Technological Forecasting & Social Change xxx (2013) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Technological Forecasting & Social Change

journal homepage:

Scenario methodology: New developments in theory and practice Introduction to the Special Issue

George Wright [a,*], George Cairns [b], Ron Bradfield [c]

[a] Warwick Business School, Coventry, UK
[b] RMIT University, Melbourne, Australia
[c] Strathclyde Business School, Glasgow, UK

ARTICLE INFO

Available online xxxx

ABSTRACT

In this Introduction, we review the logic that underpinned the earlier call for papers and provide a structured sequence for the contents of the twenty selected papers that comprise the special issue.

In the call for papers for this special issue, we outlined how scenario method has been applied in a range of contexts over many years, from the military to a wide range of businesses. However, we questioned the extent to which we really know the method and whether it 'works' (howsoever we define this term). Also, in identifying the range of variants on the theme of 'scenario method', we questioned the degree to which they differ or overlap, and whether there is empirical evidence that might demonstrate the superiority of any one variant over others — or indeed, over other approaches that might be used to achieve similar analytic ends. We asked also if there are any particular domains in which the technique has proven particularly useful.

In this special issue, we have sought to gather a range of papers that focus attention on scenario technique in its widest sense, that provide an up-to-date analysis of its development to date, outline the current status of its application and use, and that point towards its future potential and prospects. Specifically, we invited papers that addressed some aspect of scenario method, including:

- Critical theoretical considerations of the method and its rationale
- Review of the use of the technique in specific applied areas, including evidence of impact on field development or policy making
- Empirical studies comparing scenario method variants, or comparing some variant of scenario method with alternative (forecasting) approaches
- Novel practical applications of the method
- Novel elaborations of the method and critical appraisal of these
- Consideration of future prospects for the technique

In response to this call, we received a substantial number of submissions that responded to these methodological considerations, and that also provided critical reflection upon the application of scenario methods across a wide range of organizational and geographic contexts. In selecting the papers that we present here, we have sought to provide a broad and inclusive overview of scenario techniques and methods, ranging from quantitative modelling approaches to qualitative narrative methods and mixed methods that encapsulate both. Some of the approaches incorporate alternative theoretical or practice-based frameworks – such as structuration theory, Delphi method, and analysis of early warning signals – in order to enhance the capability of 'basic' scenario methodology. The application of the various scenario approaches addresses multiple stages of strategic analysis — from initial environmental scanning through innovation strategy, resource planning, to assessment of alternative outcomes of implementation. The selected papers also present illustrative cases from across a wide range of

* Corresponding author.
E-mail addresses: george.wright@wbs.ac.uk (G. Wright), george.cairns@rmit.edu.au (G. Cairns), bradfield@strath.ac.uk (R. Bradfield).

0040-1625/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.techfore.2012.11.011

problem contexts — from higher education futures, through copper scarcity, the future of electric vehicles, to military strategy appraisal.

Overall, we consider that this special issue offers a comprehensive collection of papers on scenario techniques that are currently available to readers who seek to engage with the broadest range of methodological approaches. Between them, the papers relate the history and development of scenario methods and provide a wide range of illustrative cases to show their implementation in the practice arena. In order to aid the reader's navigation through this collection, we have grouped the papers under a set of broad thematic headings which we also apply to the collated summaries of the individual contributions below, namely:

- Combination of Delphi process with scenario development,
- The role of scenarios in strategy development and evaluation,
- The interplay of actor motivations and behaviours with other scenario components
- Scenario interventions in organizations: guidelines for best practice, and
- Scenarios and anticipating the future.

We hope that you will find the papers interesting, informative and challenging.

1. Combination of a Delphi process with scenario development

Delphi was originally devised as a means of identifying consensus and dissensus in group-based judgments. The focus of the Delphi process is on the anonymous exchange of initial estimates between individuals – who are then given the opportunity to revise their initial estimates on the basis of this feedback. The yield of such a Delphi process is frequently the average of second-round opinions. Delphi is focussed on estimating single quantities — perhaps estimates of a future physical quantity, a probability of a future event occurring, or the time when a particular future event might occur. Scenario thinking, by contrast, is focused on broader-brush pictures of plausible futures. In this section of our special issue, four papers propose ways of combining the outputs of a Delphi process with scenario development.

Warth et al. [1] focus on the future of electric drive vehicles using multiple stakeholders as participants. The authors note that such projects are time-consuming but, potentially, enhance scenario usability. Representatives from the different stakeholder groupings were asked to make projections on challenges to battery-based technologies using the Delphi method. Sometimes consensus was reached and sometimes not. Where consensus projections were achieved, these projections were next utilised as a common basis for scenario development. Dissensus then drove the creation of different scenario storylines.

Pincombe et al. [2] propose and illustrate the use of an on-line Delphi process whereby experts can nominate and evaluate possible basic scenario dimensions. The Delphi moderators engage in thematic analysis of the expert input to develop an initial structured hierarchy of potential scenario dimensions which are then re-presented to the Delphi panellists for critique. The process then aims to iterate towards likely – but not guaranteed – consensus on the identification of key driving forces, whilst minimising the time commitment of the expert participants.

Von der Gracht and Stillings [3] demonstrate how expert-derived scenarios can be used in the early phases of innovation management — both before the development of an innovative idea, or after an innovative service or product idea has been generated. Thus, both the future growth potential and the risk that an innovation may fail can be evaluated. These authors' methodological innovations include the use of a cross-national Delphi process to provide enhanced evaluation of particular projections before these were incorporated within scenarios.

Varho and Tapio [4] review the combination of qualitative and quantitative materials in scenario construction. Their new methodology includes a Delphi process for gathering and summarising expert views into a tabular format in order to provide a systematic basis for subsequent scenario development. Using a case study in the Finnish transport sector, they demonstrate the additional contribution of their new methodology.

2. The role of scenarios in strategy development and evaluation

Scenario thinking can be achieved without specific attention being given to strategy development. Often, when scenarios have been developed, the subsequent evaluation of alternative strategies against the range of developed scenarios has been rudimentary. In this section of the special issue, three papers focus on recent advances in strategy development and evaluation that utilise scenarios.

First, Wright et al. [5] lay out the key components of the intuitive logics scenario development technique and argue that this methodology is likely to both enhance participants' understanding of the causal processes underlying potential unfolding futures and to challenge thinking within the scenario team. These authors also detail recent enhancements to this basic method and then evaluate how each aids achievement of these two objectives. However, they conclude that the basic process and its derivatives are less-well focussed on improving subsequent decision making.

O'Brien and Meadows [6] concentrate on the use of scenarios within strategy development. Using a case study, they reveal that participants gave insufficient attention to already-developed scenarios when developing strategic options against these scenarios. From this observation, the authors develop a revision of the intervention process which focusses participants' attention on both the opportunities and threats that are present in the developed scenarios and on the organization's internal resources. Additionally, they propose a standardised, structured option-appraisal methodology.

Ram and Montibeller[7] focus attention on methods of evaluating the worth of strategic options after scenario development. They review the growing use of multi-criteria methods for option evaluation – especially those focussed on identifying robust options – that work well no matter which of several futures that have been identified unfolds. As such, these methodological developments prompt decision makers to engage in the focussed evaluation and analysis of

Please cite this article as: G. Wright, et al., Scenario methodology: New developments in theory and practice, Technol. Forecast. Soc. Change (2013), http://dx.doi.org/10.1016/j.techfore.2012.11.011

options — in order to attenuate negative consequences and enhance positive consequences.

3. The interplay of actor motivations and behaviours with other scenario components

Interest in the reactions of stakeholders to unfolding events within a particular scenario is a recent phenomenon. Powerful groups or individuals will act to preserve or enhance their own interests against unfolding events. Less-powerful groups or individuals will benefit from the attention of the more powerful who consider the issue of corporate social responsibility when planning their actions. Four papers in this section are concerned with the role and power of actors within scenarios.

MacKay and Tambeau [8] focus on the underlying basis of scenario construction and identify enduring social structures – including cultural and economic systems that are governed by rules and resources – as the major determinants of human actions. In so doing, they integrate application of "structuration theory" with scenario method. Human actions are seen here as both constrained and facilitated by existing social and economic structures and so, these authors argue, the interactions between human actions and such structures are pivotal in understanding the way in which the future might unfold.

Hughes [9] focuses on the role of scenarios in public policy making. He argues that public policy makers are often powerful and so, to a degree, can shape and secure the future. This level of power contrasts with the level of power that can be exerted by commercial organizations — where organizations often seek protection, or robustness, in strategy development and evaluation. Hughes' analysis identifies the inter-relationships between the behaviour of powerful, self-interested actors and the components of unfolding scenarios. He is concerned with the balance of both power and interests (i.e., desires and values) between actor groupings — as these forces interact with technological capabilities and technological change.

Wilkinson et al. [10] analyse how scenario development can benefit from the insights that complexity science can offer. A focus is on systemic influences that lead to non-linear shifts in the business environment — often resulting from the outcomes of the interactions between actor behaviours and driving forces. A key concept that they identify is that of "feedback mechanisms". They argue that these mechanisms can act in order to magnify emergent systemic effects and thereby amplify their impact.

Andreescu et al. [11] suggest that foresight exercises rely on a triad of underlying assumptions – a participatory process, distancing from the present, and approaching the future holistically. However, they question what predictable or recognisable generic effects participation in a normative – as opposed to an exploratory – scenario exercise has on the narrative developed. Reflecting on a large-scale normative foresight exercise, they hypothesise that the normative aspect results in scenario development in which there is a greater concern with the basic values and procedural arrangements governing the future world depicted in the scenario, as opposed to the actual events comprising the scenario. From this, they conclude that the construction of normative narratives in a participative approach predictably results in deliberations around democracy.

4. Scenario interventions in organizations: guidelines for best practice

The popular literature on the use of scenario technique mostly reports only on success stories of successful interventions. The practitioner writers are, understandably, less likely to report failure. As such, the extant literature has been less than helpful in generating evidence for guidelines on best practice. In this section, four papers provide the substantive detail to enhance practice.

Franco et al. [12] focus on the individuals who are the participants in scenario workshops. Using knowledge of the psychology of individual difference, they conceptualise and analyse workshop activity that is linked to individuals' modes of information gathering and information evaluation. These authors contend that the mix of such "cognitive styles" within the participants at a particular scenario workshop will determine the efficiency of the overall team in engaging with particular components of a scenario development process – such as reducing and selecting the key uncertainty factors and fleshing-out the detail of the scenario storylines. If the cognitive styles of workshop participants cannot be pre-selected, these authors provide guidelines for the successful facilitation of varied group memberships.

Bowman et al.'s [13] contribution is on evaluating the relative effectiveness of alternative methods of scenario intervention within public regional authority. One intervention involved the participants creating scenarios using the intuitive logics method, whilst the other involved participants adapting scenarios that had already been developed in an earlier intervention. The latter intervention led to a lack of ownership of the revision process and questioning of the plausibility of the already-constructed outlines. Additionally, individual participants sought to legitimise their respective agendas as these base scenarios were developed. Bowman et al. argue that the intuitive logics method engendered creative debate amongst participants whilst the adaptation intervention engendered self-serving additions to the developing storylines – perhaps because the eventual end-point of the process was clearer to participants in the intuitive logics approach.

In the context of "water resources planning and management", Dong et al. [14] review a generic step process for scenario development and suggest that there are three limitations in current practice, namely; the number of quantitative scenarios developed, the lack of probabilities attached to the scenarios, and the lack of transparency in how descriptive scenario storylines are converted into quantitative scenarios. These authors suggest that the first of these limitations can largely be overcome through the use of computational algorithms to develop a large number of scenarios which can be subsequently narrowed down, using a Bayesian probabilistic framework. This can also be used to elicit probabilities from multiple experts and stakeholders in a transparent manner. The third limitation can be overcome by developing protocols and applying rigorous documentation standards throughout the process.

Dermawan et al.'s [15] contribution is in adaptation of the intuitive logics scenario method to a multi-scale setting, an approach they describe as a "nested" scenario framework. The approach entails developing a multi-scale analysis structure comprising a large-scale set of critical uncertainties and a scenario logics framework. This structure can then be

Please cite this article as: G. Wright, et al., Scenario methodology: New developments in theory and practice, Technol. Forecast. Soc. Change (2013), http://dx.doi.org/10.1016/j.techfore.2012.11.011

elaborated at different scales by adopting elements of the framework to suit specific national and local situations, where driving forces may differ and act at different spatial scales. The significance of this approach is that it results in a single coherent scenario framework which is "complimentary" across scales.

5. Scenarios and anticipating the future

In the final section, six papers focus on development and use of plausible scenarios of the future. Rather than scenarios representing a range of plausible futures, can scenario thinking help managers anticipate a particular future?

Onkal et al. [16] provide an analysis and demonstration of how scenarios can be utilised to aid quantitative judgmental forecasting. These authors investigate the effects of providing scenarios as forecast advice. They demonstrate that the inclusion of alternative scenarios, at the time that a forecast is being made, can encourage forecast users to consider alternative future outcomes. These authors provide a host of indicative findings of the impact of scenarios inclusion on forecasting and so generate a research agenda for improving both forecast communication and the subsequent predictive accuracy of elicited judgmental forecasts — in individual and group-based forecasting.

Kwakkel et al. [17] consider how scenario analysts often try to capture the full breadth of uncertainty about the future in a small set of scenarios, and the implications of this in the context of dealing with multiple uncertainties faced by a multitude of involved actors. Applying a time series clustering approach, they present an augmentation of the intuitive logics method in which an ensemble of model runs is created that encompasses a range of uncertainties facing multiple decision makers. This ensemble is screened to identify runs of interest over time with consideration of different sets of behavioural dynamics. The analysis reveals the causes of occurrence of different outcomes to the various uncertainties. The dynamic scenario discovery approach is illustrated by reference to the case of copper scarcity.

Meissner and Wulf [18] examine the cognitive benefits of scenario planning, and their findings indicate that the characteristics of scenario planning processes possess significant potential to counteract judgmental errors in terms of overconfidence and confirmation bias and, additionally, to decrease framing bias, thereby potentially improving decision quality. However, these findings also show, firstly, that the de-biasing cognitive effects are only evident in the situations where there is a "comprehensive execution" of the scenario planning processes and, secondly, that a similar framing de-biasing effect can be achieved through the use of a combination of one-dimensional strategic planning tools.

Schoemaker et al. [19] consider the issue of how scenarios can be more oriented towards recognising and responding to "weak signals" in the external environment. They discuss how the contemporary, highly networked, organization has extensive points of contact with the external world and how, whilst expanding the opportunities for recognition of emergent opportunities and threats, this also presents the threat itself of leaving the organization unable to spot useful signals amongst the "avalanche of data". They outline an approach to seeking such useful signals amongst background noise based upon the adoption of a "strategic radar system" and they illustrate the approach with a brief case study of a large government agency.

Ramirez et al. [20] focus on the relationship between scenario development and the monitoring of early warning signals in the business environment. Using two case studies, Nokia and Statoil, they explore the degree of synergy between these two activities and analyse how the combination of activities can create potential competitive advantage. This combination can provide a continuous strategic service to top management, in contrast to the discontinuity often inherent in a sequence of scenario exercises.

6. Conclusion

To return to the questions that we posed in our first paragraph:

Does the scenario method "work"? The papers in this special issue indicate in a wide variety of application areas that it does. But the documented variety of combinations with other methods – principally with a Delphi process [1–4] and with methods of strategy evaluation [5–7] – illustrates the potential for enhancement.

Is any single method of scenario development superior to others? The papers in this special issue leave the direct answer to this question unresolved. However, the papers in the special issue provide prescriptions to do with selecting workshop participants [12], countering judgmental errors [18], creating scenarios afresh rather than utilising already-developed scenarios [13], using computational algorithms [14], and developing complimentary scenario sets [15]. All of these papers demonstrate incremental methodological improvements that begin to provide an answer to the main question. Combination of scenarios with judgmental forecasting [16], and systems that provide early warning signals [19,20] also demonstrate the power of method combination over a sole focus on scenario development. Increasing the focus on both actor behaviour and systemic influences within scenarios also shows promise of enhancing scenario method [8–11,17].

Overall, the twenty papers that comprise our special issue provide insights into the state-of-the-art in scenario methodology. It is clear that scenario interventions in organizations are becoming more informed by social-science based research and will thus move a step forward from being based on practitioner advice. In the future, discussions of the advantages and disadvantages of particular methodological approaches – including combinations of futures methods - will become evidence-based. As such, scenario thinking will take its place amongst other decision support technologies – such as decision analysis and statistics-based forecasting – and scenario methodology will, we predict, become a routine part of core textbooks that are focussed on supporting management decision making.

References

[1] Johannes Warth, Heiko A. von der Gracht, Inga-Lena Darkow, A dissent-based approach for multi-stakeholder scenario development —

Please cite this article as: G. Wright, et al., Scenario methodology: New developments in theory and practice, Technol. Forecast. Soc. Change (2013), http://dx.doi.org/10.1016/j.techfore.2012.11.011

The future of electric drive vehicles, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[2] B Pincombe, S Blunden, A Pincombe, P Dexter, Ascertaining a hierarchy of dimensions from time-poor experts: linking tactical vignettes to strategic scenarios, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[3] Heiko A. von der Gracht, Christopher Stillings, An innovation-focused scenario process — A case from the materials producing industry, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[4] Vilja Varho, Petri Tapio, Combining the qualitative and quantitative with the Q2 scenario technique — The case of transport and climate, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[5] G Wright, R Bradfield, G Cairns, Does the intuitive logics method – and its recent enhancements – produce "effective" scenarios? Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[6] F.A. O'Brien, M Meadows, Scenario orientation and use to support strategy development, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[7] C Ram, G Montibeller, Exploring the impact of evaluating strategic options in a scenario-based multi-criteria framework, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[8] B MacKay, P Tambeau, A structuration approach to scenario praxis, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[9] N Hughes, Towards improving the relevance of scenarios for public policy questions: a proposed methodological framework for policy relevant low carbon scenarios, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[10] A Wilkinson, R Kupers, D Mangalagiu, in: How plausibility-based scenario practices are grappling with complexity to appreciate and address 21st century challenges, xxx, (2012), p. xxx-xxx.
[11] L Andreescu, R Gheorghiu, M Zulean, A Curaj, Understanding normative foresight outcomes: scenario development and the 'veil of ignorance' effect, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[12] L. Alberto Franco, M Meadows, S.J. Armstrong, Exploring individual differences in scenario planning workshops: a cognitive style framework, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[13] G Bowman, R. Bradley MacKay, S Masrani, P McKiernan, Storytelling and the scenario process: understanding success and failure, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[14] C Dong, G Schoups, N van de Giesen, Scenario development for water resource planning and management: a review, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[15] A Dermawan, E Kemp-Benedict, A Huber-Lee, A Fencl, Testing a multi-scale scenario approach for smallholder tree plantations in Indonesia and Vietnam, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[16] D Önkal, K Zeynep Sayım, M Sinan Gönül, Scenarios as channels of forecast advice, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[17] J.H. Kwakkel, W.L. Auping, E Pruyt, Dynamic scenario discovery under deep uncertainty: the future of copper, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[18] P Meissner, T Wulf, Cognitive benefits of scenario planning: its impact on biases and decision quality, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[19] P J.H. Schoemaker, G.S. Day, S.A. Snyder, Integrating organizational networks, weak signals, strategic radars and scenario planning, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.
[20] R Ramírez, R Österman, D Grönquist, Scenarios and early warnings as dynamic capabilities to frame managerial attention, Technol. Forecast. Soc. Chang. xxx (2012) xxx-xxx.

Please cite this article as: G. Wright, et al., Scenario methodology: New developments in theory and practice, Technol. Forecast. Soc. Change (2013), http://dx.doi.org/10.1016/j.techfore.2012.11.011