



Here be dragons... exploring the 'unknown unknowns'

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ABSTRACT

Since ancient times, the phrase 'Here be Dragons' has been used to signify dangerous and unexplored territories. While wayfarers of the past realised that lack of knowledge necessitated increased vigilance and caution, today's 'Here be Dragons' generally remain hidden and unwanted. Human psychology, institutional frameworks and scientific convention have removed these unrecognised sources of ignorance from the mental maps of modern society. This omission is critical in today's interconnected, interdependent world. It is now time to counter current myopia by using the new digital tools available to draw on wider societal framing in conjunction with scenarios methodologies. This process could provide the meta risk analysis suitable to enable the 'Here be Dragons' to be identified, monitored and tackled, thereby ensuring that decision-makers and ultimately society become more aware of intractable uncertainty and adaptive in the face of inevitable change.

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1. Introduction

Engraved on the copper face of the Lenox Globe, one of the oldest known terrestrial globes that dates back to circa 1500, are the evocative words: HIC SVNT DRACONES. This phrase, "here be dragons", was used to signify dangerous or unexplored territories. It draws on a long history from Greek and Roman times, when lack of knowledge equated to danger. This danger was illustrated visually by cartographers, who filled blank areas of maps with fierce looking sea serpents, dragons or mythological creatures to warn travellers of the risks they might face as they extended the geographical boundaries of the world they knew. For any user of the map, understanding where the boundaries of knowledge lay was almost as important as the knowledge itself. Illusion of knowledge was the greatest danger of all [1].

In the modern world of today, *where be dragons?* They are conspicuous by their absence from the practice of managing risks and uncertainty, although it is becoming increasingly clear that they lie all around us: on the fringes of institutional boundaries, outside the silos of academic disciplines, beyond the risk metrics so carefully calculated... In each instance they are the unacknowledged blind spots, spanning scientific, geographical, temporal and institutional boundaries but unrecognised due to the challenges they represent to our human desire for order and control.

If ignorance, uncertainty and risk all lie on a spectrum of un-knowing, our focus here is on the uncharted issues at the far end of the spectrum. There are countless treatises defining and analysing the differences between uncertainty and risk [2], and any attempt to do this is beyond the scope of this paper. Our interest is whether the 'Here be Dragons' that denote indeterminate uncertainty are ignored – and why.

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2. Examples of ‘Here be Dragons’

‘Here be Dragons’ are unrecognised, therefore there is little research on the subject. This paper has identified three examples, namely ‘wicked problems’, ‘Black Swans’ and ‘Post Normal Science’, which are set out below.

‘Wicked problems’ or messes are not simply complicated problems. They are ambiguous, highly constrained, tightly interconnected complex social, technical, economic and political dilemmas. Their changing nature and complex interdependencies make it almost impossible to define them collectively because there are so many different perspectives and issues at stake [3].

Another example is the ‘Black Swan’, an unpredictable, improbable event characterised by its massive impact on the status quo. [4] What is interesting is that after a ‘Black Swan’ occurrence such as the 9/11 attacks by Al-Qaeda the event becomes rationalised and reframed as something more predictable, using hindsight to prove the existence of foresight [5].

A third version is the ‘Post Normal Science’ categorisation, used to denote controversial often novel forms of technology, such as genetic engineering, nanotechnology or nuclear energy [6]. Post Normal Science is characterised by high stakes, uncertain facts, disputed values and urgent decisions, hence the cost/benefit equation will invariably be fiercely debated. In these situations, peer acceptance is low or non-existent, theoretic structures are based on statistical processing and data input and the uncertainty tends towards ignorance.

These examples are very different, yet there are similarities. In each instance, they are complex problems with many dimensions. They all deal with interactions between multiple interconnected and interdependent systems, each involving different stakeholder groups and interests. Therefore information will always be incomplete and the ambiguity of these different perspectives will magnify their ability to challenge conventional thinking and the status quo.

3. The value of ‘Here be Dragons’

“Ignorance is like the blank spaces in our map of knowledge: within them, there is no detail, no usable information. On the Renaissance world maps... the mapmakers understood that worse than ignorance of facts is ignorance of ignorance; the illusion of knowledge could then lead them confidently to disaster.” [7]

The success of any attempt to manage uncertainty or risk depends on analysis appropriate to the issue. In cases of indeterminate uncertainty, this means recognition of the un-knowing. Socrates claimed that he knew nothing except the fact of his ignorance [8], yet today ignorance is not associated with wisdom.

Due to the lack of acknowledgment, ‘Here be Dragons’ generally remain hidden, unwanted and unrecognised – an omission that can be critical when dealing with controversial issues involving scientific complexity, inherent uncertainty [9], multiple stakeholder groups, complex interdependent systems [10] or longer time frames. The consequences of airbrushing out the ‘Here be Dragons’ can also lead to sub-optimal decisions, unreliable trade-offs, erosion of institutional credibility and research implications of these sources unattended [11]. Most importantly, given that we live in postnormal times, as Ziauddin Sardar argues in his article in this publication [12], is it not time to abandon the ideas of ‘command and control’ and accept the value of ‘Here be Dragons’ as a warning signal in order to navigate and adapt in the face of uncertainty?

The critical issue to understand is why the existence of ‘Here be Dragons’ provokes such widespread and complete denial. This paper attributes the lack of recognition to three factors, namely:

- Human psychology and the desire for control
- Institutional pressures and boundaries
- Scientific convention and the pressures of the rational mindset

4. Human psychology and the desire for control

All human beings share the innate desire to exercise control over their environment. Some researchers argue that the feeling of control, whether real or illusory, is one of the wellsprings of mental health [13]. In terms of perception of risk, the two critical factors influencing human judgement are whether the risks are controllable - i.e. the ‘dread’ factor and whether the risks are known to science - i.e. the level of uncertainty [14].

Unexplained or incomprehensible events have qualities that amplify and extend their emotional impact. Because they are perceived to be out of the ordinary we are more likely to keep thinking about them, trying to make sense of them in order to avoid future similar occurrences.

“Once we explain an event, we can fold it up like freshly washed laundry, put it away in memory’s drawer, and move on to the next one; but if an event defies explanation, it becomes a mystery or a conundrum. . . they generally refuse to stay in the back of our minds.” [15]

In an attempt to understand and control events that are out of the ordinary, human beings draw on their imagination. However, this is limited by our experiences, culture and worldviews. For example, in 1520 Ferdinand Magellan sailed into Tierra del Fuego, on the tip of South America. He and his crew were surprised to find that the Del Fuego Indians had not spotted their boats entering the bay. It became clear that the Indian concept of a vessel was a small dugout canoe, and

nothing in their past experience and understanding had prepared them for large sailing ships with furling sails [16]. Similarly, our experiences are bounded by our concepts of reality, and it is difficult to imagine potentially disruptive events that have no historical precedent. However, by avoiding the contemplation of possible events outside our experience, we make ourselves not merely ignorant of the facts, but ignorant of our own ignorance.

There are differences in the extent to which societies feel threatened by uncertain or unknown situations. These differences in the tolerance that we display with regard to uncertainty depend not only on culture, affluence and socio-political institutions, but also on worldviews [17]. Foresight tools such as scenarios enable groups with diverse and conflicting views to collectively explore weak signals of potentially disruptive change and assess intractable uncertainty together, so bridging the psychological barriers set out above.

5. Institutional responses to uncertainty

Although policy makers and institutions are neatly divided into constituent parts; complex human, technological and environmental systems are not. More often than not, analysis or decision-making impacting such multi-faceted issues is tackled piecemeal within institutional boundaries using a single-issue lens. This enables policymakers to be perfectly right within a narrow model under precise assumptions – or absolutely wrong should any of their assumptions prove to be incorrect.

Modern post-industrial society is one where a preoccupation with risk and risk avoidance is high in the collective consciousness. As the originator of the Risk Society concept describes: *“The movement set in motion by the risk society... is expressed by the statement: I am afraid!”* [18]. For institutions responsible for managing society and the risks it faces, this poses real challenges and a critical question is whether the acknowledgement of uncertainty will amplify this fear. Clearly, this is a conundrum given that transparent communication is a key element of public trust. Admitting uncertainty can enhance the credibility of the communicator; however, it also could also escalate public fear or erode trust by creating perceptions of incompetent decision-making [19].

In many cases, institutional responses err on the side of caution and opt for uncertainty denial, so avoiding the institutional discomfort that acknowledgement of the ‘Here be Dragons’ type of risk might provoke. The result is that they neatly sidestep immediate political, social and technological dilemmas, but not without consequence.

There are several ways in which institutional uncertainty denial takes place. Higher level conflicts with high levels of scientific uncertainty can be reframed into lower level ones where there is more scientific certainty and where scientific experts can debate with greater authority [20]. Alternatively, the institution can transfer the responsibility for risk assessment to the producers of the risk in question, or if this strategy is unsuitable, simply avoid the onus of decision-making and leave a policy vacuum [21]. The result of this abrogation of responsibility is that citizens who participate in the discourse are forced to debate the issues they raise within a narrow technocratic framework drawing on factual arguments. This ensures that concerns regarding contested values and worldviews are rationalised and in most cases unarticulated, so discouraging meaningful debate and gradually alienating the public from the decision-making process [22].

‘Here be Dragons’ are ignored by policy makers for a number of reasons. Sometimes this is done to reassure the public, sometimes because experts do not want to expose their ignorance, sometimes because the institution cannot expose the extent of the gap between regulatory remit and reality. Whatever the reason, there is one certainty: denial of these uncertainties does not make them disappear, it simply means that there are no mechanisms to monitor their whereabouts and the potential danger they pose. Perhaps it is time to focus more on the systemic nature of risk and uncertainty, by acknowledging the ‘Here be Dragons’ and finding tools to better identify, monitor and manage the most serious ones.

6. Scientific convention in the face of uncertainty

While the medieval world recognised both the concept and the value of ‘Here be Dragons’, science, based on the principles of observation and experiment, approaches the issue of indeterminate uncertainty from a different standpoint. The very essence of science is the notion of conjecture and test. Science cannot provide certainty – at its core is the current best working hypothesis. At any time new data can emerge to refute current theories and require them to be modified. In principle, science is therefore a dynamic process, accepting and encompassing fallibility, evolving as more accurate theories replace earlier ones. However, the historic success of scientific thinking in driving rapid and radical technological innovation and the accompanying economic growth has meant that in practice it has become almost impossible to challenge the trajectory of scientific endeavour and the inherent risks the new technologies it spawns might pose.

Science relies mainly on two processes, namely abstraction and analysis. The process of abstraction is used to establish organising principles that enable scientists to deal with large groups of ideas and things on the basis of their common features, and the process of analysis enables scientists to fragment a subject to the smallest possible scale [23]. This narrow lens view encourages the perception that the modern world is ordered and predictable. In addition, the reductionist nature of both processes is based on an assumption that the detail under analysis is representative of the whole – thereby ignoring the innate complexity of many human and natural systems [24].

These scientific conventions have resulted in the modern perception of a rational, measurable and quantifiable world. There are many approaches to risk and uncertainty, drawing upon various base units, methodologies, risk measures and objectives: decision analysis, quantitative risk analysis, psychometric game theory, risk communication, insurance

calculations, natural hazard research [25]. What these disparate outlooks all have in common is an underlying assumption of rationality. This rational model is underpinned by the perception that uncertainty has been bounded and that risks can be identified and controlled – the inconvenient ‘Here be Dragons’ therefore successfully ignored or slain.

According to the National Research Council “uncertainty analysis is the only way to combat the “false sense of certainty,” which is *caused* by a refusal to acknowledge and (attempt to) quantify the uncertainty in risk predictions.” [26] However, there is still no recognised guidance on a scientifically defensible and consistent approach to uncertainty analysis [27], particularly as even experts are likely to use intuitive processes or biases where there is indeterminate uncertainty [28]. One approach is the NUSAP set of guidelines devised to quantify the extent of uncertainty inherent in Post Normal Science. The NUSAP notation is an acronym for five categories which reflect the quality of the information on uncertainty, ‘Numeral’, ‘Unit’, ‘Spread’, ‘Assessment’, and ‘Pedigree’ [29]. Other possibilities are the ‘social arena’, where various actors struggle to mobilise social resources and evidence to gain public support, under the watchful eye of a governmental rule enforcer and the media or an ‘agora’, a public arena where science and society, the market and politics can negotiate the context of future scientific knowledge and the uncertainties it produces [30]. These proposals all include both ‘expert’ and ‘public’ inputs, the questioning and broadening of the knowledge base and an explicit acknowledgement of the ‘Here be Dragons’.

7. Acknowledging the ‘Here be Dragons’

In the previous sections I have argued that human psychology, institutional frameworks and scientific convention have all conspired to remove ‘Here be Dragons’ from the collective consciousness. I have also mentioned the dangers that arise from the reluctance to recognise these areas of uncertainty. Here, I set out how this process might be countered, utilising the new digital tools and processes available to draw on wider societal framing. By doing so, it should be possible to incorporate disparate cultural values and worldviews, so achieving greater societal legitimacy and also acknowledging and locating more ‘Here be Dragons’.

There are other potential advantages. In today’s networked society, there is unprecedented and possibly limitless access to knowledge. The information available to society impacts its perception of the world together with the risks and opportunities that this represents [31]. Without the information constraints of the past, today’s interconnected society has a stark choice of two potential outcomes: a modern-day Babel, or alternatively, greater collective societal wisdom.

How does one avoid the Babel result? There are certain characteristics required for a group of people to have the ‘wisdom of crowds’ [32]. Critically, the group must possess sufficient diversity in order to produce varied opinions and independent thinking, together with the ability to challenge other viewpoints, and access to context specific knowledge, be it of a specialist or localised nature. However, it requires suitable tools to turn many individual judgements into a aggregated collective decision, and the digital era has spawned different types of these.

Some examples include *Wikipedia*, the collaborative encyclopaedia website; *Slashdot*, a technology-related website with news submitted by its readers, and evaluated by editors; or the *Open Directory Project* which draws on sixty thousand volunteers. The United States Patent and Trademark Office recently established a Peer-to-Patent pilot process that enabled members of the public with a certain level of expertise to become community reviewers and assist the patent office in finding information relevant to assessing the claims of pending patent applications [33]. During the 2008 presidential election TechPresident, a cross-partisan group blog set up the Personal Democracy Forum, an interactive website monitoring how voters responded to the candidates, but also how the content they generated affected the campaign [34]. In each case the knowledge and talents of a group were leveraged to create content, predict problems or to organise issues [35].

Crowds are not always wise and under certain conditions the Babel result is a more likely outcome. Without sufficient diversity or the ability to challenge the views of others, there is the likelihood of ‘groupthink’, the psychological avoidance of dissenting opinions [36]. For example, *digg*, an internet site using online technology to rate issues by the votes they receive, was manipulated by an author keen to influence the opinions of the group. He simply bought votes in order to achieve sufficiently high popularity – but interestingly, once he had reached a certain level, he no longer needed to buy votes, as his intervention had created its own momentum [37]. The human desire to be associated with success and group acceptance led to a ‘tipping point’, where ideas, products, messages and behaviour spread the way viruses do [38]. This phenomenon can result in suboptimal decision-making or sophisticated manipulation by certain stakeholders.

In today’s networked information economy, the sheer volume and complexity of information available means that some form of editing of available information usually takes place. There are many web-based tools and processes available to provide such an editorial function, but this position is associated with great power. The gatekeeper/editor is able to control the flow of information and filter its contents, thereby impacting not only the information available, but also the site’s perception of the world and its ‘Here be Dragons’ – or lack of them.

A more rigorous approach to exploring different perceptions of a particular risk is the CMU Mental Models methodology, initially developed to explore public perception of radon, a dangerous substance that can contaminate indoor air quality and cause lung cancer. The methodology has been adapted for use in other contexts and provides a theoretical framework for the systematic analysis of the attitudes, values and perception of the public, together with the ways in which they process their information [39].

Another approach to collate and locate ‘Here be Dragons’ is information mapping. A characteristic of ‘Here be Dragons’ is the intrinsic complexity of their multiple dimensions, making them difficult to grasp. This information can be visually represented by a large mural, illustrating relationships and interconnections with adjacent issues and creating a visual

lexicon and shared mental map that can be both duplicated and amended – complete with the ‘Here be Dragons’ located where appropriate [40].

There are many issues that need to be addressed if the desired wider societal framing is to be achieved. One issue is whether the public is able to freely select and change their editor and, if not, what the levels of dependence and choice might be. A second concerns the interest level of contributors necessary in order to warrant their input into the collective process, and what form of reward is implicit in the process. Ultimately, the critical question is whether these new digital tools and processes could result in growing awareness and acknowledgement of the ‘Here be Dragons’ – or whether the pressures of human psychology, institutional frameworks and scientific convention continue to maintain their stranglehold on acceptable knowledge. My personal belief is these tools, used in conjunction with scenarios and foresight methodologies discussed below, could ensure that the ‘Here be Dragons’ become located on our collective mental maps.

8. Scenarios as meta risk analyses

Foresight is the process of exploring the future. Our human powers of foresight allow us to imagine what has not yet happened in order to protect ourselves from the harsh realities of actual experience. We undertake this process in order to understand and shape the direction in which the future might unfold, as some futures are infinitely more desirable than others. However, there are cognitive processes and heuristics that will bias the information we draw on [41]. This can thwart attempts to locate and understand the ‘Here be Dragons.’

The scenarios methodology is a foresight tool that lends itself to the exploration of complexity as well as conflicting belief systems. Scenarios offer a means of collectively exploring uncertainties and so generating a common understanding of the underlying dynamics and issues that might impact the future. Because scenarios adopt a longer time horizon, scenario builders have a license to look beyond the short-term interests and issues that characterise much institutional and political decision-making, thereby giving scenario builders ‘permission’ to explore the ‘Here be Dragons’.

Although not an end in themselves, scenarios are a useful mechanism with which to understand a range of possible options as well as to identify possible risks and opportunities. They are built by a diverse group of people incorporating expertise from a wide range of disparate disciplines, thereby encouraging collaboration and cross fertilisation, so minimizing potential groupthink. Scenarios come in a set, containing several alternative, equally plausible future states, so forcing disparate groups to acknowledge some information that challenges their worldviews, but at the same time recognises their perspective. The process increases the likelihood of discerning possible ‘Here be Dragons’ and ultimately, should create greater awareness of and responsiveness to the inherent risks of our complex world.

The use of scenarios as meta risk analyses has inherent limitations: the outcome will only be as good as the inputs. The quality will depend on the process and the requisite variety of the collective minds of the participants in the room, or those whose thinking has in some way been incorporated. Although scenarios are an imperfect tool, they facilitate preparedness for the future. In the absence of a crystal ball, it is usually better to be partially right across a wide range of possible assumptions than totally wrong.

People and their institutions are usually resistant to change. Almost five centuries ago Machiavelli said: “It ought to be remembered that there is nothing more difficult to take in hand, more perilous to conduct or more uncertain in its success than to take the lead in the introduction of a new order of things. Because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new.” [42] However, there has never been greater need for societal adaptability in the face of exponential change. Human societies today are so interconnected and interdependent that there is a great need for resilience, yet this will require recognition of the ‘Here be Dragons’ and strategies to deal with their materialising. For this reason, I believe that scenarios provide a potential tool for meta risk analysis of the ‘Here be Dragons’ systemic issues society faces. They could overcome the illusory security created by societal myopia and also address issues of procedural fairness, and possibly outcome fairness [43].

9. Conclusion

Science has provided many answers to the world we live in. The result has been unprecedented technological progress and economic development. However, ignorance, ambiguity and scientific uncertainty have all too often been conveniently airbrushed off our knowledge maps. ‘Sound science’ is usually invoked as the basis for policy decisions, yet with scientific experts available to argue either for or against as the need arises, any semblance of neutrality and rationality is undermined.

It is now time to acknowledge the ‘Here be Dragons’ and explore which ones pose the greatest risk to the society we desire for ourselves and our offspring. This should ensure that short-term decision-making is not at the expense of the long-term prospects for Humanity. It should also result in a fairer and more effective allocation of scarce resources.

The world is forever changing. The only certainty in this uncertain world is that the ‘Here be Dragons’ of tomorrow are unlikely to be those of today. Today’s dragons might be hidden, unwanted and unrecognised, but they will not remain outside the confines of our collective mental map forever. Our decision-making today will impact the world of tomorrow – including the whereabouts, size and scale of the ‘Here be Dragons’. Whatever the conclusions reached by policymakers and institutions, ignorance increases the potential for systemic volatility and disruptive change. The ‘Here be Dragons’ are around us, and human beings dependent on the complex webs of interconnected human and natural systems ignore them at their peril.

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