Decision making and planning under low levels of predictability: enhancing the scenario method.

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Abstract

In this paper we review and analyse scenario planning as an aid to anticipation of the future under conditions of low predictability. We examine how successful the method is in mitigating issues to do with inappropriate framing, cognitive and motivational bias, and inappropriate attributions of causality. Although we demonstrate that the scenario methods contain weaknesses, we identify a potential for improvement. Four general principles that should help to enhance the role of scenario planning when predictability is low are discussed: (i) challenging mental frames, (ii) understanding human motivations, (iii) augmenting scenario planning through adopting the approach of crisis management, and (iv), assessing the flexibility, diversity, and insurability of strategic options in a structured option-against-scenario evaluation.

1. Introduction

Consider the following events which have occurred in the last twenty-five years: 9/11, the rise of SMS text messaging, the predominance of Google, the collapse of share prices on 19 October 1987, Black Monday, and the global financial melt-down of 2008. All of them are characterised have two attributes in common: they took most people by surprise and they have had a large impact on the lives of many people. But did these events have a low level of predictability? Predictability can be viewed from two perspectives: i) our ability to arrive at reliable or well-calibrated probabilities, and ii) the dispersion of the underlying probability distribution. If well-calibrated probabilities can be established, decision theory can be used to indicate how to make rational decisions on the basis of them, even if the dispersion of the underlying probability distribution is large (Goodwin & Wright, 2004). The problem of low predictability therefore arises: i) when it is not possible to arrive at well-calibrated probabilities, and/or ii) when it is not possible to measure calibration, so that one cannot assess the level of confidence that one should attribute to probabilities. This means that unpredictability is a major concern in relation to unique, unprecedented, or rare events which, if they occur, will have a high impact. In particular, there is the potential to underestimate the probabilities of these events by implicitly, or even explicitly, assigning to them extremely low probabilities or probabilities of zero. Moreover, an absence of past data means that the calibration (or reliability) of such probabilities cannot be assessed, so any biases associated with them will not be recognised. We will first examine the potential reasons why the predictability of specific high-impact events may be low. Then we evaluate the effectiveness of the scenario method – a method that attempts to avoid these problems by excluding a direct consideration of probabilities. Having identified the weaknesses of the scenario method, we then discuss potential improvements.

2. Reasons for low predictability

2.1. Inappropriate framing

The way in which a decision or planning problem is framed, or viewed, will determine the extent to which account is taken of the different uncertainties that may impinge on the problem. Research suggests that planners and decision makers often have overly narrow frames of reference, or frames that are too embedded in the past – so that inadequate attention is paid to changes and the potential threats and opportunities that these may represent. For example, in one study it was found that Scottish textile producers saw other Scottish companies as their main competitors, despite the fact that foreign companies represented their most serious challenge (Porac, Thomas, & Baden-Fuller, 1989). At the extreme, an important threat or opportunity may go totally unrecognised (de facto, a zero probability is given to its occurrence), with the result that the organisation is totally unprepared when the event occurs. Incomplete, inaccurate, and otherwise inappropriate mental models may "prevent managers from sensing problems, delay changes in strategy, and lead to action that is ineffective in a new environment" (Barr, Stimpert, & Huff, 1992). In times of rapid change, Wack (1985) contends, strategic failure "is often caused by a crisis of perception, that is, the inability to see an emergent novel reality by being locked inside obsolete assumptions, particularly in large, well-run companies". Further evidence of inappropriate framing comes from Johnson's (1987) single longitudinal case study of the UK retail clothing industry. The focus of the study was on the (mis)match between changes in the firm's strategy as it sought to succeed in a changing environment, the objective of the study being to identify whether incremental changes in strategy were beneficial or harmful to the overall survival and success. The study concluded that market signals of a failing strategy were not interpreted as such within the organisation, and that managers in a previously successful business sought to reduce the perceived importance of dissonant information, such that the prevailing strategy was not threatened. Johnson showed that the resultant incremental change in strategy did not keep pace with environmental change, leading ultimately to strategic drift. The objective sensing of external signals, it was reasoned, is muted within the organisation because the signals are not meaningful in themselves, but take on relevance from the viewpoint of the manager's mental model. This so-called frame blindness can lead to effort being wasted in forecasting the wrong events, or predictions being based on erroneous assumptions about the nature of the real world.

Experts in many fields are particularly susceptible to the adoption of particular frames which are consistent with their specialism or prejudices, so we should be somewhat sceptical of the confidence levels assigned to their forecasts (Armstrong, 1980; Tetlock, 2005). Indeed, in a huge study of approximately 28,000 predictions made by approximately 280 experts that were related to the political and economic futures of approximately 60 countries, Tetlock found that experts usually fared no better than simple statistical models. Moreover, Tetlock found that experts usually fail to question their own frames when evidence emerges that their forecasts are wrong. Instead, they have a developed an impressive ability to explain away their errors by redefining inaccurate forecasts as relatively accurate: "the forecasted event almost occurred" or "OK, the event has not happened yet, but it will" or "my timing was just off". In addition, Tetlock found that the experts were less likely to change their views than non-experts, despite compelling evidence to the contrary.

2.2. Cognitive and motivational biases

When judgment is used in the prediction task, cognitive biases can lead to low predictability. These biases can emanate from forecasters' use of heuristics like availability and representativeness (Tversky & Kahneman, 1974) or they can be the result of optimism or wishful thinking. For example, Fildes et al. (2008) found that judgmental adjustments to statistical point forecasts by managers in four UK companies suffered from the inefficient use of available information and optimism bias. Some research has focussed on methods for de-biasing judgmental assessments, but it has become generally accepted that, although the probability assessor could be made aware of potential bias, the amelioration of bias is less straightforward. At the same time, other studies have demonstrated excellent calibration in judgmental probability assessments – most notably in weather forecasts (see Orrell & McSharry, this issue). Bolger and Wright (1994) and Rowe and Wright (2001) argued that the short, non-confounded, prediction-outcome-feedback loop that is found in weather forecasting may be ideal for developing well-calibrated assessments in judgemental probability forecasting. Of course, in many decision and planning situations involving the prediction of unique or rare events, such enabling conditions for well-calibrated judgement do not exist. Here, judgmental prediction may be poor whilst at the same time judgmental forecasts may be overconfident – with such overconfidence exacerbated by hindsight bias (Fischhoff, 1975).

Events like 9/11 and the collapse of Enron are novel and one-off and hence will lack a suitable reference class of similar events. However, Bazerman and Watkins (2008) have argued that these were 'predictable surprises' in that key decision makers 'had all the data and insight they needed to recognize the potential for, and even the inevitability of, a crisis'. Note that such predictable surprises are not examples of the operation of the hindsight bias, since bias is prevalent at the time of the prediction rather than being inherent in later, misjudged, recollections of accurate predictions. Bazerman and Watkins suggest that the problem with these types of events is a failure to act on the information and insight because the costs of implementing the necessary actions in the present loom large when compared with the 'vague' benefits of reducing the probability of a disaster in the future. In addition, no decision maker receives credit for preventing a disaster that did not occur, and those with vested interests may conspire to stop any such preventative action that is to their disadvantage being taken. Consider the armour-plating of airliner cockpit doors – would this expenditure have been implemented by the airlines pre-9/11? All of this is overlaid by the tendency of organisations to maintain the status quo and to act incrementally, when in fact step changes are required (Wright, van der Heijden, Bradfield, Burt, & Cairn, 2004). This is, of course, primarily a problem of failing to act on the implications of a forecast, rather than a failure of forecasting, but these motivational factors may lead to an attitude of denial that the event in question may occur, so that its probability, from an operational perspective, is seriously underestimated.

2.3. Inappropriate attributions of causality

Our ability to predict rare or unique events is relatively low when these focal events are caused by complex interactions between other, pre-cursor, events. Indeed, even actions subsequent to a forecast may be part of such interactions. For example, a forecast of an election victory for a political party may change voters' behaviour so that the forecast turns out to be wrong. Chaos theory and the law of unintended consequences exemplify these problems. Taleb (2008) refers to 'the three body problem' demonstrated by Poincare:.

"*If you have only two planets in a solar-style system, with nothing else affecting their course then you may be able to indefinitely predict the behaviour of these planets… but add a third body, say a comet, ever so small between the planets... initially the third body will cause no drift but later its effects may become explosive... small differences in where this tiny planet is located …*" (p. 176-177)

The further into the future we want to forecast, the greater will be the difficulty. The occurrence of future inventions, which will transform the way we live, may be the result of such chance interactions over long periods. Such future inventions will be developed on the basis of future knowledge which, by definition, we cannot have at the present point in time. As Taleb points out:

"*To understand the future to the point of being able to predict it you need to incorporate elements from the future itself... assume you are a special scholar in a medieval university's forecasting department… you would need to hit upon inventions of electricity, atomic bomb, internet, airplane… Prediction requires knowing about technologies that will be discovered in the future. But that very* *knowledge will almost automatically allow us to start developing those technologies right away. Ergo, we do not know what we will know.*" (p 172 – 173)

In short, Taleb argues that the accurate prediction of future, causal, chains of events is impossible. To his mind, the sequence of causal impacts of one event upon another is not a simple linear sequence – for example like a stacked row of dominoes falling in one direction, with each domino's fall causing the next one in line to fall. By contrast, each observed event may have many causes and impacts. We add to this viewpoint our view that only when a high consequence event has, in fact, occurred does the sequence of underpinning causes become salient, with hindsight.

Humans have a tendency to invent causes for patterns in events that are best regarded as random. Many studies have demonstrated that humans have a strong tendency to see patterns within randomness (Ayton, Hunt, & Wright, 1989), and they are also adept at finding reasons to explain these patterns, even though these reasons may lack any evidential support (Fildes & Goodwin, 2007a). For example, consider the prevalence of the fallacious belief amongst basketball players and fans that players' attempts at scoring with a shot are more likely to succeed following a hit than following a miss (Gilovich, Vallone, & Tversky, 1985). Also, of course, countering the propensity to see patterns in randomness is the major purpose of using inferential statistics in the social sciences (Pollatsek & Konold, 1991). The search for causality thus seems to be a basic drive in human cognition, and it follows that confidence in our post-hoc constructions of causality may also generalise to (inappropriate) confidence in our predictions of the causal unfolding of future events. For example, causes of the 9/11 attack were analysed in detail by journalists using post-event hindsight, but the coverage of likely terrorist attacks within the US continent was mute, pre-event.

3. Problems with the scenario method and a proposed solution

We next assess the extent to which these three causes of low predictability can be mitigated by the scenario method. Given the difficulties in assessing probabilities for unique, unprecedented and rare events, scenario planning, using the intuitive logics method, offers an approach for handling situations of low predictability which avoids the requirement to make such estimates (van der Heijden, Bradfield, Burt, Cairns, & Wright, 2002).[1] The intuitive logic method has been extended and developed from its military origin to become a popular tool for policy planning.

In chronological order, the approach first requires that the scenario team members identify predetermined elements and critical uncertainties. These elements are then categorised under the STEEP headings (social, technological, economic, ecological, and political), then 'cross-disciplinary' clusters are constructed between elements, such that causal impacts of one element on another are identified by arrows of influence. In this way, causally-linked clusters of elements are generated and named that are, to a large degree, independent of one another. The next step is to identify those cluster headings whose content is both: (i) of high impact on the focal issue of concern (usually the viability of the host or focal organization), and (ii) of high uncertainty. The two cluster headings that combine the greatest (a) impact, and (b) uncertainty over what that impact will be, are selected as the 'scenario dimensions' that are utilised to produce four detailed scenarios – developed with a common, temporal, starting point, but ending in four diverse, yet plausible, causally-unfolded end-states. It is after this point that scenario development may focus on stakeholder analysis – what would each of a set of stakeholders (e.g., competitors, regulators, customers, suppliers, etc) do as a particular scenario unfolds in order to preserve or enhance their own interests? This optional ingredient of the scenario mix is perceived as adding a degree of realism to the scenarios. The final step is to evaluate the organization's strategies (previously kept separate and distinct) against each of the scenarios. Is a particular strategy robust against a range of scenarios, or is it fragile against some? This focus often leads to: (i) the re-design of strategic options, or, more fundamentally, (ii) the re-design of the success formula of the organization.

It can be seen that the emphasis in scenario planning, as we have proposed it in this paper, is on uncovering the causal nature of the unfolding future. As Burt, Wright, Bradfield, Cairns, & van der Heijden, (2006) note, scenarios are not predictions, extrapolations, good or bad futures, or science fiction. Instead, they are purposeful stories about how the contextual environment could unfold over time, and these stories consist of the following:

1 *A description of a future end state in a horizon year* – That is, the combinations of uncertainties and their emergent resolution at the final point in time in a particular scenario story. As we shall argue later, the conventional intuitive logics methodology is limited in the degree to which a broad range of uncertainty is addressed.

2 *An interpretation of current events and their propagation into the future* – The scenario methodology is designed to help participants make sense of yesterday's events and the causal impact that they are having into the future. In addition, some of yesterday's events may not yet have been fully manifested as outcomes, and their full manifestation may be carried forward in time toward the horizon year of a particular scenario

3 *An internally consistent account of how a future world unfolds* – That is, an explanation based on causal logic of how a particular scenario unfolds from the past to the present to the future. The story will represent the dynamic interplay of predetermined elements and resolved uncertainties, showing how these factors interconnect and impact each other, and revealing their logical consequences.

Note that, in general, the two clusters that result from the application of the intuitive logic approach to scenario construction will each contain a mix of pre-determined elements and what are perceived as critical uncertainties that are causally linked together. Generally, four scenarios are constructed that are derived from the resolution of events within each cluster into two major outcomes – with each of the outcomes of the first cluster then being combined with each of the outcomes of the second cluster (see van der Heijden et al, 2002, chapter 7, for more details). Thus, the resolution of the contents of the two high-impact, high-uncertainty, clusters drives the development of the storylines of the four resultant scenarios. The development of the four storylines will, in practice, also utilise other uncertainties and pre-determined elements that have been generated by scenario workshop participantsbut which are seen by these participants to have less impact on the focal issue of concern. It follows that each of the four resultant scenarios will be separable from the other three, and also more extreme than the other three in some ways. Since each scenario represents an intersection of resolved uncertainties, each detailed scenario will, logically, have an infinitesimal likelihood of actual occurrence. It also follows that the interactions of resolved uncertainties that are identified by participants but which are not part of the two high-impact clusters may have led to the development of quite different scenarios, if they were instead taken as the focal uncertainties that drive the construction of the scenarios – c.f. Taleb's three-body problem that we described earlier. In short, the step-by-step components of the intuitive logic method of scenario construction may restrict the diversity of the constructed scenarios. We return to this issue in the final section of our paper, when we propose new approaches to coping with low predictability.

Scenario planning is thus designed to be an organizationally based social-reasoning process which utilises dialogue and conversation to share participants' perceptions of the environment and to facilitate participants' interactions as they engage in a process of sense-making through theory building and storytelling. The process of building scenarios should serve to bring latent issues to the surface, so that it is more difficult to deny the prospect of high-impact events when there is objective information available that they are liable to occur. This is particularly likely to be the case where outside participants or independent facilitators are involved in the process. Thus, scenario planning may help to reduce some of the motivational biases that were outlined earlier.

Gregory and Duran (2001) and Healey and Hodgkinson (2008) reviewed some problematic issues with scenario planning. Included in these is the issue that having individuals, or groups of individuals, imagining the occurrence of a sequence of events makes the focal sequence appear more likely to occur than the normative probability computed for the intersection of these individually-evaluated events would imply. Tversky and Kahneman labelled this as a bias due to the operation of the "simulation heuristic". Specifically, if the events' occurrences are linked in a causal chain (where one event causes the occurrence of the next), the intersection will be viewed as having an increased likelihood. As such, the act of constructing scenarios may, by itself, produce increased, but inappropriate, confidence in one's ability to anticipate the future (Kuhn & Sniezek, 1996). Thus, while the focus on causal chains in scenario planning is a strength, because a knowledge of the causal interactions of events, in principle, allows the decision maker to go beyond the use of extrapolation based on historical data in the reference class, it can also be a weakness. The use of multiple scenarios that provide plausible, but different, chains of causality thus provides one potential way to alleviate such overconfidence in the unfolding of a single, focal, scenario.

However, Healey and Hodgkinson noted that the increased plausibility of focal scenarios may exacerbate another problematic issue: if the components of a scenario are derived from the current mental models of the decision makers, then these mental models will be strengthened by the operation of the simulation heuristic. As O'Brien (2004) argued, in practice, scenario participants tend to regularly emphasise economic factors – such as exchange rates, interest rates, and the focal country's economic activity – as uncertainties that are subsequently given prominence in the scenarios that participants constructed. Also, recent and current media-emphasised concerns (e.g. of terrorism activities) tend also to replicate themselves in constructed scenarios through the operation of the availability bias. O'Brien labelled these practice-recognised issues as "future myopia". By contrast, as Wright, Cairns, and Goodwin, (forthcoming) note, one way, which is used in practice by scenario practitioners, is to challenge the decision makers' mental models by the introduction of what the scenario community term "remarkable people" into the strategic conversation – i.e., including as participants in a scenario exercise individuals (often from outside the host organization) who hold disparate and contradictory views on key uncertainties. Scenario planning practitioners argue that between-workshop activity spent on researching the nature of critical uncertainties identified in earlier workshops will also add to the quality of a strategic conversation about the nature of the future, but there is no empirical evidence on the benefit of such desk-based research.

In summary, while the application of the scenario method may reduce any tendency to deny the prospect of undesirable events because of its explicit nature, it may reinforce existing framings of the future unless the addition of the views of "remarkable people" can counter these viewpoints. The creation of detailed scenarios – containing particular causal chains of events – may also serve to increase the perceived likelihood that a specific scenario will, in fact, occur. Also, the method may cause participants to discount the possibility of high impact events which are not reached via these causal chains. Crisis management has been proposed as one method to deal with unexpected events, and we next to summarise this method and evaluate whether there are any insights within this approach that can usefully be applied to the development of the scenario method, in order to ameliorate the weaknesses that we have identified and discussed.

3.1. Crisis management

Pearson and Clair (1998) reviewed organizational crisis management, defined as "… low probability, high-impact events that threaten the viability of the organization and are characterized by ambiguity of cause, effect, and means of resolution…" (p. 60). The authors list an array of such crises, including environmental spill, computer tampering, malicious rumour, a natural disaster that disrupts a major product or service, terrorist attack, and plant explosion. The fundamental aims of crisis management are to sustain – or resume – operational activity, minimise losses, and learn lessons for the future. As such, crisis management is focussed on management rather than prediction, although the literature does discuss the failure to heed warning signals of impending crises, and links such failures to limitations of perception and cognitive limitations. Perrow (1984) was one of the first to warn of the risks inherent in high technologies that are characterized by "interactive complexity" and " tight coupling", arguing that "…multiple and unexpected interactions of failures are inevitable"(p. 6).

Pearson, Clair, Hisra, and Mitroff (1997) noted that many organizations prepare for the crisis that they believe to be the most probable or expect to have the most impact if it occurs. These authors argue that, instead, "… the best-prepared organizations compile a crisis portfolio for an assortment of crises that would demand different responses… this may seem a wasteful approach but… the most dangerous crises… cause greater trouble, specifically because no-one was thinking about or preparing for them" (p. 55). Pollard and Hotho (2006) argued that scenario planning (see the previous section) can be combined with crisis management to identify "crisis futures", but, as we have seen, scenario planning has inherent problems in achieving this goal.

In summary, crisis management delineates inappropriate framing as a focus of attention, but it is unclear as to how inappropriate frames are identified. The explicit focus of the method on undesirable events should reduce any tendency to deny the prospect of these occurring. The general focus of the approach is on the management of crisis outcomes rather than on the prediction of particular crises. However, the cost-benefit trade-off of preparing an organization for all possible crises is not addressed in the extant literature. Nor has a systematic approach been offered to enable managers to rank-order crises for differential attention. Nevertheless, the focus of crisis management on preparing the organization for a wide range of extreme events is in stark contrast to the intuitive logics scenario method where, as we have discussed, the range of focal scenarios is likely to be constrained by components of the construction methodology.

4. Coping with unpredictability: enhancing the scenario method

In decision making and planning, of particular concern are possible high impact events that are implicitly assigned a probability of zero, or, at most, an extremely low probability. From our analysis of the limitations and weaknesses of the scenario method, any method that is likely to improve predictability, or allow for effective planning when it cannot be improved, will have the following characteristics.

1. Predictions must not by restricted by data in the reference class. They should also offer the potential to generate surprises.
2. There is a need for the method to challenge existing mental frames
3. Cognitive biases in the estimation of probabilities must be avoided
4. The method needs to surface possibilities which there may be a motivation to ignore, so that they can be explicitly addressed.
5. Overconfidence in a single future scenario, or in a narrow ‘range’ of such scenarios, should be avoided.
6. The method should exploit certainties or near certainties about the nature of the future.

7. The method should help decision makers to assess uncertainty by distinguishing what we know from what we don't know.

8. The method should identify the uncertainties which have the greatest potential impact.

As we have seen, scenario planning, when applied correctly, meets criteria (1), (3), (4) and (6), but it can fail on (2) and (5). Scenario planning tries to achieve (7) by identifying the boundaries of uncertainty (the 'known unknowns'), but, as we have argued, the diversity of scenarios can be too restrictive. For example, the range of scenarios may contain GDP growth figures for an economy ranging from –1% to 4%, but how secure can decision makers be that this represents the complete range of possibilities? The same consideration applies to the qualitative elements of scenarios. One of the authors has run regular scenario planning exercises with employees of a major company in the UK defence sector. Sometimes participants propose the development of scenarios which contain events such as impending meteor collisions with Earth or even threats of invasions by extra-terrestrials. How do we deem whether such events should lie within or outside the range of plausibility? As we have seen, scenario planning is concerned with the identification of causality and, as such, events without causes linked to events in the present are not part of the content, or outcome, of the intuitive logics scenario process. Therefore events which cannot be reached from the present through these linkages, such as large meteor collisions with Earth, would not be valid scenario components, and hence these sources of uncertainty would not be addressed through scenario planning. Scenario planning explicitly addresses point (8), above, by identifying cluster headings whose causally-related content has a high impact on the focal issue of concern. However, this is usually specified at a higher level (e.g. the viability of the host or focal organization), so that that impact on the specific objectives may not be addressed. In the following sections, we suggest how the approach could be improved so that it meets all of the above requirements.

4.1. Challenging framing and the perceived boundaries of uncertainty

In scenario planning, the employment of 'remarkable people' and the accommodation of minorities with apparently heretical views about the future is likely to reduce frame blindness in the context of a facilitated process intervention within an organization. However, at present, the incorporation of such potential insights is unstructured and unevaluated. The inclusion of devil's advocacy and dialectical inquiry techniques as ways of challenging team-based opinions has, however, been studied quite extensively, but from the perspective of the perceived value added to the decision process, rather than the resultant validity of any forecasts underpinning decision making. However, there is no reason why scenario planning should not include formal methods to challenge existing frames. In decision making, techniques like the "frame analysis worksheet" (Russo & Schoemaker, 1989) have been designed to serve this purpose. In scenario planning such a worksheet could ask decision makers to assess their scenarios by asking them to respond explicitly to questions like:

- What boundaries have we put on the scenarios? What aspects have we left out of consideration?
- Why do we think about this question in the way we do?
- What do the scenarios emphasize?
- What do they minimize?
- Do our competitors or our consumers think about these issues differently from the way we do?

4.2. Constructing scenarios using backward logic

An alternative to providing challenges to already-constructed scenarios using the frame analysis worksheet is to formally build challenges to frames and boundaries into the scenario planning process. This could be achieved by a employing a fundamentally different method to derive scenarios. Rather than moving forward through causal chains to arrive at scenarios, as in conventional, intuitive logics and scenario planning, an alternative is to work backwards from objectives. An analogy can be drawn between event trees, which use forward logic, and fault trees, which use backward logic. The latter start with a top event (e.g. the failure of a system) and then identify the ‘underlying events’ (e.g. failure of a component) that need to occur in order for the top event to be realised. The combined use of both event trees and fault trees has been found to enhance reliability analysis (Paté-Cornell, 1984).

An organization’s over-riding objectives can be identified using techniques like objectives hierarchies and value-focussed thinking (c.f. Keeney, 1992; Wright & Goodwin, 1999), and the worst and best possible levels of achievement of these objectives can be estimated. Such assessments can be made quantitatively (as in the case of profit or returns on investments) or qualitatively (as in the case of a company image). Next, it should be possible to list the factors that drive the extent to which these objectives are achieved (e.g. profit may be driven by factors like sales volume and raw material prices, while the company image might be driven by factors like industrial relations). Third, the ranges of possible achievement (worst possible and best possible case) for each of these objectives should then be extended beyond the ranges already put forward (i.e., made more extreme), and planners should be asked whether they can envisage circumstances where the behaviour and interaction of the drivers could make these more extreme best- and worst-case levels of achievement plausible. If appropriate, they should be encouraged to envisage whether additional drivers may exist which could account for these more extreme levels of achievement. If such levels are thought to be implausible, the process should stop and the scenario workshop participants should be encouraged to write out explicit reasons why this is the case. Conversely, if plausibility is established, the ranges should be further extended and the process repeated until implausibility is obtained. Once the ranges of plausibility have been established for the objectives, it should be possible to work backwards to identify the drivers or interactions of drivers which are having the greatest impact on these ranges. For example, uncertainty in government regulatory measures may be judged to be having the biggest impact on the range of possible market shares that a company will achieve in five years’ time.

Alternatively, the interaction of regulation and the number of new entrants to the industry may be the main contributor to uncertainty. These drivers, or combinations of drivers, can be ranked in terms of their impact in a manner that is analogous to tornado diagrams in risk analysis.

This backward logic approach has the advantage of focusing participants' attention on the possibility of extreme impacts on an organization's objectives. As we argued earlier, forward causal reasoning may fail to identify these possible impacts because of (i) the huge potential range of causal chains, only a few of which may be simulated in the scenarios, and (ii) the absence of a focus on objectives in the scenario construction process.

One problem with fault trees, and hence with this analogous approach using backward logic, is the difficulty that people have in identifying a full range of drivers for the top event, a tendency that Fischhoff, Slovic, and Lichtenstein (1978) have referred to as the 'out-of-sight-out-of-mind' phenomenon. The encouragement to consider the possibility of additional drivers (see above) may be helpful here, but some research suggests that an effective technique is to ask scenario workshop participants to assume that the top level event has already occurred (e.g., in this case, a return on an investment 10% below that originally thought to be possible), and then to ask them to imagine what caused it. This shift in perspective from the future to the past was found to generate more causes for the top event in a study by Mitchell, Russo, and Pennington (1989).

4.3. Understanding human motivation by emphasising stakeholder analysis within scenario planning

Our proposed backward-logic approach to scenario construction will enable the generation of scenarios that permutate the focal organization's achievement of extremes in its over-riding objectives. The next step is to "flesh-out" the scenario storylines by developing and evaluating the causal linkages in the skeleton scenarios. Given the human pre-disposition to impose patterns on random sequences of events, as discussed earlier, what principles should guide the construction of causality? One of the (almost) certainties that will apply to the future is that human motivation and self interest will be a key causal factor in determining the characteristics of the future. Maslow's "theory of human motivation" (Maslow, 1943) was a goal-based conceptualisation. Maslow argued that the basic needs of humans are physiologically-based – the need for food, water, sleep and sex. If the physiological needs are "relatively well satiated", then physical safety needs become the focus of attention. If both physiological and safety needs are relatively well satisfied, then the need for love, affection and belongingness become a focus. The next set of needs in Maslow's hierarchy is the need for esteem from others. The ultimate need is that of self-actualisation – the desire for self-fulfilment and the desire to know and understand.

From this short summary of Maslow's theory, we can see that Taleb's medieval scholar, described earlier, has a basis for anticipating the nature of the future: humankind will strive to satisfy the hierarchy of needs. Thus, the invention and development of electricity supplies aid the satisfaction of physiological and safety needs – e.g., a warm and light home. The invention and development of mass immunization aids the satisfaction of safety needs. The invention and development of the internet aids the satisfaction of the need for self-actualisation – e.g., instant access to knowledge. The invention and development of the aeroplane allows, for example, contact with family and business colleagues – thus, in part, satisfying the love, affection and belongingness needs.

It follows, therefore, that specific technological developments cannot be predicted, but general technological development can – since any development will be to satisfy human needs. For example, suppose that the effect of an unknown event is the end of international air travel. How would self-interested humans react? Managers still need to hold face-to-face meetings with overseas colleagues, and we could also expect enterprising people to respond to this new situation. The result would be likely to be a huge growth in the use of video conferencing, and an associated enhancement of the availability and quality of such services. In short, basic human motivations can be modelled and analysed in an enhanced scenario planning methodology. We discuss an outline logic and procedure for such an enhancement in the following paragraphs.

As outlined earlier, the scenario approach, as practised, is based on the premise that stakeholder values and actions, once surfaced, add realism to already-constructed scenarios. However, accepting Maslow's theory of human motivation, it follows that understanding stakeholder motivations can provide primary insights into the nature of an unfolding future. As a first step, stakeholder groupings need to be identified and differentiated. In a comprehensive review, Bryson (2004) presented fifteen stakeholder identification and analysis techniques. The basic techniques focus on: (i) brainstorming a list of potential stakeholders, (ii) listing criteria for how each of these groupings would view the (focal) organization's performance, and (iii) analysing what can be done by the focal organization to satisfy each stakeholder.

As we have seen, the scenario method explores the complex relationship between social, economic, technological, environmental and political factors from multiple perspectives, enables sense making of their interactions, and provides a vehicle for the development of plausible futures. The incorporation of an enhanced stakeholder analysis enables this exploration to be structured to take into account the input of and impact upon all involved and affected parties. In the context of the organizational scenario workshop, an emphasis on stakeholder analysis assumes that scenario participants will be able to put themselves in the shoes of each particular stakeholder grouping when this does not involve actual interactions with representatives of such groupings. At the same time, stakeholder interests and values may be more subtle than those that are obvious on the surface. However, there is evidence that role-playing unfamiliar roles can lead to insights. Green (2002) showed that when university students were first asked to role-play the participants in six heterogeneous conflict situations, their group-based resolutions of the conflict – or the group-based forecasts of the outcomes of these conflicts – were accurate. Intuitively, it would seem that one's own experiences of the past resolution of conflicts – perhaps as recalled or previously experienced, and including both personal and non-personal conflicts – offer a strong guide to the prediction/resolution of the outcomes of novel conflicts. In other words, if the resolutions of conflicts are, generally, the result of the operation of basic human motivations and value systems, then the conditions for reasoning by analogy are favourable (Wright, 2002).

4.4. Augmentation

As we pointed out earlier, events which cannot be reached from the present via causal chains will not constitute valid components of scenarios. This means that the range of uncertainty embraced by the scenarios may not include surprise events for which the causality was not apparent, like natural disasters, the effects of malicious rumours or accidents causing major pollution. Attempts to incorporate such events into scenarios would be likely to imperil the cohesiveness of the scenario development process, and we therefore suggest that they should be addressed outside this process by a process of augmentation (Makridakis, Hogarth, & Gaba, 2009). Processes akin to those used in crisis management can be used to draw up a portfolio of potential events (both benevolent and malevolent) that may impact on the organisation. Techniques like brainstorming may be particularly effective in generating lists of such events, which can subsequently be filtered on the basis of their perceived likelihood and impact. An alternative is the "red team/blue team" method (e.g. see Carter, 2001), where one team play the role of an adversary trying to damage an organisation as much a possible, though the outcomes of this process are likely to be confined to malevolent, human-generated events like sabotage. Employing specialists from different areas to identify risks and opportunities relating to their specialism may also be productive.

One issue that remains unresolved, however, is the one that we identified previously in our discussion of crisis management. There, the extant advice is that the organization should compile a portfolio of crises that demand a wide range of responses. However, the cost-benefit trade-off of creating such organizational preparedness was not addressed in the literature. The same dilemma arises in our proposed augmentation of the scenario method. Should all possible scenarios be addressed by the focal organization? We posit that such preparedness for all possible scenarios is unrealisable. For this reason, we propose that the focal organization should create flexibility, diversification and insurability in its response to the particular scenarios constructed by our advocated methods of backward logic and augmentation.

4.5. Evaluating flexibility, diversification, and insurability in option-against-scenario evaluations

Thinking about the future in as general terms as possible should reduce the dangers that people will suffer from the simulation heuristic and become overconfident in relation to particular scenarios. Thus, a scenario may refer to technological innovation in car engine efficiency, rather than, for example, the invention of a hydrogen-powered car engine. We can then make an allowance, within our planning, for the occurrence of a specific event within a general category, e.g., one that impacts – either negatively or positively – on the over-riding objectives of the focal organization. The desirability of characterizing the future in general terms suggests that the organisations that will best cope with poorly predictable future events will be those that are flexible and diverse. Firms should not operate in the airline business or the video conferencing business, but should instead operate in the face-to-face communication business. Firms should not operate in the electricity business, but should instead operate in the energy business. As such, these general-purpose organisations will be less susceptible to negatively-valenced events that disrupt particular technologies, and will be receptive to positively-valenced events that provide unexpected opportunities. Thus options to upscale, or downscale, a particular activity should also be held open (cf Miller & Waller, 2003). Additionally, insurance could be sought to downside risks.

From this discussion, our prescription for decision making and planning in the face of low levels of predictability is straightforward. The decision maker should be alert to the degree to which a strategic option is: (i) flexible – i.e., the investment can be up-scaled or down-scaled at any point in the future; (ii) diversified – i.e., following the option that diversifies the firm's current major offering(s) by providing a different technology base, a different production base, or a different customer base; and (iii) insurable – i.e., allows the possibility of insuring against extreme down-side risk. Our prescription can be implemented as a necessary check-list that must be completed in any option evaluation or as part of a more formalised, multi-attribute, evaluation of options against scenarios (c.f. Goodwin & Wright, 2001).

4.6. A short demonstration of our enhancement of the intuitive logics scenario method

Imagine that a London-based, black-cab, taxi firm is interested in understanding future demand for its services in a particular part of London. One of its over-riding objectives is high short-term profit. Profit is driven by revenue, which is driven by the demand for taxi journeys. Apart from weather conditions and other seasonal effects, the owners of the firm believe that demand is influenced by the efficiency of alternative modes of transportation – including subway trains and over-land buses. Imagine that the firm's owners are particularly concerned with the speed of the subway trains on particular routes, reasoning that the faster or slower the journey times, the smaller or greater the demand for taxi services. One way forward is for the firm to measure average journey times for particular journeys over days and months, and compute averages and measures of dispersion. Assume that measurements exhibit a normal distribution and remain fairly constant over the months. What are the plausible worst and best outcomes for profitability for the taxi firm over the next few years? What would cause a dramatic, but still plausible, weakening in demand? What would cause a dramatic, but still plausible, strengthening in demand? Focusing on the speed of the subway trains, we can intuitively see that a reduction in a particular journey time from 30 minutes to less than 20 minutes is implausible – assuming that new technology investments will not be made by London Transport in the next few years. By contrast, it is easy to see that a substantial lengthening of journey times is plausible, for example, if bag searches of passengers are introduced in response to further terrorist activity in London. What could cause an increase in terrorist activity in London? Questions such as this, when focussed on the motivations and capabilities of stakeholder groupings (including terrorists, passengers, and the London authorities), will reveal each grouping's likely reaction to both (i) changes in the contextual environment, and (ii) the self-interested actions of each stakeholder grouping as the events within a particular scenario start to unfold. After a range of plausible scenarios have been constructed, the next step would be for the taxi firm to evaluate its strategic options – for example, its ability to quickly up-scale its service provision within the particular scenario that we have just outlined.

5. Conclusion

Low predictability is a concern where we have difficulties in estimating reliable probabilities for high impact events and/or where we are unable to measure the reliability of these probabilities. Scenario planning attempts to avoid these problems by not requiring estimates of probabilities. We have assessed the ability of the scenario method to deal with the problem of low predictability. In evaluating the effectiveness of this technique in dealing with three factors that lead to low predictability – inappropriate framing, cognitive and motivational biases, and inappropriate attributions of causality – we identified some serious deficiencies of the method. In the light of these, we have made four proposals that should help to improve the effectiveness of scenario planning when organizations wish to formulate plans to cope with conditions of low predictability. These involve (i) providing conditions for challenging mental frames by creating objectives-focussed scenarios using backward-logic; (ii) understanding human motivations and emphasising their implications within scenarios; (iii) enhancing scenario planning though adopting the approach of crisis management in order to augment analysis of uncertainty; and (iv) evaluating strategic options against constructed scenarios in terms of flexibility, diversification, and insurability.

In these ways, the essence of scenario planning – based on understanding the causality of events – is preserved and augmented by a mix of backward logic and crisis management approaches to aid in the construction of an extended and more extreme range of scenarios. Currently, as we have discussed, conventional scenario planning, using the intuitive logics method, is restricted, in that the range of potential scenarios is constrained by limited choice of available scenario dimensions. If scenario planning is to be enhanced to deal with low levels of predictability, then, as we have argued, developments in the application of the scenario method are both necessary and desirable.

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[1] Note that scenario planning has been developed in many forms, some of which do involve the estimation of subjective probabilities (Bradfield, Wright, Burt, Cairns, & van der Heijden, 2005).