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Coordination in the Age of Industry 4.0

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Abstract: Coordination, competition and cooperation are the three main types of strategic interactions. Coordination, despite its importance in structuring business interactions and its impact on firm performance, remains an understudied phenomenon, with the bulk of the research on business interactions focusing on competition and cooperation, and, more recently, on their simultaneous use in coopetition. However, growing complexity and specialization of enterprises increase coordination needs and call for renewed academic interest in the topic. Advances in digitalization and the rise of Industry 4.0, predicated on the growing interconnectedness and interdependence of technologies and business organizations, make the topic of coordination more relevant than ever before. The aim of this paper is to present a simplified model of coordination reflecting both the demands of Industry 4.0, and the possibilities it creates. Following the established conceptualizations of coordination, the model has two main components – interdependencies and coordination mechanisms. However, the conventional models presented the relationship as direct and unidirectional, with interdependencies viewed as given and the mechanisms of coordination as organizational responses aimed at achieving coordination. In contrast to the traditional approach, we allow for two-way causality between interdependencies and coordination mechanisms, as the latter not only are set to manage existing interdependencies, but also can elicit specific interdependencies, particularly those connectivity- and communication-related, as these are needed to induce all parties to follow the overall or common goal. ICT plays a central role in the model as mediating in managing interdependencies. Finally, the Industry 4.0-related public policy is recognized as capable of affecting business organizations' ability to effectively manage interdependencies.

Keywords: Coordination, Fourth industrial revolution, Industry 4.0, Interdependency

1. Introduction

Coordination is a topic of interest to various disciplines, such as economics, sociology, psychology, political science, organization theory and strategic management. In business settings, coordination has long been recognized as critical to firms' operations and success. For example, Barnard (1938) conceptualized organizations as systems of coordinated activities, Thompson (1967) and Lawrence and Lorsch (1969) – as systems of specialized interrelated behaviors that demand high levels of coordination, and Fayol (1949) listed coordination as one of the five main functions of management. More recently, Beer, Eisenstat, and Spector (1990) related coordination to two other types of strategic interactions – cooperation and competition – arguing that cooperation is a prerequisite of coordination which, in turn, is necessary for competitive success, and Malone and Crowston (1990, p. 2) argued that even competing parties can in some spheres coordinate actions.

Coordination can therefore be viewed as pervasive in organizational settings. In fact, it occurs both within and across organizations, and both vertically and horizontally linked individuals, groups and enterprises can coordinate activities. Although early studies focused on coordination among individuals and groups within organizations, recent advances in information and communication technologies (ICT) altering the rules of competition and triggering dramatic changes in interorganizational relationships (Malone and Crowston, 2012, p. 9) make the problem of coordination among organizations more relevant than ever. The advent of Industry 4.0, predicated on the growing interconnectedness and interdependence of technologies and business organizations (Kagermann, Wahlster and Helbig, 2013) and demanding the simultaneous pursuance of efficiency of integrated value chains and flexibility of networks, puts an extra pressure on coordination, further increasing its importance.

The prevalence of coordination does not explain when or how it is achieved. Early studies have found that the need for coordination arises whenever various tasks or resources must be employed together to produce desirable outcomes (Malone and Crowston, 1990), implying that the more complex the tasks and the more people are needed to accomplish them the bigger the coordination needs. The unprecedented pace of technological advancement manifested in the accumulation of digital (e.g. Big Data, cloud, IoT, AI, blockchain) and physical (e.g. 3D printing, nanotechnologies) technological breakthroughs which are growing on each other and coalescing to enable cyber-physical systems (Schwab, 2016), demands widespread cooperation and coordination as knowledge is dispersed and no company is able to advance technologies entirely in-house, without tapping external sources of knowledge (Alcácer, Cantwell and Piscitello, 2016). These new cyber-physical systems (CPSs) fed with data from Internet-of-Things (IoT) and deployed in so-called smart factories are the enabling features of Industry 4.0 (Liao, Deschamps, Lourdes and Ramos, 2017, p. 3618). It can be argued that by their nature, they both demand enhanced coordination within and across organizations, and are themselves deployed to foster coordination, making coordination in the age of Industry 4.0 a particularly timely and challenging endeavor.

However, the coordination topic has not yet been systematically addressed in Industry 4.0 studies, with the bulk of research emphasizing the need for coordination without later giving the topic due consideration. The aim of this paper is to partially fill this gap by presenting a simplified model of coordination in the age of Industry 4.0.
Despite a long history, the coordination studies remain at the pre-theory stage of development, with simplified frameworks and models used as a way to advance our knowledge (Malone and Crowston 2012, p. 8). The same approach has been adopted in this paper. It models coordination as reflecting both the demands of Industry 4.0, and the possibilities it creates. The model puts digital technologies central stage as mediating in establishing coordination. Moreover, in contrast to the traditional models of coordination, we model two-way causality between these variables, as coordination mechanisms not only manage existing interdependencies, but they can also elicit specific interdependencies, particularly those connectivity- and communication-related, as they are needed for inducing all parties to follow the overall or common goal. Finally, the Industry 4.0-related public policy is viewed as contextualizing the relationship, as certain measures can affect the ability and effectiveness of business organizations in coordinating interdependencies.

The paper is structured as follows. The second section provides a coordination literature review, the next one examines the nature of Industry 4.0, and the fourth section develops a simplified model of coordination in the age of Industry 4.0. The fifth section concludes.

2. Literature Review

In social sciences, coordination is typically conceptualized together with cooperation and conflict as three basic types of strategic interactions, defined as interactions in which outcomes of one actor's decision depend on decisions by other actors. In a pure conflict interaction one party gains only at the cost of another, in a coordination interaction each party can gain only if the other also gains, and cooperation interactions involve elements of both conflict and coordination (Hardin, 1990, p. 359). In economics, the topic of coordination, cooperation and conflict is typically addressed in game theoretic models of reaching equilibria by rational decision-makers. In the business context, coordination is typically viewed as a precondition for the achievement of firm objectives (Espinosa, Lerch and Kraut, 2004). Organization and management literature defines coordination as organization of individuals' efforts toward achieving common and explicitly recognized goals (Blau and Scott, 1962), the combination of parts to achieve the most effective or harmonious results (Thompson, 1967), the act of working together harmoniously (Malone and Crowston, 1990, p. 4), the integration or linking together of different parts of an organization to accomplish a collective set of tasks (Van de Ven, Delbecq and Koenig, 1976), activities required to maintain consistency within a work product or to manage dependencies within the workflow (Curtis, 1989), bringing into a relationship otherwise separate activities or events, typically with the goal of increasing efficiency (Frances, Levacić, Mitchell and Thompson, 1991, p. 3), and managing dependencies among activities (Malone and Crowston, 2012, p. 11).

The managerial and organizational definitions of coordination revolve around two components – organization of separate activities and, explicitly or implicitly, orientation at achieving an overall, common or mutually beneficial goal. It implies that the activities must be performed in a way that helps achieve the goal, making their performance interdependent (Malone and Crowston 1990, p. 4). Hence the goal-relevant relationships between activities can be referred to as interdependencies (Crowston, 1994; Malone and Crowston 1990, p. 4; Thompson, 1967), defined as the extent to which outcomes of one unit (activity) are directly controlled by or contingent upon the actions of another unit (activity) (Victor and Blackburn, 1987, p. 490). What follows is that coordination is the act of managing interdependencies – if there is no interdependence, there is nothing to coordinate (Malone and Crowston 1990, p. 5-6; 2012, p. 11).

All organizations face coordination problem arising from interdependencies (Malone and Crowston, 1994), which can be both internal (within organization) and external (across organizations), similarly to organizational responses to interdependencies, that is coordination strategies based on mechanisms of coordination. Coordination mechanisms must be chosen in such a way as to effectively address existing interdependencies. As the latter amplify, increasingly powerful coordination mechanisms are needed (e.g. mutual adjustment rather than standardization), alternatively, actions to reduce the degree of interdependency can be taken (McCann and Ferry 1979). Coordination literature categorizes interdependencies in various ways. For example, Malone and Crowston (1990, p. 7) hypothesize (1) prerequisite (output of one activity is required by the next activity), (2) shared resource (resource required by multiple activities), and (3) simultaneity (time at which more than one activity must occur) interdependencies, Thompson (1967, s. 54-55) theorizes three types of interdependenices – pooled (discrete or autonomous contributions to one pool), sequential (output of one unit is necessary for the performance of the next unit), and reciprocal (one agent's output is another agent's input and vice versa), and Van de Ven, Delbecq and Koenig (1976) extend Thompson's (1967) framework with the fourth category – team arrangement (tasks are performed jointly). March and Simon (1958) describe two coordination mechanisms – task organization mechanisms and communication (i.e. coordination by feedback), Espinosa, Lerch and Kraut (2004) distinguish explicit (task programming and communicating) and implicit (cognition based on shared knowledge) coordination mechanisms, Fugate, Sahin and Mentzer (2006) analyze price, non-price, and flow coordination mechanisms, whereas Morgan and Hunt (1994) point at norms as playing a key role in coordination. Solidarity, mutuality, restraint in the use of power, concern for reputation, and information sharing are some of the norms discussed in the coordination literature (Fugate, Sahin and Mentzer, 2006). Table 1 summarizes selected generic coordination frameworks presenting theorized patterns of interdependences and corresponding coordination mechanisms.

Table1: A summary of selected generic coordination frameworks

Framework's author(s)	Patterns of interdependencies	Coordination mechanisms
Thompson (1967)	• Pooled, • Sequential and • Reciprocal	• Standardization, • Plan, • Mutual adjustment
Van de Ven, Delbecq and Koenig (1976)	• Pooled, • Sequential, • Reciprocal, • Team arrangement (simultaneous)	• Standardization (rules) (impersonal), • Planning (impersonal), • Exchange of information and adjustment (personal and group mechanisms) • Exchange of information and adjustment (personal and group mechanisms)
Malone and Crowston (1990)	• Prerequisite, • Shared resource, • Simultaneity	• Goal decomposition, ordering activities, moving information from one activity to the next; • Allocating resources; • Synchronizing activities
Crowston (1994)	• Task-resource, • Common effects • Common preconditions, • Effect of one is precondition of other	• Resource assignment • Negotiation or picking one task to do • Scheduling or acquiring more resources • Managing flow of resources
Espinosa, Lerch and Kraut (2004)*	Task-level, team-level, technology-level, organization-level, synchronicity, collocation vs. dispersion	Explicit (e.g. strategy) and implicit (e.g. shared mental model, task awareness)

Source: Based on respective publications indicated in the left column of the table

Note: coordination mechanisms marked by bullets in the right column correspond to individual patterns of interdependencies marked by respective bullets in the central column.
Espinosa, Lerch and Kraut (2004), individual categories of coordination mechanisms in the right column do not correspond to individual types of interdependencies, as – according to these authors – typically a mix of coordination mechanisms is needed to deal with interdependencies. Therefore no bullets are used.

In the last 20 years coordination literature evolved to emphasize more domain-specific (e.g. supply chain management) approaches to managing interdependencies, as allowing more detailed, context-specific analyses and inferences. Moreover, economic and organizational studies on coordination mechanisms have been complemented by computer science contributions focusing on computational coordination mechanisms in the context of cooperative work settings, particularly on how computer systems can reduce the costs (Malone, Yates and Benjamin, 1987) and complexity of coordinating interdependent cooperative activities (e.g. Schmidt and Simone, 1996). In the age of Industry 4.0 these two disciplinary approaches come together as the interactions are mediated by information technology systems and solutions.

3. Industry 4.0 and Coordination

The new economic era called Industry 4.0 (e.g. Kagermann et al., 2013), or the fourth industrial revolution (e.g. Schwab, 2016), began roughly in the 2010s (Arthur, 2017), building on previous achievements of digitalization and industrialization. Similarly to the preceding industrial revolutions, its central theme is the transformation of the production system, i.e. manufacturing value chains (Wee, Kelly, Cattel and Breunig, 2015).
The fourth industrial revolution has been ushered in by feeding huge amounts of data into manufacturing environment using the IoT (Kagermann et al. 2013, p. 5). The manufacturing environment itself is being transformed by cross-fertilization and coalescing of digital and physical technologies (Kagermann et al. 2013) producing strong technological interdependencies. Although it has long been acknowledged that individual technologies seldom operate in isolation from other technologies, as interoperability is typically required in order to create the intended value (Baden-Fuller and Haefliger, 2013, p. 422), requirements of the Industry 4.0 make the interdependencies between technologies more important than ever. The reason is that bringing advanced digital and physical technologies into integrated cyber-physical systems (CPSs) enable a wealth of value networks (Kagermann et al., 2013, p. 6), where multiple physical systems and applications communicate with each other as a network (Desmet, Maerkedahl and Shi, 2017). Such communication is mediated by CPS platforms, which monitor the physical processes of smart factories and make decentralized decisions (Young, Petutschnigg Barbu, 2017, p. 565). With CPS platforms, the physical systems communicate in real time exchanging huge amounts of data, which are then fed to algorithms to coordinate and manage production processes.

Although the scope of Industry 4.0 remains uncertain, comprising – according to various authors – a variety of technologies, applications, processes and business models (Schlund and Baaij, 2018, p. 341), Kagermann et al. (2013) in what is the most widely cited Industry 4.0 reference (Liao, Deschamps, Lourdes and Ramos 2017, p. 3618), present the vision of Industry 4.0 as encompassing dynamic, real-time optimized, self-organizing value chains. IoT and CPS platforms, covering entire manufacturing processes and a dynamic network of companies, play a central role in this vision as enabling three key ICT-based integration features – horizontal integration (both within a company and across companies in inter-firm value networks), vertical integration (at different hierarchical levels, e.g. sensor, production management, corporate planning levels), and end-to-end digital integration (end-to-end integration of the engineering value chain). Achieving the paradigm shift (Kagermann et al., 2013) of combined integration of ICT systems across manufacturing stages and hierarchical levels along entire value chains creates an unprecedented coordination challenge.

Moreover, the advent of computerized manufacturing technologies mark a clear departure from the logic of the previous economic era (third industrial revolution (Schwab, 2016), or the second morphing of the digital revolution (Arthur, 2017) in which the advancement and growing complexity of technologies demanded progressing specialization and led to modularization of technologies and fragmentation of value chains (Alcácer, Cantwell and Piscitello, 2016: 505; Langlois, 2002). Currently, computerized manufacturing technologies allow consolidating intermediate stages in manufacturing processes into fewer stages and enable more integral product architecture, which demands close, detailed coordination of activities (Rezk, Srai and Williamson, 2016). Laplume, Petersen, and Pearce (2016) study one of such technologies – 3D printing – and find that its capacity to consolidate some intermediate phases of production partially reverses the trend towards specialization, fragmentation and dispersion. What follows is that improving coordination capacity is central to the advancement of Industry 4.0 and computerized manufacturing technologies and CPS platforms should be seen as its critical mechanisms.

4. Industry 4.0 Coordination Model

Certainly, patterns of interdependencies and coordination mechanisms identified and described in early models of coordination should not be all too eagerly dismissed in the age of Industry 4.0. However, new perspectives on interdependencies and new mechanisms specific to Industry 4.0 can be proposed, reflecting both the possibilities and demands the new era creates. For simplicity, the model developed below expressly addresses the latter, that is specificities of interdependencies and coordination mechanisms that grow out of advancing digitalization and computerized manufacturing technologies indicative of Industry 4.0 manufacturing value chains. Included are also aspects of interdependencies omitted or neglected in previously developed models but which gain prominence in the Industry 4.0 context. In the model, both interdependencies and coordination mechanisms are considered at the activity level, with the overall goal of coordination interpreted as the performance of the entire manufacturing system, regardless of the ownership status of individual units performing activities.

Based on Kagermann's et al. (2013) integration features, horizontal, vertical and end-to-end interdependency patterns can be featured. Horizontal interdependencies can be defined as any interdependencies existing either within a company or between companies in the production system (e.g. sequential or related to risk management). Vertical interdependencies are any interdependencies that can be identified between different hierarchical levels (for example, data quality or timeliness-related interdependencies). End-to-end interdependencies can be defined as interdependencies observed in the engineering value chain (e.g. relating product features and production process requirements). However, this categorization seems overly generic, and as such it would have a limited utility in explaining the nature of limitations and demands that interdependencies produce, as well as inferring coordination mechanisms that could address them. Therefore, the model summarized in Table 2 below portrays identified interdependencies that are more specific, easy to interpret and can be easily referred to when conceptualizing types of responses, i.e. mechanisms of coordination. Moreover, rather then focusing on patterns of interdependencies it depicts aspects or dimensions of present-day interdependencies. The reason is that interdependency is a multifaceted phenomenon as two actions or units can be interdependent in several ways. To the best of author's knowledge, in all early models interdependency was viewed as a one-dimensional variable, that is depicted patterns of interdependencies were distinguished from a single point of view. In the more recent model (i.e. Espinosa, Lerch and Kraut, 2004) the portrayal was inconsistent, with majority of patterns distinguished along one dimensions, and remaining ones representing additional aspects.

Our model depicts the following aspects (or dimensions) of interdependencies: (1) interoperability, (2) flexibility, (3) adaptability, (4) data-related interdependence patterns (volume, velocity, veracity and security), (5) risk sharing, and (6) intellectual property and know-how protection. Coordination mechanisms characteristic of Industry 4.0 include (1) computerized manufacturing technologies, (2) cyber-physical system platforms, (3) network access and governance, and (4) trust in data and algorithms.

Table 2: Dimensions of interdependencies and coordination mechanisms characteristic of Industry 4.0

Dimensions of interdependencies	Coordination mechanisms
Interoperability Flexibility Adaptability Data-related interdependencies Risk sharing Intellectual property and know-how protection	Computerized manufacturing technologies CPS platform, algorithm, Rules of access and governance Trust in data and algorithms

4.1. Dimensions of Interdependencies

Interoperability is a dimension of interdependency in which two components of a production system need to exchange and automatically interpret information in order to produce expected value. The same applies to two levels in the production system, e.g. actuator or sensor and production management levels. Flexibility in relations is a characteristic required to establish a dynamic configuration of different aspects of production processes (Kagermann et al., 2013, p. 16). That makes flexibility, that is openness to and acceptance of ad hoc network relations, the second dimension of interdependency, indispensable if Industry 4.0 production systems are to deliver expected value. Adaptability is a dimension emphasizing evolutionary and innovation-driven nature of contemporary production technologies. Advancements in some parts or aspects of manufacturing processes may require adaptation by other components, making them interdependent. Data-related interdependence has four components – volume, velocity, veracity (correctness) and security. Incessant collection, transfer, and feeding of data into CPS platforms and algorithms underpins system-wide production optimization. Algorithms interpreting data and automating processes and, ultimately, decisions (Bughin, Catlin, Hirt and Willmott, 2018) require data of sufficiently high volumes, on time and of consistently high quality, transferred both vertically and horizontally, producing strong multilateral interdependencies. Data security breaches can compromise the whole interconnected system, which can fall victim to industrial espionage despite most of its components being otherwise well protected. Data security issue links data-related interdependence to risk sharing. Risk sharing is a distinct dimension of interdependency in integrated production systems. Mistakes or flaws in one spot can result from and affect operations in another. Technology innovations at both development and commercialization stages often require complementary innovations development and deployment (Adner, 2006), respectively. The more intermediaries must adopt an innovation before it reaches end users and the more complementary innovations are needed, the higher the risk. Risk sharing can also be related to Alter and Hage's (1993) task uncertainty dimension of interdependency, defined as the degree to which tasks have unknowable outcomes. Fusion and coalescing of technologies (Schwab, 2016) make intellectual property (IP) and know-how protection an important dimension of interdependency. End-to-end engineering involving multiple actors cooperating and competing to develop overall best solutions may require network-specific (idiosyncratic) investments and trade-offs between individual members of the network, and sharing sensitive IP and know-how to the common benefit, making this issue an important dimension of interdependency.

The above list is not meant to be exhaustive. Rather, it depicts dimensions of interdependencies specific or of increased importance to the Industry 4.0 production systems and their coordination. Thus, for example, the traditional factors of the type of complementarities (Teece, 1986) and frequency and complexity of interactions, are not included despite their indisputable role in shaping interdependencies.

4.2. Coordination Mechanisms

Industry 4.0 production systems both demand and enable close coordination. While in the purely digital ecosystems technological modularity allows interdependent components of a product to be produced by different producers, with limited coordination, in the Industry 4.0 production systems computerized manufacturing technologies (e.g. 3D printing) provide close coordination in consolidating intermediate stages in manufacturing processes into fewer stages, thus enabling more integral product architecture and fewer interactions with external partners (Rezk, Srai and Williamson, 2016). These traits make computerized manufacturing technologies a key Industry 4.0 coordination mechanism, addressing particularly interoperability and flexibility dimensions of interdependencies.

To operate properly, Industry 4.0 manufacturing systems necessitate CPS platforms able to interact with, and expand the capabilities of the physical production systems (Baheti and Gill, 2011, p. 161). These platforms assure coordination of manufacturing processes through collection, processing, distribution and use of data to monitor the physical processes and make decentralized supply chain decisions (Young, Petutschnigg Barbu, 2017, p. 565). They also take an important part in value-add by designing individualized products based on information exchange with customers and by supporting product and process engineering. CPS platforms and algorithms they operate, provide the concept of interconnectivity with substance. They relate to all the aspects of interdependencies covered in the model, and those connected to data particularly strongly.

Industry 4.0 manufacturing systems are similar to digital ecosystems in that their coordination relies on rules of access and governance. Such rules, describing inter alia standards and providing interfaces, are set to provide structure, determine the roles (including control rights) and incentives (Adner, 2017) for owners of activities and processes, thus encouraging engagement and alignment of all the parties. Coordination through rules of access and governance allows the entire manufacturing system to economize on transaction costs. Rules of access and governance are critical coordination mechanisms for designing and actually using new business models which Industry 4.0 is to elicit and support. For example, such rules could enable micropayments, product-as-a-service models, property rights-based models, and data-driven business models (Wee, Kelly, Cattel and Breunig, 2015, p. 8). Rules of access and governance are aimed predominantly at risk sharing and intellectual property and know-how related interdependencies.

Industry 4.0 production systems involve endless exchanges – of data, component and product flows as well as financial transactions. For the system to work properly, all these transactions must be trusted. Trust is a powerful coordination mechanism (McEvily, Perrone and Zaheer, 2003) allowing all parties involved to economize on transaction costs. Traditionally, transacting parties extended trust to an institution, typically an intermediary, who guaranteed transaction. Industry 4.0 production systems comprise individual components of the production system incessantly communicating and transacting, both horizontally and vertically. In such systems, trust in institutions as guarantors of transactions is replaced with trust in veracity of data and, above all, in algorithms. One particularly conspicuous coordination mechanism based on this logic is blockchain, which explicitly replaces trust in institutions with trust in algorithms. Thanks to its consensus protocols and advanced cryptography-based verification process and immutability of data it can be used in supply chain management for tracking and payments while dramatically reducing the risks of unauthorized access and compromising data quality. Thus, trust in data and algorithms as a coordination mechanism specifically addresses data-related and risk-sharing interdependencies.

Apart from coordination mechanisms described above as characteristic of the Industry 4.0, some more traditional coordination mechanisms are still valid. For example, goals are still decomposed, resources allocated, and the manufacturing value chain leader can set the vision of the whole production and engineering system, enabling its partners to align their investments and find mutually supportive roles. Finally, the Industry 4.0-relevant institutional environment and infrastructure should be seen as an enabling factor, affecting both the interdependencies and coordination mechanisms. In this vein, Kagermann et al. (2013, p. 6-7) point at the existence of technical standards and common architecture, methods and tools for industry 4.0 engineers to develop planning and explanatory models to manage complexity of products and manufacturing systems, broadband internet infrastructure, safety and security standards concerning, among others, data, labor market and training measures (e.g. lifelong learning), and legislation taking into account Industry 4.0 innovations (e.g. protection of corporate data, liability issues, handling of personal data, model contracts).

5. Conclusion

The success of Industry 4.0 manufacturing systems hinges upon effective coordination. The unprecedented pace of technological change, intensified competition and increased customer expectations have created business environment which favors speed and flexibility, which, in turn, demand new forms of organizing value creation embracing new and evolved technological and organizational interdependencies. The paper presents a simplified model of coordination embracing both the demands of Industry 4.0, and the possibilities it creates. The model covers dimensions of interdependencies and mechanisms of coordination specific to Industry 4.0, that is reflecting advances in digital technologies and their integration with physical technologies as well as changes in the nature of interactions such technological advancements enable and demand.

Unlike and the traditional models of coordination, the above model depicts coordination as technology mediated. Moreover, in contrast to the traditional models, we allow for two-way causality between these variables, as coordination mechanisms not only manage existing interdependencies, but they can also elicit specific interdependencies, particularly those connectivity- and communication-related, as they are needed for inducing all parties to follow the overall or common goal. Finally, we look at dimensions – and not patterns – of interdependencies in recognition that interdependencies are a multifaceted phenomenon. In contrast to early models, typically prioritizing coordination mechanisms, we see these mechanisms as partial and complementary in their pursuance of coordination.

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