The Modular Architecture of Organizational Trust in the Digital Age

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Abstract
In this essay, we address the intersection of trust and modularity in organization design. We argue that, while advanced digital technologies favor more modular organizational arrangements, contemporary trust scholarship has largely failed to adopt the network-based approach that is necessary to understand relationships in such settings. Addressing this void, the article introduces a framework that differentiates between and elaborates on within- and between-module trust dynamics. Our argument offers insights into the challenges and opportunities presented by modular designs, particularly regarding the concerns they raise surrounding trust pluralism and organizational coherence. The discussion extends to practical implications for organizational designers, suggesting strategies for navigating trust in modular organizations. We also point to recursive effects of trust on the emergence of modular structures. By advancing theoretical discussions on modularity and trust, our work serves as a foundation for future theoretical and empirical research aimed at refining the strategies organizations can employ to leverage modularity while fostering a trustworthy environment.

Keywords: trust, modularity, organization design, digital technology, collaboration

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Introduction

Trust is the bedrock of collaboration (Arrow, 1972; Fukuyama, 1995) and thus plays a foundational role in facilitating access to valuable resources (Levin & Cross, 2004; McEvily, Perrone, & Zaheer, 2003), the resolution of within- and between-firm conflict (Lumineau, Eckerd, & Handley, 2015; Sanders & Schyns, 2006) , and the ultimate success of organizations (Dyer & Chu, 2003; Zaheer, McEvily, & Perrone, 1998). As a result, a substantial body of literature in strategic management has been devoted to the study of trust (Barney & Hansen, 1994; Poppo, Zhou, & Li, 2016). From resource-based theorizing (Fainshmidt & Frazier, 2017) and transaction cost economics (Cuypers, Hennart, Silverman, & Ertug, 2021) to the behavioral theory of the firm (Evans & Schilke, 2024), trust has consistently emerged as a central theme in strategic management discourse over the field's history.

However, an important question has largely remained unaddressed in the literature: How is trust affected by organizational structure? That is, what are the implications of different structural arrangements for the degree and the types of trust that exist within the organization? While both organizational structure and trust are well-studied in their respective literatures, integration across them is rare (see the work by Hurley, Gillespie, Ferrin, & Dietz, 2013; Puranam, 2018 for notable exceptions), resulting in a lack of investigations exploring how structural variations impact trust dynamics and vice versa. This question is particularly timely, as recent developments associated with the Fourth Industrial Revolution have fundamentally altered the organizational environment (Lumineau, Schilke, & Wang, 2023; Schwab, 2017) and may call for different designs, raising the questions of whether and how organizational trust will be affected.

The purpose of this article is to present one approach to contemporary organizational structure—modularity—and to theorize about its implications for organizational trust. High degrees of modularity, with organizational components operating largely independently while still functioning as part of the larger system, come with the promise of organizational efficiency and flexibility (Baldwin & Clark, 2000; Ethiraj & Levinthal, 2004; Sanchez & Mahoney, 1996), which are crucial in a fast-changing technological landscape. However, modularity also presents substantial challenges because of the constraints it imposes on interactions among organizational members (Langlois, 2002; Weick, 1976). Developing theory on how modular structures can be designed to maintain or even enhance trust is thus essential for managers seeking to navigate the trade-offs between organizational agility and coherence. However, much extant trust research in management focuses primarily on the dyad as the unit of analysis while largely ignoring how the social structures surrounding the dyad shapes trust dynamics (de Jong, Kroon, & Schilke, 2017; McEvily, Zaheer, & Soda, 2021). Our network-based approach addresses and aims to overcome this limitation.

The remainder of this essay proceeds as follows. We start by reviewing the general notion of modularity before addressing the role of advanced digital technology as a key enabler of modularity. Next, we argue for the need to approach trust from a network perspective to appreciate its role in modular organizing. We then develop such a network-based account, addressing both within-module and between-module trust and the complexity involved in boundary spanners' efforts to navigate both logics simultaneously. We also discuss important implications for organizational designers aiming to optimize modular structures for trust and propose meaningful research agendas for future scholarship. Our article concludes with a broader discussion of how trust both shapes and is shaped by modularity.

Modularity

Modularity can be understood as the decomposition of "a system of activities into subsystems (also known as modules or components), such that activities within a module are highly interdependent with one another, but there are few dependencies between activities that are part of different modules" (Srikanth & Puranam, 2011, p. 853). Modularity can also be nested, with submodules within modules.

In general, the notion of modularity can be applied to three domains: engineering, human processes, and institutions. "Engineered modularity" is the structure of a complex artifact, such as a machine or piece of software, into modular subsystems. Garud, Kumaraswamy, and Langlois (2009) convincingly argue that modular systems, particularly those involving engineered modularity, provide organizations with the flexibility to manage complex tasks by decomposing systems into interchangeable components "Process modularity" is a pattern of human activities that is modular, often because the activities are devoted to the design or production of an artifact that is characterized by modular engineering. Process modules thus include teams, task forces, or departments within a larger organization. The traditional, hierarchical organization chart is a high-level map of nested process modules. "Institutional modularity" is the allocation of these human process modules to different institutions—and thus, by implication, the boundaries of such institutions and the set of arrangements by which these institutions transact to perform the overall task. Institutional modules comprising larger ecosystems thus include corporations, subcontractors, sole proprietors, and other legal entities.

Often, engineered modularity shapes the pattern of process modularity, which in turn shapes the pattern of institutional modularity. This idea is at the heart of the so-called "mirroring

hypothesis," which claims that increased modularity in products and tasks will ultimately go hand-in-hand with greater modularity in the structure of the organizational systems that execute those tasks (Colfer & Baldwin, 2010; Sanchez & Mahoney, 1996). Baldwin and Clark (2000), tracing the evolution of modularity in engineered computer systems (hardware and software) in their classic *Design Rules*, argue that the modular architecture of the IBM System/360 ultimately propelled the breakup of the IBM monopoly and the emergence of multiple specialist companies, each "mirroring" a specific technical module. In short, institutional features come to reflect underlying engineering logic.

An organizational structure is 'modular' to the extent to which its members group into clusters such that within-module connections are dense whereas between-module connections are sparse. 'Members' in this context could be individuals or they could be subgroups that are themselves modular. Modularity is a matter of degree: we can think of the 'degree of modularity' as the difference between the average densities of within-module and between-module connection (e.g., Jung & Simpson, 2017). On that definition almost all organizations beyond some very small threshold are to some extent modular. The paradigmatic hierarchical organization is modular where the defining between-module connections are vertical (relating to accountabilities, budgets…). Vertical connections are characterized by relative formality and asymmetries of power, so mutual 'trust' is not very important. The paradigmatic 'agile' organization is also modular, but the defining between-module connections are horizontal among peers or peer teams, and typically relate to 'real work' (Zaleznik, 1997). Such horizontal connections are more likely to be *ad hoc* and prompted by some immediate task or unforeseen challenge, and because the parties are peers, their mutual trust may be critical to successful

collaboration. Thus, the advent of agile or flexible organizational models enhances the importance of the interrelation between trust and modularity.

Modular organizing has several merits. The principal benefit of modularity is the encapsulation of complexity; by limiting the extent to which "everything depends on everything else," modularity allows large and complex systems (of components, teams, or companies) to function effectively. Encapsulation is effected by what Baldwin and Clark (2000) call "design rules": fixed, or at least infrequently changed, definitions of the interface that one module delivers and another module depends upon. Because they rely on the stability of these design rules, teams or institutions focused on one module need not concern themselves with the "hidden" internal workings of other modules; instead, they can concentrate on improving their own module within tightly defined "dimensions of merit" (cost, time, etc.), and their goals and incentives can be aligned.

The system additionally benefits from the interchangeability of modules, as long as they conform to the design rules. In the context of digital technologies, this interchangeability is often called "plug-and-play": at any point in time, the end user can select from alternative candidate modules to meet the needs—and only those needs—specific to the intended application. Modularity thus enables cheap customization. The larger production ecosystem can also enjoy the "option value" of multiple parallel bets. It may be unclear beforehand which technology or which supplier will develop the best version of a module, but afterward users can cheaply adopt whichever alternative wins, without needing to retrofit any other part of their system. The ecosystem thus enjoys a "portfolio of options". Disk drives, for example, interact with larger computer systems via standard interfaces (SATA and SAS) and are valued on very simple dimensions of merit such as speed, capacity, and cost. As a result, drives become commodities,

and companies assembling the final product can easily swap one supplier for another. This makes the disk-drive industry intensely competitive, and the end-user benefits from aggressive performance improvements.

There is, however, a downside. Design rules are difficult to change, especially when an entire industry has adopted a particular interface. (QWERTY is the classic example of an interface that has long outlived its original logic, but everybody still uses it—because everybody else still uses it; see David, 1985). Modular systems are thus characterized by greater rigidity at the architectural (inter-modular) level, offsetting lower complexity and greater flexibility within modules. Typically, the overall challenge in system design evolves over time: at a certain point, the architecture matures, the design rules become fixed, and the locus of innovation shifts from the initial architectural experimentation to dimension-of-merit improvement within modules. This evolution results in the tendency, noted by Clayton Christensen and colleagues (Christensen & Raynor, 2003; Christensen, Verlinden, & Westerman, 2002), for the degree of modularity within an industry to increase as it matures.

Digitalization and Modularity

Technology, especially advanced digital technology, drives modularity. Modularity is *possible* because interactions (e.g., exchanges of data or instructions) can be precisely defined and therefore compatible with design rules. Modularity is *warranted* by the extraordinary—and increasing—complexity of hardware and software, which can only be managed by encapsulating that complexity in nested sub-systems. This logic is magnified by the rapid spread of many such technologies, enabling—through the sheer scaling of the market or supply chain—a more granular division of labor as defined by the modules. Digital products or services are therefore

characterized by deep and nested modularity in their physical and virtual componentry, and their modularity is mirrored in the human processes by which the product is designed and assembled. Very often, it is further mirrored in the boundaries of the businesses involved in its production.

Now, when it comes to understanding the boundaries of the corporation (and to a certain extent, the boundaries of departments, teams, and other internal organizational units), there is a much more general, relevant theory with which organizational economists are more familiar—namely, transaction cost theory. The basic proposition of this theory, which originates, of course, with Ronald Coase (1937), is that transactions tend to be inherently cheaper *within* than *among* organizations; the boundaries of the corporation are therefore determined by a trade-off between the transaction costs thereby reduced and the overhead costs imposed by supervision. From this perspective, design rules are simply a way of defining technical aspects of a certain transaction in a standardized way such that the overall cost of transacting (negotiating, coordinating, monitoring, recourse, etc.) is lowered. Given the low overall cost, there is no need for any superordinate organization to further manage-down human or institutional transaction costs, as such further benefits are outweighed by the flexibility gained from arm's-length market transactions.[1]

Technology has transformed the economics of transaction costs in general. Digitalization has lowered the cost of search, communication, price discovery, contract drafting, settlement, and compliance monitoring, which Carliss Baldwin (2007) calls "mundane transaction costs."[2] These lowered costs, together with the substitution of digital for physical goods and a dramatic

[1] A comprehensive synthesis of the relation between modularity and transaction costs is presented by Baldwin (2007).

[2] Baldwin (2007, p. 156) defines "mundane transaction costs" as the costs of "work to define, count (or measure), and pay for the transacted objects."

drop in transportation costs, have together engendered the "death of distance" and thus massively enlarged many, if not most, collaborative networks, both within and among organizations. As a result, mundane transaction costs have ceased to be the binding constraint on the scale and complexity of collaborative networks.

Within the organization, the fall in mundane transaction costs enables much larger and denser collaborative networks. The classical organization chart, resembling an inverted tree, strictly minimizes the number of connections needed to tie the network together: between any node and any other, there is one and only one path. This makes sense, among other reasons, as a means of economizing on the amount of, and therefore the cost of, coordination. As that cost decreases, so does need for such minimization, and redundant "lateral" modes of collaboration become economic: teams, self-organization, and indeed the whole panoply of modern management techniques. Modules emerge that are dense and fluid in their internal, collaborative relationships and connect to other modules via the intermediation of a small number of brokers (Burt, 2005).

Among institutions, larger markets afford broader options to both buyers and sellers. As markets become more liquid, the cost of switching falls. This change often reduces another kind of transaction cost: the need to protect oneself from the consequences of being "locked in" to dependence on a counterparty (Williamson, 1975). This hold-up problem is frequently cited as a rationale for vertical integration. Falling mundane transaction costs, the possibility of establishing digitally-defined design rules, and the diminished acuteness of the hold-up problem all contribute to an overall reduction in transaction costs across entire industries. However, as Brynjolfsson, Malone, Gurbaxani, and Kambil (1994) remarked, if the (Coasean) purpose of

organization is to economize on transaction costs and there is less and less to economize on, then markets should substitute for hierarchies—a further extension of the mirroring hypothesis.

Trust—or, rather, the lack of trust—is itself a transaction cost in two senses. First, parties that are not fully trusting incur mundane transaction costs as a means of self-protection (e.g., lawyers' fees, audits, and so forth). Second, absent trust, parties may fail to reach Pareto-optimal bargains by the logic of the prisoner's dilemma (hold-up is a specific example of this problem). In a world where the cost of discovery, communication, and transportation constrained actors to transactions with a small number of local counterparties, trust generally emerged as a consequence of repeated transactions (Axelrod, 1981; Blau, 1964); however, the removal of those constraints now allows wider choice and cheaper switching, so the "shadow of the past" (Poppo, Zhou, & Ryu, 2008; Swärd, 2016) becomes less compelling as a basis for trust. Of course, some of the power of face-to-face interaction to engender trust quickly and organically may get lost when communication is virtual (e.g., Schilke & Huang, 2018; Wilson, Straus, & McEvily, 2006). Thus, as other transaction costs fall, the cost of establishing trust may actually be rising, Trust therefore increasingly becomes the binding constraint on transactions—a constraint that can be just as important for members of a team attempting to work remotely as for buyers and sellers in a digital marketplace.

This shift from transaction cost minimization to value generation aligns well with the perspective of Zajac and Olsen (1993), who argue that trust plays a strategic role in fostering transactional value. In modular systems, trust not only mitigates risks but also creates opportunities for deeper collaboration and innovation. As such, trust should be seen not merely as a cost-reducer, but as a key enabler of strategic advantages within and across organizations.

To recap, in two mutually reinforcing trends, technology propels modularity and drives down many transaction costs. However, as other transaction costs diminish, trust grows more important, potentially even becoming the binding constraint on system performance. So how is trust shaping, and being shaped by, an increasingly modular world?

The mirroring hypothesis, when applied in isolation, represents a form of technological determinism: purely engineering considerations of complexity and interdependence shape the predicted or prescribed structures of human processes and the boundaries of economic institutions. However, the consideration that design rules are merely one method of lowering transaction costs indicates that there can be more factors involved. In particular, if trust is another way of lowering transaction costs, then there should be some interaction between patterns of trust and patterns of human and institutional modularity beyond the mechanistic predictions of the mirroring hypothesis. The presence or absence of trust among human actors and the presence or absence of mechanisms for engendering trust might constrain or shape the way that mirroring is, or should be, applied to organization design. Conversely, mirroring might require patterns of coordination and transaction among actors with insufficient mutual trust, implying a trust-building agenda for the organizational designer. The starting point, therefore, is an understanding of how trust emerges and is sustained withing the topology of a modular collaboration network.

The Need for a Network Approach to Understanding Trust in Modular Organizations

Unfortunately, contemporary trust research in management is strongly dominated by dyadic accounts and thus provides only limited insight into systemic trust processes in broader networks (de Jong et al., 2017; McEvily et al., 2021). That is, while much is known about how

two actors develop trust with one another, the role of the network surrounding their relationship has been overlooked in much recent scholarship on trust. This focus can be traced back to seminal models of trust (e.g., Mayer, Davis, & Schoorman, 1995; McAllister, 1995), which center on the interactions between two directly connected actors. These models have shaped research priorities and methodologies, often sidelining the more complex network dynamics of trust.

We argue that the strong dominance of dyadic trust models has certain downsides, especially considering the increasingly connected environments facilitated by digital technologies. Primarily, it tends to overlook how trust in one relationship can be influenced by or influence other ties within the broader network. Trust is not merely an outcome of isolated interpersonal interactions; it also flows through the indirect connections linking individuals to one another (Burt & Knez, 1995; Coleman, 1988; Ferrin, Dirks, & Shah, 2006; Stewart, 2003; Uzzi, 1997). This broader perspective on trust acknowledges that trust between two parties can depend significantly on their network positions and the network's inherent design features.

For example, trust can manifest among individuals who are not directly connected, through mechanisms such as shared affiliations or third-party ties, which dyadic models do not sufficiently account for. As such, trust can emerge not only from direct interactions but also from the structural characteristics of the network itself. This view draws attention to the roles of relational patterns, influencing trust dynamics across the entire network rather than only within isolated pairs. Table 1 compares network forms of trust with the more commonly discussed dyadic trust, as well as other collective forms of trust in the literature, such as institution-based trust (Zucker, 1986) and generalized trust (Yamagishi & Yamagishi, 1994). While these forms of trust are distinct enough for analytical differentiation, we also acknowledge that they share certain overlaps and similarities.

---Insert Table 1 about here---

In sum, a more inclusive approach that integrates both dyadic and collective perspectives can enrich the understanding of how trust is built, sustained, and propagated within complex environments. In what follows, we will start to develop such a perspective, with a specific focus on trust development in modular systems.

Two Types of Trust in Modular Organizations

Considering the trend of increased modularity, it is imperative to better understand how modularity shapes trust production, calling for a network approach to theorize the processes at play. To systematize our analysis, we start with a simple typology of trust in modular organizations that distinguishes between within-module and between-module trust and points to important differences between the two. Understanding both within-module and between-module trust is vital for designing a modular organization that can effectively balance specialization with integration, ensuring both efficient exchange within modules and effective collaboration across the organization. We thus believe our proposed typology has significant merit in giving organizations a framework within which to tailor their practices more effectively to each type of trust scenario, enhancing both the operational efficiency and strategic flexibility that are at the heart of what motivates modular organizing.

Within-module Trust. Within-module connections refer to the relationships that occur within a single module of an organization. These connections are internal to the module and involve the coordination of activities for which the module is directly responsible. Activities within a module tend to be highly interdependent, meaning that the tasks performed by actors within the module are closely linked and directly affect each other. There is usually a tight

integration of communication within modules, facilitating rapid information flow and decision-making among members, who are often co-located and/or functionally related. Strong within-module connectedness can lead to high levels of cohesion, as members often develop a strong sense of identity and belonging.

As a result, each dyad is strongly embedded at not only the relational but also the system level. Not only do actors interact with one another frequently, enabling the production of relational process-based trust based on their interpersonal experiences and perceptions of the counterpart's ability, benevolence, and integrity (Zucker, 1986), but also high within-module density of connection raises the relevance of network forms of trust, as actors have multiple indirect ties with one another (McEvily et al., 2021). As such, what happens in the dyad is substantially informed by and has consequences beyond it. The presence of multiple "third parties"—actors with ties to both the trustor and trustee—shapes trust in several ways. For instance, a trustor may approach such third parties to inquire about the trustee's past behavior, or, vice versa, a third party could approach the trustor to tell them about their experience with the trustee. Both processes help the trustor learn about the trustworthiness of the trustee. In addition to such learning mechanisms, high embeddedness of within-module relationships also has important control-related implications (Buskens & Raub, 2002). Densely connected modules, in which everyone is closely connected, enhance the effectiveness of sanctions because they enable information about trust abuse to spread quickly and broadly, increasing the power of "voice" about actors' opportunistic behavior. Knowing that such indirect sanctioning will be highly effective, trustors are more likely to place trust given their confidence that any abuse of that trust will lead to tangible consequences for the trustee, resulting from not only the trustor's but also third parties' likely withdrawal from future interactions. In other words, the "shadow of the

future" (Axelrod, 1985; Molm, Takahashi, & Peterson, 2000) weighs more heavily when it falls onto everyone in the module.

We anticipate that these embeddedness mechanisms will be even stronger with the further advancement and diffusion of digital technologies. Technologies like augmented and virtual reality and AI-supported project management tools will likely facilitate richer and more frequent communication even among remotely working module members. Further, modern technologies often come with systems that provide greater transparency about work processes. Collaborative platforms built on cloud computing give decentralized access to information and make it possible for all module members to see the status of tasks, access everyone's work, and thus evaluate other module members' reliability and competence.

In summary, within-module connections not only facilitate frequent and direct dyadic interactions among module members but also furnish a robust network structure that supports trust via third-party learning and control mechanisms. The dense connectivity within a module affords sharing of reputational insights and sanctioning against trust breaches. The increased integration of advanced digital technologies may further amplify these dynamics, enhancing learning and sanctioning mechanisms even further by making interactions more frequent, information more accessible, and accountability more palpable.

Between-module Trust. Between-module connections refer to the relationships that occur between distinct modules. These connections are essential for integrating the work of various modules to produce outputs that align with organizational objectives. While essential, the interdependence between modules is typically much lower compared to within-module interactions, as each module retains a degree of autonomy.

In modular organizations, connections between modules are governed, at least in part, by standardized design rules, which determine how modules exchange information, materials, or outputs. One solution to address the problem of between-module trust is to make the design rules comprehensive, thereby minimizing the number and frequency of inter-modular communications and eliminating any discretion in how one module chooses to interact with another. Consequently, high levels of built-in control minimize the need for between-module trust (Bijlsma-Frankema & Costa, 2005; Cao & Lumineau, 2015; Sitkin & Roth, 1993).

This philosophy was reputedly imposed by Jeff Bezos on Amazon.com in 2002 when, in a notorious memo,[3] he insisted that all organizational units within the company interact with each other via a "service oriented architecture", i.e., open networking protocols such as XML and SQL. No other modes of collaboration were permitted. This decision massively reduced the richness of inter-modular collaboration; however, because those design rules were externalizable, it also maximized the interoperability of current and future modules in the Amazon supply chain. This approach proved fundamental to Amazon's ability to add millions of other retailers to the website, suppliers to their warehouses, and data users to what became Amazon Web Services. While the reality was probably never as clean as this memo proposes, the Amazon exemplar can be seen as a "limiting case," where modularity has been maximized using digital technology to minimize the need for inter-modular trust.

More commonly, however, design rules specify some but not all interactions between modules, and it is at the human interface, managed by boundary spanners, that trust issues will continue to arise. The *need* for trust at this intermodular nexus can be especially acute. If the

[3] This was reported by Google (formerly Amazon) engineer Steve Yegge, paraphrasing an internal memo by Bezos. Yegge's account was accidently published on Google+ and then withdrawn in 2011. Quoted at https://plus.google.com/+RipRowan/posts/eVeouesvaVX

modules are different teams or different organizations, they will have, to some extent, different goals, different cultures, and different internal metrics of success and failure. It is at the inter-modular interface that these differences must be negotiated (e.g., the engineering team wants to make the product better, but the marketing team wants it cheaper). At the inter-modular nexus, there is therefore less collaboration and more negotiation, quite possibly more politics.

Typically, interactions between modules are limited to one or two boundary spanners (Dodgson, 1993) in each module, whereas all other module members rarely, if ever, interact with members outside of their own module. This scenario often results in between-module relationships having extraordinarily low levels of network embeddedness.

The primary mode of between-module trust production is akin to Kramer's (1999) discussion of rule-based trust. In this mode, trust rests mainly on formal trust mechanisms rather than on a history or expected future of exchange. Trust is predicated on actors' adherence to rules that define what is appropriate and that constrain allowable behavior. In contrast to the inter-module design rules that minimize the need for trust, these formal trust mechanisms enhance, rather than substitute for, trust—a central theme in the enduring debate on the relationship between trust and control (Möllering, 2005). Examples (shown in Figure 1) include knowledge repositories that function as reputation systems and make interaction records transparent, as well as project management guidelines that coordinate work processes across modules. These structures offer a certain guarantee that the interaction will take place as anticipated (engendering an element of "system trust" that is perhaps most salient in digital ecosystems such as AirBnB, Uber, and Red Hat; see Aguiar et al., 2021), while potentially limiting the development of spontaneous interpersonal trust that is typically found within modules. That is, the formal trust production systems compete with and potentially override

interpersonal trust mechanisms among individuals (Abrahao, Parigi, Gupta, & Cook, 2017; Mao, Jones, Li, Wei, & Lyu, 2020). The learning and sanctioning dynamics that develop organically and are based on the dense structure of the human network within modules are essentially replicated through rules at the between-module level.

---Insert Figure 1 about here---

Although the idea of design rules comes from engineering and that of formal trust mechanisms from the literature on trust, the practical distinction between the two is really one of degree rather than kind. A "pure" design rule, as exemplified by the Bezos memo, would be universal in its applicability and would substitute entirely for trust, whereas a "pure" formal trust mechanism would be specific to a particular nexus and would exclusively support the generation of trust between the connected nodes. The examples enumerated in Figure 1 are, to varying degrees, artifacts of underlying engineered processes *and* instruments for engendering between-module trust. This observation suggests that we extend the concept of design rules to include such trust mechanisms or, alternatively, that we recognize a spectrum along which interfaces can vary in the way that they substitute for, or support, between-module trust.

Technology enhances both, although it is clearly not the only means to implement design rules, which can also be based on non-digital structures (Shapiro, 1987). Nonetheless, technology has become central for scaling trust across modular networks. Not only can Unified Communications Platforms (UCPs) simplify communication flows, but also AI technologies can automate routine interactions, such as information requests and status updates, which traditionally may have required the involvement of human support. Similarly, integrated ERP systems enable real-time data sharing and visibility across modules, such that only a single boundary spanner is needed to access up-to-date information. Automation tools, including those

embedded in blockchains, can enforce standardized processes across different modules, making it difficult for humans to deviate from the rules programed into those systems (Lumineau, Wang, & Schilke, 2021). Moreover, if deviations from established norms do occur, AI and machine learning can analyze patterns in between-module interactions to identify and highlight them. All of this reduces the frequency of human contact among modules, cements the interface into what are effectively additional design rules, and supports the formalized transparency that sustains between-module trust.

To sum up (see Table 2), the need for trust and the likelihood of distrust are both inherently higher at the inter-modular interface. Design rules somewhat limit the need for trust across modular boundaries, but, for that very reason, the boundary spanners managing the remaining human interfaces are isolated. In the absence of organic trust development, formal trust mechanisms are therefore needed to sustain these connections. In their practical implementation, design rules and formal trust mechanisms blend into each other. Technology can reduce the need for intermodular coordination and also enhance between-module trust.

---Insert Table 2 about here---

Implications of Modularity for Organizational Trust

Building on the distinction between within- and between-module trust, we can derive some important trust-related implications for organizations with modular structures. In particular, we anticipate potential problems of high levels of modularity in terms of boundary-spanning complexity and organizational coherence.

Trust Pluralism. Our discussion of the structure of interactions in modular organizations points to the critical importance of boundary spanners in holding the organizational system together. Despite the autonomy of individual modules, their interdependencies require careful

coordination by the boundary spanners overseeing the interactions that must align tightly to ensure seamless collaboration. Their critical role places boundary spanners under significant pressure to perform, handle information overload, and deal with diverse types of information, which can lead to stress and burnout. The overload can be political as well as informational: boundary spanners must simultaneously represent the interests they share with intramodular colleagues and build trust with similarly pressured peers from other modules.

We argue that this situation is further exacerbated by the need to simultaneously juggle different logics of collaboration and trust production. Building on research on "institutional pluralism"—which highlights how actors face conflicting institutional logics (Greenwood, Raynard, Kodeih, Micelotta, & Lounsbury, 2011; Kraatz & Block, 2008)—we introduce the notion of "trust pluralism." Trust pluralism captures the specific challenge of navigating multiple, often conflicting, modes of trust production across within- and between-module relationships. While institutional pluralism primarily focuses on dealing with diverse organizational logics, trust pluralism specifically reflects the difficulty of reconciling different trust logics across varying social and structural contexts, such as within- and between-module relationships.

Boundary spanners in modular organizations embody this complexity, as they must operate under distinct trust production regimes: within-module trust, which relies heavily on dense interpersonal relationships and embedded social norms, and between-module trust, which is more formalized and dependent on contractual or rule-based systems. These distinct forms of trust present boundary spanners with divergent expectations and require constant adjustments to meet the demands of each. In this sense, trust pluralism highlights not only the multiplicity of trust modes but also the inherent friction in managing both formal and informal trust systems.

Within-module trust production calls for creating rich organic relationships with module members—relationships that are strongly embedded in a densely connected network of exchanges. Between-module trust production, on the other hand, is strongly formalized, and relationships to other boundary spanners are highly isolated, lacking the ability to turn to third parties for learning or sanctioning purposes. In many ways, these trust production logics are diametrically opposed, yet a boundary spanner must master both.

Further complicating matters, transitioning from within-module to between-module interactions, and vice versa, demands dynamic changes from one trust production mode to another and thus requires adjusting one's attitudes and behavior to match the formal or informal expectations of the respective environment. Drawing from Goffman's (1959) *The Presentation of Self in Everyday Life*, research on "code-switching" (Anicich & Hirsh, 2017; Hymes, 1972) suggests that such transitions can lead to considerable psychological strain due to the cognitive and emotional labor involved. Code-switching between trust modes requires significant mental effort and agility, as boundary spanners must constantly adjust from one logic to another, which can lead to increased cognitive load and make it harder to focus on other tasks. Over time, this constant mental juggling can lead to fatigue, reduced cognitive capacity, and even impaired decision-making. Moreover, beyond the mental effort required, code-switching often demands considerable emotional energy as well, as it involves not only changing speech or behavior but also managing one's emotional expressions to fit different norms and expectations associated with within- vs. between-model trust logics. Such efforts can be particularly draining if these adjustments are not in harmony with the individual's authentic self or personal values.

While prior discussions have highlighted distinct modes of trust production (e.g., Kramer, 1999; Zucker, 1986), the problems that may result from dealing with more than one

have rarely been the subject of debate in trust scholarship. To fill this gap, our discussion of trust pluralism highlights the important implications of actors having to accommodate different trust dynamics. Importantly, an analysis of trust pluralism is not merely a theoretical exercise; the notion has significant practical implications. As digital technologies increase modularity in organizations, trust dynamics will likely become more fragmented, amplifying the importance of managing trust across different contexts. Recognizing the distinct demands of trust pluralism allows us to develop more effective strategies for boundary spanners, providing them with the tools and support needed to balance both relational and formal trust production systems effectively.

While our discussion thus far has highlighted the challenges posed by trust pluralism, it is also important to recognize that the ability to integrate various forms of trust can turn out to be a significant asset for boundary spanners. A high degree of adaptability, once developed and practiced, can foster versatility and cognitive flexibility, allowing actors to operate effectively, especially in complex, dynamic environments (Huxham & Vangen, 2004). Boundary spanners who excel at trust pluralism are uniquely positioned to facilitate negotiations and collaborations that are productive and enduring (Ferrin, Bligh, & Kohles, 2007). The synergies created by the interplay between these trust forms may not only enhance the potential for smoother coordination but also lead to greater relational and structural flexibility in organizations. Thus, the capacity to navigate different trust logics is likely to emerge as a highly valuable skill, giving individuals a distinct competitive advantage and making them indispensable to their organizations.

Organizational Coherence. Even when boundary spanners can successfully handle the challenge of navigating trust pluralism, modular structures may threaten organizational

coherence in two ways, which can be tracked back to the "thin" between-module and the "thick" within-module trust (Nooteboom, 2002; Williams, 1988). First, the highly standardized interactions among modules facilitate a type of trust that is impersonal and based on general expectations of social roles or norms, rather than on deep personal knowledge or emotional bonds. While such trust can be formed relatively easily, it is inherently fragile, as thin trust tends to break down whenever the counterpart's behavior deviates from the norm. In particular, organizational change can disrupt the established expectations upon which thin trust is based, which in turn can lead to uncertainty and withdrawal. As such, high degrees of modularity have the potential to create silos that can restrict the flow of information and reduce the overall sense of community and shared purpose across the organization.

Second, the thick trust that exists within modules can, somewhat counter-intuitively, further exacerbate this trend. Closure within modules facilitates strong trust and cooperation, but it concurrently reduces the likelihood of trust and cooperation beyond the module (Burt, Opper, & Holm, 2022; Cook, Levi, & Hardin, 2009; Yamagishi & Yamagishi, 1994) due to a contrast effect. Frequent interactions, and the reputation and sanctioning possibilities that exist in these environments, make within-module relationships feel highly comfortable. At the same time, they make interactions with outsiders that lack these enforcement mechanisms appear alien and fraught with uncertainty. In effect, the boundaries established by modules and the resulting within-module trust can lead to selective exclusion and foster distrust towards those outside the module. These dynamics further jeopardize the coherence of the organization across modules.

Equipping Modular Organizations for Trust

Short of reducing the organization's level of modularity, what can organizational designers do to proactively preempt these problems of trust pluralism and organizational fragmentation? We can think of five structural solutions that may help to reap the benefits of modularity while preventing some its trust-related downsides.

Provide Support Resources for Boundary Spanners. Organizations should provide robust support for boundary spanners, such as by offering training programs focused on communication and stress management. This training can help them better navigate the complexities of managing both within- and between-module interactions. In addition, organizations can make development support personnel available to boundary spanners. These specialists can offer targeted advice and strategies for enhancing between-module cooperation and managing plural trust relationships. Finally, organizations should equip boundary spanners with state-of-the-art communication tools and technologies that facilitate seamless interactions across modules. These can include collaboration software, project management tools, and platforms that support real-time information sharing.

Host Regular Between-Module Meetings. While design rules are a key ingredient to modular organizing, they do not have to be the exclusive mechanism to connect modules. Regular in-person or virtual meetings between boundary spanners from different modules can foster mutual understanding and collaboration. These meetings can help thicken trust by creating a shared context, aligning efforts, and reducing the likelihood of misunderstandings and conflicts.

Implement Role Rotation Programs. Organizations can encourage members to rotate roles across different modules. This may not only enhance cross-functional skills but also build a more integrated understanding of the organization, fostering trust across different modules.

Moreover, role rotation can help dismantle silos by spreading organizational knowledge and best practices, thereby promoting a more cohesive and collaborative work environment.

Establish Clear and Transparent Communication Channels. Dedicated channels for open and transparent communication across modules can help to ensure that all organizational members are aware of ongoing changes, challenges, and developments. Such transparency can demystify operations in other modules, reduce rumors and misinformation, and build a foundation of trust through informed understanding.

Establish a Shared Vision for Organizational Purpose. Organizational designers in modular organizations should prioritize establishing a shared vision for the organization's purpose to align the actions and goals across different modules. By clearly defining and communicating the overarching objectives, managers can foster a sense of unity and ensure that both within-module and between-module interactions contribute positively towards the collective goals (Grice, Reeves, & Fuller, 2019). This alignment helps maintain consistent behavior among all parts of the organization, supporting the overall system's effectiveness.

Nested Modularity

While we have so far analyzed only the single layer of "peer" modules interacting in a single system, we noted earlier that modularity can be nested. Thus, our argument can be extended by interpreting it as an account of the relationship between within- and between-module trust between any two adjacent levels in the hierarchical nesting of modules. Trust *within* each of the submodules is likely to be more densely embedded and organic, while trust *among* the submodules (which, from a higher organizational perspective, is the same as trust "within the

module") is likely to be less embedded and more formal. The mix varies as a matter of degree as we move up the nested hierarchy.

There is an important implication for boundary spanners: conflict and trust failures can arise that do not map neatly onto the modular architecture. An individual (or sub-submodule) working within one submodule could experience a breakdown in trust in interactions with another individual working not just in a different submodule (which can be resolved locally) but in a different module. In that case, the boundary spanner must operate (resolving the issue or engendering mutual trust) at the between-module level, not the between-submodule level. The larger the overall system is, and the greater is the extent of hierarchical nesting, the greater is the burden placed on boundary spanners across the higher-level modules. The system may not scale. The greater is the extent to which the modular architecture of the organization correctly maps onto a modular architecture for the underlying tasks, the less this will pose a problem. Conversely, however, the larger the organization is, and the greater is the rate of change (e.g., due to technology), the greater is the pressure on high-level boundary spanners. An obvious response to this problem is the imposition of more rigorous design rules in order to push decision-making down to submodular levels.

Recursive Effects of Trust on Modularity

While the argument advanced in this article primarily emphasizes the effects of modularity on organizational trust, it also adds insights into how trust impacts modularity—that is, how modularity can take on a life of its own as a function of the level of organizational trust. Not only does modularity influence the actual and optimal pattern of trust, but also patterns of trust influence both empirical and normative patterns of modularity. The boldest argument for

the *empirical* impact of trust on institutional structures was made by Francis Fukuyama (1995), who claimed (somewhat controversially) that trust in different societies has shaped and constrained the emergence of capitalist institutions. Specifically, he identified low-trust societies (notably France, Italy, and Korea) where he claimed patterns of trust were restricted to family and kinship, inhibiting the emergence of modern, large-scale corporations (the institutional "modules" of the modern capitalist economy). Governments, he argued, had to intervene directly in these economies to overcome the barriers of extra-familial distrust. This scenario contrasts with high-trust societies such as Germany and Japan, where the broad diffusion of social capital facilitated the formation of large-scale enterprises without government sponsorship or intervention.

In the narrower world of strategic management, there are episodes in which the existence or absence of trust has had a visible effect on patterns of organization and collaboration. One spectacular example occurred in the Toyota supply chain in Japan in 1997, when a fire broke out in the Kariya Number 1 factory of Aisin Seiki, the sole supplier of a mundane but critical automotive component called a p-valve (Evans & Wolf, 2005). Facing the prospect of the entire Toyota supply chain grinding to a halt, some fifty suppliers "swarmed" over the problem, improvising collaborations to produce these valves. This self-organizing modularity emerged with minimal direction from Toyota and without any prior negotiation as to how the suppliers would be compensated for their efforts. A high level of mutual trust curated by Toyota over decades (and perhaps, per Fukuyama, reflective of Japanese society at large) enabled the rapid improvisation of an emergency supply network. At the end of the crisis, Toyota generously compensated all of its suppliers for their efforts, thereby reinforcing the mutual trust on which those efforts were predicated.

The Toyota story raises the obvious *normative* question of whether a company's reliance on trust is the "correct" strategy. It is reasonable to suppose that if the same incident had occurred in the more litigious, financially ruthless, and lower-trust environment of the US automotive supply chain, the OEMs would have secured multiple sources, maintained buffer inventories, and perhaps resorted to legal action in anticipation of, or response to, such a disruption. Moreover, the American OEM purchasing departments most certainly would have exercised their bargaining power to the maximum (at the expense of trust) in securing the cheapest supply contracts—probably cheaper, *ceteris paribus,* than those of their Japanese peers. The key difference here is not in the overall pattern of modularity in the two supply chains but, rather, in the role of trust in defining the relationships between the institutions executing those modules. Because they enjoyed a higher level of mutual trust, the Japanese suppliers were able to adapt to an alternative modular architecture (the emergency p-valve supply chain) at very low cost, whereas in the US context, such an evolution would have required substantial negotiations (i.e., transaction costs). In other words, greater and more generalized trust lowered the cost of *changing* the pattern of modularity in response to an emergency. In an environment where such an emergency is deemed improbable, the *a priori* cost to the OEM of establishing such trust might exceed its economic value; conversely, the greater is the importance of robustness in the face of unforeseen circumstances, the greater is the value of trust in allowing a modular architecture to adapt.

Similar considerations can apply in the context of internal organization. Open-source software communities, such as the Linux community, exemplify the mirroring hypothesis with remarkable accuracy; in essence, their "organizational chart" corresponds to the nested, modular architecture of the code that they build. The leaders of such communities have very wide spans

of communication (far wider than is typical of a regular corporation) and play the roles of motivating contributions, arbitrating disputes, and writing code themselves. For them as individuals, trust is the primary—and perhaps the only—source of legitimacy (Zucker & Schilke, 2019), and it is striking how the most successful leaders of open-source communities have indeed been individuals respected for their likability and impartiality. By some benchmarks, this may make them weak leaders, dependent on social legitimation rather than the authority of ownership and hierarchy. In particular, it is difficult for such leaders to formulate and impose "strategy" in the top-down visionary sense in which the term is frequently understood.

The creator of Linux, Linus Torvalds, has been explicit in claiming this inability to impose strategy as a virtue, saying that strategy for the Linux community is simply the aggregation of decisions by its thousands of members. They decide where to focus their personal energies and thus collectively "vote with their feet." The computer desktop environment presented an interesting example of this: whereas Apple and Microsoft each imposed a single desktop interface for their PC operating systems, the Linux community tolerated rivalry between two major systems, KDE and GNOME, without leadership ever pronouncing one the winner.[4] Thus, while the proprietary systems were more monolithic, the open-source alternatives were more modular.

Again, it is not at all obvious which pattern of trust and modularity is advantaged. The concentrated exercise of power and authority, possibly at the expense of trust, facilitates clean, top-down strategic choices. On the other hand, diffusion of power in a trusting community facilitates enthusiastic, emergent, bottom-up collaboration. Both are mechanisms of adaptation.

[4] Indeed, to this day desktop interfaces for Linux and related systems have continued to proliferate.

All three contexts—Fukuyama's account of nations, Toyota's supply chain, and Linux as a productive organization—point to the same pattern. Technology broadly shapes modularity in human tasks and efficient institutions; the mirroring hypothesis applies quite independently of patterns of trust. However, if technology or any other aspect of the environment *changes*, then patterns of trust can enable or inhibit bottom-up *adaptation*. The formation of new non-family enterprises, the self-organization of emergency production, the development of alternative desktop interfaces—these are all distributed, bottom-up re-modularizations of a prior system that are facilitated by pervasive trust (both trust of leadership and peer-to-peer trust). The alternative is top-down imposition of authority—government sponsorship of new enterprises, OEMs renegotiating supply contracts, or Steve Jobs and Bill Gates making discrete strategic choices. These approaches do not depend as much on pervasive trust—indeed, they may actually erode it—but they are fast and focused. Thus, it is not *a priori* obvious which arrangement is better. Trust, we conclude, has an independent causal impact less on the structure of modularity than on the mechanisms for changing it.

Illustrative Examples of Modularity and Trust in Practice

To further elaborate on the concept of modularity and its interaction with trust, we highlight two real-world examples of organizations that have successfully implemented modular designs. These cases—ING Group and Schneider Electric—demonstrate the critical role of both within-module and between-module trust in fostering organizational success.

ING. The agile transformation of ING exemplifies the creation of a modular organization, where two distinct types of trust are critical to the organizational architecture. Agile squads, as the innermost modules, rely heavily on within-module trust among team

members. This trust emerges from relational dynamics, fostered through co-location and collaborative efforts, allowing the team to take full accountability for their tasks (Kerr, Gabrieli, & Moloney, 2018). Such trust is crucial for driving innovation, as these teams are empowered to directly contribute to customer-centric solutions and business outcomes with minimal dependency on external groups. For example, at ING, the adoption of continuous delivery practices has enhanced within-module trust by fostering a culture of frequent integration and immediate feedback among team members (Vassallo et al., 2016). Transparency is "hardwired" within these squads, preventing blame-shifting and ensuring clarity in decision-making and execution, reinforcing a high degree of camaraderie and internal trust.

However, scaling agile across the organization, from squads to tribes and further into the top-level structure, introduces a reliance on between-module trust. This form of trust, unlike the relational dynamics within squads, often hinges on organizational guardrails—such as enterprise architecture, coding standards, and management-defined priorities. As ING expanded its agile transformation, the necessity for between-module trust grew, relying on clear organizational frameworks and consistent leadership to maintain alignment across diverse teams (Calnan & Rozen, 2019). Senior leadership plays a critical role in maintaining alignment, as between-module trust tends to be more rule-based, influenced by strategic imperatives and regulatory requirements. Without strong guidance from senior management, the interdependencies between teams can become fragile, as teams may prioritize their own outputs over collective goals, leading to inefficiencies like the well-known "prisoner's dilemma" in IT, where some teams may hesitate to build APIs unless others do the same.

Both forms of trust—within and between modules—were essential for ING’s success in their original agile transformation ambitions (del Carpio, Doz, Guadalupe, & Brandwein, 2017).

Acknowledging the limitations and interplay between these types of trust allowed the organization to dynamically strike a balance between autonomy and coordination, driving both on-going innovation and alignment at scale. Lastly, as with any agile transformation initiative, the ING agile organization (originally envisaged in over 8 years ago) continues to evolve, though it is not the focus of this study to examine those intricacies.

Schneider Electric. Schneider Electric's multi-hub organization serves as a prime example of a modular organizational structure, more akin to a network of operations distributed globally. The company's regional teams and central functions operate in a cohesive manner utilizing a shared "Trust @ Scale" framework to ensure adaptability to diverse market demands while maintaining operational consistency and corporate culture. This commitment to achieving Trust @ Scale relies on embedding a culture of trust across every level of the company—from the CEO's office to the shop floor—and is built on three pillars: integrity, transparency and resilience (Schneider Electric, 2023). As Schneider Electric strives to be the most local of global companies, sites across the globe enjoy considerable autonomy in responding to local market needs provided they operate within the confines of a well-established, centrally defined framework covering (among others) decision rights, performance and risk management.

The multi-hub nature of Schneider's organization is evident in the emerging self-similarity of behaviors across geographies, even in the absence of a rigid command-and-control structure. This reflects a shift from a traditional matrix organization to a more decentralized decision-making process that empowers Schneider's employees, allowing for a more agile response to changing market conditions (Rambach, 2015). This decentralized structure is supported by a strong commitment to fostering trust in the digital ecosystem through a robust risk management framework and transparent practices across the operation (Blassiau, 2020).

Schneider's organizational design also incorporates nesting properties characteristic of modular architecture, as seen in the structures that connect market-facing units to central operations. For instance, regional structures integrate these units/modules and depend heavily on relational trust and shared rules among their constituent components. Schneider identifies its model as a trust-based organization, where a global network of operations is coordinated through a shared framework, which the company views as a key contributor to its organizational effectiveness. According to Schneider Electric (2025), "…in today's global, digital and ever-changing environment, [Schneider Electric's] ability to cooperate with colleagues, partners and customers in an agile, inclusive, and trusting manner is critical for success." The texture of such a commitment, and what Schneider deems as Trust @ Scale, is visible in Hervé Coureil's, Schneider Electric Chief Governance Officer and Secretary General, statement: "…we adopt an 'end-to-end' approach to incident response. This entails breaking down silos and ensuring that, in the event of, say, a cybersecurity incident, experts from across the company (from IT and legal, to PR and customer relations) can collaborate seamlessly to address all the varied and interconnected stakeholder concerns that will arise" (Schneider Electric, 2023).

Future Research Agendas

Our article raises a number of important issues regarding the interplay of trust and modularity and, in doing so, provides a springboard for a new research agenda on the interaction of collaboration and organizational structure. This research agenda will benefit from further theoretical extensions of the ideas presented here as well as from empirical exploration and testing.

In terms of expanding our theoretical development, there is a clear need for more in-depth investigations into the key concepts discussed here, including design rules, trust pluralism, and network trust. For instance, what are the key dimensions of design rules—such as their formalization, transparency, quantity, bottom-up vs. top-down construction, technological implementation, and adaptation frequency—that may shape between-module trust in different ways? What are the challenges and opportunities associated with trust pluralism—at the level of the individual boundary spanner, the level of the module, and the level of the organizational system? Most broadly, how does trust operate beyond dyadic interpersonal interactions in the context of the broader organizational network?

For empirical studies, we see great value in qualitative research that offers deeper insight into the intricacies and unexpected aspects of the modularity–trust nexus. Researchers may start by conducting detailed case studies of organizations that have successfully adopted modular structures and those that have failed, focusing on the role of trust in these outcomes. A particularly promising avenue would be to take a longitudinal approach to studying the coevolution of modularity and trust to examine how trust develops over time within organizations that shift to a more modular structure, as well as whether such differences in trust have feedback effects on the level and structure of the organizations' modularity. These studies should also consider the impact of digital technologies on modular trust, analyzing how specific digital tools may affect the levels of trust within and between modules.

Quantitative research will prove useful to test some of the arguments developed in our article, such as the proposed effects of modularity on types and levels of within- and between-module trust. To that end, future investigations could employ social network analysis techniques to examine the structure of connections both within and between different modules of an

organization. Such an analysis would map out the frequency and quality of interactions between modules, identifying key nodes and pathways that facilitate or hinder trust. This approach may help identify structural modifications that could enhance between-module trust and overall organizational coherence. Research based on surveys could usefully be complemented by experimental designs and simulation studies. Experiments building on those reviewed by Vincent, Rense, and Chris (2020) will prove helpful to study the effectiveness of various design levers (including transparency tools, cross-module team-building activities, or enhanced communication systems) for supporting trust within and across modules. Finally, computer simulations can manipulate various parameters such as the degree of modularity, communication frequency, and the introduction of trust-building initiatives to observe potential impacts on the development or decay of trust across the organization. The emergent outcomes can help predict how changes in organizational structure might facilitate or hinder trust, providing valuable insights for designing more effective modular systems.

Conclusion

This article draws attention to the critical interplay between modularity and trust within organizational structures, offering significant insights that promise to shape future research and practice. As the rise of digital technology ushers in an era of modular organizational structures, understanding and leveraging the implications for trust becomes crucial for enhancing organizational efficiency and coherence. This article not only deepens our understanding of these dynamics but also sets the stage for further discourse that will help to unravel the complex relationship between modularity and trust in the digital age.

Table 1: Forms of Trust: Dyadic, Network, Institutional, and Generalized Trust

Form	Target	Locus of Operation	Underlying Mechanisms
Dyadic trust	Positive expectations regarding the behavior of a specific individual directly connected with the trustor	Direct, interpersonal relationship	Personal interactions, past interpersonal experiences, one-to-one communication
Network trust	Positive expectations about the behavior of actors in a social network, including those not directly connected to the trustor	Relational dynamics between actors in specific network positions	Indirect connections, shared norms, reputation effects
Institution-based trust	Positive expectations about the behavior of actors based on broader (formal or informal) institutions	Institutional environment	Legal frameworks, formal authority, standardized procedures, habitualized routines
Generalized trust	Positive expectations about the behavior of others in general, extending beyond specific relationships or contexts	Societal-level belief	Cultural norms, socialization, cultural reinforcement

Table 2: Comparison of Within-Module and Between-Module Trust

Within-Module Trust	**Between-Module Trust**
More frequent, flexible, dyadic interactions	Less frequent, more formal dyadic interactions
High degree of shared goals and group cohesion	Different goals, cultures, and different internal metrics of success and failure; hence more negotiation, compromise, and politics
Dyadic actors are embedded in a dense third-party network of frequent connection	Relatively sparse networks of infrequent connection
Third parties are aware of and react to trustworthy behavior, engendering reputation and sanctioning against trust breaches	Trust is more predicated on actors' adherence to rules that define and constrain allowable behavior; these rules can be imposed ('design rules') eliminating the need for trust, or explicit norms that define expected behavior
Few explicit mechanisms are needed to support this network-embedded trust, though more, perhaps with the increase of remote collaboration	Design rules and explicit norms must be supported by mechanisms such as knowledge repositories, resource sharing standards and project management guidelines

Figure 1
Illustrative System of Design Rules Governing Between-Module Relationships

Roles

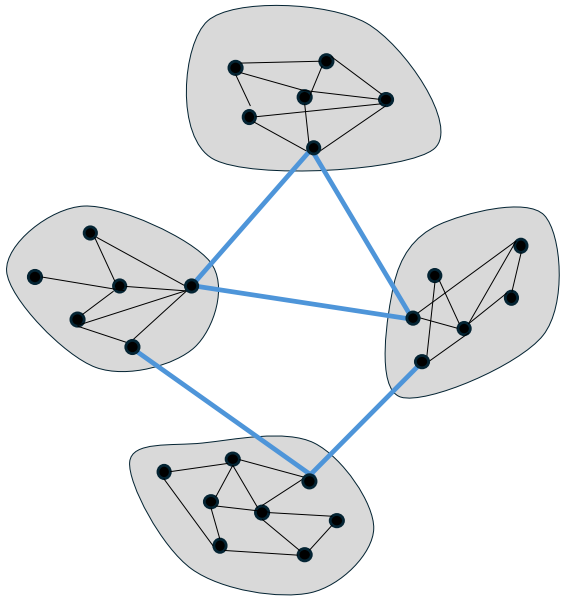
Roles of each organizational module included in a collaborative project and appointment of boundary spanners responsible for overseeing the collaboration efforts and ensuring that information flows smoothly between the modules.

Resource Sharing Standards

Procedures for the distribution and utilization of physical, technological, and human resources among modules. These may encompass rules for accessing communal databases, using shared equipment, or seeking assistance from members of other modules.

Knowledge Repositories

Knowledge repositories where modules can access information about past collaborative interactions.



Communication Protocols

Standardized methods for communication across modules, including preferred channels (such as email, project management tools, or meetings), frequency of updates, and procedures for urgent communications.

Project Management Guidelines

Uniform project management tools to ensure consistency across modules and routine time intervals to monitor the advancement of cross-modular projects.

Performance Metrics

Criteria for assessing the success of cross-module collaboration and processes for conducting such assessment.

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