that is highly resourceful and occupies a powerful position in the project organisation. Maintaining synchronisation must be viewed as the responsibility of each person in each organisation taking part in the construction project.

I conclude this chapter with a brief discussion of what makes for a world-class ice hockey team. First, the team requires highly skilled players. For example, the players need to have excellent skating skills, very high situational awareness, and the skill of passing the puck to a teammate without allowing the opposing team to intercept it. However, even if a team could recruit the best 20 players in the world, it would not necessarily be the strongest team in the world. To win, the team must work together seamlessly, flawlessly executing complex manoeuvres involving perfectly synchronised activities of multiple players with complementary roles and abilities. Although it is necessary to rehearse formal game plans and moves, there is no substitute for responsiveness to the context and run of play. Finally, to remain competitive over a longer period of time, the team must receive the support and resources needed to maintain the commitment of the players and the coach and to continuously attract new talent.

Analogously, a successful construction project comprises talented, motivated, and cooperation-oriented individuals working for firms driven by integrity, led by strong project management and possessing the necessary tools. These firms are joined via a governance structure that aligns the goals of the participating firms, rewards collaboration, and detects and punishes opportunistic behaviour and zero-sum games. Such a project has the capacity to operate like a well-oiled machine in which organisations work together in a synchronised and efficient manner.

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Figure 12.1 Process of desynchronisation in inter-organisational projects.

Figure 12.2 Categorisation of approaches to responding to desynchronisation.

Table 12.1 Management of task interdependencies in construction projects.

Type of interdependence	Pooled	Sequential	Reciprocal
Examples of construction projects	Material supply chains, work tasks of low complexity (e.g. painting)	Most tasks during the implementation phase	Many design activities, installation of subsystems in constructed building
Need for task synchronisation	Low	Moderate	High
Examples of	Synchronisation	Resourcing techniques	Frequent communication, shared

managerial approaches for maintaining the synchronisation of activities	typically unnecessary and scheduling (resource planning, purchasing)	working practices and tools, co-location, joint problem-solving approaches (mutual adjustment)

Table 12.2 Performance implications of desynchronisation.

	Potential negative implications of desynchronisation	Potential positive implications of desynchronisation
For individual firms	• Reduced productivity o Need for rescheduling of activities o Need for reallocation of resources • Reputational damage • Contractual penalty clauses • Increased time pressure	• Reduced time pressure • Opportunities for highly paid extra work/change orders
For the construction project	• Reduced productivity • Compromised teamwork culture (culture of blaming) • Increased pressure to reduce project scope • Higher probability of quality problems	• Potential for innovative solutions resulting from joint problem-solving activities

Table 12.3 Factors associated with the frequency of desynchronisation events in construction projects.

Factors that decrease the	Factors that increase the frequency

	frequency of desynchronisation events	of desynchronisation events
Organisational level	• Standardised processes for monitoring progress of tasks • Project managers with a high level of autonomy for decision-making (relative to their parent organisation) • Individuals with a personal preference for collaborating in key roles	• Ad hoc project-management practices that vary from person to person • Individuals with a personal preference for tight negotiations and zero-sum games
Project level	• Emphasis on expertise rather than hierarchy • Co-location of project's core team • Many participating firms with prior experience with collaboration • Project schedules shared across participating organisations • Use of cross-organisational teams • Main IT tools standardised across the project (e.g. scheduling, cost control, document storage) • Use of rich and flexible	• Large number of reciprocal task interdependencies • Emphasis on hierarchical chain of command • Widespread use of lump-sum contracts • Very long supply chains and low visibility • Communication restricted to approved channels only • Few participating firms with prior collaboration experience • Sharp and explicit delegation of the project's responsibilities

	communication channels and applications • Open sharing of task-progress information across the entire supply chain • Gain- and pain-sharing agreements • Responsibilities that overlap organisational boundaries	
Institutional/industry level	• Collaborative mindset dominant • Frequent use of alliance-based contracts • Disputes settled mostly outside courtrooms • Competition based mostly on superior deliverables	• Claims culture dominant • Late market cycle (economic activity at its peak, available resources scarce) • Disputes widely settled in courtrooms • Competition based mostly on price (very low margins)