The Challenge of Managing in a Dynamic Environment: From Complexity Theory to Exponential Organizations

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Introduction

In the academic field, researchers have developed several papers about Complexity Theory (Moran, 1974), (Morin, 1990) (Morin, 1999), (Morin, 2007), (Tarride, 2013), and other ones have linked this theory with Management or Organizational Theory (Chia, 1998), (Anderson, 1999), (Cohen, 1999), (Tsoukas, 2005), (Kay & Goldspink, 2009), (Narváez, Gutiérrez, & Senior, 2011), (Villalba Puerta M. E., 2012). Nevertheless practitioners had not taken this theory in consideration to deal with the hyper competition era, characterized by a dynamic, complex and unpredictable environment (LLoréns Montes, Verdú Jover, & García Morales, 2006). Instead of that, practitioners have considered an empiric book as a good way to deal with this situation. "Exponential Organizations" is the book in which lectors have found answer to deal with disruption and change (Ismail, Malone, & van Geest, 2014).

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Although there are some academic analysis of this book, these ones have considered some characteristics of exponential organizations (Diamandis & Kotler, 2015) or have critiqued these type of organizations (Mohout & Kiemen, s.f.).

In that way, the fist purpose of this paper is to do a literature review to know is there a link between Complexity Theory and Exponential Organizations in order to determine if the last one is contributing to the epistemology of management. This research will identify the main concepts of both fields, the concepts associated to dynamic environment during the last years, and will conclude sustaining if Exponential Organizations is contributing to the epistemology of management. The second purpose of the paper is to purpose a framework with the elements that can be useful to manage in a dynamic environment.

At the beginning, the paper will develop the main ideas of Complexity Theory, Complexity Theory and Management, and how some of its concepts could have a link with systemic thinking and change. Then, I will propose how we can connect Dynamic Environment with other concepts like organizational communication, innovation and ecosystem innovation, dynamic capabilities, and, lean methodologies. Why these concepts? Because, in my research I found that the papers more related to dynamic environment were these. Therefore, I will organize the information provided to compare with Exponential Organization' ones, and finally, I will purpose a framework in order to know how to manage in a dynamic environment according to my research.

What a Complexity Theory is?

It is important to say that Morin is the author who has worked in a deep way Complexity Theory. He emphasized that complexity included itself a problem and not a solution (Morin, 1990).

Nevertheless, first, we need to know what a simple concept is. It could be simple when it can be conceived clearly and distinctly, as a unit which can be separated from surroundings (Moran, 1974). Moran developed the concept of complexity based on his approach to the fundamental characteristics of biological complexity, which have a great number of interrelations as compared with those of machines. In this sense, life is a complex phenomenon with an advanced degree of complication and confusion (Moran, 1974). Thus,

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"complexity begins as soon as there is some system, that is, interrelations between various elements in a unit which becomes a complex unit" (Moran, 1974). Moreover, when the system is open, there is another order of complexity: when its being and the preservation of its diversity are attached from interrelations with the environment, interrelations which provide to the system material or energy and, a higher level of complexity, increasing the level of information (Moran, 1974).

On the other hand, not only self-organization make systems more complex, but also they affect their relation with environment (the ecosystem), predominantly in regard to behavior. "The more complex behavior becomes, the more flexibility there is in regard to adaptation to the environment" (Moran, 1974). Behavior have to respond to external changes and to modify its immediate environment.

There are several "roads" of complexity for organisms and societies. Even there is a hyper-complexity system, like human brain, in which there is a "low level of differentiation between units (neurons)" (Moran, 1974). Based on an orientation to a low level of complexity or to a hyper-complexity and on human society, Moran proposes some characteristics for each one:

Table 1: Tension between low complexity and hyper-complexity

Oriented towards a low level of complexity	Oriented towards hyper-complexity
High degree of specialization of individuals.	Low degree of specialization of individuals. Versatility.
Strong hierarchical (control) relationship.	Weak hierarchical (control) relationship.
High degree of centralization.	Polycentrism, decentralization.
Rigid programs for individuals behavior and social action.	Inventive/heuristic strategies rather than programs.
Little individual autonomy. Coercion.	Great individual autonomy. Freedoms.
Rigid constrains.	Loose constrains.
Little communication and interactions between individuals and between	Much communication and interactions between individuals and between

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subsystems.	subsystems.
Suppression of uncertainty, "noise", disorder.	Much "noise" and disorder.
Stability, not much scope for invention and evolution.	Instability. Great scope for invention and evolution.

Source: Adapted of (Moran, 1974)

These characteristics are very similar to bureaucratic and innovative organizations. The first ones tending to be more formal, process inclined, traditional, repetitive and to the order. They tend inside organization and have many levels in their hierarchy. On the other hand, innovative organizations are based on anticipation, creativity, collaboration, flexibility, and sense. They tend outside organization and promote participation avoiding many levels in their hierarchy (Eichholz, 2015). Therefore, bureaucratic organizations tend to develop their business in a stable environment, while innovative ones in a dynamic one.

The point of view of Moran is close to system thinking because he sustains that business and others human firms are systems. They are related by relationships, which effects can take years to show their consequences (Senge, 2005). System thinking is a conceptual framework, a body of knowledge and tools to understand patterns and to modify it. It is a holistic point of view, a way to see "the wood" not only "the tree", and the way to understand the links between each element of the system and its possible consequences. Companies, as complex systems, are open, adaptive, dynamic, unpredictable, nonlinear, and, tend to learn   (Senge, 2005).

Organizations are open systems, without equilibrium, and with creativity possibilities more than factual realities. Some of them are mechanicals, based in order and equilibrium, and others has this new vision of organization, based in disequilibrium, complexity (order and disorder can live together in it) and locking for creativity tension across evolution processes. To manage with this kind of organizations, is important to consider those main factors information, communication, strategy, learning, change, and adaptation. In addition, as transversal components, it is important to considerer conversations and self-organization (Villalba Puerta, 2012).

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Linking the characteristics proposed by Moran with organizational ones, some authors argue that complex organizations are systems without equilibrium, with nonlinear relationships, auto regulatory, and with limited stability. From complexity, is important to know about open systems, complex learning, self-organization, adaptation, and strategic management to take decisions with a holistic view (Narváez, Gutiérrez, & Senior, 2011). Even, Tarride proposed to reserve the word complex to refer to systems that are treated as an undecomposed and irreducible totality and the act of measuring them does not take place (Tarride, 2013).

Another concept related to complexity that it is important to mention is change. Beyond a traditional point of view based on equilibrium, change is rare, risky and sporadic. Nonetheless, nowadays organizations continuously change thus change is frequent, persistent, and even endemic to the company (Brown & Eisenhardt, 1997), especially in a dynamic environment.

In addition, some authors had linked Complexity Theory with Management or Organizational Theory. They considers that Sciences of Complexity can contribute to understand the social phenomenon of organization although an organization is not a natural system. Nevertheless, complex thinking "may be more adequate" to reveal the "whole spectrum of human lived experiences" characterized by subjectivity, meaning, the limitations of language, and experiences (Chia, 1998). Moreover, complex organizations exhibit unexpected and nonlinear behavior. Thus, in order to simplify complexity, some "complex adaptive system models" characterized by agents with framework, a network to get energy, "coevolution to the edge of chaos, and system evolution based on recombination" could be applied to "strategic management leads to an emphasis on building systems that can rapidly evolve effective adaptive solutions" (Anderson, 1999). Therefore, managers could modify environments and reconfigure the organizational structure.

The interest in complex systems has increased in the last years not only in biology, physics, and computer science, but also in Organization Science because of dramatic changes occurred "in the structure and operational scope of business, governmental and nonprofit organizations" as globalization, process reengineering, workforce diversity, quality

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improvement, public service privatization, information revolution, technology revolution, etc. As environment is changing, organizations have to change as well. However, complex system models have some limitations. Sometimes they fit data too easily or they are criticized for not being checkable by any data (Cohen, 1999).

Organization and order have been historically related with "classification, generalizability, and predictability". Thus, these terms presuppose someone who classifies, generalizes, predicts. In formal organizations these activities correspond to the managerial elite. However, the organization coexists with surprise, unpredictable events, and sometimes with chaos. For that reason, Chaos Theory is a new language to understand non-linearity, disorder, and noise. A way to do that, is "by constructing an idealized world in the form of an abstract model, in order to approximate the complex behavior of real objects". Therefore, modeling is a way to understand complexity (Tsoukas, 2005). Complexity Theory also provides meanings to the knowledge management and helps to build its epistemology because, as complex systems, organizations are contain for "human (biological, reflexive) agents", thus, organizations need a way to theorize about the implications of human behavior there (Kay & Goldspink, 2009).

The paradigm of complexity is a response to conflicts, uncertainty, chaos, irrationality and disorder. This implies that uncertainty and chaos are not predictable and that the causes-effects relationships are not defined. Consequently, complex organizations need complex learning, self-organization, adaptation, and strategic management to respond from a holistic point of view to the environment. In that way, companies have to be creative and proactive, have to achieve equilibrium between innovation and efficiency and order and chaos, changes and transformations are vertiginous, there is an integration between levels and functions with a flexible structure, they mix soft and hard skills, their emphasis is on action, networking, and global vision (Narváez, Gutiérrez, & Senior, 2011).

Finally, organizations, examined by the paradigm of complexity, are integrated, their components have interactions permanently and these interactions cause complex situations. They can be delimited from others systems, tend to accomplish their goals, and apply efficiency, and ethics criteria (Narváez, Gutiérrez, & Senior, 2011).

Therefore, Complexity Theory is a response to understand human behavior in organizations, systemic thinking is a holistic view to understand causes – consequences relationships in the organizations and concepts like innovation, creativity, communication and skills are relevant in this context.

How to manage in a dynamic environment?

A growing body of literature has emerged in recent years from the intersection of complex systems and dynamic environment, concepts like organizational communication, innovation and ecosystem innovation, dynamic capabilities, and, lean methodologies, to provide some advices to deal with a dynamic environment. I will summarize them.

1. Organizational communication

There are five clusters in the perspective on complexity in the field of organizational communication (Poutanen, Siira, & Aula, 2016):

1. Agent-based models & network analysis: connected to the use of Networks of communication and information diffusion.
2. Network of texts: associate to the use of language or text as a symbolic representation and with semantic linkages.
3. Meaning and interpretation: related to negotiation and exchange of meaning.
4. Narratives and language: related to narratives and discourse.
5. Living activity: related to relational action, collective sense making, and complex responsive processes.

As a complex system has different internal and external relationships, "the boundaries between the different clusters are not definitive; the clusters interact in many ways and share some similarities, such as the focus on text and speech in both paradigms and the focus on organizations as networks" (Poutanen, Siira, & Aula, 2016). Then, managers have to use these clusters in order to attend their internal or external goals.

2. Innovation and ecosystem innovation

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Innovation is an ability of the company that have the knowledge to move and to manage resources (scientist and technical) and capabilities by processes of exploration, exploitation and organizational ambidextrous, which permit the development of ideas, processes or products with success, to implant competitive strategies in order to look for superior business results in dynamics environments. High level of innovation is a way to answer to a dynamic environment (Acosta Prado & Fischer, 2013).

On the other hand, an ecosystem innovation originally is related to IT field. All firms and their partners ("Microsoft, Apple, Google, Intel, Cisco, ARM, Qualcomm, EMC, and hundreds if not thousands of other firms, small and large, build hardware and software products as well as applications, and provide a variety of services, for computers, cell phones, and consumer electronics devices"), which participate in a platform-based system, conform an ecosystem innovation (Gawer & Cusumano, 2013). "Platforms are also often associated with "network effects": that is, the more users who adopt the platform, the more valuable the platform becomes to the owner and to the users because of growing access to the network of users and often a set of complementary innovations" (Gawer & Cusumano, 2013).

Ecosystem innovation is also related with openness because openness can be defined "in terms of external linkages generates learning effects, which enable firms to generate more innovation outputs from any given breadth of external linkages" (Love, Roper, & Vahter, 2013). Some authors provide "evidence of such learning effects: establishments with substantial experience of external collaborations in previous periods derive more innovation output from openness in the current period" (Love, Roper, & Vahter, 2013).

3. *Dynamic Capabilities*

Organizational capabilities are the group of abilities that it uses to do an activity. They are intangible resource and are linked with a social phenomenon. In a first level, we can find capabilities connected to functional activities in the company. In the second one, we can find dynamic capabilities, which permit to develop new capabilities to been more competitive in a dynamic environment. In the third level, is the capability to learn (Acosta Prado & Fischer, 2013). Other way to talk about capabilities is referring to the core

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competences of the organization. "Core competences are the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies" (Prahalad & Hamel, 1990).

Nevertheless, some studies had putted their attention on dynamic capabilities. There was a study in China that explored the relationship between dynamic capabilities and competitive advantage and, the role environmental dynamism plays. This empirical study (217 enterprises in China), found that dynamic capabilities do significantly positively affect competitive advantage, and environmental dynamism is a driver rather than a moderator (Li & Liu, 2014). Another study found that an innovation strategy can build and upgrade dynamic capabilities in stable and rapidly changing environments (Alon, Jiao, & Cui, 2010).

Researches are talking about a new type of leadership, "paradoxical leadership", which is related to "strategic agility" (Lewis, Andriopoulos, & Smith, 2014). "Strategic agility evokes contradictions, such as stability-flexibility, commitment-change, and established routines-novel approaches. These competing demands pose challenges that require paradoxical leadership—practices seeking creative, both/and solutions that can enable fast-paced, adaptable decision making" (Lewis, Andriopoulos, & Smith, 2014). These authors propose practices to effectively respond to these challenges.

4. *Lean methodologies*

In the context of aggressively change embracing and growth-oriented, "lean" or "agile" methodologies had found a space to grow in order to provide a dynamic way to deal with a dynamic environment. In IT field, "agile software development approaches such as Extreme Programming, Crystal methods, Lean Development, Scrum, Adaptive Software Development (ASD), and others view change from a perspective that mirrors today's turbulent business and technology environment" (Highsmith & Cockburn, 2001). These lean methodologies born in contraposition to traditional methods, which are "heavy" because they generate a lot of documentation and take much time. For example, Scrum is a new way to manage projects, which is based in the goals of the projects, having short time

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to develop them across to frequent iterations with flexibility (Armijos, Fiallos, Villavicencio, & Abad, 2015).

Another agile methodology is Design Thinking. It propose to use the design in a management field through an iterative process of five steps to solve problems based in a client comprehension: empathizing, definition of the problem, ideation, prototyping, and testing (Brown T. , 2009).

Some benefits of agile methodologies are their flexibility, low costs, less time, high levels of client' satisfaction and engagement. In addition, the team of the project and the client are more motivated because they work rapidly and efficiently. Furthermore, these methodologies remove unnecessary characteristics of the products, improve their quality and detect earliest troubles and mistakes (Martínez, 2014).

Consequently, these four concepts (organizational communication, innovation and ecosystem innovation, dynamic capabilities, and, lean methodologies) propose some ideas to manage in a dynamic environment and respond to a complex system (or to an innovative organizations).

Exponential Organizations

In the book "Exponential Organizations" (ExO), authors develop the concept of these type of organizations in terms of disruption and change. This book introduce a new way to think on the future of organizations based on interviews to practitioners (CEOs and entrepreneurs) "whose companies are leveraging a newly available set of externalities and, as a result, scaling their organizations at many times the normal rate of typical companies". In addition, authors researched about innovation management (they reviewed the books of John Hagel, Clayton Christensen, Eric Ries, Gary Hamel, Jim Collins, W. Chan Kim, Reid Hoffman and Michael Cusumano), they investigated the characteristics of the one hundred fastest growing and most successful startups across the world, and they gleaned key insights from core faculty members at Singularity University. This book pretends to help "Exponential Executives" how to manage in this accelerated new world, how to manage the constant change, and how to guide to the creation and maintenance of an ExO (Ismail, Malone, & van Geest, 2014).

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The concept of Exponential Organization was created at Singularity University which is focused on exponentially growing or on accelerating technologies in areas like computing, sensors, networks, artificial intelligence, robotics, digital manufacturing, synthetic biology, digital medicine, and nanomaterials. The mission of Singularity University is "to help people positively impact the lives of a billion people". An ExO is one "whose impact (or output) is disproportionally large – at least 10x larger – compared to its peers because of the use new organizational techniques that leverage accelerating technologies" (Ismail, Malone, & van Geest, 2014).

An Exponential Organization "is able to eliminate the incremental, linear way traditional companies get bigger. It leverages assets like community, big data, algorithms, and new technology into achieving performance benchmarks ten times better than its peers. This new breed of company has revolutionized how an organization can accelerate its growth by using technology". ExO are built upon information technologies. E. g.: Airbnd (hotels), GitHub (software), Local Motors (automotive), Quirky (consumer goods), Valve (gaming), Tesla (automotive), Tangerine (banking), etc. (Ismail, Malone, & van Geest, 2014).

The book starts exploring the main characteristics of Exponential Organizations (Figure 1) (Ismail, Malone, & van Geest, 2014):

- They have a Massive Transformation Purpose (MTP). This central idea link the "right side" and the "left side" of a "brain". The purpose is important to inspire and to attract top employees around the ecosystem, to support a collaborative culture and to support agility and learning.
- They have five external characteristics ("SCALE"): staff on demand (on demand employees), community and crowd (relationship with their community and their environment), the use of algorithms (with algorithms, they can learn automatically and in a deepest way, so they can change their industry), leverage assets (external actives, they use external resources to get their goals, changing their traditional structures) and engagement. This side function like the right side of the brain: with creativity, growing and uncertainty.

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- They have internal characteristics ("IDEAS"): interfaces, dashboards, experimentation, autonomy and social. This side is like the left side of the brain. It looks for order, control and stability.

Figure 1: Massive Transformation Purpose (MTP).
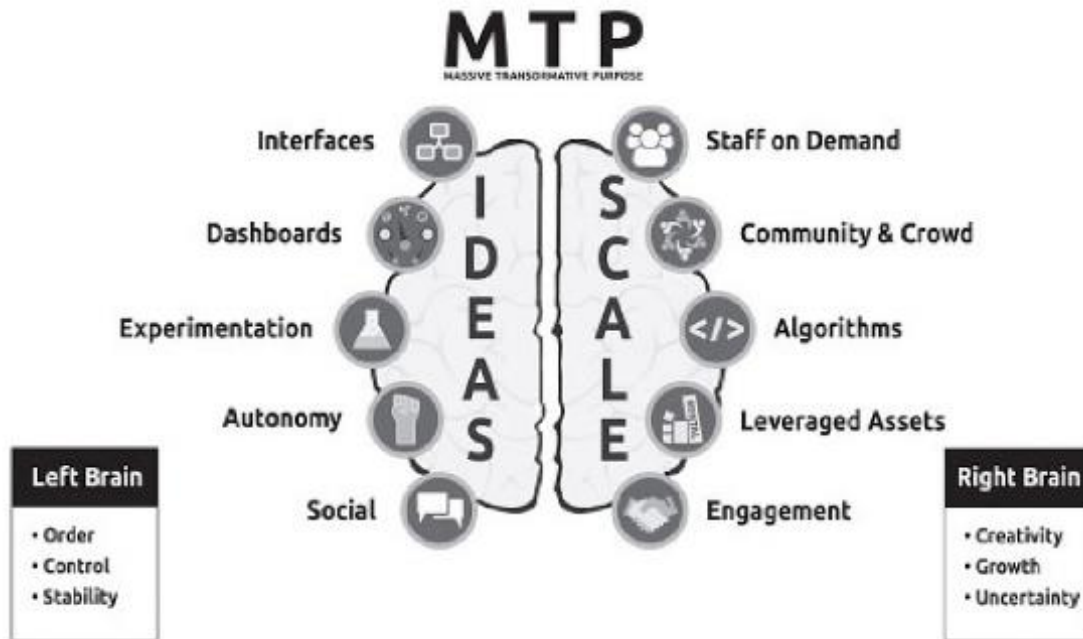
Source: (Ismail, Malone, & van Geest, 2014)

Not every ExO has all ten attributes, nevertheless the more it has, the more scalable it tends to be. Moreover, to be scalable, the ExO have to think big because its business strategy is based on rapid growth. Thus, the Massive Transformative Purpose (MTP) is the higher, aspirational purpose of organization. MTP have to answer two critical questions: "Why do this work? And, why does the organization exist? Some ExO wants to transform the planet, others only an industry. A strong MTP also serves as an exceptional recruiter for new talent, as well as an instrument for retaining top talent. Nevertheless, the MTP not only is to attract and to retain customers and employees, but also for the company ecosystem (developers, NGOs, governments, partners, etc.). Therefore, MTP inspires and motivates all community (Ismail, Malone, & van Geest, 2014).

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Talking about external characteristics, "Staff on demand" provides to the ExO the speed, functionality and flexibility it needs. In any information enabled business, having a large internal staff could be unnecessary, counterproductive, and expensive. Moreover, it is important to consider that the "volume and quality of freelancers gone up dramatically in the last ten years". On the other hand, "Community and Crowd" refer to the core teams and personal networks, users, costumers, alumni, vendors, partners, fans, staff on demand and everyone else (the crowd). For an Exponential Organization is important to interact with its community to get it engaged to the company and collaborate together. The crowd is important because is a source of creativity, innovation, communication, validation and founds (Ismail, Malone, & van Geest, 2014).

Several companies are using "Algorithms" to have dynamic prices, to give recommendations, to show especial information, to perform complex tasks, etc. "In particular, there are two types of algorithms that are at the frontier of this new world: Machine Learning and Deep Learning". Machine Learning is an engine which learn from training or historic data, and based on predictions. Deep Learning is a subset of Machine Learning based on neuronal net technology, it helps to discover new patterns. Thus, algorithms allow fully scalable products and services. On the other hand, Exponential Organizations use to rent, to share or to leverage assets. Technology enables organizations to easily share assets locally and globally. "The latest wave of non-asset businesses is something called Collaborative Consumption". Renting, sharing or leveraging assets permits obtain lower marginal cost of supply and increases agility to the company (Ismail, Malone, & van Geest, 2014).

The last external characteristic of ExO is Engagement. Engagement is crucial and companies could get it through positive feedback of their networks, competitors, and all community. Moreover, engagement helps to inject to ExO with new ideas and innovation (Ismail, Malone, & van Geest, 2014).

Exponential Organizations also have internal characteristics. The first one is "Interfaces" which connect the company with its external characteristics (externalities), such as its community. Interfaces are useful to manage work and projects and share them with all interested locally or globally. "Dashboards" in other internal characteristic of ExO which

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allow organization to access data in real time. This characteristic is very important in order to have information at the moment people need to take better decisions. Adaptable dashboards provide data from customers and employees and permit to ExO adopting the "Objectives and Key Results" (OKR) method which answer two questions: Where do I want to go (objectives), and How will I know I am getting there? (Key results to ensure progress is made). OKR are determined bottom-up (Ismail, Malone, & van Geest, 2014).

On the other hand, "Experiment" is fundamental at ExO. All Exponential Organizations have to take risks through doing experiments. Employees can experiment with innovative ideas in a safe space without distraction and looking for new solutions to their problems. The authors define experimentation as the implementation of Lean Startup methodology. "Autonomy" is the fourth internal characteristic of ExO. These kind of organizations need autonomous, multidisciplinary, and decentralized teams to find different ways to achieve customer expectations. Finally, the last internal characteristic is "Social Technologies" which enable diverse communication channels and they have seven key elements: Social objects, activity streams, task management, file sharing, telepresence, virtual worlds, and emotional sensing. More communication, more transparency and more connection to its Massive Transformative Purpose (Ismail, Malone, & van Geest, 2014).

Exponential Organizations have "Exponential Executives" who have to detect meta-trends to know the way the industry could go to, have to be constantly on alert for new competitive pressures or disruptive startups (Ismail, Malone, & van Geest, 2014).

In an interview, Ismail said that to transform an organization managers need not only good manage or specials abilities, but also efficiency and stability. He suggested creating a little team in the company, in order to work in innovations and to generate a disrupted business model (Forbes, 2015).

Some authors have critiqued these type of organization asking if it is really essential to grow exponentially. Instead, they suggest "the focus should be on the hyper-scalable organizational structure". Moreover, having hyper-scalable organizations could be dangerous because markets can become fragile (Mohout & Kiemen, s.f.). Other authors

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only have emphasized some characteristics of exponential organizations (Diamandis & Kotler, 2015).

Findings

As we can notice, several the ideas of the authors of Exponential Organizations are linked with complexity theory, and the four main concepts that I have develop before. Therefore, to manage the company in a dynamic environment managers need to understand the system in which they develop their activities, and the interrelations produced between all systems involved in the industry. Managers also have to recognize that dynamic environment is complex, disruptive, change all time, and, as open systems, need specific tools like five clusters of communication, high levels of innovations, to build an ecosystem of innovation, some dynamic abilities, and to apply lean methodologies to solve problems or to create new products or services.

In the following figure, I show the framework to manage in a dynamic environment:

Figure 2: Framework to manage in a Dynamic Environment
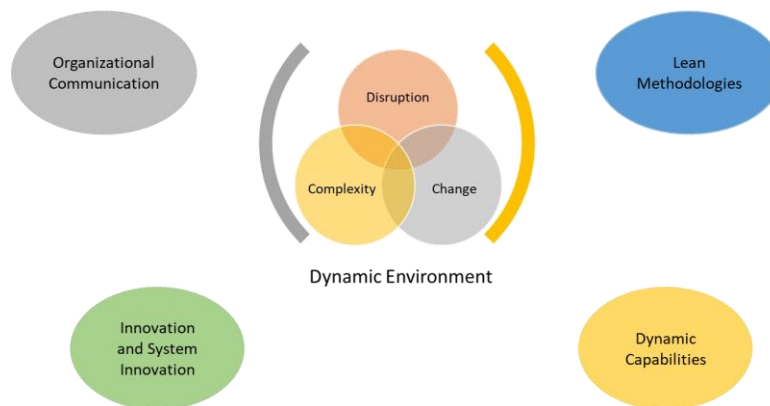
Conclusions

We can connect the ideas of Exponential Organizations with the concepts of Complexity Theory and with the organizational communication, innovation, ecosystem innovation, dynamic capabilities and lean methodologies. Therefore, Exponential Organizations do not contribute to epistemology of management.

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