

Capitalizing on Complexity in Modern Business Environments: A Network-Based Perspective for Projects and Organizations

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Traditional approaches to design organizations are insufficient to withstand the constraints imposed by modern business environments that are in permanent transformation with a constant flow of information, interactions and behaviors of agents, and the non-linear relationship between resources and products. By building on the nature and dynamics of Networks, it is possible ideating organizational architectures and processes that capitalize on the complexity emerged from modern economies. These novel architectures have a significant potential to induce self-adaptation and co-evolutionary processes between agents, organizations and the external environment. The design of organizations able to navigate complex environments requires the adoption of a conceptual framework that accounts for the strategic characterization of the Network agents and the adoption of an open-systems perspective that guides the effective interaction with the external context. This allows optimizing information assimilation and knowledge production processes that will drive the ideation of strategic scenarios. As a result, the organization will increase its potential to synchronize adaptation with its business ecosystem and its readiness for strategic transformation.

Keywords: networks, complexity, complex adaptive systems, open strategy, scenarios

KNOWLEDGE AND ORGANIZATIONS IN MODERN BUSINESS ENVIRONMENTS

Technological progress has changed the way knowledge emerges and distributes. Modern interaction allows information to expand at proportions and speeds without precedents, enhancing the potential to access and combine perspectives from different settings and shaping the mechanisms of collaboration and competition. Furthermore, these advancements have progressively unleashed important networks effects across multiple sides of the market, creating innovative business models that, in some cases, are orthogonal to scale and have led to the rise of niche activities: E-bay, for instance, connects groups of buyers and small sellers scattered across the globe (Teece, 2018). A global oil corporation engaging technological initiatives with competitors, individuals joining efforts to advance an open source software, a student that obtains an online degree or simply the person that learns how to repair a leak in a fridge via YouTube are just a few examples that show how interconnectivity has progressively shaped business environments in the last decades.

The evolution of modern business environments has made more evident the agent-based nature of knowledge creation and has challenged the linearity in traditional models where growth results from the combined effect of aggregated contributions of agents, the efficiency of adequate organizational structures and the optimization of resources. Moreover, the creation and transfer of knowledge catalyzes strategic

transformation: massive flows of available information and the actions of other agents are determinant in replacing old assumptions, triggering adaptation modes in organizations that do not follow basic notions of linearity, rationality and equilibrium. Knowledge is no longer “caged” within institutions (e.g.: universities, corporations), and it does not always follow structured processes of inductive or deductive analysis.

LINEARITY IN TRADITIONAL FRAMEWORKS: A BRIEF OVERVIEW

From a traditional (neoclassical) perspective, markets form and evolve by the aggregate contributions of individuals that, acting rationally, seek their own interests. The division of labor and specialization are considered the most basic mechanism for economic growth and sustainability ^[1], thus organizations are conceptualized as market entities that, through mechanisms of coordination and hierarchization, reduce transactional costs of activities carried out by individuals acting alone (Coase, 1937). The specific constraints of a region and the outputs of organizations operating locally will shape supply and demand, characterizing the market and defining the growth prospects for each organization.

Keeping in mind that economic growth is the key indicator for the performance of organizations and projects, multiple economics models have attempted to predict how growth occurs. One of the most notable, Robert Solow’s growth model, built on previous econometric models to parametrize output as a function of two key resources: Capital and Labor (Solow’s model also accounts for productivity gains due to technological progress). However, as resource utilization increase, inefficiencies will naturally emerge around coordination, specialization and space, progressively reducing the potential of these resources to generate value. This negative effect, known as the Law of Diminishing returns to scale (a key result from Solow’s model ^[2]), is self-intuitive when organizations are observed as closed systems: Suppose the execution of an activity needs to be optimized (e.g. transporting goods, production line, construction, etc.) using a particular strategy or technology. A marginal point will be reached where adding more resources is counterproductive (e.g.: limitations in space will generate conflicts between laborers, simultaneous operations will reach a maximum, equipment capacities will be reached, changing technology is not economical, etc.)

From traditional models, contemporary management revolves around the optimal allocation of resources as a vehicle to generate competitiveness and growth in organizations. Progressively, a myriad of management and strategy frameworks appeared in the 20th century, notably Taylor’s principles of Scientific Management on human productivity (Taylor, 1911) Fayol’s Administrative theory on command and control (Fayol, 1949) and Weber’s on strategic hierarchization (Weber and Wittich, 1978) among others. As markets evolved and became more turbulent, process-oriented organizational frameworks emerged to address the increased complexity of competition, focusing on efficiency and competitiveness and shaping the way we see strategic organization today. Some of the most remarkable frameworks include Penrose’s resource-based view of the firm (Penrose, 1959), Porter’s five competitive forces (Porter, 1979), Deming’s quality framework (Deming, 1986) among others. Concisely, these frameworks aimed on generating superior capabilities in the organization that, by guiding the strategic configuration of its internal resources and investments, increase the value generation potential and protect the organization from external threats and competitors.

It is important to highlight is that, when these frameworks emerged, sophisticated forms communication like Internet were not yet available. Knowledge transmission and the interconnectedness of agents was limited to regions, sectors and industries. Processes for knowledge generation, absorption and assimilation in the organization depended on a “dominant logic” comprised by influential individuals such as leaders and executives. As a result, Decision-making followed personal preconceptions and beliefs of these individuals as “guardians” of the strategic vision, hence loss of corporate knowledge (e.g. a key employee quits, information leakage, etc.) demonstrated to have significant negative effects, compared to the loss of other type of asset in the organization. Delta Airlines experienced a remarkable evidence of this: in 1991, a high number of experienced mechanics left the company due to the implementation of salary reductions across the organization to offset losses. Delta filled senior positions with less experienced workforce, resulting in longer time for the diagnostics and repair of airplanes and other significant inefficiencies. All

this translated into substantial flights delays and unhappy customers switching business to competitors (Parisse, Cross and Davenport, 2006).

MODERN BUSINESS ENVIRONMENTS: A COMPLEX SYSTEM PERSPECTIVE

The emergence of new communication technologies substantially enhanced the interaction potential of agents from different settings and backgrounds, facilitating the creation of transdisciplinary knowledge and substantially changing the dynamics of competition and collaboration. This also affects decision-making processes due to the fast pace of today's contexts and the difficulty to assimilate large amounts of available information and with diverse levels of completeness. Therefore, agents must make "best guesses" by screening only relevant data, making decisions based on "rules of thumb" and "best practices" (Sull and Eisenhardt, 2015) based on available (and interpreted) information and the actions of other agents. Since agents' interactions are spontaneous, iterative and follow self-referential "local" rules, mutual adaptation occurs, defining the evolution modes of the organizational setting they belong to (Cunha and Cunha, 2006). Finally, individuals judgements are subject to bounded rationality as behavioral economics has repeatedly demonstrated (Tverski and Khanenman, 1974; Simon, 1955).

Based on the arguments above, it is possible to conceptualize markets as complex systems comprised by formal and informal networks with no central control. This brings two important connotations for the mechanism of creation, sharing and transference of tacit and explicit knowledge: First, social norms, social bonds and informal institutions (Millar and Choi, 2009) serve as vehicles for knowledge transmission and provide stability to the overall system. Second, ideas are non-rivalrous (i.e. their use by one person does not reduce their usefulness to someone else) and they do not need to be reinvented (Jones, 2014). Although knowledge can be excludable through legal rights, confidentiality, etc., communication technologies and competition limit this excludability: information is at the fingertips of anybody with a computer or a smartphone.

The permanent changes in agents' interactions and the rapid creation and transmission of knowledge increased the dynamism in modern business environments. New forms of organizations emerged reporting results that challenged traditional economic theories and the performance of organizational models based on diminishing returns to scale. For instance, some organizations created separate knowledge generation units, as "small start-ups". The main objective of these units where incubate ideas and foster interactions to create innovative solutions that could not be conceived in the core business of the corporation, ultimately deriving increasing returns. Analogously, other organizations have been able to co-evolve with the business environment and have reshaped organizational ecosystems, generating network-oriented results not envisioned during the strategic planning stage.

As new forms of organization emerged, modern economic theories progressively developed to address the discrepancies with traditional models. For example, the Theory of Endogenous Growth proposed by Paul Romer, adjusts neoclassical paradigm of diminishing returns to scale by proposing that economic growth is a function of a dynamic interplay between Objects (Capital and Labour) and Ideas, successfully explaining why some modern organizations have been able to achieve increasing returns^[3]. Similarly, Brian Arthur, along with other scientists at the Santa Fe Institute, pioneered the new field of Complexity Economics that explains how technological change is a catalyst of market disruption and enhancer of reconfiguration processes that originate from local actions of agents reacting to new information (Arthur, 2015).

IMPLICATIONS FOR PROJECTS AND ORGANIZATIONS

One of the most fundamental assumptions of traditional economic models is the possibility to reach an absolute state of equilibrium, framing the optimization of algorithms in econometric and statistical models that predict possible states of nature by running sensitivities on input variables (e.g.: labor, capital, changes in productivity, etc.). On the other hand, organizations are, in essence, network-oriented social systems, with interrelationships patterns that describe how knowledge and information emerge, evolve and flow

between agents. This phenomenon not only affects outputs and the growth potential of corporations, but also their stability and subsistence, intrinsically limiting the predictive power of algorithms: in today's turbulent business environments, as new information emerges, individuals validate assumptions and replace old hypotheses with new ones that fit better during particular situations, affecting operations and the resulting outputs.

In essence, organizations are entities that provide structure, standard mechanisms and frameworks to conduct operations, with clear hierarchies and protocols to manage and control activities, resources and flow of information. However, in spite of these mechanisms, agents' interactions occur locally, in a multidirectional and behavioral base, without system-wide rules or centralization, which naturally induces mutual adaptation (Mitchell, 2009; Cialdini, 2009) ^[4]. Moreover, interactions between agents happens via cultural codes in a similar fashion as genetic codes in biological systems, ultimately triggering processes of self-organization (Gharajedaghi, 1999; Cunha and Cunha, 2006). In summary, organizations are Complex Adaptive Systems where knowledge and information serve as catalysts for strategic transformation.

An adoption of a complex view allows visualizing organizations as dynamic systems operating in a metastable state where agents engage in diverse (and new) modes of competition and collaboration. Take for example iPhone: when Apple integrated advancements in computer technology with a phone, it disrupted the telephone business and displaced successful corporations like Nokia that produced superior devices. The former CEO of Nokia stated “[Apple] is not taking our market share with devices; they are taking our market share with their entire ecosystem” (Ziegler, 2011). In reality, Apple created a new ecosystem that includes app developers, corporate accounts, music industry and, more recently, voice-controlled systems. Similarly, we are currently witnessing a fast and turbulent development of voice-controlled systems, with leading competitors such as Amazon's Alexa[®] and Google's assistant. These companies are progressively reshaping business ecosystems with partner companies that offer supplementary services.

AGENTS, NETWORKS AND MODERN ORGANIZATIONAL ARCHITECTURES: THE PATH TO CAPITALIZE ON COMPLEXITY

The turbulences and rapid changes in modern business environments permanently affect the growth trajectory in organizations. This makes imperative the development of dynamic capabilities to leverage agents' interactions, knowledge creation and information exchange. These capabilities not only provide an understanding on how the organization it is interplaying with its context, but also will steer strategic transformation in synchrony with the business ecosystem, enhancing the potential of the organization to achieve increasing returns largely negated in traditional economic models. It is worth clarifying what distinguish dynamic capabilities from ordinary ones:

Ordinary capabilities are simply corporate best practices focused on making effective routines and production processes. They normally originate in one or two corporations and later spread across an industry (Kleine, 2013). Some examples these capabilities include: prefabrication and modularization technologies for construction projects, proprietary horizontal drilling techniques, optimization of a production line in the automobile industry or the efficient operation of an oil facility to maximize production. Although necessary, ordinary capabilities are not enough to cope with the dynamic and recurrent adaptation essential to thrive in complex business contexts.

Dynamic capabilities on the other hand are unique to the organization. They define the way to do business; they are “signature features” derived from experience and progressive learning through the sequential enactment of cultural codes; they assist the organization in sensing the environment, seizing opportunities and timely readjust and/or transform the organization's resource base and structures as new situations emerge (Tece, Pisano and Schuen 1997; Kleine, 2013). Without these capabilities, the organization will become stagnant and potentially perish due to lack of adaptation. In complex environments, successful adaptation requires that “experience guides changes in the system's structure so that, as time passes, the system makes better use of its environment for its own ends” (Holland, 1995).

Dynamic capabilities must enable the organization to navigate uncertainty and capitalize on complexity. Therefore, the design of these capabilities must be oriented towards an effective scanning of the context, the timely identification of changes in external forces, the interpretation weak signals and the rapid assimilation of information to ensure adaptation and evolution in turbulent markets. With this in mind, it is possible to identify two overarching dynamic capabilities aimed to ensure sustainability and growth in modern business environments:

The first capability consists in the ability to characterize networks acting on the organization, identifying the significance of each group of agents and determining the robustness of links defining their interactions.

The second one is an ability to ideate unique organizational architectures that stimulate the effective interplay with the business environment in order to frame knowledge creation and organizational learning for the successful steering of the organizations towards its strategic direction.

Characterizing Networks: The Role of Agents and Interactions Dynamics

From a traditional lens, organizations are closed system whose value generation potential depends on the effective coordination and integration of activities normally conducted by individuals in open markets (Coase, 1937). However, the dynamism of modern markets, and the advancement of technology, evidenced not only the complex nature of organizations, but also their role as self-regulating social networks. In these networks, agents interact in different ways to get things done: “as work become more complex and interdependent, individuals rarely achieve anything of substance on their own; they rely on both coworkers and external parties” (Parise, Cross and Davenport, 2006). Self-organization emerges from the transference of information, the presence of market signals and the mutual adaptation of agents. Since this occurs without central planning, the organization experiences states of temporary stability with (almost) unpredictable outcomes (Pyke et al, 2018).

Understanding the configuration of networks, specifically the role(s) performed by agents, is essential to characterize interplay of the organization with its business environment, optimize value generation chains and the evolution and subsistence of the organization itself. Recent research, including Parise, Cross and Davenport (2006) and Cross and Prusak (2002), categorize four roles agents typically play in an organizational network: Central Connectors, Boundary Spanner, Information Brokers and Peripheral players:

Central connectors are carriers of significant amount of information in the organization. These agents normally have a deep understanding of the corporate strategy, internal processes and cultural elements that surround operations. They are the “go-to” agents and work as network hubs, with multiple links representing their rich social capital, and have enough knowledge of how the divisions operate and interact within the organization (as well as their particular contribution to the corporate strategy). Central connectors know where roadblocks are and where to find agents that can address specific situations. With a wealth of experiential knowledge, central connectors can substantially accelerate the onboarding of new employees and are key in building organizational legacy. Normally, a central connector is an individual who interacted in the past with multiple agents in different divisions of the organization.

The second type of agents are Boundary Spanners. Given their networks and traits, these agents have the capability to link the organization with external networks and the business environment. Their exposure to external agents and information allow them to develop solutions to complex problems not evident within the organization. They obtain cooperation through an effective engagement of external agents and diverse interests, managing relationships and interdependences through a permanent appreciation and awareness of differences between agents (Williams, 2012). Due to this privileged exposure to the outside, boundary spanners are the best candidates to become “organizational radars” (Tain, 2016) and are catalysts for innovation and corporate growth. In a major Oil Sands project in Alberta, a development engineer leveraged on his personal network in other corporations to understand the latest trends in water treatment technologies. One of these technologies aligned with the design philosophy of the plant, resulting in an innovative solution that substantially reduced the facility footprint and saved millions of dollars in execution.

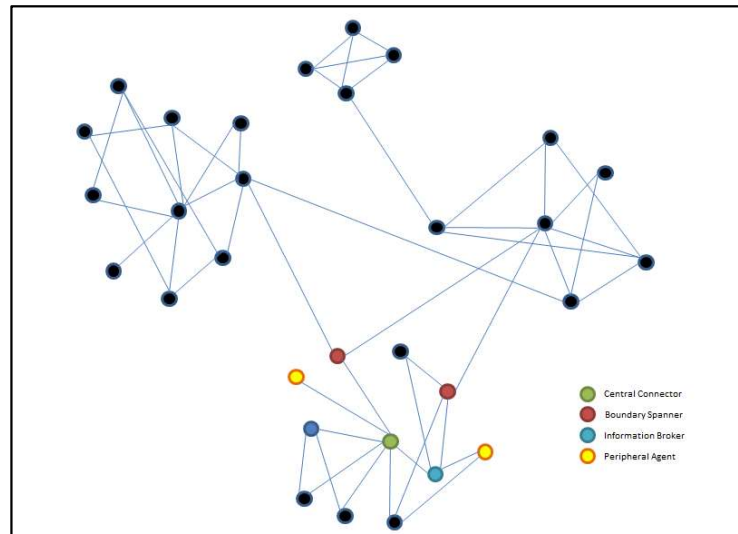
Information Brokers, the third type of agents, do not have the number of direct connections as Central connectors do, but their wealth of indirect links allow them to connect subnetworks within the organization. These agents are privy to large amount of cross-functional and interdepartmental information hence they are particularly beneficial to lead integrative efforts. Brokers can support the controlled transfer of specialised knowledge between groups, increase cooperation by liaising with people from both sides of the gap, increasing efficiency by introducing “good ideas” from one isolated setting into another (Long, Cunningham and Braithwaite, 2013). They are essential to increase organizational speed and overcome the hurdles from bureaucracy and silo-based organizations. An engineering coordinator in a multidiscipline project, for instance, plays the role of information broker by coordinating diverse flow streams of information from diverse technical backgrounds across the organization. The timing and quality of the information provided by the coordinator to the different project divisions is crucial to ensure integrity and optimality in the project.

Finally, Peripheral Players are agents with the lowest amount of connections in the network. Normally, these agents are specialists in a particular field whose activities require creating and holding formal and tacit knowledge. Although these individuals may have produced an important amount of information, such as procedures and manuals, it is quite difficult to document what they actually know. Sadly, the role of the peripheral players tends to be marginalized due to the lack of exposure in organizational networks -in some cases, due to their social skills or low desire to interact with other agents. Their expertise might not be relevant for day-to-day operations, but their contributions prove to be vital in critical situations. During the commissioning of a high-temperature froth chiller unit in a major Oil Sands Project, a safety device was not providing the correct readings in the control panel, compromising the start-up of a unit that was already delayed and critical for production. After several unsuccessful iterations, a Controls engineer, normally assigned to isolated tasks, became the only person with deep knowledge on this particular technology. After troubleshooting the elements in the controls system, the engineer corrected the algorithms to visualize readings and graphs in the control panel, allowing to start-up the system and resume production without further delays.

Understanding network structures in the organization is essential to identify knowledge flow patterns and the role agents play at a specific moment. This allows managers to take important decisions regarding orchestration of efforts. Some of these decisions include optimizing the flow of information across the organization, fill knowledge gaps, reallocating specific expertise in the network, rationalize levels of centralization in subnetworks and implement legacy initiatives among others. In addition to this, a baseline knowledge of the network configuration allows strategically adapting the role of an agent based on the specific needs in the organization, especially during business transitions. Today, multiple computer packages in the market can assist network analysis and simulate how the network will behave when changing links and agents.

Figure 1 represents the different types of agents and their roles as a function of interactions as described in previous paragraphs.

FIGURE 1
THE ROLE OF AGENTS IN ORGANIZATIONAL NETWORKS



Context-Driven Organizational Architectures: Objectives and Design Frameworks

Provided the dynamism in modern markets, it is paramount the design of organizational architectures that effectively sense the business environment, seize opportunities and trigger transformation (Teece, Pisano and Schuen, 1997) as new information becomes available from the business environment. By building on the attributes of networks, these architectures must facilitate the exploitation of existing capabilities and resources in the organization while permanently exploring new competences (March, 1991; O'Reilly III and Tushman, 2016), calibrating the organization's clock speed and permanently steering its growth trajectory.

Based on recent ideas in organizational design (Nadler and Tushman, 1999; Tain, 2017), it is possible to ideate an architecture that covers key elements to capitalize on the complexity of modern business environments. The proposed architecture integrates three dynamic capabilities and accounts for 1- strategies for the effective interaction with the business environment, 2- adaptive configurations that facilitate the flow of knowledge and adaptation and 3- strategic planning practices and processes that dynamically steer the growth direction of the organization.

Interacting With the Business Environment:

A strategic intrusiveness in the business environment is essential to enhance absorptive capabilities in the organization. By embracing open strategy and open innovation (Chesbrough and Appleyard, 2007) as mechanisms for collaboration and knowledge creation, it is possible to integrate the external context with organizational processes, allowing capitalizing on changes in the ecosystem based on open invention. Essentially, by adopting an open-systems view of the business, "firms try to benefit from, and even orchestrate, an external environment that functions as an ecosystem for its own business model" (Schoemaker, Day and Snyder, 2013). An interesting evidence of open strategy was when IBM decided to open up its personal computer's architecture. The immediate response was the rise of computer "clones", and companies like Compaq replicated IBM's specifications and triggered competition among multiple corporations in diverse niches. Ultimately, this contributed to the reconfiguration of the whole business and the emergence of new ecosystems (for instance, the alignment of IBM's architecture with Microsoft's Operating systems that derived that Intel's microprocessors became a standard in the PC industry) (Moore, 1993)

Through open strategy, it is possible for organizations to synchronize activities with external agents and capitalize on contingencies, by building on the similarities between external and internal actors to

design operational practices and move joint-research (Hatzuz, Seidl and Wittington, 2017). The Italian oil giant Eni moved from an outsourcing strategy to an open innovation approach that leveraged on academia and service companies to address internal R&D weaknesses. Through global alliances with universities and service companies, multiple ready-to-use solutions were developed, and Eni came to own a significant patent portfolio that derived multiple instances of technological innovation (Pellegrini, Lazzarotti and Pizzurno, 2012).

More recently, in November 2018, Eni collaborated with growITip launching the open innovation initiative “CallForGrowth”. This initiative is currently calling on Italian start-ups to “undertake cutting edge projects, specifically aimed at 1- digitalization of areas related to the health and safety of Eni’s people, 2- digital solutions to enhance customer experience at service stations, and 3- digital solutions to make operating manuals completely interactive and integrated with the digital twins (3D environment)” (ENI, 2018).

Adaptive Configurations to Facilitate Knowledge Flow and Adaptation

The design of modern organizational structures must focus towards the enhancement of interactions to stimulate information assimilation. As discussed in previous paragraphs, traditional structures tend to focus exclusively on output control and operational efficiency, using hierarchization, activity integration and departmentalization to aggregate efforts and meet strategic objectives. However, rigidities induced by hierarchy makes the organization to “ignore new opportunities that require transformation because these don’t align with the core purposes of maintenance and optimization” (Kotter, 2011). Blockbuster’s hierarchy, for instance, was set to meet quarterly earnings targets so they underestimated Netflix’s video streaming, considering it a “distraction” rather than a market opportunity.

Flexible structures that build on the intrinsic and unique complexities in business environments are necessary to adjust organizations to emergent constraints. An attractive solution to achieve this optimal flexibility is the concept of Structured Networks. Originally proposed by Goold and Campbell (2003), structured networks are network-based organizational designs that, by building on the specific attributes of the business environment, set a multidimensional matrix structure that is open to multiple perspectives, dynamically defining agents’ roles and distributing organizational resources. The flexibility of these structures is key to stimulate knowledge assimilation: business units are created to receive and prioritize information from the external context, such as product type, geography, end customers, etc.; corporate processes and rules are rationalized to ensure they don’t get in the way of business drivers; and the responsibility of cross-functional collaboration lays within the units. In other words, structured networks are optimized matrix structures where units are designed around key market drivers.

An example of a corporation based on structured networks is Uber: the company designs its organizational structure and deploy resources based on of the characteristics of the markets and the particular region they are operating in. For instance, when Uber penetrates a new city, a General Manager is appointed to grow the business locally. Building on the culture and the quirks of the region, a Community Manager is in charge of marketing, social media and local business development. Finally, a Driver’s operations manager oversees drivers’ relations ensuring they are on the road at the adequate location and time to ensure customer satisfaction (Moran, 2014)

Setting the Strategic Direction of the Organization

The organizational vision shape strategic planning processes in the organization that eventually will revolve around the corporate culture. Agents with high influence in the organization (leaders, executives, etc.) control the objectives and results of the planning process that, with their collective view of the business, form a dominant logic. Because strategic planning depends on the evolution of the market, it is subject to numerous ambiguities and knowledge gaps associated to the difficulties in predicting the future.

During traditional strategic planning, views on future, states of nature and probability distributions are set from extrapolation, perceptions and experiences of agents in the organization. Subsequently, well-structured bottom-up processes frame forecasts and growth strategies. It is not difficult to see therefore how planning is not only subject to the bounded rationality of a dominant logic, but it is also influenced by

individual agendas and personal perceptions of the future. This scheme creates a strategic handicap that blindsides the organization and makes it vulnerable to emerging forces and the complex adaptive structures in modern markets. US carmakers underestimating Toyota's penetration, Blockbuster's refusal to partner with Netflix and Kodak's focus on films instead of digital photography are just a few examples where corporations failed at strategic planning. Narrow-sighted strategic plans put these organizations at the mercy of the rapid evolution of the business environment thus, they were not able to anticipate and evolve new variables emerged: they just "reacted" to what they perceived from the external environment (Miles, Snow and Pfeffer, 1974).

In a world where knowledge creates and disseminates at unprecedented speeds, scenario-based methodologies are crucial to guide the evolution and growth trajectory of the organization. The adoption of scenario planning as a formal multi-level process creates a "sense-making" capability in the organization, capitalizing on networks, agents and information flows to analyze emerging forces and trends. By incorporating of multiple perspectives, noise can be removed from valuable insights with potential to affect sustainability and growth. It is important to highlight that the objective of scenario planning is not to forecast the future or fully characterize uncertainties, as in traditional planning, via probability distributions. Instead, it is about creating uncertainty ranges of the future using structured frameworks and managerial discussions (Schoemaker, Day and Snyder, 2013).

Scenario planning prepares the organization to deal with two worlds: the world of facts and the world of perceptions (Wack, 1985). Essentially, it relies on multiple perspectives to visualize driving forces that "often seem obvious to one person and hidden to another", understand which elements are truly predetermined (or factual), and discriminate uncertainties that are truly critical to the organizational strategy (Schwartz, 1996). Specifically, incorporating multiple perspectives in the planning process, through multi-level stakeholder inclusion, substantially enhances the organization's intelligence as it dilutes the influence of the dominant logic, favouring pragmatism and naturally provoking to "think the unthinkable" to avoid the legitimization of "taboo scenarios" (Shoemaker and Tetlock, 2012).

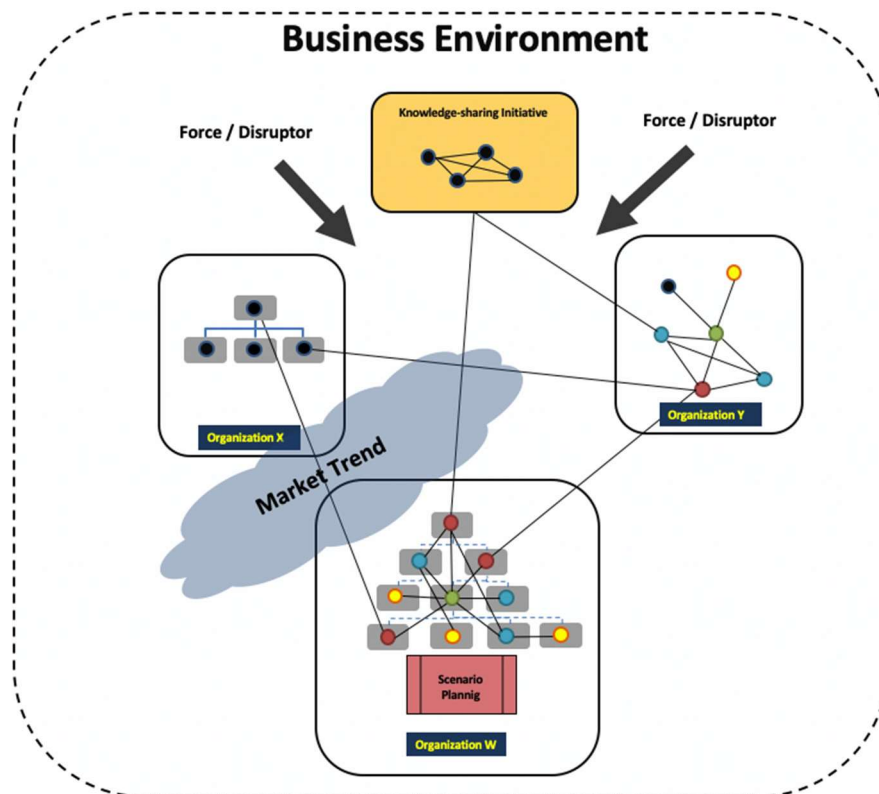
Lastly, thinking in scenarios creates an interpretive capability that constantly challenges strategic paradigms within the organization. Through the active participation of agents with multiple backgrounds, the organization's boundaries and assumptions are permanently tested with new perspectives (Roubelat, 2000), expanding the range of action of the corporation in the market. Because of this, the adoption of Scenario Planning has been game-changer in global organizations that have successfully navigated turbulent and evolving business environment. One of the most famous cases is Shell that has adopted scenario planning as one of its core processes (Shell, n.d.). By incorporating multiple views, the company was able to systematically evolve with the business environment in the 70's and 80's: it rapidly adjusted to emerging events, like the 1973 oil crises, the outbreak of the Iran-Iraq war in 1981, the acceleration of the inflation rate in 1978 and the early recovery in 1980. The company also showed a particular resiliency to the severe recession in 1982, and when major oil operators stockpiled reserves, Shell timely sold off their excess and avoided massive losses when oil price collapsed. Scenario Planning enabled Shell successfully navigating uncertainty, moving away from the forecast-dependent behavior of other organizations that did not anticipate pivotal events (Wack, 1985a, Wack, 1985b).

ORGANIZATIONS, NETWORKS AND DYNAMISM IN MODERN BUSINESS ENVIRONMENTS: A LOOK INTO THE FUTURE

Traditional models conceptualize economic growth by aggregating agents' contributions and optimizing activities and resources in organizations normally conceived as closed systems. In open and fast-paced business environments, however, growth is a non-linear product originated from the dynamic adaptation of agents' behaviors, the recurring validation of organizational hierarchies and the reconfiguration of self-regulating structures, all catalyzed by the permanent flow of new ideas. The successful organization of the future is, therefore, the one capable to capitalize on the interplay between strategic hierarchies and adaptive networks. While hierarchy is important for structuring work processes, it is at the network level where big change happens: in a network-based organization, the identification of

opportunities is supported by flexible structures are able to self-adjust accordingly to seize them (Kotter, 2011). Figure 2 graphically represents different types of organizations operating in modern business environments, emphasizing “Organization W” at the bottom as a proposed optimal architecture to capitalize on complexity.

FIGURE 2
ORGANIZATIONAL ARCHITECTURES AND INTERACTIONS IN MODERN BUSINESS ENVIRONMENTS



Network-based organizations are adaptive systems that create value through iterative and systematic interactions between agents. These architectures enhance knowledge creation in modern environments that, characterized by emerging situations and turbulences, naturally obligate agents to seek solutions outside their functional boundaries. In order to maximize value creation, it is essential therefore to characterize the role of agents in organizational networks, implementing an entrepreneurial organizational culture where agents understand their responsibilities in seeking new opportunities and have incentives to make them happen (Teece, 2018). This makes imperative the support of experimentation and innovation across the organization. At 3M, for instance, technical employees are encouraged to devote 15 percent of their work-time to independent project 3M Regardless their assignments. This is known as “the 15 percent rule for innovation” (3M, 2002).

By adopting an open strategy framework, information absorption is enhanced through the efficient interaction of the organization with its external environment. Again, this also calls for incentivizing innovation and fostering an open atmosphere that allows capitalizing on diversity and knowledge heterogeneity. The Canadian Oil Sands Innovation Alliance (COSIA), for instance, is an inter-organizational research initiative that gathers individuals from major Oil Sands operators to work in a common space with the objective of “accelerating the pace of improvement in environmental performance

in Canada's oil sands through collaborative action and innovation" (www.cosia.ca/about-cosia). On the other hand, specific organizational structures must be in place to maximize information inflow and assimilation, aligning the organization with the realities of the business environments and facilitating adaptation and co-evolutionary processes. Optimized matrix structures, conceptualized in Structured Networks, induce mutual learning and capitalize on agents' interdependences, guiding the correct allocation of responsibilities and accountabilities. This approach provides flexibility through the permanent validation and testing of hierarchies and internal configurations, facilitating self-adaptation and the evolution of networks and sub-networks acting on the organization.

Finally, strategic planning efforts must be dynamic and should capitalize on all streams of knowledge relevant to the organization. By building on knowledge diversity from multi-level agents, it is possible to appreciate possible future states of nature and synchronize the organizational clock speed with the business environment. Transdisciplinary perspectives enhance the quality of decisions and calibrate decision-making processes in the organization. Framed in the power of networks, and encouraged by the active scanning of the business environment, agents can ideate multiple scenarios serving as strategic radars in the organization. Ultimately, the strategic direction of the organization will emerge from collective intelligence, amalgamating experiential knowledge and identifying early signals with the potential to affect or benefit the organization.

In today's markets, organizational sustainability and growth depend on the generation of dynamic capabilities that allow corporation to build unique strategies and structures to capitalize on knowledge streams and the complexities of modern markets. Although traditional management strategies of cost reduction and product differentiation (Porter, 1985) are necessary for operational effectiveness, they are not sufficient to ensure corporate growth in today's turbulent contexts. Identifying, stimulating and managing an optimal flow knowledge is "the last and only sustainable untapped source of competitive advantage in business" (McElroy, 2000), provided its fragmented nature and distribution across groups, geographies and institutions. Managers must therefore reformulate paradigms aimed to "reduce complexity" and devote efforts to gain a robust understanding of the configuration and power of internal and external networks as complex adaptive systems. Only by embracing a truly organic view of the business, it will be possible to capitalize on the complexities that surround operations in modern business environments and maximize the value creation potential of the corporation.

ENDNOTES

1. We can see this in Adam Smith's famous "invisible hand" to depict the unobservable force resulting from the individual non-coordinated contributions of market participants that, seeking their own well-being, balance the supply and demand of goods in a market reaching a natural equilibrium (Smith, 1776). Analogously, David Ricardo's principles of competitive advantage describe why each organization should focus on what they do best and trade with other corporations to ensure the common welfare (Ricardo, 1912)
2. Conceptually: $Y(t) = F[K(t), L(t), A(t)]$ where Y = production Output, L = Labor, K = Capital and A = productivity factor - associated to technological progress.
3. In essence, the endogenous growth phenomenon emerges from internal forces in the corporation derived from knowledge spillovers. Productivity increases correlate with the speed of innovation.
4. We can see this in nature: ants foraging or birds flocking create patterns by doing what the neighbor does – and not due to what a "leader" does as normally believed. Humans follow the psychological principle of social proof to identify and follow others (Cialdini, 2009)

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