

Le Coze's normal accident: integrating complexity into Charles Perrow's theory

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This article is a review of the book *Thirty years of accidents: the new face of socio-technological risks* (from the original *Trente ans d'accidents: Le nouveau visage des risques sociologiques*, 2016) by Jean-Christophe Le Coze, published in Portuguese in 2023 by Blucher.

The book takes a fresh look at opinions and instruments developed in recent decades in the area of industrial safety. Although it contains a wealth of theoretical discussion, the author seeks to find an answer to some very pragmatic questions: “where, who, what, how and when to question or observe the multiple actors and heterogeneous entities that make up these systems in order to gain a better understanding of them, but also to anticipate and prevent industrial disasters?”

With this proposal as its aim, the book offers contributions that can be divided into three main parts.

The first is an in-depth analysis of the theoretical development of different disciplinary fields that focus on major technological risks and industrial safety. To this end, Le Coze uses four analytical dimensions.

Initially, “installation” refers to the classic methods of risk analysis developed in the 1990s, such as HAZOP (*Hazard and Operability Study*) or FMECA (*Failure Mode and Effect Analysis*), which are based on the assessment and control of risks through linear and quantitative analysis of the events, where the probable cause of failure is mainly the operator.

Next, “cognition” relates to the seminal studies of Jens Rasmussen¹ and his proposal for models of human error. Since then, various other authors have appeared and developed their research, such as Erik Hollnagel, René Amalberti and Sidney Dekker, defending the positive aspects of error, such as its ability to develop individuals' expertise and stimulate learning.

The third dimension of analysis is “organization”, that is management's responsibility for the protection or weakening of safety measures. To this end, Le Coze applies, among others, the notions of “coupling” and “complex interweaving” of the systems of Charles Perrow², as well as those of “organizational redundancy”

or the “self-organizing capacity” of High Reliability Organizations.

Finally, as the last criterion for analysis, the author considers “regulation”, or a reflection on the instruments of public action and state control for preventive purposes in organizations.

The second major contribution of Le Coze's book is the original relationship between complexity and safety. For this purpose, he draws on the work of the philosopher and sociologist Edgar Morin, who, from the 1970s onwards, has developed a non-compartmentalized way of regarding the role of the subject in the action.

Morin³ argues that, for different reasons, science is never able to encompass reality. Firstly, because reality varies according to the context, since it is made up of a great diversity of interconnected elements, which influence each other in an intricate manner. Next, because of the constant presence of uncertainty and ambiguity in reality, making phenomena intrinsically uncertain. Thus, in order to deal with the complex society, it is necessary to take account of this unpredictability in systems, seeking to “weaken or erase the rigid principles of programming, hierarchization and specialization in favour of creative or inventive strategies, functional polyvalence (of basic units or subsystems), polycentrism in the control of decision-making”³ (p. 192). Finally, science does not attain reality because it tends to treat causal events in a linear manner, in relatively simple relationships of cause and effect, overlooking the fact that “a) the same causes can lead to different or divergent effects [...]; b) different causes can produce the same effects [...]; c) small causes can lead to very large effects [...]; d) large causes can lead to minimum effects [...]; e) causes are followed by opposite effects [...] the effects of conflicting causes are uncertain”⁴ (p. 269).

As a result, science does not attain complex and multifaceted reality, but only interacts with it through models that are often limited and partial. Consequently, it is necessary to accept that human error will always occur, even among the most experienced, and that constant reflection on this issue is therefore necessary in organizations.

*When thought discovers the gigantic problem of the errors and illusions that never cease to impose themselves as truth in the course of human history, when [thought] consequently discovers that it carries within itself the permanent risk of error and illusion, it [thought] must then seek to know itself*⁵ (p. 9).

In this respect, the technological development that aims to eliminate errors and thus exclude people



from such processes must be reassessed. Fractals, algorithms and automata that seek to collect data to simulate future situations will never succeed in fully contemplating complexity. In the words of Robert Laughlin, Nobel Prize winner in physics in 1998: “these abstractions are a pact with the devil, because they often distort things so grotesquely that you no longer have any faithful representation of reality”⁶ (p. 131).

Complexity, then, is related to the interaction between people, work and the environment. Analyzing an event requires the analyst to put himself in the situation in question in order to understand the information available and the possible interpretations produced by those involved in the heat of the action. Otherwise, we fall into the trap of retrospective bias, in which we reassign to the past the uncertainty of the future; in other words, we analyze past facts with data from the present, generating conclusions that usually fall back on blaming the conduct of the victim.

From this contextualization in Morin, Le Coze proposes advances in the relationship between complexity and safety, which is the third major contribution of the book under review. The incomplete and interconnected nature of scientific knowledge requires a more integrated approach that takes into account the complexity and interrelationship of various elements. Complex systems must therefore move away from a structure of strong centralization, hierarchy and coercion, with low levels of individual independence, and move towards an alternative structure based on polycentrism, decentralization, autonomy, versatility, multiple interactions between individuals and groups, as well as tolerance of deviations and non-conformities. Similarly, accident analysis requires more sophisticated approaches that take into account the elements of complexity, rather than those based on analysis trees, with linear schemes of causes and consequences, associated with probabilistic calculations.

In this context, Le Coze carries out a critical assessment of classic models of analysis, such as James Reason’s Swiss Cheese and Jens Rasmussen’s Migration Model, and proposes other models. His

so-called Systemic and Dynamic Model for the Construction of Industrial Safety addresses more explicitly the managerial, sociological and political dimensions of industrial safety in the causing or prevention of accidents. The Modified Sociotechnological System proposes a new approach to Rasmussen’s vision of the sociotechnical system, inspired by underlying considerations of a more epistemological and philosophical nature.

Based on these three major contributions, the author proposes a re-formulation of Charles Perrow’s² concept of “normal accident”, incorporating the notion of complexity. According to Le Coze, an accident is normal for more contemporaneous reasons: 1) risk systems operate under technological, competitive, social and financial pressures and constraints that involve complex balances and decision-making processes; 2) operators and managers adapt, decide and construct safety in universes made up of technological uncertainties in design, operation, installations, organizations and markets; 3) no-one can claim to have a global vision of the system because our reasoning is limited in view of complex causalities; 4) operational safety limits are probably much more ambiguous and less apparent than many public and private operators are prepared to admit.

Le Coze’s work therefore provides fundamental theoretical and practical contributions to contemporaneous reflection on the prevention of industrial accidents around the world. As a consequence, the author also makes contributions to the field of collective health. Specifically in Brazil, research studies relating complexity and safety are still rare. Even studies that discuss safety culture and power dynamics⁷ still rarely address the question of complexity. By discussing this relationship in depth, Le Coze offers original reflections that help to abandon classic approaches that disassociate units of analysis between technical systems (machinery, processes and standards) and human systems (behaviour and deviations). As a result, the work reviewed in this article opens up an important pathway towards the prevention and preservation of lives in the world of modern industry. It is therefore a fundamental work for this day and age.

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