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LIST OF ABBREVIATIONS

EA	Enterprise Architecture
ETM-CT	Emery-Trist Model on the Causal Texture of organizational environments
ETSP	Emery-Trist Systems Paradigm
OST	Open Systems Theory
SLR	Systematic Literature Review
STS	Socio-Technical System

INTRODUCTION

Organizations evolve in rapidly changing and dynamic environments with high levels of complexity, uncertainty and inter-relations, which threaten their success, stability and even their survival. Indeed, even large organizations can be at risk of disappearing despite being leaders in the market (e.g., Kodak, Motorola and Nortel). As the world has witnessed over the last decade, even goverments are at risk of imploding (e.g., Grece). Consequently, in order to be sustainable, organizations must learn how to deal with uncertainty and manage complexity and their inter-relations; they must actively adapt to their environments by defining strategies that integrate, in addition to their internal inter-relations, inter-relations with their environments and the inter-relations of several actors within those environments.

Entreprise architecture (EA) helps organizations overcome the challenges of managing complexity (Laplame and de Guerre, 2014a). Therefore, adopting enterprise architecture is important for any organization wishing to survive in these uncertain and complex times. The term enterprise architecture can be used as either a noun or a verb (Laplame and de Guerre, 2014b). Enterprise architecture as a verb refers to engaging in purposeful activites related to designing an enterprise. Enterprise architecture as a noun can refer either to a model of an enterprise (i.e., a model such as defined byArchiMate) or as the current state of an enterprise. In this report, we focus on enterprise architecture as a verb.

Despite the benefits put forward by the community related to persuing enterprise architecture, it appears that a good number of enterprise architecture teams are not very popular within their organizations (DeGennaro, 2010). Indeed, current frameworks of enterprise architecture do not rely on complete models that integrate adaptation of the organization to its environment.

This vision of the organization, as an organism that coevolves with its environment through continuous bidirectional transactions (referred to as *system-in-environment*) is the very core of the Emery-Trist model on the causal texture of organizational environments (ETM-CT).

The causal texture represents the inter-relations between the parts of the environment of an organization. Originally developed by F. Emery and Trist (1965), and subsequently advanced and used by other authors, this model has multiple uses: (1) it discusses the characteristics of an environment; (2) it leads to the emergence of concepts fostering adaptive strategies in an organization in relation to its environment and (3) it helps an organization take advantage of the opportunities present in the environment while protecting itself from its threats. To our knowledge, it is the most complete model that defines the concept of systems that evolve within and with their environments (i.e., system-in-environment). In addition, the model provides valuable knowledge in the form of active adaptation strategies for coping with different environment types. This knowledge about an organization and its environment is crucial for enterprise engineering, and incorporating this model into the design process of enterprise architecture will help an organization to design or redesign itself in a sustainable way.

While reviewing the literature, and given the great value of the model with regards to organization sustainability, we were surprised to discover that there is a lack of studies that summarize and synthesize contributions to the model. It was hard to trace the development of concepts related to the model. Moreover, the existence of divergences between authors demonstrated the importance of conducting a literature review to assess the state of the art of approaches concerning the ETM-CT. To obtain a high-quality literature review, we chose to adopt a systematic literature review methodology (SLR).

The primary contribution of this study is to offer a synthesis of the model's evolution, which has not previously existed, shedding light on how the ETM-CT has evolved. The particular emphasis on identifying divergences between contributions enables practitioners to understand points of contention and provides researchers with possible topics needing further investigation. Another major contribution is the introduction of the ETM-CT to the enterprise architecture community.

This report is structured as follows: CHAPTER 1 outlines the focus of other literature reviews related to the model; it also reviews if existing EA approaches integrated a complete model fostering active adaptation of an organization to its environment and if they at least integrated the relationship between an organization and its environment; CHAPTER 2 describes the review process we conducted (SLR methodology), as well as its specificities; CHAPTER 3 consists of the definitions of certain concepts introduced or developed by the model and the associated studies; and CHAPTER 4 summarizes the findings of the review, which are discussed in CHAPTER 5. CHAPTER 6 enumerates the limitations of our SLR methodology. CHAPTER 7 exhibits some implications of the ETM-CT on EA research, and finally, CHAPTER 8 presents insights related to our future work.

CHAPTER 1

LITERATURE REVIEW

The aim of conducting this literature review was twofold: on one hand, to investigate if EA approaches exist that integrate a complete model that fosters the mutual influence between an organization and its environment, as is the case with the ETM-CT (subchapter 1.1). On the other hand, the goal was also to determine if a literature review exists that analyzes and synthesizes the evolution of the ETM-CT (subchapter 1.2).

1.1 Literature review on enterprise architecture

As previously mentioned, one of the main contributions of this study is the introduction of the ETM-CT to the EA community. This model can certainly help the design or redesign of sustainable organizations by providing concepts fostering adaptive strategies of organizations in relation to their environments. Hence, the objective of this literature review is to outline state of the art of EA approaches that have tackled the issue of integrating the relationship between an organization and its environment. To our knowledge, there is no such study in the literature. We focused primarily on determining if a complete model of an organization's adaptation to its environment (as is the case with the ETM-CT) is used by EA approaches.

In this subchapter, we analyze the key studies we found in the literature on EA related to the topic of system-in-environment. While literature reviews on EA exist, they do not have the same focus as our study. We used these reviews to derive insights on the relationship between an organization and its environment and on the use of the ETM-CT. We enriched our analysis by discussing references of EA promoting organizations' interaction with their environment. We concluded that even if some EA approaches use some principles of adaptation of the organization to its environment, current EA frameworks do not rely on a complete model that integrates adaptation of the organization to its environment.

As shown in the results of the literature review on EA conducted by Tamm et al. (2011), EA is positioned between IT and business strategy formulation, on the one hand, and project-focused solution architecting on the other. Drawing on the findings of the literature review, the paper proposes the Enterprise Architecture Benefits Model (EABM), in which EA leads to organizational benefits through its impact on four key benefit enablers: organizational alignment, information availability, resource portfolio optimisation and resource complementarity. The study of contextual (internal or environmental) factors led Tamm et al. to suggest that under some circumstances some (large and more complex) organizations are better positioned to benefit from EA investment. Also, EA can improve an organization's flexibility and change capability. However, the authors suggested further investigation of contextual factors and encouraged the improvement of the EABM model, as there was no theoretical basis to guarantee the completeness of the model. Hence, the study encourages the investigation of the internal inter-relations of an organization and its interrelations with its environment. It also shows the need to use a complete model that is developed on a theoretical basis. This is the case of the ETM-CT, as we show in this report.

After a review of the key literature on EA, Lapalme (2012) highlighted the emergence of three schools of thoughts in regards to aligning scope and purpose of EA; each school of thought has a unique belief system consisting of definitions, concerns, assumptions, insights and limitations. According to the author, these schools of thoughts represent ideals around which EA approaches gravitate. They are:

- Enterprise IT Architecting: EA is centered on aligning information technologies with an organization's strategies. The objective is to effectively enable the business strategy by using the proper and optimized IT capabilities;
- Enterprise Integrating: EA aims to ensure an organization's consistency (coherence between its parts) by designing all its facets and effectively implementing its strategy;
- Enterprise Ecological Adaptation: EA is focused on representing the organization in its environment. It enhances the organizational innovation, coherency and sustainability, and it promotes ecological learning.

It appears that the Enterprise Ecological Adaptation school of thought is most appropriate in regards to helping the organization to assess and improve its adaptive capacities to the environment and to represent all internal and external inter-relations. In opposition, the Enterprise Integrating school of thought only manages its environment. Note that these two schools of thought adopt holistic visions leading to outcomes representing all the enterprise aspects (facets) and jointly optimizing the social and the technical systems. Lapalme (2012) listed some references on EA approaches classified in the Enterprise Ecological Adaptation school of thought. Although the author tackled the system-in-environment co-evolution between the schools of thoughts, which were compared in part to the management of the internal and environmental interrelations of organizations, the author did not investigate the ETM-CT, which integrates all the principles listed in the paper.

According to Simon et al. (2013), the evaluation of well-known frameworks by Leist and Zellner (2006) suggested that, in general, there are several areas for methodological improvement; Langenberg and Wegmann (2004) concluded that the framework of Zachman (1987) was, at the point of publication of their article, the most referenced framework, after which Buckl et al. (2009) concluded that "The Open Group Architecture Framework (TOGAF) has become the most prominent approach in practice," (in Simon et al., 2013, p. 4) showing the dominance of the Enterprise IT Architecting vision. Schmidt and Buxmann (2011) found that stakeholders' participation and communication were considered of less importance than architecture governance for the success of EA management. All these studies demonstrate that EA approaches do not lead to the design of sustainable organizations, as the organizations cannot adapt to their environment. Indeed, these approaches do not take into account all the internal interrelations of an organization or integrate the relationship between an organization and its environment. These interrelations, which are demonstrated by the ETM-CT, are reported in our report as being among the conditions necessary to ensure an organization's sustainability. Note that the development of the model was based on strong theoretical ground resulting from the contributions of scientists from different fields. This analysis of previous literature reviews cited by Simon et al. (2013) exploring EA research through the study of academics' and practitioners'

publications showed that there is a gap between theoretical foundations and practical issues in EA research and that research has been more concerned with the business organization than with the business strategy and model.

According to Wegmann (2003), the purpose of EA is to align more effectively enterprises' strategies with their processes and resources (business and IT). Wegmann argued that "Business and information technology (IT) integration is essential for enterprises to achieve their competitiveness" (p. 1) and defined an enterprise model as a representation of "the resources found in the enterprise and in its environment, together with the processes in which they participate" (p. 2). The author discussed the importance of the concept of a systemic paradigm in system sciences to provide necessary theoretical foundations to EA. The author argued that his systemic paradigm would improve enterprise architects' understanding of the existing methodologies, therefore improving their capacity to explain the practical problems they face. The author presented the Systemic Enterprise Architecture Methodology (SEAM), which is an application of his systemic paradigm. This methodology can be supported by a tool. The author highlighted the need for a shift in paradigm and promoted some principles present in the ETM-CT but emphasized that these principles are not sufficient in regards to adaptive strategy of decision making defined by ETM-CT.

Lapalme and de Guerre (2014a) developed a framework about complexity and its management. They then discussed the EA schools of thought proposed by Lapalme (2012) related to their associated perspectives on complexity management. They proposed a design perspective of EA to offer a comprehensive approach to manage complexity resulting from working towards organizational sustainability. Hence the authors presented the key guidelines, assumptions, implications, and limitations of this perspective grounded in open socio-technical system theory (OST), which was developed essentially from the ETM-CT. Note that OST is a specific theory promoting system-in-environment co-evolution and joint optimization of its interrelated social component (people, culture, norms, interactions, roles, etc.) and technical component (technology, tools, materials, etc.). Emery and Trist (Trist, 1981) proposed the socio-technical systems theory, which includes the ETM-CT. Indeed,

Babüroğlu (1992), in reviewing the Emery-Trist Systems Paradigm (ETSP), showed that ETSP developed in four tracks, the last three of which concerned the ETM-CT (see subchapter 1.2). Note that the version of OST used by the authors in this paper used some concepts developed by F. Emery about which there exist divergences between contributing authors to the ETM-CT. These divergences are discussed in CHAPTER 5. The authors transformed the main principles promoted by that theory into principles to integrate into an EA approach. Finally, Lapalme and de Guerre (2014a) provided a comparison between their perspective and typical EA methodologies.

Rabaey (2014, p. 99) defined complex systems as systems that "interact with an environment where a high degree of uncertainty exists." The author referred to complex adaptive systems as dynamic systems that have to adapt their goals, means and structure in order to survive in an unstable environment as it evolves rapidly. For this purpose, the author proposed a concept of EA, named Complex Adaptive Systems Thinking – Enterprise Architecture (CAST-EA). This concept is based on the Cynefin framework, which makes the organization and/or its parts aware of their possible contexts and where "The context defines the unique environment in which the system is situated (Gharajedaghi, 2011) which requires permanent observing and intelligence (Rabaey et al., 2012)" (in Rabaey 2014, p. 103). The author discussed types of contexts and the adaptation of organizations to them. The CAST-EA concept aimed to avoid the damage for the organization that may be caused by Cynefin dynamics if the organization is not aware of the shift from one context to another. This concept supports an agile organization. Rabaey (2014) showed that the concept of intelligence increases and assesses existing knowledge, and supports decision making by reducing uncertainty. CAST-EA promotes a holistic vision of the organization, which is considered as an open system. We noted that the author promoted some principles and concepts present in the ETM-CT independent of the model. However, in the ETM-CT, humanity has shifted between environments through its history. It is now experiencing a turbulent environment and the objective of the adaptation strategy of the ETM-CT is to transform the environment of an organization into a more stable one with less uncertainty, inter-relations and complexity.

Villarreal (2014) presented an analytical framework that aims to integrate the many elements of sustainable development and their interrelationships and that fosters a systemic perspective. The objective was to highlight the advantages of the EA approach to improve sustainable development. The author believed that presenting a systemic description of sustainable development would attract and facilitate contributions from practitioners of EA. The author integrated only some principles of adaptation to ensure sustainability. The proposed framework does not rely on a complete model, such as the ETM-CT.

This literature review exhibited that different authors have demonstrated the importance of integrating some concepts present in the ETM-CT into EA approaches. This suggests that it would be interesting to introduce the model to the EA community. Indeed, the added value of this study is to exhibit a model that fosters the system-in-environment co-evolution and how this model evolved through time. In addition to the principles that have been proven as critical to an organization's sustainability, convergences and divergences between authors were identified, shedding light on the points of contention that will help researchers and practitioners to develop the model further and provide principles to EA approaches to design or redesign sustainable organizations.

1.2 Literature review on reviews on the ETM-CT

To our knowledge, no prior study has analyzed the evolution of the ETM-CT, which is the focus of our study. Indeed, the studies reported in this subchapter only partially reviewed the model and provided only partial and fragmented information on its evolution. Merrelyn Emery (2000) summarized some of the key concepts that are related to the model and mentioned divergences between Fred Emery, Trist, and Ackoff regarding some concepts.

Babüroğlu (1988) wrote a literature review that focused on only one portion of the model (i.e., the vortical environment) as defined by Emery and Trist (1973). His paper highlighted the lack of studies on the topic, citing only four: Emery and Trist (1973), Emery (1977), Crombie (1972) and McCann and Selsky (1984).

Babüroğlu (1992) reviewed the Emery-Trist Systems Paradigm (ETSP) through four publications that reviewed and summarized this model. The aim of the paper was to introduce the model to a stream of systems thinking known as critical thinking. The author showed that ETSP developed in four tracks, the last three of which concerned the ETM-CT. The first track tackled the joint optimization of socio-technical systems. The second track integrated the concepts of system-in-environment co-evolution and active adaptation. The third track promoted the concepts of inter-organizational domain and referent organization as a means for active adaptation to turbulent environments (Trist, 1983). The fourth track focused on refining the conceptualisation of environment types initially defined by Emery and Trist (1973). The author analyzed the four tracks in relation to the heuristics of social systems design developed by Ulrich (1983) based on the purposeful systems model of Ackoff and Emery (1972), which helped derive some concepts of the model.

CHAPTER 2

LITERATURE REVIEW METHODOLOGY

As previously mentioned, the focus of this study is the analysis and synthesis of the evolution of the ETM-CT. Accordingly, a review of contributions pertaining to the model was crucial. Hence, we identified the systematic literature review (SLR) methodology as the most appropriate means for guiding our review, as explained in the next subchapter.

2.1 Comparison between literature review types

Conventional literature review

There are two types of conventional literature reviews (Kitchenham and Charters, 2007; Okoli and Schabram, 2010):

Literature review as the theoretical foundations and context of a research question: This type of literature review is often labeled a "literature review" or "theoretical background review" and is relevant for studies that seek to:

- Bring the research question into focus (e.g., journal papers);
- Identify important methods, information or people in the field of the study;
- Justify funding and grant applications;
- Help practitioners make decisions;
- Introduce material that is less easily available.

Literature review as a chapter of a graduate thesis: The thesis literature review aims to:

- Synthesize the understanding of a student on a research topic;
- Justify the novelty of the student's work and future research in general;
- Constitute a basis of an analysis and a synthesis of the research topic for future academic discussion;
- Demonstrate the student's rigor in conducting the research;

- Welcome “the student into scholarly tradition and etiquette” (Okoli and Schabram, 2010. p. 3).

This type of literature review provides a basis for future work by describing the content and quality of available knowledge. Indeed, the results of the studies reviewed are considered as data for the literature review. It is only when the review synthesizes the available material and offers a scholarly critique of theory that it becomes valuable research.

Stand-alone literature review

Stand-alone literature reviews (e.g., SLR) can vary “from little more than an annotated bibliography to scientifically rigorous syntheses of a body of primary research” (Okoli and Schabram, 2010. p. 4). An SLR-guided study follows a systematic, rigorous, explicit, comprehensive (completeness in the coverage of the literature), open-minded and transparent methodological approach to enable the replication of the study. This type of study aims to produce an identification of all relevant studies, evaluations and syntheses to produce a critical analysis of a body of knowledge related to the topic expressed as research questions.

The SLR methodology was initially developed and used in medical-related research as a means for systematically collecting, analysing and synthesizing results across multiple studies (Fink, 2005). Today, the SLR methodology is used in other fields such as information systems (Okoli and Schabram, 2010), the social sciences (Hart, 1998; Petticrew and Roberts, 2006), and business management (Rousseau et al. 2008), which are fields concerning our study.

Hence, our study was conducted according to the prescribed practices of the methodology (see Kitchenham and Charters, 2007; Okoli and Schabram, 2010 for details and examples of the SLR methodology and its stages). The following subchapters present the main phases of the study, which are the purpose of the review and related research questions, the search and selection processes, the data extraction (collection) and the synthesis of the selected studies. In CHAPTER 6, we discuss the consistency of the review by presenting its limitations.

2.2 Purpose and research questions

Our study focuses on investigating the following research questions: How did the Emery-Trist model on the causal texture of organizational environment evolve over the years? The underlying sub-questions are:

1) Who are the authors who contributed the most to this model? (RQ1)
2) How did they contribute? (RQ2)
3) What are the similarities and differences between these authors? (RQ3)

2.3 Search process

Relevant sources were defined, the search was performed. To obtain a comprehensive literature review, the studies used were selected from:

- Search results on digital libraries Scopus, Inspec and Compendex, which were scanned every 14 days from May 2014 until the report submission date;
- Publications of F Emery, Trist and M Emery;
- Previous works on open systems theory that the authors were aware of;
- Reference lists of papers, such those of Babüroğlu and McCann;
- CVs of authors that wrote about the model such as Selsky;
- References from the moderntimesworkplace.com website related to the Tavistock Anthology. The Tavistock Institute is where F Emery and Trist conducted their first work on the model.

The search started with one set of keywords (“causal texture” or “turbulent environment”) and was refined by adding “open system” and limiting the results to social science studies, when possible. These additional search criteria were used because, in the previous search results, the keywords only appeared in the titles of references and not in the text body. The numbers decreased significantly after search refinement (Table 2.1). Please note that the numbers in Table 2.1 don’t represent unique studies because there are overlaps between the digital libraries.

Table 2.1 Number of hits by selection criteria

Database	Keywords	Search criteria	Number of studies found
Scopus	causal texture	causal texture	625
		causal texture AND open system AND social and human sciences	63
	turbulent environment	turbulent environment	4160
		turbulent environment AND open system AND social and human sciences	78
Compendex and Inspec	causal texture	causal texture	4
		causal texture AND open system	0
	turbulent environment	turbulent environment	606
		turbulent environment AND open system	1

For all the keywords, quotation marks were used. The term "social and human sciences" refers to a filter criteria on the discipline and not a keyword.

The list of publications of Fred and Merrelyn Emery was mostly derived from the list of references of M Emery's papers. Some of their publications are also available on the Tavistock Anthology website. The list of publications of Trist was provided by his life partner and exists on the same website.

2.4 Selection process

All obtained studies were scanned and rejected if the keywords existed only in the reference list. If not, parts of the text of the study were read, including the keywords. After that inclusion and exclusion criteria were applied. Twenty-four studies were included in the literature review (see Appendix I) and 38 were excluded (17 did not develop the model and we did not have access to 21) (See Appendix II and Appendix IV for an analysis of the references). All studies that contributed to the development or enhancement of thinking on the model to which we had access were selected. With regards to the studies for which we didn't have access, two mitigations strategies were used; these strategies will be discussed in a later section.

Table 2.2 summarizes the selected studies count by source. Please note that the sum of counts is greater than twenty-four because some studies were found via multiple sources.

Table 2.2 Number of selected references found by each search source

Search source	Number of selected references found
Scopus	7
Inspec and Compendex	0
Publications of Emery F, Trist, E and Emery, M.	14
Previous studies	14
Reference lists	13
CV	4
Tavistock	13

2.5 Challenges concerning the gathering of relevant studies

We faced two challenges related to gathering relevant studies. The first challenge was regarding the accessibility of older publications written by Trist and F Emery. It was not possible to get access to all the articles we identified that were published by F Emery and Trist. Local publishers had published many of the older articles in hard copy and in limited numbers. Consequently, only a very few copies exist today in foreign country libraries (i.e., Australia and England). For example, according to Emery (1977), there were five contributing studies to the model made by him and/or Trist (see Appendix IV); Emery also referred to other works, for instance with Ackoff and with Trist, that helped develop the concepts of the model. We could not access these works. In Trist (1983), while the author identified thirteen contributing publications by him and/or Emery, one of which was by Emery and Emery (see Appendix IV), we were only able to access five. The second challenge was with regards to obtaining complete bibliographies for F Emery and Trist. To our knowledge no official and complete bibliography exists for both authors; this was confirmed by Beulah Trist, Trist's life partner, and Don de Guerre, a close collaborator of F Emery.

These challenges were mitigated by: (1) using a “sandwich” approach: articles written by the author that were published just before and after each inaccessible article were compared. If no divergences were identified, it was assumed that the inaccessible article did not contribute new concepts; (Appendix IV discusses another way to use the sandwich strategy; it concerns the case where a study cannot be sandwiched between two publications of the same author published just before and after the study); (2) using experts to validate the analysis and assumptions: Alan Trist, Trist’s son and an organizational specialist mentored by F Emery who worked with his father’s concepts during the 1960s at the Tavistock Institute and afterwards in the United States, and Dr. Don de Guerre, an expert in organizational design and development who worked closely with F and M Emery for many years.

2.6 Data extraction (collection)

For each study, the following information was collected: authors, year of publication, title, source, reference, concepts (related to the review) and content related to each of these concepts.

2.7 Synthesis of studies (data analysis)

Selected studies were presented chronologically to analyze the evolution of concepts (RQ). The contributing authors (RQ1) and their contributions (RQ2) were identified. Convergences and divergences were highlighted (RQ3). Selected and rejected studies are listed in Appendix I and Appendix II respectively. Also the key contributions per study are summarized in Appendix III.

CHAPTER 3

BACKGROUND

This chapter presents the concepts related to ETM-CT for which there is an agreement between the authors contributing to the model. However, we included definitions of other key concepts for which divergences exist between authors. These divergences are discussed later in the document.

3.1 Origin of causal texture

In 1965, Fred Emery and Eric Trist extended von Bertalanffy's (1950) open systems theory with the concept of the *causal texture* of the environment (a term suggested by Tolman and Brunswik (1935) and drawn from Pepper (1934)). The causal texture of the environment added a formal conceptualization of the environment component, where the authors dealt with processes in the environment (Emery and Trist, 1965), in comparison to the original open systems theory.

3.2 Open system and its components

An *open system* differs from a *closed system* by the fact that it is conceptualized as participating in bidirectional transactions with an external environment that is independent of the system. The conceptualization of a closed system does not include the concept of an environment. What the causal texture brings to the original conceptualization of an open system is the interrelations between the parts of the environment (Emery and Trist, 1965). Therefore, the conceptualization of bidirectional transactions between a system and its environment led the authors to create the four parameters (or components) of an open system (Emery and Trist, 1965; Emery, 2000): L_{11}, L_{12}, L_{21} and L_{22} are lawful connections designated by (L), which expresses inter-relations, and the suffixes 1 and 2, which designate the system and its environment, respectively. They are illustrated in Figure 3.1.

The meanings of the parameters are:

- L_{11} represents the system's internal interrelations.
- L_{22} is the causal texture, which represents the environmental interrelations between the environment's parts, also called contextual environment according to Ramirez and Forssell (2011).
- L_{12} is the planning function. It represents the transactions from the system, through which the system acts on the environment.
- L_{21} is the learning function. It represents the relations from the environment to the system, through which the system is informed about the opportunities the environment offers to the system and the way the environment constraints the system.

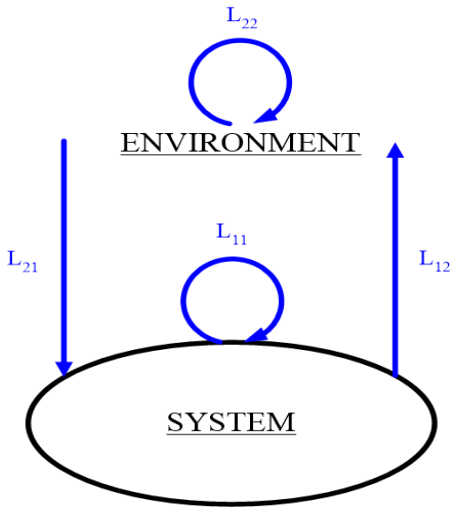

Figure 3.1 Parameters of open system

3.3 System-in-environment co-evolution and directive correlation

The overall evolution process of a system and its environment resulting from their bidirectional relationship defines the concept of *system-in-environment co-evolution.* The way a system and its environment co-evolve may be represented as a process named *directive correlation over time* (Sommerhoff, 1969; de Guerre, 2000). Co-evolution is motivated by the fact that in order to adapt to the environment, both the system and the environment need

to evolve in the same direction with respect to initial conditions and goals. The system and the environment influence each other, leading to a new set of conditions that would be the next initial conditions.

3.4 Types of causal textures

F. Emery and Trist derived and conceptualized four ideal types of causal textures experienced by humans, also called the Emery-Trist levels of organizational environments (Babüroğlu, 1988). They defined a fifth type, but did not conceptualize it. The causal textures are (Babüroğlu, 1988; Emery and Trist, 1965, 1973; Emery 2000; Trist, 1981):

- *Type I: Random placid.* This type is the simplest form of environment that can be experienced by humans. Elaborating tactics are sufficient to adapt to it. Any action gives one chance of two to success;
- *Type II: Clustered placid*. This type is static. The values are stable, and it is composed of cooperative systems (i.e., organizations). Most of human history has been spent in this type, from 50000 B.C to the industrial revolution in the 1790s. To adapt to this environment, a system has to elaborate strategic and tactical planning (based on its knowledge of the environment);
- *Type III: Disturbed reactive.* This type of environment did not last for very long (from the 1790s to 1950s). It appeared with the industrial revolution. The introduction of mechanism and bureaucracy transformed organizations such that maladaptive responses started to appear. Only large, technocratic and bureaucratic organizations that had expertise to make competitive challenge and maximize their independent power could survive. Organizations in competition had the same information and wanted to reach the same part of the environment and they knew that their competitors were aware about it;
- *Type IV: Turbulent environment*. This is the type of environment in which we presently live. High levels of inter-relations, complexity and uncertainty characterize this type. As it is dynamic (like Type III), the context changes rapidly. Organizations experience instability. To adapt to this environment, turbulence should be managed to recreate a new form of Type II environment. In opposition to Type III, an organization should take into

account not only interactions with other competitive systems but also interactions with others parts of the environment;

- *Type V: Vortical environment*. The environment will be vortical when it reaches extreme degrees of complexity and dynamic inter-relations, and the turbulent conditions continue to persist and the maladaptive responses of organizations to turbulence are accentuated (as a result of a failure of the organizations' adaptation strategies to the environment).

3.5 Ideals

Based on the characterization of causal texture types, it appears that contemporary organizations are evolving in dynamic and rapidly changing environments with high levels of complexity, uncertainty and inter-relations (i.e., turbulent environments). Such conditions can threaten the stability of organizations. This context forces organizations to actively adapt in order to succeed, or at least not disappear. Organizations are populated by humans who, by their very nature, are ideal-seeking. They may contribute to a system's adaptation to a turbulent environment by pursuing ideals. The sets of ideals proposed by Emery and Ackoff (1972), Emery (1977) and Trist in Emery and Trist (1973) are outlined in Table 3.1. Indeed, Trist outlined ideals related to the industrialism (column 1) and post-industrialism (column 2) periods. For the post-industrialism period, Emery and Ackoff also proposed a set of ideals (column 3), which was modified by Emery (column 4). For each ideal, the associated ideals per author(s) and period are given. Emery (1977) offered an interesting survey of how the set of ideals evolved from those of Ackoff and Emery (1972) to those proposed by Emery (1977). However, Emery (1977) did not compare them with those of Trist.

Maladaptive strategies appear if the ideals are not pursued and not pursued as a set (Emery and Emery, 1979). The pursuit of ideals and maladaptive strategies affect decision-making by offering people and organizations a broader range of choices, hence offering more chances of adaptation (Emery, 1977). The pursuit of maladaptive strategies reduces choice, and therefore hinders the chances of adaptation.

Table 3.1 Sets of ideals by historical period as proposed by different authors

Emery and Trist[1]		Ackoff and Emery[2]	Emery[3]
Industrialism[1]	**Post-industrialism**	**Transition**	**Post-industrialism**
Achievement	Self-actualization	Truth	Nurturance
Independence	Interdependence	Plenty	Homonomy
Self-control	Self-expression	Good	Humanity
Endurance of distress	Capacity for joy	Beauty	Beauty

Table developed by Emery (1977); 1 Emery and Trist (1973), 2 Ackoff and Emery (1972), 3 Emery (1977)

Table 3.2 presents the relationships between parameters of open systems (column 1), parameters of choice behaviour (column 2), passive maladaptive strategies (column 3) and active maladaptive strategies (column 4). This table was adapted from the one by Alvarez and Emery (2000). Note that the correspondence between parameters of open systems and parameters of choice behaviour has been changed over the time (Emery, 1977; Emery and Emery, 1979; Alvarez and Emery, 2000). In addition, there is a divergence between the correspondence of parameters of open systems and passive maladaptations (Emery, 1977; Babüroğlu, 1988). The modifications and divergences between authors are reported and are discussed later in this document.

3.6 Maladaptive strategies

Maladaptive strategies are divided in two types: passive and active. The passive forms are defenses against turbulence most usually expressed by the people at large. The active ones are attempts to reduce uncertainty and complexity mostly expressed by elites to initiate strategies aiming to achieve those ends; they are the correlates of the passive maladaptive strategies (Crombie, 1972; Emery, 2000). Passive maladaptive strategies include segmentation, dissociation, doomsday and superficiality (Alvarez and Emery, 2000; Emery, 1977). Active maladaptive strategies include authoritarianism or law and order, evangelicism, social engineering and synoptic idealism (Alvarez and Emery, 2000; Crombie, 1972). Note that maladaptive strategies are also referred to as maladaptive responses or

maladaptive scenarios (Emery, 1977), maladaptions (Alvarez and Emery, 2000; Toffler in Crombie, 1972) or maladaptations (Crombie, 1972).

3.7 Parameters of choice behaviour

Ackoff and Emery (1972) (in Emery (1977)) defined four parameters (conditions) of choice behaviour:

- *Probability of choice*, which is the probability for a person to make a specific choice dependent on what fits the best for him;
- *Probable effectiveness*, which is based on the knowledge of the effectiveness of the courses of action;
- *Relative value of the intention* leading to choice;
- *Probable outcome*, which derives from the probability of choice and the probable effectiveness.

3.8 Design principles

For foster active adaptation, F. Emery (1967, 1977) proposed the design of an organization according to two design principles. There are two organisational design principles proposed by F. Emery (Emery, 2000). The first design principle, DP1 (also called redundancy of parts), is characterized by the fact that at any given time a task can be performed by more parts (people) than it requires, and coordination and control are undertaken by part(s) in at least one level above, i.e., hierarchical governance (Barton and Selsky, 2000). The second design principle, DP2 (also called redundancy of functions), is characterized by the fact that every part may acquire more skills and perform more functions than it can use at any given time, and coordination and control are undertaken by the part accomplishing the task, i.e., democratic governance (Barton and Selsky, 2000).

Table 3.2 Relationships between parameters of open system, parameters of choice behaviour and maladaptations

Parameters	Parameter of choice	Passive maladaptive	Active maladaptive[1]
L_{11}	Probability of choice	*Segmentation* represents the separation of means and ends; parts pursue their own ends independent of the ends of the whole.	*Authoritarianism or law and order* is manifested by using power of the parts to achieve the ends of the whole system.
L_{21}	Probable effectiveness	*Dissociation* is the manifestation of a lack of coordination and collaboration between the parts in the whole feeding the "us" and "them" vision; commitments are made only for the group.	*Evangelicism* occurs when homonymous tendencies are dominant.
L_{12}	Probability of outcome	*Doomsday* is the expression of people feeling powerless to influence outcomes.	*Social engineering* is the result of deliberate action of the elite in favour of their most desirable outcomes.
L_{22}	Relative intention	*Superficiality* is a retreat from a turbulent environment due to high uncertainty and high complexity, as a result of which it expresses a reduction in investment and motivation in outcomes.	*Synoptic idealism* focuses on depth; it results from the control of the elite that do not believe in the importance of people's motivation in effectiveness in producing outcomes.

(Adapted from Alvarez and Emery (2000), 1 (Crombie, 1972)

3.9 Inter-organizational domain and the referent organization

For his part, Trist (1983) defined the inter-organizational domain and the referent organization as a means for active adaptation. Inter-organizational domains concern

organizational populations where a population “engages with a set of problems, or a societal problem area, which constitutes a domain of common concern for its members” (p. 269). A referent organization should be regulative, not operational, controlled by the stakeholders involved in the domain and not isolated.

CHAPTER 4

RESULTS

This chapter reports our findings with regards to our research questions. The findings are based on data from 24 studies.

4.1 Authors who contributed the most to the ETM-CT

RQ1. Who are the authors who contributed the most to this model?

We cite contributing authors in chronological order of their first publications on the model: Fred E. Emery and Eric L. Trist, Alastair Crombie, Merrelyn Emery, Joseph McCann, John W. Selsky, Oguz N. Babüroğlu, Don de Guerre, Rossana C. Alvarez, Frank Heller, James Goes, James Lee, Rafael Ramírez, and Madeleine Forssell.

4.2 Authors' contributions to the ETM-CT

RQ2. How did the authors contribute?

In this subchapter, we present the contributions of authors to the evolution of the ETM-CT. These contributions are organized by author or group of authors for joint contributions.

Fred Emery and Eric Trist. They are the original authors who contributed the most to the model of causal texture.

- They primarily developed the model by adding to the concept of open systems (conceived by von Bertalanffy, 1950);
- They defined the four parameters of an open system (i.e., L_{11}, L_{22}, L_{12}, L_{21});
- They conceptualized the ideal types of causal texture;
- They proposed the use of shared values between members of a system and its environment as a means for transforming turbulent fields, hence reducing uncertainty and fostering stability (new forms of Type II environments);

- They specified the relationships between the parameters of choice behaviour and the passive maladaptive responses;
- They conducted the first Search Conference as a means for helping organizational systems to coevolve with their environment by fostering proper active adaptation and ideal seeking (in 1959).

Fred Emery. His contributions are:

- He described in greater detail the texture of the environment types and he gave an historical account of the transition to turbulence;
- He added bureaucratization as a fifth trend towards the emergence of the turbulent environment;
- He derived the passive maladaptive responses to turbulent environments (initially superficiality was also designated as fractionation and fragmentation was used instead of segmentation) from Angyal's (1941, 1965) dimensions of a dynamic whole;
- He defined the doomsday scenarios as a fourth passive maladaptation;
- He defined passive adaptation planning (satisficing planning and optimizing planning);
- He discussed active adaptive planning relative to shared values, desirable future, learning, decision-making and parameters of choice behaviour;
- He proposed a set of ideals (see Table 3.1);
- He discussed the relationship between ideals, maladaptive strategies, parameters of choice behaviour and parameters of open systems;
- He established a correspondence between the parameters of open system, the environment types, learning and planning;
- He developed organizational design through design principles;
- He proposed the Search Conference as a kind of intervention concerning the process of change;
- He highlighted the difference between policy-making and strategy making;
- He redefined the role of policy expert.

Eric Trist. His contributions are:

- He matched environmental types with the planning modes of Ackoff (1974);
- He discussed limitations of reductionism and bureaucracy in turbulent environments;
- He tackled the transition (adaptive response capabilities) from Type III to Type IV environments (system characteristics);
- He elaborated the society sectors list and socio-cultural list regarding increasing and decreasing turbulence;
- He discussed the power of the person to reduce turbulence;
- He investigated the development of an inter-organizational domain as an active adaptive strategy to turbulence and presented some of the key characteristics of domain formation;
- He specified the role of the referent organization to provide appropriate leadership. He described its functions and defined various types of referent organizations.

Fred Emery and Merrelyn Emery. Their contributions are:

- They added a new active maladaptive response named "eugenics," which is the correlate of the "doomsday" passive maladaptive response;
- They stated that ideals must be pursued as a set in order to actively adapt to the environment;
- They noted that Search Conferences could help members of an organization to define a desirable future that integrates all ideals;
- They demonstrated that quantitative data may be obtained from qualitative data of Search Conference results and documented causal path analysis as a method;
- They defined categories and subcategories of codes associated to ideals and maladaptive scenarios. These codes are useful for the thematic analysis of Search Conference data;
- They developed the Participative Design Workshop to design or redesign an organization according to DP2.

Alistair Crombie. His contributions are:

- He defined the active maladaptive responses by drawing on the concept of adaptation, expressed by the directive correlation, developed by Sommerhoff (1950), and the

conceptualization of living systems, developed by Angyal's (1941) based on the dimensions of a dynamic whole: vertical or depth dimension, progression or means-end dimension, transverse or breadth dimension;

- He proposed that Angyal's process left open the possibility that further dimensions might be recognized;
- He correlated the obtained active maladaptive responses to the passive maladaptive ones.

Merrelyn Emery. Her contributions are:

- She stated that a system could be fully characterized only if we can characterize its environment and vice versa. This defined co-implication between a system and its environment (de Guerre, 2000);
- She presented the two-stage model for active adaptation composed of the Search Conference and the Participative Design Workshop;
- She discussed the environment types relatively to the design principles and the main waves of social change over time until 2011;
- She made changes in the Search Conference methodology and modified the codification of subcategories of ideals and maladaptive scenarios.

Joseph McCann and John W. Selsky. Their contributions are:

- They discussed the emergence of the Type V environment, which they called the totally hyperturbulent environment or the partitioned environment and which is the result of escalating turbulence until it becomes endemic. They placed hypertubulence at mid-range between the turbulent environment and the vortical environment;
- They stated that turbulence is related to the perception of the field's members of their adaptive capacity (either individual or collective) to manage turbulence;
- They discussed limitations of collaboration as an adaptive response to turbulent environments;
- They explained that ineffective partitioning, which is initially an adaptive response, makes hyperturbulence endemic;

- They identified maladaptive processes: *social enclave*, which "is a domain of less turbulent, more manageable social space that is created and protected by one or more members" (McCann and Selsky, 1984, p. 465) and *social vortex*, which "contains members who collectively lack sufficient adaptive capacity relative to prevailing environmental conditions"(McCann and Selsky, 1984, p. 466)
- They proposed, based in part on the work of McCann, Selsky and Lee (2009), agility and resiliency as two of the most critical elements for sustaining, and even building, superior performance in increasingly turbulent environments;
- They highlighted the mutual correlation between agility and resiliency and recommended that they be considered together for adaptation;
- They described the characteristics of highly agile and resilient individuals, teams, organizations and ecosystems;
- They proposed an organizing model to guide the development of high agility and resiliency.

Oguz N. Babüroğlu. His contributions are:

- He showed the existence of signs and trends of vortical environments;
- He conceptualized the vortical environment;
- He defined the maladaptive responses present in this environment, building on Angyal's (1941) dimensions of dynamic whole and passive maladaptive responses described in Emery (1977). These maladaptive responses are *stalemate*, which is being stuck in the middle of a transition as the parts of the system are not purposeful and pursue their own means-ends purposes; *polarization*, which is often represented by intense ingroup-outgroup dynamics; *monothematic dogmatism*, which is to perceive the reality as absolute. These maladaptive responses are crystallization of maladaptive responses to turbulent environment and "Maladaptions are active responses in the sense that they emerge as remedies to the perplexity of turbulent environments" (Babüroğlu, 1988, p. 199). He considered it impossible to formulate a set of passive maladaptive responses;
- He discussed adaptation strategy to this environment;

- He noted that Trist (1984) highlighted the novel contribution of Angyal in thinking of dynamics of systems through the conceptualization of the inter-relation between the system and the environment..

Don de Guerre. His contributions are:

- He showed the need for directive correlation between cultural change in an organization and change in the organization's environment to ensure the sustainability of the cultural change in the organization (one cannot develop companies without developing countries);
- He also showed, by using Sommerhoff's (1969) model of adaptation, that organizations and environments are co-implicative through cultural change.

Rossana C. Alvarez and Merrelyn Emery. Their contributions are:

- They improved the Search Conference methodology and, based on the method of Emery and Emery (1979), developed a method to obtain quantitative data from qualitative data, after enlarging the scope of the initial method;
- They changed "eugenics" maladaption (Emery and Emery, 1979) to "social engineering."

Frank Heller. His contributions are:

- He extended joint optimization to be achieved between three systems: the social, the technical and the ecological;
- He stated that the influence from the organization to the environment, in the causal texture model, was not developed.

John W. Selsky, James Goes and Oguz N. Babüroğlu. Their contributions are:

- They compared two strategies of adaptation to turbulence: the neoclassical perspective and the socioecological one. They stated that the two perspectives have different conceptualizations of turbulence;
- They gave the characteristics of the socioecological perspective: It is field focused, meaning that sets of players with varying interests constitute the field. It is holistic, which is expressed by considering the organization's social structures and cultural contexts in

decision-making. It is future responsive, which is translated by taking into account both long- and short-term effects and repercussions of action in decision-making. And it has a collective and whole view mode of sense-making, which induces collaboration and deliberation in decision making;

- They defined properties of hyperenvironments (hypercompetition (D'Aveni, 1994) and hyperturbulence (McCann and Selsky, 1984)).

Joseph McCann, John W. Selsky and James Lee. Their contributions are:

- They highlighted the importance of agility and resiliency to foster adaptive capacity;
- They suggested the development of both to achieve active adaptation;
- They proposed the introduction of scenario planning.

Rafael Ramirez and Madeleine Forssell. Their contribution is:

- They discussed the importance of developing scenarios to face turbulence.

John W. Selsky, Rafael Ramirez and Oguz N. Babüroğlu . Their contributions are:

- They proposed a third design principle, DP3 (Redundancy of Potentialities), arguing that it may design or redesign social fields at levels of inter-organizations, organizations and teams to encourage creative collaboration; however, they focussed on inter-organizations;
- They noted that DP3 was already widespread in practice;
- They reported that the purpose of DP3 is to identify potential connections and capabilities existing in trans-organizations; and that it supports innovation more explicitly than DP2.

Table 4.1 lists the main contributing authors we identified as well as the key concepts they contributed to. Note that the key contributions per study are summarized in Appendix III.

Table 4.1 Main contributing authors and main contributions

Authors	Parameters of open system	Types of causal texture	Ideals	Maladaptive strategies	Parameters of choice behavior	Design principles	Search Conference	Participative Design Workshop	Adaptation (*)	Inter-organizational domain	Referent organization
Fred E. Emery	X	X	X	X	X	X	X	X	X		
Eric L. Trist	X	X	X	X	X		X		X	X	X
Alastair Crombie				X					X		
Merrelyn Emery			X	X		X	X	X	X		
Joseph McCann		X		X					X		
John W. Selsky		X		X		X			X		
Oguz N. Babüroğlu		X		X		X			X		
Don de Guerre		X				X			X		
Rossana C. Alvarez				X			X		X		
Frank Heller		X							X		
James Goes		X							X		
James Lee									X		
Rafael Ramírez						X			X		
Madeleine Forssell									X		

(*) Adaptation strategy and/or adaptation principle(s)

CHAPTER 5

DISCUSSION

Our third research question (RQ3) (What are the similarities and differences between these authors?) is addressed in this chapter.

5.1 Convergences between authors

In general, the authors agreed about the open character of organizations and existence of a bidirectional relationship of mutual influence between an organization and its environment. They also agreed on the main characteristics of the first four causal texture types and that organizations experience turbulent conditions that intensify if they do not adapt to turbulent environments. They also agreed on several principles of adaptation.

5.2 Divergences between authors

The review of the selected studies led us to identify divergences between authors. Each divergence is discussed separately; the order of presentation does not represent levels of importance.

Meaning of the term system

There seems to be divergences of opinions with regards to the meaning of the term system. Emery (2000) discussed divergences between Fred Emery and Eric Trist about what can be considered a system. For Fred Emery, the definition of a system includes a network of organizations, while for Trist, it does not. Consequently, Trist defined the concept of an inter-organizational domain.

This divergence raises the possibility that other authors might implicitly have diverging views on the meaning of the term system. Bringing clarity to the implicit meaning of the term as used by various authors could emerge new insights about their contributions. Obviously, if

there is confusion in the meaning of "system," an author may explain an organization's strategy as adaptive when, in fact, it may be maladaptive.

Correspondence between open system parameters and the behaviours related to parameters of choice

Multiple correspondences between the open systems parameters and the behaviours related to parameters of choice can be found. In Emery and Emery (1979), there is a difference in the correspondence between open system parameters and parameters of choice behaviour related to Emery (1977). More precisely, there was a permutation between L_{12} and L_{21}: L_{12} and L_{21} were associated with probability of outcome and probable effectiveness, respectively in Emery and Emery (1979) instead of probable effectiveness and probability of outcome, respectively, in Emery (1977). However, we were not capable of verifying if this modification was a contribution of that paper or another.

Beyond investigating the origins of the permutation, no literature could be found that discussed the implications of such a change. This should be investigated further because it could have important implications for the understanding, validation and evolution of the ETM-CT model. This divergence raises some important questions, such as why did the authors perform these modifications?, what is the value of these correspondences for organizations' adaptation? and what would happen if these correspondences were used to identify maladaptive responses in scenarios planning of organizations' environments?

Correspondence between open system parameters and Angyal's dimensions of a dynamic whole

There is a difference between Emery (1977) and Babüroğlu (1988) concerning the correspondence between the open system parameters and Angyal's dimensions of a dynamic whole. Indeed, while Emery associated L_{12}, L_{11} and L_{22} to the transverse, progression and vertical dimensions, respectively, Babüroğlu associated L_{11}, L_{12} and L_{21} to those dimensions without mentioning the reasons for these modifications. In addition, Babüroğlu used Emery (1977) to conceptualize the vortical environment.

This divergence raises some important questions such as why did the authors perform these modifications?, what is the value of these correspondences for organizations' adaptation?, what would happen if these correspondences were used to identify maladaptive responses in scenarios planning of organizations' environments? and what is the impact on the conceptualization of the vortical environment?

Undefined maladaptive response concerning doomsday for the vortical environment

To define the maladaptive responses for the vortical environment, Babüroğlu (1988) used Angyal's dimensions of a dynamic whole and maladaptive responses in Emery (1977). He then deduced three maladaptions, as there are three dimensions in Angyal. For Babüroğlu (1988), the doomsday and social engineering maladaptions do not have a correspondence in vortical environment. According to Crombie (1972), Angyal left open the eventuality of other dimensions, for he had no evidence that only three dimensions existed.

In contrast, Emery and Trist (1973) used the purposeful open system model of Ackoff and Emery (1972) in order to derive similar dimensions, three of which are identical to Angyal's dimensions. As the purposeful open system model proposed four dimensions, Emery derived the doomsday scenario as a fourth passive maladaptive response. This difference between the authors raises the question if Babüroğlu only considered the need for three dimensions because the fourth dimension, as defined by Emery (1977), is a combination of two other dimensions. Moreover, this could also be interpreted as a sign that there are divergences between the authors with regards to the conceptualization of the vortical environment type.

Another interesting fact is that in Emery and Trist (1973), the probable outcome dimension was not discussed when the correspondence was made between Angyal's dimensions of a dynamic whole and the dimensions of choice behaviour. This question was treated in Emery (1977). This raises the question what was the reason that Emery and Trist (1973) did not mention this fourth dimension?

Definition of ideals

There exist multiple different sets of ideals proposed by different authors. Emery (1977) noted that his proposal was the result of rethinking the set proposed by Ackoff and Emery (1972). Emery (1977) stated that he did not compare the set of ideals he proposed with the set of ideals proposed by Trist in Emery and Trist (1972), even if he believed that doing so would be interesting. Table 3.1 summarizes the lists of ideals proposed by Trist, Ackoff and Emery. Emery (1977) established a correspondence between ideals, parameters of choice behaviour, parameters of open systems and maladaptive responses. Such differences raise interesting questions, such as on what basis did Emery (1977) establish the correspondence? and if the ideals were fundamentally different, would this lead to different sets of organizational adaptation behaviours? It is also interesting to compare the set of ideals proposed by Emery with that proposed by Trist.

Need for the conceptualization of the vortical environment

There seems to be divergences between authors with regards to the need for conceptualizing a vortical environment. In Emery and Trist (1973), it is mentioned that the authors did not conceptualize the vortical environment because "they cannot conceive of adaptation occurring in such fields." (p. 41). They commented on maladaptions to turbulence: "But there are also unfavourable trends arising from the maladaptive defenses. These are producing conditions to which no adaptation is possible at all" (p. xiv). Can we then deduce that as far as survival is not compromised, the Type IV environment will continue?

In contrast, Babüroğlu (1988) argued that persistence of maladaptions and turbulent conditions change the causal texture of the environment to Type V. Babüroğlu believed that it is important to conceptualize this environment and that there are signs of its existence. Such a divergence raises the possibility that there is no consensus on the meaning of the vortical environment.

Designation of Type V environment

There seems to be multiple competing designations or labels for the Type V environment. McCann and Selsky (1984) defined hyperturbulence as a mid-range causal texture between the turbulent environment and the vortical environment; and they stated that when hyperturbulence becomes endemic that leads to the totally hyperturbulent environment also referred to as the partitioned environment. Does this mean that the vortical environment is equivalent to this partitioned environment? If so, why did McCann and Selsky not refer to it as the vortical environment? The reason could be because McCann and Selsky noted that Emery (1977) characterized the vortical environment as "an environment shaped by forces totally beyond management" (McCann and Selsky, 1984, p. 460) which leads us to believe that McCann and Selsky thought that the partitioned environment might be managed. Similar to the previous divergence, this raises the possibility that there is no consensus on the meaning of the vortical environment.

Definition of maladaptive responses for the Type V environment

There are differences with regards to the proposed set of maladaptive responses for the Type V environment. The set proposed by McCann and Selsky (1984) consists of social enclaves and social vortices. The set proposed by Babüroğlu (1988) consists of stalemate, polarization and monothematic dogmatism. We were not capable of finding an article that established a correspondence between the two sets. Such differences raise the possibility that there exists a direct correspondence between the set items or that the authors have proposed fundamentally different maladaptive responses or even that their understandings of the Type V environment are very different.

Assessing turbulence

There are different views with regards to the assessment of turbulence within an environment. According to Ramirez and Forssell (2011, p. 99), McCann and Selsky (1984) suggested that "This subjective assessment of turbulence contrasts with Emery and Trist's original stance in 1965, as they then considered turbulence to be an objective condition of a field" that affects scenario work. Such differences raise the need for clarifying the meaning

of the expression “assessment of turbulence.” Moreover, the differences open the possibility of the existence of multiple types of turbulence that could lead to a different set of adaptive behaviours and strategies.

Importance and completeness of design principles

There are divergences with regards to the importance of design principles as well as the complete set. Selsky et al. (2013) stated that, unlike Emery (1999), the two organization design principles, DP1 and DP2, are not complete and exhaustive. They proposed a third design principle, DP3. Hence, this indicates differences of opinions with regards to the adequate set but also implies the importance of the concept of design principles.

In contrast, according to Emery (2000), Trist and Ackoff never used design principles. Hence, this could imply that Trist and Ackoff found little value in the concept of design principles or that the statement made by Emery (2000) was false. These possible divergences open the possibility of questioning the theoretical validity for the design principles.

Invention of the Search Conference

There seem to be divergences with regards to the inventors of the Search Conference. According to Emery (2000), Trist attributed the Search Conference methodology to Fred Emery and that the first Search Conference was conducted by both of them in 1959. This raises the possibility of the existence of fundamental differences between the Search Conference methodology as defined by Fred Emery and the one developed both Fred Emery and Eric Trist.

CHAPTER 6

LIMITATIONS OF THE LITERATURE REVIEW

This study presents two limitations:

- While, the review was performed following a procedure defined by three researchers, the search process, data extraction and data analysis were conducted by one researcher under the supervision of the two others.
- We could not access all the studies we selected. However, as explained before, for each of the studies we could not access, we adopted a sandwich strategy to determine if it contributed to the model or not.

However, as mentioned before, to guarantee the consistency of the review, the results were reviewed by experts of the paradigm, Don de Guerre and Alan Trist.

CHAPTER 7

IMPLICATIONS OF THE ETM-CT ON ENTERPRISE ARCHITECTURE RESEARCH

The literature review on EA we conducted in the context of this study showed the need to integrate the relationship between an organization and its environment into EA approaches. This system-in-environment co-evolution is the very core of the ETM-CT. Some of the EA approaches investigated for the literature review on EA incorporated some concepts promoted by ETM-CT. In this chapter, we discuss some implications of the ETM-CT for EA research as a project proposal.

The main objective of the project is to enhance EA with principles that would enable organizations to meet the challenges that significantly impact their sustainability. Depending if the project concerns contemporary or future design sustainable organizations, a literature review of either realities (actual context) or future trends for organizations should be conducted to identify key constraints and opportunities for organizations. This mainly will consist of answering the following questions:

- What are the changes that the world is experiencing? or what would be the world changes in the future? (scenarios analysis). Based on the characterization of the environment (causal texture) types of the ETM-CT, world scenarios (future scenarios plannings in the case of future organizations) will be analysed to deduce characteristics that would inform the type of environment that characterizes or would characterize the world.
- Do world changes impact the organizations? or would the world changes impact the organizations? (trends for organizations, constraints and opportunities). This will consist of identifying, based on the ETM-CT, signs of maladaptive responses of organizations to the environment (world).

The resulting literature review will identify the characteristics (definitions and specificities) of organizations that will ensure their sustainability. Indeed, once the environment type will be defined, the decision-making strategy that would help organizations to actively adapt to

that environment will be deduced from the ETM-CT. The decision-making strategy can be decomposed in a set of characteristics.

Depending on the scope of the project, the analysis of these characteristics will focus only on the most critical characteristics. However, it would be important to determine which selected characteristics will not make the decision strategy maladaptive. We recall that, accordng to Emery and Emery (1979), ideals must be pursued as a set. Also, a desicison strategy must be an expression of the pursuit of ideals. To determine if there exists a co-implication between the organization and its environment, an analysis will be conducted to determine if successul organizations (having the identified characteristics) will influence the world.
Moreover, to change the selected characteristics into principles to integrate in EA, it is important to:

- Define which kind of EA would help successul organizations. This will consist of defining the scope and the purpose of EA.
- Identify the theories that would be the most promising to perform this change. This is a critical and crucial step.

Through the study of the ETM-CT, we identified the following systems thinking theories as candidates: Socio-Technical Systems (STS) and Open System Theory (OST). These theories are closely related to the model originated by Fred Emery and Trist (Trist, 1981; Emery, 2000). In addition to these theories, we also suggest design thinking. All these theories foster concepts of the ETM-CT. Using design thinking may also be of great value as the organization must permanently redesign its business while trying to innovate and improve efficiency to ensure its adaptation to its environment. However, to respect scientific rigor, all kinds of thinking theories should be identified and analyzed to assess their support of the kind of EA targeted by this project.

For each theory, the selected characteristics will be transformed into principles (conceptualization) serving EA and then organizations. It would be interesting to study combinations of these theories. Finally, the principles obtained will be integrated in EA. The

results and the recommendations of the project would lead other researchers and practioners to invest efforts in implementing an EA approach.

CHAPTER 8

FUTURE WORK

As future work and based on the insights of CHAPTER 5, which discusses the findings of our SLR methodology, and CHAPTER 7, which documents implications of the ETM-CT on EA research, we propose prioritizing the investigation of the following points:

- The meaning of the term "system". as confusion in its meaning may lead to the development of an organization's adaptive strategy that may be in fact maladaptive and then lead to inefficient EA approaches.
- Correspondence between open system parameters and the behaviours related to parameters of choice, and Angyal's dimensions of a dynamic whole. This would lead to identifying the impact of organizations' adaptation. Also, these correspondences will be used to identify maladaptive responses in scenarios planning of organizations' environments. The findings of these scenarios planning will determine the type and the characteristics of the environment to which an organization should adapt. This will also lead to determining the characteristics of a sustainable organization.
- Reconcile, if possible, the various sets of ideals proposed by different authors into a coherent set as well as establish the correspondence between this new set and other important concepts (i.e. open system parameters, parameters of choice, maladaptive responses).
- Define a proper means for assessing the degree of an environment's turbulence in order to determine the environment type of the environment.

Note that we focus primarily on the turbulent environment, as it is presently the causal texture of the world and it is most probable that it will be the same in the near future even if there is an escalation in level of turbulence. We also believe, through the study of turbulent and vortical environments (and based specifically on the work of Emery (1977) and Babüroğlu (1988)), that the characteristics of a sustainable organization in a turbulent environment are the same as in a vortical environment. This is due to the fact that

maladaptive responses to the vortical environment result from the crystallization of the maladaptive responses to the turbulent environment. This deserves to be investigated and needs to tackle the issue of the correspondence of the doomsday scenario in the vortical environment.

CONCLUSION

This report investigated the evolution of the Emery-Trist model on the causal texture promoting the mutual influence between an organization and its environment, and developing concepts for active adaptation of the organization to the environment. This model is also of great value for EA community as it helps the design or the redesign of a sustainable organization. A systematic literature review was conducted to gather knowledge on the model. It was based on an exhaustive study of the literature relevant to the model. The main contributing authors to the model were identified and their main contributions presented. The analysis of these contributions allowed us to highlight convergences and divergences between authors. Some of the divergences helped the emergence of eventual research issues that will foster the development of the model, such as investigating the impact of different definitions or understandings of concepts on the evolution of the model; the importance of parameters of open system, parameters of choice behaviour, maladaptations and ideals to assess the adaptation of organizations in planning scenarios; the conceptualization of the vortical environment drawing on contributions of the different authors; the assessment of turbulence and systems' adaptive capacities; and the design of adaptive organizations. Limitations of our SLR methodology were listed. We also discussed some implications of the ETM-CT on EA research. This mainly consisted on how to determine from the ETM-CT the characteristics of a sustainable organization by analyzing planning scenarios of its environment (the world); and how to derive principles to integrate in an EA approach for the design or redesign of that sustainable organization. Drawing on our insights of these implications and the research issues we identified concerning the ETM-CT, we presented our recommendations for a future work.

APPENDIX I

SELECTED STUDIES

Table-A I-1 Selected studies included in the review

Authors	Year	Source	Title	Search source (*)
Emery, F. E. and E. L.Trist	1965	*Human Relations*, vol. 18, No. 1, p. 21-32	The Causal Texture Of Organizational Environments	Tavistock Reference list Scopus Publications
Emery, F.	1967	*Human Relations*, vol. 50, No. 8, p. 885-935	The Next Thirty Years: Concepts And Anticipations	Tavistock Reference list Publications
Crombie, A.	1972	Doctoral thesis, Research School of Social Science, Australian National University	Planning for turbulent social fields, department of sociology	Previous study Tavistock Reference list
Emery, F.	1972	In *Australian High Education*, Harman, G. S. and Selby Smith, C.(Eds.), Melbourne: Angus and Robertson	Planning for Real but Different Worlds	Tavistock Publications
Emery, F. E. and E. L.Trist	1973	New York: Plenum,1973	Towards a Social Ecology	Reference list Previous study Tavistock Publications
Emery,F. E. and M.Emery	1974	In *Participative Design: Work and Community Life*, Emery, M. (Ed.).Centre for Continuing Education: Australian National University, Canberra	Participative Design for Participative Democracy	Tavistock Publications

Table-A I-1 Selected studies included in the review (cont'd)

Authors	Year	Source	Title	Search source (*)
Emery, F. E	1977	Leiden, Netherlands: Martinus Nijhof	Futures We Are In	Previous study Reference list Publications
Emery, F. E. and M. Emery	1979	Project Australia	Project Australia	Tavistock Reference list Publications
Trist, E. L.	1980	*Futures*, vol. 12, p. 113-127	The Environment And System Response Capability: A Futures Perspective	Tavistock Publications
Trist, E. L.	1983	*Human Relations*, vol. 36, No. 3, p. 269-284	Referent Organizations And The Development Of Inter-Organizational Domains	Tavistock Reference list Publications
McCann, J. and J. W.Selsky,	1984	*Academy of Management Review*, vol. 9, No. 3, p. 40-470	Hyperturbulence And The Emergence Of Type 5 Environments	Previous study Reference list
Babüroğlu, O. N.	1988	*Human Relations*, vol. 41, No. 3, p. 181-210	The Vortical Environment: The Fifth In The Emery-Trist Levels Of Organizational Environments	Reference list Previous study Tavistock CV
Emery, F. E.	1993	In *A Systems Based Approach to Policymaking*, de Greene, K. B. (Ed.), Dordrecht: Kluwer Academic Press	Policy: Appearance and Reality	Previous study Tavistock Publications

Table-A I-1 Selected studies included in the review (cont'd)

Authors	Year	Source	Title	Search source (*)
Emery, M.	1999	John Benjamins, Amsterdam	Searching: The Theory and Practice of Making Cultural Change	Previous study Publications
Alvarez, R. C,and M. Emery	2000	*Systemic Practice and Action Research*, vol. 13, No. 5, p. 683-703	From Action Research To System In Environments: A Method	Scopus Reference list Publications
de Guerre, D.	2000	*Systemic Practice and Action Research*, vol. 13, No. 5, p. 645-663	The co-determination of cultural change over time	Previous study Reference list Scopus
Emery, M.	2000	*Systemic Practice and Action Research*, vol. 13, No. 5, p. 623-643	The current version of emery's open systems theory	Previous study Scopus Publications
Heller, F.	2001	*Journal of Engineering and Technology Management*, vol. 18, p. 295-312	Towards a Socio-Ecotechnology	Scopus
Selsky, J.W., J. Goesand O. N. Babüroğlu	2007	*Organization Studies*, vol. 28, p. 71-94	Contrasting Perspectives Of Strategy Making: Applications In 'Hyper' Environments	Previous study Scopus CV
McCann, J., J. W.Selsky and James Lee	2009	*People and Strategy*, vol. 32, No. 3, p. 45-51	Building Agility, Resilience And Performance In Turbulent Environments	Previous study Reference list CV
Ramírez, R. and M. Forssell,	2011	*Ekonomiaz*, 2011, no. 76, 1.er cuatrimestre	Uncertainty, Turbulence and Scenarios	Previous study

Table-A I-1 Selected studies included in the review (cont'd)

Authors	**Year**	**Source**	**Title**	**Search source** (*)
McCann, J. and J. W. Selsky	2012	Teams and Organizations. San Francisco: Jossey-Bass/Wiley	Mastering Turbulence: The Essential Capabilities of Agile and Resilient Individuals	Previous study CV
Emery, M.	2013	*Advances in Sociology Research*, vol. 14, p. 1-68	From Tunisia to Occupy and Beyond: The New Wave Of Social Change, Past, Present And Future	Previous study Publications
Selsky, J.W., Ramírez, R. and O. N. Babüroğlu	2013	*Systemic Practice and Action Research*, vol. 25, p. 377-395	Collaborative Capability Design: Redundancy Of Potentialities	Scopus

APPENDIX II

REJECTED STUDIES

Table-A II-1 Selected studies excluded from the review because they do not develop the model

Authors	Year	Source	Title	Search source
Emery, F., and C. Phillips	1976	Australian Government Publishing Service, Canberra	Causal path Analysis	Tavistock
Trist, E. L.	1981	Ontario Quality of Working Life Center, Ontario Ministry of Labour	The evolution of socio-technical systems: a conceptual framework and an action research program	Previous study Tavistock Publications
Emery, F. E.	1981	Public Enterprises Centre for Continuing Education, New Delhi.	Educational Paradigms: An Epistemological Revolution	Tavistock Publications
Babüroğlu, O. N.	1992	*Systems Practice*, vol. 5, No. 3, p. 263-290.	Tracking the Development of the Emery-Trist Systems Paradigm (ETSP)	Reference list
Emery, F. E.	1994	*International Journal of Employment Studies*, vol. 2, No. 2, p. 327-342	Some Observations on Workplace Reform: The Australian Experience	Tavistock
Jiménez, J., J.C. Escalante, and J. Aguirre-Vázquez	1997	*Systems Practice*, vol.10, No.3, p. 255-269	Application of the Search Conference Methodology to Planning In Higher Education	Scopus
Paswan, A.K., R.P.Dant, and J.R.Lumpkin,	1998	*Journal of Business Research*, vol. 43, No. 3, p. 125-140	An Empirical Investigation of the Linkages Among Relationalism, Environmental Uncertainty, and Bureaucratization	Scopus

Table-A II-1 Selected studies excluded from the review because they do not develop the model (cont'd)

Authors	Year	Source	Title	Search source
Gloster, M.	2000	*Systemic Practice and Action Research*, vol. 13, No. 5, p. 665-682	Approaching Action Research From A Socioecological Perspective	Scopus
Selsky, J.W. and J. Barton	2000	*Systemic Practice and Action Research*, vol. 13, No. 3, p. 257-277	The Third Track of the Open-Systems-Thinking School: An Application of Domain Theory to New Zealand Ports	Scopus Previous study
Ellis, S. and N. Shpielberg	2003	*Human Relations*, vol. 56, No. 19, p. 1233-1254	Organizational Learning Mechanisms And Managers' Perceived Uncertainty	Scopus
Lin, Z. and D. Li	2004	*Group and Organization Management*, vol. 29, p. 32-66	The Performance Consequences of Top Management Successions: The Roles of Organizational And Environmental Contexts	Scopus
Barton, J., M. Emery, R. L. Flood, J.W. Selsky and E. Wolstenhome	2004	*Systemic Practice and Action Research*, vol. 17, p. 3-36	A Maturing Of Systems Thinking? Evidence from Three Perspectives	Scopus
Boyne, G.A. and K. J. Meier	2009	*Administration and Society*, vol. 40, No. 8, p. 799-824	Environmental Turbulence, Organizational Stability, and Public Service Performance	Scopus
Edwards, M.G.	2009	*Learning Organization*, vol. 16, No. 3, pp. 189-207	An Integrative Metatheory for Organizational Learning And Sustainability in Turbulent Times	Scopus

Table-A II-1 Selected studies excluded from the review because they do not develop the model (cont'd)

Authors	Year	Source	Title	Search source
Flood, R.L.	2010	*Systemic Practice and Action Research*, vol. 23, p. 269-284	The Relationship of 'Systems Thinking' to Action Research	Scopus
Ellis, S.D. Margalit and E. Segev	2012	*Knowledge and Process Management*, vol. 19, No. 2, p. 91-102	Effects of Organizational Learning Mechanisms on Organizational Performance and Shared Mental Models During Planned Change	Scopus
Moeller, L. and V. Valentinov	2012	*Systemic Practice and Action Research*, vol. 23, p. 365-370	The Commercialization of the Nonprofit Sector: A General Systems Theory Perspective	Scopus

Table-A II-2 Selected studies excluded from the review because we did not have access

Authors	Year	Source	Title	Search source
Knowles, H.P. and B. O. Saxberg	1988	*Futures*, vol. 20, No. 3, p. 252-265	Organizational Leadership of Planned and Unplanned Change: A Systems Approach to Organizational Viability	Scopus
Hawk, D.L.	1996	*Journal of Architectural and Planning Research*, vol. 13, p. 10-33	Relations Between Architecture and Management	Scopus
Lin, Z. and C. Hui	1999	*Journal of International Business Studies*, vol. 30, p. 45-80	Should Lean Replace Mass Organization Systems? A Comparative Examination from a Management Coordination Perspective	Scopus
Lorenz, F.O., J. Hraba and Z. Pechačová	1999	*Rural Sociology*, vol. 64, No. 4, p. 693-717	Privatization and Income Change in the Czech Republic: Tensions in the Lives of Rural and Urban Employed Men	Scopus
Stein, M.	2000	*Journal of Management Studies*, vol. 37, No. 8, p. 1215-1230	The Risk Taker as Shadow: A Psychoanalytic View of the Collapse of Barings Bank	Scopus
Mileti, D.S., D.M. Cress and J. D. Darlington	2002	*Sociological Forum*, vol. 17, p. 161-180	Earthquake Culture and Corporate Action	Scopus
Bryson, J.M., B.C. Crosby and M.M. Stone,	2006	*Public Administration Review*, vol. 66, p. 44-55	The Design and Implementation of Cross-Sector Collaborations: Propositions from the Literature	Scopus
Dixon, D. F. and I.F. Wilkinson	2006	*European Journal of Marketing*, vol. 23, No. 8, p.59 –-69.	An Alternative Paradigm for Marketing Theory	Scopus
Barton, J. and T. Haslett	2007	(Conference Paper), Systems Research and Behavioral Science	Analysis, Synthesis, Systems Thinking and the Scientific Method: Rediscovering the Importance of Open Systems	Scopus

Table-A II-2 Selected studies excluded from the review because we did not have access (cont'd)

Authors	Year	Source	Title	Search source
Curry, A.and A. Hodgson.	2008	*Journal of Futures Studies*, vol. 13, p. 1-20	Seeing in Multiple Horizons: Connecting Futures to Strategy	Scopus
Kira, M. andF. M. van Eijnatten,	2008	*Systems Research and Behavioral Science*, vol. 25, No. 6, p. 743-756	Socially Sustainable Work Organizations: A Chaordic Systems Approach	Scopus
Maclagan, P.	2008	*Systems Research and Behavioral Science*, vol. 25, p. 371-381	Organizations and Responsibility: A Critical Overview	Scopus
Lindquist, E.	2009	In *The Evolving Physiology of Government: Canadian Public Administration in Transition*, Dwivedi, T., A. Mau and M. Sheldrick (Eds.). Ottawa: University of Ottawa Press	Public Administration Research and Organization Theory: Recovering Alternative Perspectives on Public Service Institutions	Scopus
Emery. M	2010	*Systems Research and Behavioral Science*, vol. 28, No. 4, p. 401-417	Fiddling While the Planet Burns: The Scientific Validity of Chaordic Systems Thinking	Scopus
McCarthy, I., T. Lawrence, B. Wixted, and B. Gordon	2010	*Academy of Management Review*, vol. 35, No. 4, p. 604-626	A Multidimensional Conceptualization of Environmental Velocity	Scopus
McGuire, M. and C.Silvia	2010	*Public Administration Review*, vol. 70, No. 2, p. 279-288	The Effect of Problem Severity, Managerial and Organizational Capacity, and Agency Structure on Intergovernmental Collaboration: Evidence from Local Emergency Management	Scopus

Table-A II-2 Selected studies excluded from the review because we did not have access (cont'd)

Authors	Year	Source	Title	Search source
Pavur Jr., E.J.	2012	*Psychologist-Manager Journal*, vol. 15, p. 269-274	Leadership for Managers	Scopus
Volberda, H.W., N. van der Weerdt, EVerwaal, M.Stienstra, and A. J.Verdu	2012	*Organization Science*, vol. 23, No. 4, p. 1040-1054	Contingency Fit, Institutional Fit, and Firm Performance: A Metafit Approach to Organization-Environment Relationships	Scopus
Leonard, H.S.	2013	In *The Wiley-Blackwell Handbook of the Psychology of Leadership, Change, and Organizational Development*, Leonard, H. S., T. Lewis, A. M. Freedman and J. Passmore (Eds.). Wiley-Blackwell.	The History and Current Status of Organizational and Systems Change	Scopus
Kapsali, M.	2013	*Systems Research and Behavioral Science*, vol. 30, p. 2-14	Equifinality in Project Management Exploring Causal Complexity in Projects	Scopus
Cooper, D., P.C.Patel and S. M. B. Thatcher	2014	*Organization Science*, vol. 25, No. 2, p. 633-652	It Depends: Environmental Context and the Effects of Faultlines on Top Management Team Performance	Scopus

APPENDIX III

KEY CONTRIBUTIONS BY STUDIES

Table-A III-1 Key contributions per selected study included in the review

Authors	Year	Title	Key contributions
Emery, F. E. and E. L. Trist	1965	The Causal Texture of Organizational Environments	Development of the model by adding to the concept of open systems Definition of the four parameters of an open system Conceptualization of the types of causal texture, but their main contribution was the introduction of the turbulent environment. They do not go further and leave the need for further types as an open question. Proposal of the use of shared values to transform turbulent fields
Emery, F.	1967	The Next Thirty Years Concepts and Anticipations	A more detailed description of characteristics of environment types Presentation of passive maladaptive responses to turbulent environment Description in more details of the texture of the environment types Deduction of the passive maladaptive responses to the turbulent environment Discussion of the relationship between ideals, maladaptive strategies, parameters of choice behaviour and parameters of open system Establishment of correspondence between the parameters of open system, the environment types, learning and planning Development of organizational design through design principles
Crombie, A.	1972	Planning for Turbulent Social Fields, Department of Sociology	Definition of the active maladaptive responses to turbulence Statement that Angyal's process left open the possibility that further dimensions might be recognized Correlation of the active maladaptive responses to the passive maladaptive ones

Table-A III-1 Key contributions per selected study included in the review (cont'd)

Authors	Year	Title	Key contributions
Emery, F.	1972	Planning for Real but Different Worlds	Definition of passive adaptive planning Discussion of active adaptive planning Proposal of a set of ideals Suggestion of the search conference as a kind of intervention concerning the process of change
Emery, F. E., and E. L.Trist	1973	Towards a Social Ecology	Adding content to Emery (1967) Establishment of the relationships between parameters of choice behaviour and passive maladaptive responses. Further development of the four levels of environment Discussion of three modes of inter-relations: instrumentality, planning (L_{12}) and learning (L_{21}) Description of the texture of the fifth level: the vortical environment and reasons for not conceptualizing it Proposal by Trist of a list of ideals
Emery, F. E. and M. Emery	1974	Participative Design for Participative Democracy	Development of the Participative Design Workshop to design or redesign an organization according to the design principle DP2
Emery, F. E.	1977	Futures We Are In	Discussion on the relationship between ideals, maladaptive strategies and decision-making (parameters of choice behaviour), and components of open system Statement that the set of open system components are justification for the existence of only four choice parameters and then four ideals Establishment of the association between the parameters of open system, the environment types, learning and planning Adding bureaucratization as a fifth trend towards emergence of the turbulent environment. Providing an historical view to the transition to turbulence Mentioning the dimension probable outcome Adding doomsday scenarios as a fourth passive maladaptive response Providing a historical review of his work on values and ideals Development of design principles

Table-A III-1 Key contributions per selected study included in the review (cont'd)

Authors	Year	Title	Key contributions
Emery, F. E. and M. Emery	1979	Project Australia	Addition of "eugenics," which is the correlate of the passive maladaptive response "doomsday" Statement that ideals must be pursued as a set in order to actively adapt to the environment Search Conferences could help members of an organization to define a desirable future that integrates all ideals Demonstration that quantitative data may be obtained from qualitative data of Search Conferences results and documented causal path analysis as a method Definition of categories and subcategories of codes associated to ideals and maladaptive scenarios
Trist, E. L.	1980	The Environment and System Response Capability: A Futures Perspective	Matching environmental types with planning modes of Ackoff (1974) Discussion of the limitations of reductionism and bureaucracy in turbulent environments Tackling the transition (adaptive response capabilities) from Type III to Type IV environments (system characteristics) Elaboration of the society sectors list and the socio-cultural list increasing and decreasing turbulence Discussion of the power of the person to reduce turbulence
Trist, E. L.	1983	Referent Organizations and the Development of Inter-Organizational Domains	Investigation of the development of an inter-organizational and presentation of key characteristics of domain formation Specification of the referent organization

Table-A III-1 Key contributions per selected study included in the review (cont'd)

Authors	Year	Title	Key contributions
McCann, J. andJ. W. Selsky	1984	Hyperturbulence and the Emergence of Type V Environments	Discussion of the emergence of the Type V environment, called the totally hyperturbulent environment or the partitioned environment Placing hypertubulence at mid-range between the turbulent environment and the vortical environment Statement that turbulence is related to the perception of the field's members of their adaptive capacity (either individual or collective) to manage turbulence Discussion of the limitations of collaboration Explanation that ineffective partitioning makes hyperturbulence endemic Identification of maladaptive processes: social enclave and social vortex
Babüroğlu, O. N.	1988	The Vortical Environment: The Fifth in the Emery-Trist Levels of Organizational Environments	Showing existence of signs and trends to the vortical environment Conceptualization of the vortical environment Definition of the maladaptive responses present in this environment: stalemate, polarization and monothematic dogmatism Discussion of an adaptation strategy to this environment Showing position of Trist (1984) concerning the contribution of Angyal in conceptualizing the inter-relation between the system and the environment
Emery, F. E	1993	Policy: Appearance and Reality	Proposition of the Search Conference as a kind of intervention concerning the process of change Specifying the difference between policy-making and strategy making Redefinition of the role of policy expert
Emery, M.	1999	Searching: The Theory and Practice of Making Cultural Change	Statement that a system could be fully characterized only if we can characterize its environment and vice versa. This defined co-implication between a system and its environment (de Guerre, 2000)

Table-A III-1 Key contributions per selected study included in the review (cont'd)

Authors	Year	Title	Key contributions
Alvarez, R. C.and M. Emery	2000	From Action Research to System in Environments: A Method	Improvement of the Search Conference methodology: based on the method of Emery and Emery (1979) after enlarging the scope of the initial method Changing “eugenics” maladaption (Emery and Emery, 1979) to “social engineering”
de Guerre, D.	2000	The Co-Determination of Cultural Change Over Time	Showing the need for directive correlation between cultural change in an organization and change in the organization’s environments to ensure the sustainability of the cultural change in the organization Showing, by using Sommerhoff’s (1969) model of adaptation, that organizations and environments are co-implicative through cultural change
Emery, M.	2000	The Current Version of Emery's Open Systems Theory	Presentation of the two-stage model for active adaptation composed of the Search Conference and the Participative Design Workshop
Heller, F.	2001	Towards a Socio-Ecotechnology	Extension of joint optimization to be achieved between three systems: the social, the technical and the ecological Statement that the influence from the organization to the environment, in the causal texture model, was not developed
Selsky, J.W., J. Goes and O. N. Babüroğlu	2007	Contrasting Perspectives of Strategy Making: Applications in 'Hyper' Environments	Comparison of two strategies of adaptation to turbulence: the neoclassical perspective and the socioecological one Giving the characteristics of the socioecological perspective Definition of properties of hyper environments
McCann, Joseph, John W. Selsky and James Lee	2009	Building Agility, Resilience and Organization Performance in Turbulent Environments	Showing the importance of agility and resiliency to foster adaptive capacity Suggesting to develop both to achieve active adaptation Suggesting the introduction of scenario planning
Ramírez, R. and M. Forssell	2011	Uncertainty, Turbulence and Scenarios	Discussion of the importance of developing scenarios to face turbulence

Table-A III-1 Key contributions per selected study included in the review (cont'd)

Authors	Year	Title	Key contributions
McCann, J. and J. W.Selsky	2012	Mastering Turbulence: The Essential Capabilities of Agile and Resilient Individuals	Proposal, based in part on the work of McCann, Selsky, and Lee, of agility and resiliency as two of the most critical elements for sustaining, even building, superior performance in increasingly turbulent environments Showing the mutual correlation between agility and resiliency and recommendation to consider them together for adaptation Description of the characteristics of high agile and resilient individuals, teams, organizations and ecosystems Proposition of an organizing model to guide the development of high agility and resiliency
Emery, M.	2013	From Tunisia to Occupy and beyond: The New Wave of Social Change, Past, Present And Future	Discussion of the environment types relatively to the design principles and the main waves of social change over time until 2011 Changing the Search Conference methodology Modification of the codification of subcategories of ideals and maladaptive scenarios
Selsky, J.W., R.Ramírez and O. N. Babüroğlu	2013	Collaborative Capability Design: Redundancy of Potentialities	Suggesting a third design principle, DP3 (named Redundancy of Potentialities) Statement that DP3 was already widespread in practice Statement that DP3 supports innovation more explicitly than DP2

APPENDIX IV

SANDWICH STRATEGY

We use the sandwich strategy also as an attempt to analyze the contributions of publications of Fred Emery, Eric Trist and Merrelyn Emery that, according to Emery (1977) and Trist (1983), contributed to the development of the ETM-CT and to which we did not have access. The strategy consists of sandwiching a publication between two publications of the same author, one that appeared before the publication to analyze and the other one after; the latter should cover the content of that publication.

According to Emery (1977), the main contributing studies to the model he or Trist made are: Emery (1963), Emery and Trist (1965), Emery (1967), Emery and Trist (1972) (we cite the 1973 edition). Emery also referred to other works (for instance with Ackoff and with Trist) that helped develop concepts of the model.
Trist (1983)identified the following contributing publications by him and/or Emery: Emery (1967, 1976, 1977), Emery and Emery (1976), Emery and Trist (1965, 1972), and Trist (1967, 1976, 1977a, 1977b, 1979, 1980).

We could not sandwich the following paper:

- Emery. F. E. 1963. Second Progress report on conceptualization, Doc. T125 Tavistock Institutes of Human Relations, London

The following papers are sandwiched between Emery (1965) and Emery (1977). Note that Emery (1977) developed the main contributions to the model until 1977.

- Emery, F. E. 1976a. *In Pursuit of Ideals*. Centre for Continuing Education. Australian National University, Canberra:
- Emery, F. E. 1976b. "Adaptive Systems for our Future Governance". *National Labour Institute Bulletin*, vol. 2, p. 121-129.
- Emery, F. E. and M. Emery. 1976. *A Choice of Futures*. Martinus Nijhoff, Leiden, The Netherlands.

The following references were sandwiched between Emery and Trist (1965) and Trist (1983):

- Trist, E. L. 1967. "Engaging with Large-Scale Systems." Douglas McGregor Memorial Conference, Massachusetts Institute of Technology. Also in *Experimenting with Organizational Life*, Clark, A.W. (Ed.), New York: Plenum.
- Trist, E. L. 1976. "Action Research and Adaptive Planning." In *Experimenting with Organizational Life*, Clark, A.W. (Ed.), New York: Plenum.
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- Trist. E. L. 1979. “New Directions of Hope: Recent Innovations Interconnecting Organizational, Industrial, Community and Personal Development”, *Regional Studies*, vol. 13, No. 5, p. 439-435.

APPENDIX V

IDEALS DEFINITIONS

List of ideals proposed by Emery (1977):

- Unlike selfishness, **homonomy**, the complement of autonomy, refers to the sense of belonging to a group and the whole system, whereby interdependence is strengthened.
- In opposition to exploitation, **nurturance** cultivates and uses the means in order to contribute to the health and beauty of the whole and its parts.
- **Humanity** expresses what is appropriate for the spiritual as well as physical well-being and development of people as people, not subordinated to their institutions; the persons express what is suitable for them.
- **Beauty** is recognizing what is aesthetically ordered and intrinsically attractive and working for it.

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Babüroğlu, Oguz N., 1992. "Tracking the Development of the Emery-Trist Systems Paradigm (ETSP)". *Systems Practice*, vol. 5, No. 3, p. 263-290.

Barton, John, Merrelyn Emery, Robert L. Flood, John W. Selsky and Eric Wolstenholme. 2004. "A Maturing of Systems Thinking? Evidence from Three Perspectives". *Systemic Practice and Action Research*, vol. 17, No. 1, p, 3-36.

Barton, John and T. Haslett. 2007. "Analysis, Synthesis, Systems Thinking and the Scientific Method: Rediscovering the Importance of Open Systems". *Systems Research and Behavioral Science*, vol. 24, No.2, p.143-155.

Barton, John and Selsky John W., 2000. "Toward an Emery Model of Management: Implications and Prospects of Emery Open Systems Theory". *Systemic Practice and Action Research*, vol. 13, No. 5, p. 705-720.

Boyne, George A. and Kenneth J. Meier.2009. "Environmental Turbulence, Organizational Stability, and Public Service Performance". *Administration and Society*, vol. 40, No. 8, p. 799-824.

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