Fractal Crises – A New Path for Crisis Theory and Management

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This paper is a modest contribution to the vast exploration to be embarked upon as our maps appear increasingly outdated. We will first explore some outmoded ‘taken for granted’ assumptions and visions: this section aims to clarify why the crisis management world has profoundly changed and how the current understanding of crises and theoretical frameworks is becoming increasingly less adequate. Then, we will try to meet the second challenge of this special issue, by suggesting innovative approaches that will contribute to elaborate the building blocks of a theory of crisis management. We will propose a new theoretical framework, through the use of a fractal approach, following the footsteps of Benoit Mandelbrot, in order to rethink and capture the essence of the new theatre of operations that must be dealt with. Throughout, we will show how this original framework could be put into practice and what its limitations and perspectives are.

1. Introduction

Normality is our natural nest, stability our beloved home and certainty our paramount aspiration. Decision makers ask for action, but properly mapped. Business people ask for risk, but properly controlled. Wild weather is the friend of no one. Academics – sons of Descartes, so ‘delighted with the mathematics, on account of the certitude and evidence of their reasonings’ (Descartes, 1637) – are eager to understand the world and its laws, but within proper limits. As Alvin Weinberg put it: ‘Science deals with regularity; art deals with singularity’ (Weinberg, 1985).

Alas, from time to time, some big storm, disaster or ‘situation’ rears its ugly head to disturb, for a moment, the so-called ‘normal’ world. A dominant tendency is just to ignore such improper outbreaks, and to concentrate on the ‘normal’ game plans. Yet, some bold thinkers – philosophers, doctors, strategists, lawyers, mathematicians and economist – have always been captivated by such strange quirks of ‘nature’ and history. Ever since the ancient Greeks, ‘crisis’ has received special attention: how to envision and deal with such difficult trials sent by the gods or nature? The quest has always been seen as foolish: how to study the exception to the rule, the ‘irrational’? And dubious too: those studying such disturbances were incapable of providing a clear definition of their elusive ‘object’. And probably blasphemous into the bargain: you do not question the gods nor the laws of nature and science. In a sense, the very idea of a ‘theory’ of crisis appeared and still appears as a contradiction in terms, both inconsistent and suspect (Béjin & Morin, 1976).

However, in addition to isolated thinkers who dared to explore such fields of experience, others succeeded in developing real schools of thought and even ‘best practices’ for such ordeals. The 1960s and 1970s witnessed the remarkable development of sociological studies devoted to communities confronted with natural disasters (Quarantelli & Dynes, 1977) and studies of international crises were prolific (Hermann, 1972; Allison, 1971). In the late 1970s, and increasingly in the 1980s and 1990s, the field was opened up to take stock of the new kinds of shocks that impact complex technological societies, beyond natural disasters alone. A profusion of severe turbulences were examined – international shocks, factory explosions, product tampering, prison protests, urban riots, football stadium tragedies, train or plane hijackings, specific financial crises, etc. Case studies multiplied and sustained efforts
were made to consolidate theoretical perspectives and models (Rosenthal, Charles, ‘t Hart, 1989; Lagadec, 1993). In parallel, much was done to clarify number of ‘best practices’ to deal with these events and their ripple effects (Fink, 1986; Ten Berge, 1990). Many disciplines were mobilized to open up new lines of thought and to lend their support to the development of knowledge. Yet a lingering plea was made to consolidate, beyond mere case studies, some better ‘theory’ of crisis.

Then came the turn of the millennium, with a host of new challenges to address. It was patently clear that new kind of crises had to be considered, that a broad new ocean of complexity and ‘inconceivability’ had yet to be explored: ‘What we learn about the development and management of past crises may have limited value for improving the management of tomorrow’s crises’ (Rosenthal, Boin, & Comfort, 2001, vii).

Ten years later, such a warning appears more urgent than ever. Climate change and environmental issues, increasingly risk-prone vital networks, massive terrorist threats, huge increases in the cost of disasters due to global coupling and just-in-time production methods, global civil unrest, financial and economic meltdowns show that we have to deal, not with something more, but with something else (Boin & Lagadec, 2000). The time of mega shocks (OECD, 2011) has come. In response, the concept of mega crisis has been put forward and is now trying to get its head around a whole set of questions and theoretical challenges (Helsloot, Boin, Jacobs, & Comfort, 2012).

But scale is certainly not the most difficult factor of rupture. Crises appear to have taken on an entirely new dimension: they are no longer isolated accidents capable of threatening large subsystems – the core of our theoretical fabric of crisis theory in use. They have increasingly become opportunistic expressions of global turbulences impacting our social fabrics, while at the same time our bedrocks are losing their firmness of footing by being exposed to violent liquefaction processes. All the various isolated currents of vulnerability seem to be meshing to produce a global volatile, chaotic, incomprehensible theatre of operations.

A quarter of a century after the blossoming of crisis studies, the need for a decisive breakthrough appears crucial in the present world, where crisis is no longer the marginal exception but the core engine.

Hence, tough questions arise. Is the paradigm in which our practices (Boin & McConnel, 2007) and theories are anchored still valid? If not, Kouzmin’s perspective must be taken on board – ‘Crisis Management in Crisis’ (Kouzmin, 2008). What can be put forward at the theoretical level to ensure that analytical tools are able to grasp present realities – which are no longer those of last century? In the light of such questions and proposals, how can we develop our action repertoires, and what are the avenues of research that need to be consolidated today? This does not mean that we throw all known practices overboard, but that we must open new windows, to shed new light upon challenges poorly addressed by existing theories.

The aim of this contribution is to try to tackle this formidable theoretical and managerial challenge. In the first part, we will revisit our references in the field of crisis – those fixed in recent decades: an overview of the facts, which have effectively slipped the net of our conventional theoretical fields, followed by a critical analysis of the essential roots of our crisis theories. Then, in the second part, we will suggest a specific theoretical path, inspired by fractal geometry – which we will show to be well suited to grasping today’s volatile realities. Finally, we will look at how this original framework can lay the theoretical basis for effective crisis management.

Clearly, this contribution will not settle all the problems or clarify all the theoretical questions. The aim is only to open new doors, to suggest new approaches, understandings and grammars. It will take many years to build a satisfying theory and to forge new practices for the new world of crises.

2. Terra incognita

Indeed, our field of experience is witnessing too many upheavals to leave our visions, hypotheses and tools unquestioned, and these same visions, hypotheses and tools have to be reforged if we still want to be in a position to grasp and deal with the realities that are now shaping and overwhelming our history.

2.1. Another theatre of operations: ‘There is no box anymore’

It is common to reject any idea of novelty, especially in the disaster and crisis area – ‘Nothing new under the sun’. It is traditional to recall the cataclysmic events that have marked history or prehistory (without referring to myths like the Deluge) from the extinction of the dinosaurs by a meteorite, the end of the Minoan civilization due to a volcanic eruption, the Black Death (1347–1352) which decimated Europe, the Laki eruption (1783) and its contribution to the French Revolution, up to the Great Flu (1918) which killed more human beings than the Great War, the 1929 crisis, and so on and so forth. Not forgetting ‘near misses’ such as the Cuban missile crisis (1962), when the future of mankind was in the balance only to be saved from the brink by the intelligence of a few – or, according to the latest analyses by Robert McNamara (Morris, 2003) – by sheer luck.

Similarly, the idea that the 21st century would open a new territory of crises, and hence would threaten the
theories developed in the last decades of the previous century, has commonly been rejected. But, just over 10 years into this century, too many cases have arisen that demand a new vision (Lagadec, 2006).

Beyond immediate ‘facts’ – from Katrina to Fukushima, from the global financial and economic meltdown to global outbursts of civil unrest – we need to clarify structural factors that change the whole territory of crises, and call for a decisive upgrade of crisis theory.

- **From large-scale to off-scale:** major events are not new, but they have got denser; and appear to affect greater numbers, even entire continents and the entire planet, threatening millions, hundreds of millions – because of blackouts, pandemics, economic upheavals and social implosions. Multiplication and concomitance of such mega shocks lead to situations where the means are overwhelmed, where everyone or almost, is under the threat.

- **From complexity to the unreadable:** everything can be qualified as complex, but such events as Hurricane Katrina (2005) have shown how today mega shocks can trigger tremors that are impossible to categorize and map. The case of Hurricane Irene (2011) striking the east side of the American continent is a warning sign: it is impossible to know in advance the potential multiple-head strikes and disruption dynamics – airports, stock exchange, vital networks, military capacities, etc. – of such mega shocks. The field of the complex event gives way to the totally elusive global situation.

- **From tightly-coupled to total interdependence:** much has been said, in the 20th century, on critical infrastructures and coupled interdependent systems (Perrow, 1984, 2007). We are now switching to another picture: there is no longer a mere chain of interactions, but ‘piles’ of activities, ‘biologically’ entangled and intertwined. Hence, shocks trigger swells that swallow up ‘totalities’, beyond the idea of incremental transmission. Reverberation dynamics are unfolding, not only on the ground and from one place to another, but from one network to another, one hub to another, one underlying fabric to another – locally, nationally and globally. This was a characteristic of Fukushima (2011): the plant, the adjacent territory, the province, the nation and the world (with the partial loss of key electronic components, becoming more severe after the additional flooding in Thailand). We have clearly switched from complex problems to something else.

- **From high speed to instantaneity:** case studies in the 20th century had always underlined the speed factor, especially when it dealt with media coverage. We are now switching to something else and with a qualitative leap: in 2003, the SARS virus travelled from Hong Kong to Toronto within a few hours, and the capital city of Ontario was deep in crisis before the World Health Organization sounded the worldwide alert; in 2010, Wall Street witnessed the ‘disappearance’ of 700 billion US $ in just 7 milliseconds. More radical still: electronic media coverage is now totally in real time, globally. During the top secret operation against Bin Laden, the news of the attack was already on Twitter as the core strategic group was following the assault from the West Wing war room; during the shootings in Liege (Belgium, 14 December 2011), one tweet said that the gunman was in police uniform: and one sees the crowd fleeing from the police, the police not being aware of that item of news.

- **From local events to in-depth dislocation:** this is the most decisive watershed. Until now, we were focused on the specific event striking its target and the direct or indirect ‘vicinity’ of that target. In addition, such a strike occurred within a closed field, naturally robust and stable. Studies tried to explain how the event could affect a large territory, step by step, and how the environment could finally absorb the shocks coming from the initial ‘Ground Zero’. Now, due to global interdependences, shockwaves are finding a milieu favourable to instant chain effects without ‘watertight compartments’. As Arjen Boins underlines: ‘The modern crisis does not confine itself to a particular policy area (say health or energy); it jumps from one field to the other, unearthing issues and recombinig them into unforeseen mega-threats’ (Boin, 2004, p. 166).

Moreover, fundamental fabrics (environment, economy, culture, etc.) are often in a state of preliquefaction, already very fragile. The slightest quiver can develop into extreme tremors. The event itself does not unfold in an absorbent milieu, but in a resonance chamber. This milieu is prone to triggering rogue waves through the combination-recombination of single shocks. Hence, it becomes quasi impossible to trace an event on a graph, along predefined lines. The paradigm has shifted. We are just now witnessing the conflagration triggered in the Arab world by a film posted on Internet: a low cost weapon of mass dislocation.

- **From uncertainty to ignorance:** there is no such thing as a risk or a crisis without uncertainty, but we are now driven into ‘voids’ of understanding and action that epitomize a loss of fundamental reference points. Instantaneity, absorption of large parts of realities until then isolated, abundance of reverberations, rogue wave multiplication, loss of fundamental anchors and bedrocks . . . all this casts us adrift far beyond our familiar theatres of operations, be they intellectual or managerial. The challenge is no longer to grasp uncertainty at the margins of a strong core of knowledge. One is
instantly confronted with the unknown, with territories where cardinal hypotheses no longer have purchase.

Indeed, one could argue that not one recent event adequately translates such a model. However, it is easy to plead when considering Fukushima – economic and social dislocation, the environmental and energetic challenges, etc. – that the picture sketched above is beginning to emerge.

The concept of ‘wicked problems’, introduced by Rittel and Webber as early as 1973 is probably the most appropriate one to translate such realities (Rittel & Webber, 1973). When proposed, it applied to a few difficult issues; it now appears useful and even necessary to grasping the vast majority of our challenges in the crisis field. The basic idea is that the bulk of our conceptual and operational toolbox is designed to deal with tame problems: those that can be precisely defined, whose causes can be specified, that can be resolved by gathering additional data, by breaking them down into smaller problems, and by applying specific remedial techniques (Camillus, 2008). The basic vision is of the engineering type: the challenge is to find the best technical responses. In the conventional line of thinking, crisis issues do not trigger intractable societal discussion.

Wicked issues do not fall into any of these ‘normal’ niches, which are essential to us. There is no consensus on the definition of the problem – the very idea of a ‘definition’ is even irrelevant. The search for solutions never stops, there is no ultimate test of a solution since any response generates unexpected consequences, and each implemented solution has consequences that cannot be undone. Every wicked problem can be considered to be a symptom of another problem. Rittel and Webber put it bluntly: ‘the classic paradigm of science and engineering – the paradigm that has underlain modern professionalism – is not applicable to the problems of open societal systems’ (Rittel & Webber, 1973, p. 160). Uncertainty is global on every single component of the issue, with regard to all the outcomes of any action. Judgment becomes crucial. Fundamental values also become part of the problem, and elusive when called upon to ground a given analysis, decision or implementation. The probabilistic approach becomes ineffective. Every single move triggers possible global mutations within the system and within its global context, trial and error strategies are no longer appropriate: every move is a one off move.

These are indeed the core characteristics of mega crises, qualitatively different from ‘traditional’ event-focused crises. The starting point can no longer be the event – the crisis field must clearly depart from the emergency domain, which has been the original niche of crisis analyses and practices. The structural issue must be the global dynamics of dislocation. We are no longer dealing with specific crises, but with crisis stages where everything is linked and mutating. Dynamics are not so much mechanical chain reaction effects as engulfing global vortices. Hence, we could put forward a tentative definition of the mega crisis as – the embedded engine of an overly complex world that evolves and mutates through global dynamics whose texture is made up of unstable webs of ongoing, major dislocations. (Lagadec, 2012)

Since the turn of the century, and particularly since 9/11, the motto of the crisis world has been ‘Think outside the box’. That already constituted a serious challenge for our Descartes-inherited habits of thinking. The current reality, on all fronts, opens a new landscape: As Mike Granatt puts it: ‘There is no box anymore’ (Granatt, 2011).

2.2. The need to revisit our theoretical framework

Outstanding constant features have marked our reflections on the notion of crisis since the end of the 1970s: the vigorous calling for the absolute necessity of a solid theorization so that crisis study could be recognized as a genuine science; frustration due to the extreme difficulty encountered in satisfying conventional demands to secure a grading of academic excellence; hesitation between the addition of case studies, giving way to ever more data, but poor additive knowledge and an extraordinarily difficult theorization, impossible indeed within the usual and normative codes. The whole leading to a contrasted situation made up of undeniable advances in the building of a reference body and in case-study publication, but with repeated calls for a better theorization capable of observing the canons of a noble discipline, well recognized by the scientific world.

There is something pathetic in this frantic race. The demands to be satisfied in order to secure a degree of recognition are in effect essentially incompatible with the substance of the crisis phenomenon and the kind of intelligence it requires. As the issue of crises becomes increasingly more strategic, it is urgent to understand and to establish as a founding principle the fact that crisis studies cannot satisfy the requirements of classical theoretical models. Crisis studies must not beg for recognition by simply trying to play into paradigms that are not and cannot be theirs; they must open their own fields and routes. If not, crisis intelligence will exhaust itself, and miss its target by the same token.

This supposes, first and foremost, accepting to break, however painfully, with the past so as to escape the usual pitfalls – and to open new routes. Instead of requesting here, the ever mentioned founding texts (Hermann, 1972; Béjin & Morin, 1976; Rosenthal et al., 1989), rewriting pages now become classic (Lagadec, 1993, pp. 24–41; Dayton, 2004), citing the conventional
references (the Greek tradition, medicine, economic references, psychology, etc.), or trying to embrace the whole of organization theory literature – we will focus on a critical handful of stumbling blocks that must be decisively revisited.

- **Definition.** The literature is marked by a ritual: emphatic regret for the lack of ‘really scientific’ definition of the crisis concept has become a matter of course. Such a preliminary confession appears to be essential to acquiring a kind of scientific royal warrant. Take, for example, James A. Robinson, who scathingly opens his article ‘Crisis’ in the International Encyclopedia for Social Sciences with: ‘“Crisis” is a lay term in search of a scholarly meaning’ (Robinson, 1968, p. 510). The bill of indictment is well known: a term ‘gutted from within’ (Morin, 1976, p. 149), an ‘empty shell, a ready-to-use catch-phrase’ (Béjin & Morin, 1976, p. 1), ‘a convenient cliché’ (Starn, 1976, p. 13), ‘a vulgar and hollow little word’ (Morin, 1976, p. 163); ‘a very useful word in the age of mass media’ since ‘it creates emotion without requiring reflection’. (Starn, 1976, p. 13). Nothing here is all that new. Historian Randolf Starn points out that as early as 1860, an Italian lexicographer decried the abuse of the medical term ‘crisis’ (Starn, 1976, p. 7). However, such accusations and regrets are not false, especially with the growing importance of the mass media, so fond of the little word. As Mike Granatt (2011) put it recently: ‘The word “Crisis” has replaced “Emergency” just because it is shorter, hence a much better fit for the media format’. But it is necessary to go beyond these basic condemnations: they tell us more about the limits of our understanding of crises than about the intrinsic limits of the concept itself.

The core of crisis is precisely the fact that an event, a dynamic, does not fit into the conventional references, formats and codes – and moreover, is threatening to destroy those very references, formats and codes. Demanding that crisis should fit into univocal, non-hybrid, clear-cut definitions, accepted by all and quietly settle into fixed nomenclatures, is just one more sign showing how we refuse to accept and enter crisis territory. Mitroff, Murat, and Green (2004, p. 176) are right when they underline: ‘It is our contention that crisis management deals with problems that are inherently ill-structured. . . . To insist, therefore, on agreement as a precondition for studying ill-structured problems, is to ignore and to deny their basic nature. It is to misinterpret them ontologically. When crisis management experts call for agreement on the definition of basic terms, in effect, they are committing the same kind of error that we accuse practitioners of making when they ignore the complexity of crises’ Inherently, the crisis field is the world of the ill-structured, the intractable and the ‘wicked’. Even if it is useful to explore, find and use formulations that help to shape and consolidate approaches of the crisis phenomenon, it is necessary to state a preliminary and basic condition: ‘Crisis’ will resist any attempt to be ‘defined’. Moreover, the underlying principle to be laid down should be that any request for a definitive, clear and univocal definition of the concept should be understood as a cognitive and psychic refusal to genuinely accept and explore crisis territory.

- **Classification.** Crisis literature is marked by constant efforts to deliver typologies (natural, technological, social), segmentations (internal, external, technical, organizational), time scaling (before, during, after), categories (from product defects to international crises, etc.) and myriads of crisis components, in a kind pointillist picture helping to fix at least some part of this elusive reality. All these attempts to characterize the crisis phenomenon are interesting and useful, if only they do not strive to reach an erroneous objective. In crisis territory, more than in any other, a typology can help to clarify – a little – the theatre of operations, but must not dream of locking it down. Mutating, elusive realities do not let themselves be taken prisoner.

In essence, crisis is, and will remain, a wild and maverick reality, impossible to understand and grasp within frameworks shaped, built and stamped to contain stable and repeated phenomena. Obviously, this is extremely tiring for us, as if we were still the disciples of the naturalists of the 18th century: ‘Causes which result in effects which are rare, violent and sudden must not affect us, they are not part of the ordinary process of Nature. Our causes and reasons are the effects that occur each day, movements that follow one another, effects that are continuously renewed and endlessly repeated’ (Buffon, 1749).

- **Measure.** Crisis studies and theory of crisis management have developed in the wake of risk analysis. The conventional view is that crisis develops when risk control has failed, when ‘residual risks’ have taken their toll. The good news is that the whole is clearly measured, with probabilities. And crisis lies in a residual territory, limited in essence. The new theatre of operations in the risk domain compels us to step outside of this vision of ‘residual accidents’. The ingredients of a new vision are pointed out, but with caution, in Bernstein’s (1996) ‘Remarkable story of risks’. The conquest of the crepuscular territory of risks has been extraordinary throughout the centuries but many ‘details’ that could have been ignored in the past now rush back to centre stage as we enter a much more complex, turbulent, volatile world. Dice throwing follows regularities . . . ‘if the dice is honest’
(Cardano, p. 45). Nature follows regularities, but . . . ‘only for most of the part’ (Leibnitz, p. 4). ‘Players can anticipate processes, as long as . . . they stick to the rules upon which they agreed at the outset.’ (Pascal, p. 67). The issue is that such difficulties, marginal in a stable, controlled and compartmentalized world, are capable of overwhelming the whole landscape in a globalized, volatile and turbulent world. This is exactly Bernstein’s ultimate point: the cosmology of risks, and hence of crises, could mutate since ‘Discontinuities, irregularities and volatilities seem to be proliferating rather than diminishing’ (p. 329) – which justifies the title of the conclusion: ‘Awaiting wilderness’ (p. 329).

If, as it is the case today, the world is mutating and is now shaped around volatility, discontinuity and nonlinearity, then our whole cosmology based on regularity measurement and modelling appears suddenly outmoded and leaves a huge theoretical void. How to think, model and handle instability, shifting dynamics and the intrinsically mutating?

2.3. The all season challenge: overcoming ‘normal science’, opening routes into the unknown

The Age of the Unthinkable (Cooper Ramo, 2009) demands a radically new science and new theoretical foundations. Crisis theorists cannot develop their endeavour through normalization but only through invention. Crisis is a specific ‘object’, which demands a specific, different, theoretical universe. But cognitive habits, academic recognition constraints, the difficulties of any discovery process and probably above all, the great ordeals that accompany any exploration of the unknown – ‘It was as if the ground had been pulled out from under one, with no firm foundation to be seen anywhere, upon which one could have built’ (Einstein, in Kuhn, 1962, p. 83) – tend to lead to ‘normal thinking’ rather than invention. An illuminating example of such recoil has been given in a book recently written on the subject of cataclysmic risks. The author of one of the chapters rightly underlines that, for such off-scale risks, it would be necessary to change our paradigm; but his whole contribution is strictly embedded in ‘normal science, normal knowledge’. He explains: ‘The challenge of existential risks to rationality is that, the catastrophe being so huge, people snap into a different mode of thinking . . . I thought it better that this essay should focus on the mistakes well documented in the literature – the general literature of cognitive psychology, because there is not yet experimental literature specific to the psychology of existential risks’ (Yudkowsky, 2008, p. 114).

The fundamental challenge for academics is to understand and confront the violent negative reaction to any attempt to produce, or even to admit the necessity of, new theoretical ground and practices. Just as engineers, or decision makers have difficulty in thinking outside the normally formulated hypotheses, rules and practices.

The preliminary necessity is then to accept the difference between science and technique. Science evolves in the unknown, and on the frontier between the known and the unknown. And there is a cardinal responsibility in science: understanding the moment when a dominant paradigm, which inspired and structured scientific and operational activity until then, begins to show signs of inadequacy. Such a requirement becomes a failing if evidence accumulates to indicate that the hypotheses, visions and tools of reference no longer fit, while people stubbornly remain – out of habit, myopia or terror of change – within outmoded maps. That scientific demand is all the more extreme in the risk and crisis arena: theoretical fault lines rapidly and inevitably lead to collective tragedies. The intellectual fault line has been a decisive driver of failures and repeated fiascos in crisis territory. Being a ‘war behind’ is a sure way of being ‘defeated in every battle’ as Sunzi (1999) put it in his Art of War.

It is well known, after Thomas Kuhn (1962), how such strategic vigilance with regard to tired paradigms is not the norm: ‘Normal science’ (p. 5), which imposes its norms and bans is more than reluctant to wander beyond usual closed-in and reassuring frameworks. The usual day-to-day accepted work consists of documenting ‘residual ambiguities’ (p. 27), very far from disturbing the ‘residual validity’ of conventional hypotheses. The obstacle is all the more unyielding in the crisis field because, precisely, the very prospect of going beyond ‘signed and sealed’ schemes often triggers an instant and irrepressible need for protection and negation – which leads to further entrenchment in conventional – outmoded, yet so comfortable – practices and theories.

Within this line of thinking, any questioning of the dominant paradigm is an immediate ordeal for anyone trying to open up the approach. The burden of proof, with very rare exceptions, has to be borne by the dissenter, never by the obedient servant of the codes in place – which guarantee a solid margin of security for established theories. Moreover, the dissenter will be asked to provide proofs judged and measured according to the previous paradigm – which, as Kuhn underlines, is an impossible condition to satisfy. Hence, the leap to the new paradigm will necessarily happen too late, when major events, impossible to hide or negate any longer, will have overwhelmed the entire field of analysis and action. In the words of Hegel (1820): ‘The owl of Minerva takes its flight only as the shades of night are gathering’.

The issue of the effective relevance of our reference models is however, crucial and must be subject to repeated auditing, all the more rigorous and frequent, given that the stakes are high, and the environments
mutating and turbulent. That is precisely the case now as we enter the second decade of the 21st century.

As Thomas Kuhn (1962) has underlined, when a current theory encounters more and more difficulties in its attempt to encapsulate reality, the time is ripe for a paradigm shift. This appears to be the case in the crisis world – and in management science globally. We must confront the unknown, and prepare a scientific leap, even if going beyond ‘normal science’ is always a difficult path to pursue. It requires the acceptance of the risk of trial and error, the acceptance of great discomfort. After all, exploration beyond known paradigms is a vertiginous affair. It requires acceptance of denial; it is impossible to convince people of the validity of a new paradigm with the arguments of the previous paradigm; moreover: any paradigm shift will be a source of anxiety, and blunt refusal is the usual initial response.

There are numerous new pathways to be explored, tested, rejected or elicited. Thus, in the second section we are going to modestly open up a few avenues and propose a number of signposts from the field of fractal geometry. This theoretical body of knowledge has frequently been referred to, but most often only in passing, or by way of a gloss, without a genuine understanding of the theory itself. It is important to go further, yet with caution.

### 3. A new paradigm: fractal geometry for crisis theory

Fractal geometry, formalized and developed by Benoît Mandelbrot, has shown its importance in areas subject to crisis such as finance, a domain also well known for its great complexity, volatility and discontinuity (Mandelbrot, 1982). It is therefore natural to wonder whether this body of concepts could be used in the field of contemporary crises, which also show these same features. This line of thought in terms of fractal geometry is not entirely new (Sornette, 2006), but it is worth giving it a second look as mega crises (Helsloot et al., 2012; Lagadec & Topper, 2012) are more than ever becoming the norm.

The first challenge is to master the scientific use of a foreign set of concepts in order to apply them to the field considered here. The idea is not to propose a ‘miraculous key’ or a ready-to-use toolbox but rather to initiate new thinking, innovative perspectives for the field of crises, through the understanding of the potentials and limitations of this approach.

#### 3.1. Importing theories: danger and opportunity

When one happens upon the need for a paradigm shift in the theory of complex societal phenomena, as is the case today in the theory of contemporary crises, the temptation exists to import apparently attractive, but sometimes illusory, ‘theories’ from elsewhere – especially from the world of physics and mathematics. In recent years, chaos theory for example has often been put forward – but, if one looks closely, its use has always been more metaphorical than genuinely useful for understanding societal phenomena. Moreover, such concepts and theories cannot be extended to social sciences simply because they cannot, by definition, be translated from mathematical language to that of the social sciences (Thiétart & Forges, 1995).

If such imports are to be made, it is only provided that:

- The underlying assumptions of the imported theoretical concepts and ideas are effectively understood (beyond the mere attractiveness of the words and images used);
- The contribution is not put forward as a solution or an explanation to everything, but as a means to open up new avenues that will bring new theoretical perspectives and operational avenues.

In this paper, we argue that it is possible to develop the new concept of fractal crises and show how the principles it is based upon can be of real help in deepening our understanding of crisis theory and in offering ways – among other new avenues – to renew crisis management theory.

We will also underline the limits of the proposition: fractal geometry cannot answer all the challenges that contemporary crises bring up and shall not be applied without a careful reflection on its practicability.

#### 3.2. Keys to complex dynamics and volatility

Mandelbrot suggested that the underlying mathematics behind market prices is based on fractals (Mandelbrot, 2005). A fractal can be defined as ‘a geometric shape that can be split into parts, each of which is a reduced-size copy of the whole’, a property called self-similarity, which itself is a subset of a larger class called invariance principles.

Hence, fractals and invariance principles are strongly linked. Such invariance principles are beloved of physicists and mathematicians, because finding an invariant means finding a key to grasping the way the system is behaving, as this property is intrinsic to the system under study.

What we will be doing here is not only basing ourselves on invariance principles, but it going beyond Mandelbrot’s approach by looking at how complexity can be reframed using fractals, founding our approach on the various scales and the complex dynamics that are at play in a crisis event.

The existence of unchanging properties in market prices was, at first, not given much weight by most statisticians in finance. But Mandelbrot managed to
prove that his way of thinking was more adequate to model the behaviour of the financial markets, especially in times of crisis and high volatility.

The classical financial model follows a Gaussian distribution, and is therefore blind to extreme events. To be more precise, the mathematics underlying portfolio theory handles extreme phenomena with benign neglect: it regards large market shifts as too unlikely to matter or as impossible to take into account. Therefore, the theoretical approach in itself does not allow working on extreme phenomena. If portfolio theory can account for what occurs 95% of the time in the market, the picture it presents does not reflect reality, and is biased towards a downscaling of major events. If the weather is moderate 95% of the time, can the mariner afford to ignore the possibility of a typhoon?

The introduction of invariance principles by Mandelbrot, thus proving the link between the volatility that can be tracked every day in market prices and massive market crashes, allowed a return of the exceptional to the theoretical field. The use of fractal geometry does not come closer to forecasting a price drop or rise on a specific day on the basis of past records, but it provides adequate estimates of the probability of what the market might do and allows one to prepare for the larger scale changes, for extreme events.

In other words, Mandelbrot came up with an approach that allowed bringing the extreme phenomena into the scientific field. It was no longer necessary to label them as ‘exceptional’ and leave them aside. They were taken into consideration, and as we are seeing today, 5% of the extraordinary can have more weight than the conventional 95%. The theoretical leap, not only had relevance, but it became crucial.

The power of this approach and its potential application in crisis theory is to allow us to work in universes of high volatility, with extremes being the norm, multiple domains interacting at high speed, etc. These characteristics are not considered as aberrations on the margins any more, but as an intrinsic dynamic of the identity of the new paradigm.

3.3. Key parameters and their role in contemporary crises

The efficient use of fractal geometry to model the extreme events in the stock market is a strong argument for applying it to the world of crises, as it also deals with complex interactions and unpredictable shocks. We, therefore, suggest here a modest contribution, and will try to show how it is possible to build a new path for crisis theory in terms of fractal geometry, and in turn build a new path to crisis management through the search of key parameters that we call ‘invariants’ as they will prove to be a useful toolkit for grasping a large spectrum of crisis events.

The idea behind fractal geometry and its use of ‘invariants’ is, instead of asking ourselves what is being dislocated, what is falling apart, what is being torn to pieces, to suggest a new set of questions and a new set of actions to find out what has not changed, what is invariant from one state to the other and what can be undertaken to better prepare and manage upcoming crises.

Looking for invariants not only means looking for elements that are common in different crisis events, it also means being able to understand what remains unchanged and what is dynamic, what is part of the solution and what is part of the problem. Our new conceptual approach is based on looking for underlying principles that allow a better understanding of global catastrophic events, in the same way that invariants can represent fundamental keys to understanding fractals and volatility.

A number of methods are available for identifying complex realities in terms of fractals. In most cases, fractal theory is described through invariance principles, i.e., considering what is common in universes where crises happen on different scales. But we can also go in complementary directions, where one seeks to understand the specific properties of each level. Invariants are then the key to analyzing the more important interactions, the potential tipping points, the weak signals that allow one to anticipate possible turbulence, etc.

Many papers have documented how the world has become global or interconnected, but very little exists on a deeper conceptualization of what that implies. The introduction by N. Taleb (2007) of the concept of black swans, i.e., the rare events that have dramatic consequences, was a first step towards making people understand that rare does not mean inexistent and that a rare but destructive event is not to be neglected.

Although his point was a very interesting conceptual advancement, it did not in itself imply a rethinking of how the world has changed. It was merely remembering people that Gaussian statistics are just an approximation of reality, the tip of the iceberg. A useful approximation, as long as everything is normal, i.e. in the smooth 95%.

A precise definition of a crisis has always been difficult to give. Our approach allows us to go beyond classic definitions, by approaching crisis events as the transition from one state of equilibrium to another through a massive disruption.

Our contribution here is a new way of thinking, based on a simple, new, principle: looking for fundamental principles of action and identifying their effects. We aim to show that invariants are a general characteristic of modern crises, a pattern that has been long hidden in the fabric of crises and that those invariants have very observable effects, some of which are already well documented, as we shall see.
The path we are suggesting is not the only possible one, and although it has some very appealing features, it does suffer numerous limitations that we shall explain in the next section.

Our first steps into this new world imply a new set of tools to characterize crises. We will be looking at different features of crises, not limiting ourselves to invariance principles but going beyond that by looking at the intrinsic complexity of crises and its key parameters: global effects, high speed, deep complexity and weak signals.

3.3.1. Spatial parameters: the domino effect
The shift from small, localized events to global impact catastrophe has become a common feature of modern crises. This widespread feature is commonly referenced in the literature (Körnert, 2003) as the ‘domino effect’. We can for example think about the Fukushima event and its impact on world energy policies, but numerous other examples can be documented.

3.3.2. The magnifier effect as an illustration of speed on all time scales.
Modern means of communications and transportation has shortened the characteristic time of all events to its strict minimum. Trading is reduced to the millisecond (high-frequency trading), communications from one side of the world to the other are almost instantaneous, etc. In turn, crisis has spread from a short-term event to a long-term impact crisis. The observable effect is most commonly known as the ‘magnifier effect’, for example in finance where microsecond trading (Birraux, 2010) leads to market crashes (the example given earlier of the 6th May 2010 market crash being a perfect illustration of it). Any discrepancy, any error, any rigidity propagates extreme volatility and turbulences to the entire deck of cards.

3.3.3. Rank invariance and the aggregation effect
The third feature we are introducing is rank invariance, which is linked to how individuals act one towards the other. It is very similar to the domino effect, but this time it is not places that are affected, but people through their interactions. This invariance explains why modern crises can start by impacting one single individual on one side of the world and turn it into a global changing event. The observable consequence of this invariance principle is commonly documented as the ‘aggregation effect’. The best recent example of such an effect is Mohamed Bouazizi’s self-immolation that led to the Arab spring (Mc Kay, 2011).

3.3.4. Blurring and sense-making
The fourth characteristic at play is sense-making (Weick, 1995) invariance. Understanding this key principle allows a better understanding of why, during modern crises, the loss of control affects equally the isolated individual, who does not understand what is happening, and the state leaders, who fail to grasp the magnitude of the ongoing crises, leading to global dislocation. This sense-making invariance is best illustrated (Smallman & Weir, 1999), by the well-known blur effect, which has been used to explain how absurd decisions were taken not only by common individuals but also by eminent leaders. It leads to what we like to call ‘information asymmetry’, i.e., the loss of information when one goes up or down the decision ladder, which we shall explain more in depth in the next section.

With this set of rules, we have built a grammar of reading that provides common guidelines for crisis theory, relying on a small number of dimensions (space, time, rank and sense). This classification allows for more powerful tests to establish a generic mapping of crisis and avoids entering immediately into hierarchical classifications, which cannot grasp the power of systemic crises.

Moreover, instead of building a theory designed for the ‘normal world’ and trying to map it to crisis situations, we immediately built its roots a vision that contains complexity. It goes far beyond Taleb’s principles and the possibility of a black swan. Here, we are in a world where normality is not the norm, where the black swan is no longer the outlier and where the search for invariants is especially relevant in a world built from variability and stress.

We have laid the ground to a new understanding of crisis theory, showing that well-documented phenomena can be linked to a set of simple principles that can trace stability and instability in the context of crisis events, which is already a big step forward. This new conceptualization of crises can bring theoretical foundations to crisis management techniques that are already being implemented and can help to provide a deeper understanding of conceptual and practical problems.

4. Crisis management theory
The power of the fractal approach is that it allows you to get rid of a linear and stable vision of the world, an approach inconsistent with the field of crisis. As long as it remained in the realm of low scale emergency it was possible to keep our unified approach, where consequences are additive and relatively simple to control. Yet we must go beyond simple adjustment when we enter global, volatile worlds.

4.1. Building a theoretical body able to capture mega crises in turbulent environments
Fractal theory opens up the possibility of envisioning and navigating multiple, unsettled domains, multiple layers and dynamics.
1. From a spatial point of view, it becomes possible to work separately on the hyperlocal, local, regional, national, continental and global. We can multiply the fields considered, each with their relevance, specificity and dynamics. We work at the outset, where the vision is plural and where one must be able to operate multiple levers of action at the same time.

2. From a temporal point of view, it becomes possible to work on speed and evolutions, even mutations, in new ways. For example, instantaneous dynamics (type social networks) and fast dynamics (radio and television), can all be linked to the same building blocks. One is not limited to a single timeline approach, but is allowed to immediately think of many overlapping timelines that have different dynamics and fundamental building blocks such as contradictions, oppositions, factors of evolution and mutations, that blur the view of actors who have different perspectives.

3. From an actor’s point of view, the individual, family, organization, country, etc., find their place, taking into account that everyone has different information, different perceptions of the same information or different information.

4. From the point of view of ‘making sense’, one can also escape reductive simplistic visions and make room for multiple subjective ‘sense making processes’.

These are just a few well-known dimensions, but there could be many others: the multiplicity, interaction and volatility of fields and dimensions are basically included in the code of the fractal approach.

Let us work out an example where information is minimal, where there are only weak, wild signals, where there is no warning light, no simple data to analyze and where only vigilance, examination of blind spots and informed assumptions based on fractal crisis theory can give a clue as to what the dynamics at play is really about.

4.2. Beyond the classic approaches: top-down or bottom-up, information asymmetry and dealing with complexity in crisis management

For decades, disaster literature has highlighted the limitations and problems hazards caused by the ‘Command and Control’ vision, the centralized top-down approach (Rodriguez, Quarantelli, & Dynes, 2006; Drabek, 1986). The approach developed here escapes from these dilemmas and conflicts of vision. There is no overriding principle that is able to support a global dynamic in which each component has autonomy, an impulse and a specific variability. One must go beyond top-down and bottom-up; simply because as information gets diluted and transmitted along the decision chain, it gets distorted and reinterpreted.

The specificity of a crisis event is the amount of distortion that a ‘piece of information’ (in its broad meaning) can suffer: during a crisis event, one piece of information is received differently by the actors (partial transmission, mutation, distortion, etc.) and every single actor interprets it differently based on his local reality and acts differently. Thus, talking about bottom-up or top-down approaches is largely insufficient because there are multiple realities at play.

4.2.1. The situation

The common practice has most often been to centralize the decision-making process and to concentrate on a top-down approach, with the strategic oversight of the highest people in the hierarchy often conflicting with what is happening on the ground. That practice in a crisis situation can be easily understood as a response to the top-down approach needed for our judicial and governance system which needs to have a clear chain of command to attribute responsibilities during and after the crisis.

One of the most disturbing facts during a crisis event is how information, or misinformation, circulates and propagates. When a leader at the top of the decision chain tries to give an order to someone at the other end of the chain, he thinks that his decision can and will be understood. But in reality, while his decisions seem to be properly transmitted, with everyone in the decision chain thinking they have all understood the same thing, they all end up interpreting the decision in different ways, thus leading to incoherent, conflicting and sometimes absurd action.

4.2.2. Our understanding

Fractal crises theory teaches us that crises happen on all scales and that the built-in invariants imply that leaders and decision makers will be impacted by effects just as those who are closer to the situation area. That is to say, taking the decision power away from those closest to the ground, best able to evaluate their needs, and giving it to people far from ground level and supposedly less impacted by the crisis is a fallacy.

What is at play here is the conflict between the way decisions circulate and the way information flows.

That is why a full top-down or a full bottom-up approach cannot work. It all happens exactly as for a fractal pattern: every time you switch to a different scale, you have the sensation of seeing the same thing, but in reality the resolution has changed and what looks the same is in fact different.

The blur effect created by sense-making invariance forbids someone on one step of the decision ladder to communicate freely with someone on another step.
fractals teach us, the information flowing, at any scale, that is to say going up or down the ladder, gets distorted.

What one gains in overview one loses in micromanagement, and therefore, one interprets information received in a different way. The current situation, with the decision process being top-down and the information flow going both ways with losses, is incoherent. This realization means that there is something wrong with the conception of crisis management where decisions can be taken on one end of the decision chain to be put into action by someone else at the other end of the chain.

We have decided to call this situation, where no one has access to the full, undistorted deck of cards, information asymmetry. It is well known that information is a key to the resolution of any crisis, not only to reduce its impact but also in terms of communication to the public, hence such asymmetry is not a minor problem.

4.2.3. In terms of crisis management
We argue that one must not restrict oneself to a top-down approach and open one's minds to broader perspectives.

In other words, if the top-down approach allows a better distribution of responsibilities for the after-crisis, it completely destroys efforts to limit the impact of the crisis. Thus, fractal crisis theory pleads for a more pluralistic approach based not only a selective distribution of responsibilities and better trust in the personnel on the ground.

The goal is, therefore, to grasp the information as early as possible, at its point of origin, and to dispatch it to the one closest to it. It should not have to go up the decision ladder, as the information going up and the decision going down would both get distorted. Thus, the one in charge of dealing with the new information would be the one that has had access to the least disturbed information.

Dispatching the information would require an 'information over-watch' team. This special group would be in charge of collecting all new information, evaluating its credibility and importance, and delivering it with the appropriate context to the right person on the ladder. This organizational innovation would thus reduce the loss of information from bad contextualization or improper priority rating. We here, base our work on previous key approaches such as that developed by Mike Granatt (Granatt & Paré-Chamontin, 2006), going beyond the top-down/bottom-up discussion. Each layer has its own dynamics; none can have a steering role and one needs to step back to understand the complexity of the system. We need people who can master the broad view and act within an intensely connected and susceptible world.

Thus, the decision shall then be taken by the person who receives the information, whatever his or her position in the current 'normal' decision process. The role of this information over-watch team is therefore crucial. In our system, responsibility and decision making would therefore be distributed throughout the decision chain, and the one closest to the new information is the one that acts according to it. The goal is not to produce people who can apply pre-planned answers; we need people who expect and embrace the new and the novel. We need them to accept strange signals and 'impossible' scenarios, to enter strange seas without being paralyzed by the absence of maps. We need people who relish the challenge of creative thinking and action, even in the most inconceivable and rapidly developing contexts.

The concept and method of the Rapid Reflection Force (Béroux, Guilhou, & Lagadec, 2007; Béroux, Guilhou, & Lagadec, 2008) has been suggested, developed and tested to help organizations overcome such challenges. A specific group of people are asked to clarify the high complexity and volatility of a situation, and to suggest new visions and paths of action enabling the whole system to better navigate the turbulence.

4.3. Limitations and perspectives
Clearly, these new paths into the unknown are still in a very preliminary form. Every single facet of crisis theory and management should now be revisited within this framework of fractal theory. For instance, dimensions such as leadership, signal, emergent behaviour, information and communication, sense-making, etc. should now be re-explored. It will take time before we develop more precise specific theories and practical knowledge on all these facets.

It does not mean that our more conventional approach to crisis management should be forgotten. Our classical knowledge is still valid for relatively limited crises, and should be used. It would be dangerous to switch too swiftly to the mindset we suggest.

But we must also underline that it will remain difficult to develop and to strengthen the view developed in this paper. Such perspectives are and will remain a source of very deep and severe discomfort. Our deep seated Cartesian culture is very strong and stronger still in times of crisis, as we tend to immediately reject complexity by calling it 'chaotic'. Many decision makers might even find such perspectives disturbing. Hence, the idea that we should prepare future leaders to open their minds to such new avenues.

If we can overcome these obstacles, we will have embarked upon the exploration of unknown lands: it will remain very difficult, but at least we will be on a relevant track.
5. Conclusion

The world of crises is facing extreme upheavals. It is not just an extension of accidental phenomena within a system; we are confronted with extreme turbulence, in global and highly unstructured environments. Rude surprise will be the name of the game (LaPorte, 2007a,b). Our crisis management theories and practices were not designed to grasp such ‘wicked’ environments: they are largely outdated. The first section of this paper documented this challenging situation – in the field as well as in the theoretical arena.

In response, there is a growing need for a theoretical leap – obviously resulting from the conjunction of a diversity of inputs. The objective of this contribution has been to consider the possibilities offered by the fractal geometry as a candidate to help those in charge of navigating in unknown, extremely turbulent environments. The path we suggest is one of many ways that can be taken on the road to crisis management theory and operational crisis management. The ideas underlying Mandelbrot’s mathematical work can be effectively used to better describe modern crises as analogous to fractals, and the underlying invariance principles can be mapped into well-known effects in crisis management. Yet beyond Mandelbrot’s own work, the crucial advance offered by fractal theory is the possibility to envision, capture and handle very unstable, blurred and hypercomplex states of the world.

A lot remains to be done to test the feasibility of this approach, to assess what it can bring to the field, and last but not least, to detect the limitations of this line of thought. We are only at the beginning of the intellectual brainstorming required by the age of mega crises. On the research agenda, we will modestly plead for launching research projects – case studies, training methods, operational guidelines, theoretical lines of thought, seminars and workshops – to shed some additional light and to promote innovative knowledge in the field of emerging mega crises. After all, tackling the unknown is the very object of research and theory.

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