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Title: Morphological prospection: profiling the shapes of things to come
Year: 2009
Journal: Foresight
Volume: 11
Issue: 6
Pages: 4-20
URL: <http://hdl.handle.net/1959.3/69196>

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The definitive version is available at: <http://dx.doi.org/10.1108/14636680911004939>

Morphological prospection: Profiling the shapes of things to come

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15 September 2009

Abstract

Category: Research paper.

Purpose: The purpose of this paper is two-fold. First, to describe in detail a particular sub-class of powerful prospective methods based on the method of ‘morphological analysis’. And second, to extend their use to create a basis for strengthening strategic analysis and policy development.

Design/methodology/approach: Examines the history and use of morphological methods in foresight work, briefly describes three main ‘lineages’ currently in use, and proposes some extensions to models of practice.

Findings: Recent research in cognitive psychology suggests that requiring a detailed and systematic examination of future possibilities before a decision is made leads to more effective assessments of futures. Morphological methods, by design and construction, are perfectly suited to this, and so can form an exceptionally strong basis for thinking systematically about the future.

Practical implications: The paper also describes how to go about designing a foresighting capacity based on a systematic evaluation of future systemic contexts, as well as discussing what aspects of the external environment to include in robust competitive intelligence, strategic monitoring, environmental scanning, and ‘horizon scanning’ activities.

Originality/value: Proposes some extensions to existing practice and describes some ways to tie the development of a strategic meta-language to clearly-targeted intelligence scanning. This paper should be of interest to anyone involved in trying to strengthen strategy development, policy planning or intelligence analysis.

Keywords: morphological methods, strategy development, policy planning, strategic and competitive intelligence, horizon scanning, emerging issues.

A version of this paper appeared in:

Foresight vol. 11, no. 6, 2009. Please quote from the original article.

Published by Emerald: <http://www.emeraldinsight.com/fs.htm>

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Contents

1	Introduction and motivation — prospection and failures of prospection	3
2	Morphological methods — a brief history	4
3	Morphological approaches — a brief description	6
4	Practical uses of morphological methods in strategy and policy	10
4.1	Intelligence scanning and monitoring	10
4.2	Internal strategy configuration	11
4.3	Assessing policy responses	11
4.4	Nested contextual fields	12
4.5	Context-specific intelligence scanning	12
5	Adapting to novelty — ‘emerging issues’, ‘wild cards’ and ‘black swans’	13
6	Imagine strategy and policy with foresight and intelligence...	14
7	Concluding remarks	15
	Notes	16
	References	16

Figures

1	Sample simplified sector/factor array, with one configuration highlighted . . .	8
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1 Introduction and motivation — prospection and failures of prospection

This paper continues a series of articles on aspects of a ‘generic’ foresight process (‘GFP’) framework (Voros 2001, 2003, 2005, 2006a,b). In the GFP view, foresight is conceived as a process of broadly-overlapping phases of generating futures-relevant information. A range of methodological choices are made depending upon whether the purpose of the information-generating activity being undertaken is: Input; Analysis; Interpretation; or what was there termed ‘Prospection’—i.e., thinking about or creating images of the future (Voros 2003). Previous papers have dealt with various aspects of each of these four phases of the GFP. The focus in this paper is on the undertaking of the process of prospection in a particular highly systematic and rigorously-disciplined way, and on feeding the Outputs of that foresight work more directly into either: the processes of strategy formulation and continuing strategic analysis; or—depending on the context in which the foresight work is undertaken (Voros 2005, p. 34)—into policy planning and development. The discussion is ultimately aimed at describing how to go about designing a robust foresight capacity based on a systematic evaluation of future systemic contexts, as well as discussing what and how to include aspects of the external contextual environment in competitive intelligence, strategic monitoring, and horizon scanning activities in order to support strategy development, policy planning, and social analysis.

A great deal of very interesting work using brain imaging techniques has recently been taking place that is shedding light on which mechanisms and parts of the brain seem to be involved in prospective thinking and prospection (see, for example, Abraham et al. 2008; Addis et al. 2007, 2009; Ainslie 2007; Buckner 2007; Buckner & Carroll 2007; D’Argembeau et al. 2008; Gilbert 2006; Gilbert & Wilson 2007; Okuda 2007; Schacter et al. 2007; Suddendorf & Corballis 2007; Szpunar & McDermott 2008; Szpunar et al. 2007, and numerous references therein). One imagines, as our knowledge continues to grow of how the brain-mind system constructs pasts, presents and futures, that this knowledge will be able to help us design more effective methods and techniques for undertaking futures research and foresight work.¹

Harvard psychologist Daniel Gilbert has written extensively on the many ways in which our attempts to think about the future—especially our likely emotional responses to the futures we imagine—may be incorrect or wildly inaccurate (see, e.g., Gilbert 2006; Gilbert & Wilson 2007). As he reports it, the brain-mind system tends to add in details which may be lacking, or to leave out detail which may be required for a more adequate assessment. Gilbert and Wilson (2007) have also found that people who are asked to think more systematically about the future, including about the future context of decisions, tend to produce an assessment of their future satisfaction which is much closer to the actual satisfaction they ultimately feel. It seems from this work, then, that being required to think systematically about a range of futures issues tends to result in better-considered future-oriented choices. This is a satisfying empirical validation of what futurists have been suggesting for decades. Any approach to prospection, therefore, which increases the amount of detail and (so to speak) ‘systematic-ness’ with which the futures thinking is conducted is—at the very least theoretically and, it now seems, empirically—more likely to lead to more effective conjectures about the future (de Jouvenel 1967).

Consequently, this paper will examine a particular sub-class of the many possible approaches to futures work (see, for example, Bell 1997; Bishop et al. 2007; Cornish 2004; Fowles 1978; Glenn & Gordon 2009; Jantsch 1967; Slaughter et al. 2005; Voros 2006a, and numerous further references therein)—specifically those based upon the so-named ‘morphological approach’ to problem definition and research developed by the legendary astrophysi-

cist Fritz Zwicky during the first half of the 20th century. The morphological method is predicated upon the systematic enumeration and examination of all conceivable possibilities within a ‘possibility space’, and would therefore seem to be perfectly suited as a foundation for thinking systematically about the myriad systemic possibilities inherent in the evolution and futures of social systems.

2 Morphological methods — a brief history

Morphological methods have been part of the wider futures toolkit since as early as the 1960s. The morphological approach itself was developed by Zwicky in the 1930s (Zwicky 1947, 1948, 1969). In effect, the morphological approach attempts to systematically examine the entire range of possible combinations of various attributes or dimensions of the object or area of interest. These dimension/attributes Zwicky called ‘parameters’—there could in principle be any number of parameters, and each could have any number of discrete ‘values’, which need not necessarily be numerical (see later). In essence, *every* aspect of any object or area of inquiry could be considered as ‘contingent’ rather than ‘fixed’ and therefore open to consideration of other possible parameter values; so, in this view, the range of parameters and their values has no *a priori* conceptual limit. For example, the fact of a car having four wheels could be considered simply an instance of the parameter ‘number of wheels’ having the particular value ‘4’. This sort of ‘contingency thinking’ immediately primes the mind to open up to a much wider range of possibilities to consider. Thus, we might consider cars with 3 or even 5 or more wheels, and this type of extension to the basic ‘shape’ or ‘morphology’ of the ‘space of possibility’ can lead to novel combinations and potentially new ideas for research and development. Zwicky used this startlingly simple but very powerful approach to make basic discoveries and innovations in a number of fields, such as astrophysics and the design of jet engines (Zwicky 1947, 1948). The morphological approach entered the futures field initially through its application to technological forecasting (see, e.g., Ayres 1969, chap. 5). It was also explicitly mentioned by Erich Jantsch many times in his seminal report for the OECD (Jantsch 1967, *passim*) as a technique with, as he put it, “particular significance” and a variety of potential applications to futures research, especially technological forecasting. (More recently, its place in the wider palette of scenario-generating futures techniques has been examined by Bishop et al. 2007).

Subsequently, Russell Rhyne (1974) described a closely related approach, ‘field anomaly relaxation’ (FAR), developed independently (and unaware) of Zwicky’s work (Rhyne 2009). Rhyne used the method for over two decades in a variety of projects, but published somewhat rarely in the open literature (a summary of his experiences can be found in Rhyne 1974, 1981, 1994, 1995a,b,c). More recently, he has published two books laying out this approach in more detail, which also includes an in-depth discussion of a novel theory of the act of choosing in decision-making (Rhyne 2003; Rhyne & Duczynski 2008). Rhyne based his approach in part on the social field theory of Kurt Lewin (see the discussions in Rhyne 1974, 1981, 1995b). In his terminology, the parameters are called ‘Sectors’, while the individual parameter values he called ‘Factors’. This terminology is often more convenient for general discussions in futures work than the original ‘parameter/parameter value’ terminology.

Rhyne’s approach was designed to be used in decision-making contexts to provide ‘scaffolding’ for the processes of thinking during those activities, and it was intended that each specific configuration of Factors (i.e., parameter values) should be viewed as a ‘gestalt’ to be appreciated ‘as a whole’. As a result—in contrast to the open possibility of a potentially unlimited number of parameters and their associated values—Rhyne adopted a rule-of-thumb to the effect that there should be no more than about 7 or so Sectors, and no less than 5 (later, revised to 6). This structural limitation was based on the then well-known work on

cognition which found that human working memory is able to work well with up to around 7 or so distinct elements, as well as on the practical observation that too few Sectors results in a somewhat ‘thin’ description of the complexity of the target social field. Thus, Rhyne’s insistence on around 6 to 7 Sectors is based rather more on observed practical utility than on formal theoretical considerations.

Rhyne’s work was later taken up by Geoff Coyle and collaborators (Coyle et al. 1994; Coyle & McGlone 1995; Coyle & Yong 1996; Powell & Coyle 1997) and used to analyse complex regional contexts, such as the possible military-geopolitical futures of South-East Asia. More recently Coyle has situated the use of FAR as a part of an approach to strategic analysis for organisational strategy (Coyle 2003b, 2004). There is also computer software available which is designed to support the organisational strategy framework Coyle has developed (see www.actifield.com).

Independently of Rhyne and Coyle, Michel Godet has also been using the morphological approach since discovering Zwicky’s work in the late 1980s (see Godet 2000b, p. 7), and has included it as a part of his method of foresight work (Godet 1994, 2000a,b, 2006). Godet and his collaborators have also developed a suite of software to support their approach (Godet et al. 2003, 2004), which is freely available through a related web site (www.3ie.fr/lipsor) together with manuals showing how to use it. Again, similarly to Coyle’s approach, the morphological aspect forms only a part of wider toolkit for strategic analysis. Godet also adds several other elements, each of which has an appropriate software module to enable their easier use.

A third line of morphological methods in foresight work is the one developed by Tom Ritchey at the Swedish Defence Research Agency (see, e.g., Ritchey 2006), which he terms General Morphological Analysis (‘GMA’), about which more information is available at the web site of the Swedish Morphological Society (www.swemorph.com). The web site maintains an extensive range of resources, including case studies, a bibliography of morphology-related references, and descriptions of the proprietary software which has been developed there to aid their morphological work. Unfortunately, the software is not available to the general public, as it was developed under the auspices of the Swedish military. And again, as with Coyle’s and Godet’s approaches, the morphological aspect is a part of an embracing methodology of strategic and policy analysis. Of the approaches in current use in futures research, Ritchey’s GMA is perhaps the ‘purest’ in the sense of adhering most closely to the precepts that Zwicky laid down, and so it is a good source of information about how to undertake morphologically-oriented work from that more ‘canonical’ perspective.

(A distinction between exploratory and normative futures work has frequently been noted in the futures literature (see, e.g., Börjeson et al. 2006; Glenn 1999; Jantsch 1967; van Notten et al. 2003). Jantsch remarked (p. 19) that the morphological approach was well-suited to the exploratory arm of futures work, no doubt owing to its systematic elucidation of possibilities, and its usage has indeed largely tended to be exploratory in character. But it has also recently been used as part of a normative approach to seek out pathways to a preferred future in an industry under pressure from globalisation and the off-shoring of manufacturing to low-cost countries (Navarro et al. 2008).)

Recently, all three of these ‘lineages’ of morphological approach in futures research have been described in a single volume—the recently-published *Futures Research Methodology* ‘version 3’ CD-ROM (Glenn & Gordon 2009). The discussions by Ritchey and Coyle found there each provide an excellent background on the general use of the morphological method. Godet’s is rather more succinct as he is focussed more on the total toolkit he is describing and explaining rather than any one element in particular.

3 Morphological approaches — a brief description

This section seeks to briefly lay out some of the basic characteristics of morphological approaches. A more complete exposition, with examples of their use, can be found in the original papers (Coyle et al. 1994; Rhyne 1995b; Ritchey 2006) or in the relevant chapters in Glenn and Gordon (2009). More mathematically-oriented treatments can be found in Jantsch (1967, pp. 174-80) and Ayres (1969, pp. 72-93).

As Zwicky used it, morphological analysis begins with an exhaustive statement or definition or description of the situation/object or problem being analysed or to be solved (Zwicky 1969). In practice this means listing all of the independent ‘dimensions’ or ‘parameters’ that characterise the problem. Each of these parameters may take on certain known values, which are also enumerated. These parameter values are not necessarily numerical and may simply be qualitative descriptions of discrete independent possibilities. For example, in Zwicky’s paper on the morphology of jet engines (1947), parameter four dealt with the physical state of the propellant, and had three possible values: gas; liquid; or solid.

In more precise language: Let there be n parameters which characterise an exhaustive statement or description of the problem/object/area of inquiry. Each individual parameter p_i in the full set of parameters $\{p_i : i = 1 \dots n\}$ will be characterised by a number k_i of irreducible values, which should therefore be independent and mutually-exclusive. These n parameters p_i generate an n -dimensional ‘morphological space’ or ‘morphological field’ that consists of every possible combination of every possible value of every parameter. It has also been known as a ‘Zwicky box’ (Ritchey 2006).

If one specific value is chosen for each parameter in the set, this is known as a ‘configuration’ within the morphological space/field (which is also sometimes known as a ‘configuration space’, for the obvious reason). The key idea to take from this is that of a multi-dimensional ‘hyper-space’ which represents a kind of n -dimensional box or ‘filing cabinet’ with a placeholder for every configuration. When the number of dimensions n is 3 (or less), we can usually visualise the resulting morphological space by using our physical intuition—any position or location in three-dimensional space can be represented by some linear combination of three ‘basis directions’ from some ‘origin’ or reference position, for example. In much the same way, any position in a four- or higher-dimensional morphological space can be specified by a configuration or combination of values, one for each parameter.

The total number ξ of distinct possible formal configurations is found from the product of all the values k_i thus:

$$\xi = \prod_{i=1}^n k_i = k_1 \times k_2 \times k_3 \times \dots \times k_n \quad (1)$$

One can see that, therefore, even a relatively small number of parameters can lead to a very large number of possibilities. For example, 7 parameters (i.e., $n = 7$) each with 7 values (i.e., $k_1 = k_2 = k_3 = \dots = k_7 = 7$) gives rise to $\xi = 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = 823,543$ possible combinations which could, in theory, be part of the process of consideration. In practice, there are techniques which make the process of examining the possibilities much more tractable than would first appear to be the case given these large numbers.

It is important to mention here, lest any confusion arise, that—despite the use of a mathematical style of notation—the method itself is generally not a quantitative one. The quasi-mathematical form of notation is used in FAR and GMA simply as a convenient way to carefully and consistently undertake and describe complicated combinatorial processes—i.e., taking many combinations of possible Sector/Factor states (‘configurations’) and comparing them systematically and exhaustively to ensure that all possibilities have been explored and considered. As mentioned above, the Factor values are not necessarily numerical. Rather,

they are usually representations of plausible ‘real-world states’ of the social system Sectors in which they reside. They each may have (and indeed may be defined by) rich, detailed, qualitative descriptions of the real-world social context in which decisions, strategy and policy must play out. In other words, the use of formal quasi-mathematical notation is solely for the purposes of precision and conciseness of representation and to allow a systematic elucidation of the many combinatorial possibilities inherent in the method. One should resist the temptation to view this approach as a quantitative system of mathematical equations with numerical values that are ‘crunched’ to somehow give ‘an answer’, for it is usually not.

The use of formal quasi-mathematical notation, while suitably precise and definite, tends not to be immediately intuitively obvious or practically useful for most people. Thus, another way to conceive of or to represent the morphological space is as a collection of line matrices, with each matrix representing one parameter, and with each entry within a matrix representing one of the possible parameter values. As each parameter may in general have a different number of values, the matrices are not generally the same length. Zwicky usually rendered these as row matrices set out underneath each other (e.g., 1947), whereas Rhyne, Coyle, and Ritchey have depicted them as columns set alongside. This latter convention is used here, so as to enable easy comparison with the existing futures literature. Rhyne called the resulting tableau a ‘Sector/Factor array’.

It is also important to note that the choices of Sectors and of the Factors that inhabit the Sectors are usually elaborated during periodic engagements between the members of the study team and the intended ultimate end-users of the results, namely decision-, strategy- or policy-makers. An important job for the analysts is to distil and synthesise the insights and expertise of the decision-maker client group so that the array forms a meaningful and useful basis upon which to carry out the more detailed and systematic examination of the myriad combinatorial possibilities (i.e., the ‘configurations’). In this way, the method may have great practical utility for its intended end-users—a utility that can be built into it by design and construction.

In FAR, the different sectors are each represented by a unique letter value so chosen that the whole set of sector letters produces an otherwise meaningless but nonetheless ‘pronounceable’ word/acronym, which is used as both a strategic ‘meta-language’ and as a mnemonic. Thus, constructs such as DELTRIG, ACTIVES, ESPARC, HASIKEP, MISFRUD, GEMCORT and so on can be found in the FAR-related references. Such constructs generate a strategic meta-language because one can speak about the entire set of sectors in the array using the constructed ‘word’ and/or the individual sectors using the specified letter, while the presence of the letters in the acronym itself acts as a mnemonic to ensure all sectors are remembered during strategy or policy discussions and analysis. The order of the letters has no significance other than to make the given sequence of non-repeated letters more-or-less pronounceable. For the purpose of definiteness, I will here use the obviously-artificial construct ACRONYM to represent a generic seven-sector field, and base more specific discussions upon this. There does not appear to be a comparable formation of acronyms in GMA, where the parameters are often simply labelled with letters A, B, C, etc.

Let us imagine that a given set of sectors, represented by ACRONYM, has been developed, designated and specified. Each sector will contain several factors, each one of which we may label using subscripts to the sector letters; thus, C₂ would represent the ‘second’ factor of sector ‘C’. (In some usages, it is simpler to use the format ‘C2’ which means the same thing.) Let us imagine that our Sector/Factor array looks like the one shown schematically in Figure 1. Each of the factors would represent a unique plausible value for the sector under which it placed. Each factor would also have a detailed description available to define it more completely (see below), but only a ‘pithy phrase’ (Coyle 2003a, p. 6) or ‘nickname’ (Rhyne 1981, p. 341) would appear in the working array itself, in order to prompt the memory of the study team (these are not shown here, for reasons of readability of layout; only

the letter-number pairs are shown). In terms of the parametric descriptors given above, in this instance: $n = 7$; $p_1 = A, p_2 = C, p_3 = R, p_4 = O, p_5 = N, p_6 = Y, p_7 = M$; $k_1 = 3, k_2 = 4, k_3 = 5, k_4 = 6, k_5 = 5, k_6 = 6, k_7 = 7$.

By way of an example to make this discussion less abstract, let us imagine a FAR sector called ‘National Economy’. This sector should comprise an exhaustive list of discrete and independent factors that each represents a plausible state of the social sub-system of the National Economy, and which list in total represents the full range of plausible states over the time-frame of the futures assessment. Thus, real-world social field conditions such as “Boom”, “Stagnation”, “Stagflation”, “Recession”, and “Depression” (and possibly others) would be plausible potential states. These could be represented by factors having precisely these shorthand ‘nicknames’, with each one having a detailed description that would allow a decision-maker to fully appreciate and imaginatively inhabit that field condition. If the letter descriptor for the National Economy sector were chosen to be, say, “N”, then the ordered set of factors mentioned above could be represented as: $N_1 = \text{Boom}$; $N_2 = \text{Stagnation}$; $N_3 = \text{Stagflation}$; $N_4 = \text{Recession}$; and $N_5 = \text{Depression}$. Thereafter, it would be possible to refer to each of these factors simply by their letter-number pair while undertaking combinatorial manipulations, although, as mentioned, each would have a much more detailed description available when the time came to imaginatively ‘inhabit’ that state as part of a configuration in combination with other factors from other sectors.

From Equation (1) above, we can see that the array in Figure 1 has $\xi = 3 \times 4 \times 5 \times 6 \times 5 \times 6 \times 7 = 75,600$ possible configurations, one of which is highlighted (i.e., $A_2C_3R_2O_4N_1Y_4M_6$), and where N_1 designates the National Economy sector in a ‘Boom’ state. This value ξ is the theoretical maximum number of possible configurations. In practice, the final number that remains after a ‘reduction’ process is carried out (described below) is generally much, much smaller.

(Once the ACRONYM meta-language has been fully internalised, it is possible while engaging in more detailed analytical work to dispense with the letters entirely and to simply use the numerals as a form of short-hand (see, e.g., Rhyne & Duczynski 2008). Thus, the above configuration could be rendered as simply ‘2324146’ which, since the positions of the numerals is important, is an efficient way to characterise that configuration. This should only be done once the meta-language is very familiar and ‘second nature’ to the study team.)

It is worth mentioning here that, in the special subset case that $n = 2, k_1 = 2, k_2 = 2$, we recover (as noted by Bishop et al. 2007), the more familiar 2×2 matrix-based scenario approach used by Global Business Network (www.gbn.com) which has become very popular in the past two decades or so (see, for example, Schwartz 1996). It is appropriate to use this simpler form when the field of uncertainty is completely dominated by two main ‘critically’-

A	C	R	O	N	Y	M
A1	C1	R1	O1	N1	Y1	M1
A2	C2	R2	O2	N2	Y2	M2
A3	C3	R3	O3	N3	Y3	M3
	C4	R4	O4	N4	Y4	M4
		R5	O5	N5	Y5	M5
			O6		Y6	M6
						M7

Figure 1: Sample simplified sector/factor array, with one configuration highlighted

uncertain drivers whose importance and impact overrides all the others.

Of course, given the formalised way that the morphological field is constructed out of a set of parameters/sectors which describe an area of inquiry, not all formal combinations of the parameter values/factors will necessarily be mutually ‘consistent’ (which assessment is a considered judgement by the study team), so some reduction is possible in the number of distinct possibilities that will ultimately need to be considered when making futures assessments. Ritchey (2006; 2009) terms this process a ‘cross-consistency assessment’ in GMA. An inconsistency in any pair of parameter values/factors (or triplet, etc) is usually called an ‘anomaly’ in FAR, and these are to be excluded from the final solution space. As an example of what this means in practice, let us imagine for a moment that the sector represented by the letter descriptor “R” in Figure 1 describes the funding by government of national Research and Development priorities, and for which the factor R1 represents a “high” level of such funding. Then, the factor pair R1 and N1 taken together (i.e., a national economy in “boom” and a “high” level of government research funding) would probably be considered plausible and consistent, while the factors R1 and N5 taken together (i.e., a national economy in depression and a high level of government research funding) are usually not considered able to plausibly *co-exist*, and so the pair would thereby be excluded as an inconsistency or anomaly. This highlights the need to consider each configuration of factors as a ‘gestalt’, not simply as a concatenated collection of factors. Obviously, involving intended end-user decision-makers in this assessment process generates both increased legitimacy and buy-in and potentially more robust assessments (e.g., Rhyne, 1995b, p. 669-70; Coyle, 2003a, p. 11). This process may ultimately reduce the allowed range of possibilities by a very significant amount. Rhyne’s term for the method, ‘field anomaly relaxation’, was in part derived from this process of reduction of possibilities by the exclusion of anomalies, leaving only those possible states of the system which are considered in principle consistent.

Once the field of formal possibilities in the morphological space has been reduced to only those that are considered consistent, one then has a ‘solution space’ (Ritchey 2006, 2009) of possible ‘allowable’ configurations. This space might also be further reduced if individual configurations do not in practice seem plausible during later-time considerations of the evolution of configuration states into others. The process of graphically laying out sequences of the potential future evolution of configurations is perhaps the most powerfully intuitive aspect of the FAR approach to morphological analysis. No analogue appears to exist in GMA, although there are other tools there which have no analogue in FAR and which appear to be largely computer-based, so little can be said about them, owing to the non-availability of the software for general use (although, see Ritchey 2003, 2006, and other resources on the swemorph.com web site).

Rhyne conceived of a three-dimensional multiply-branching ‘futures tree’ to represent future evolutionary changes of configurations over time. One imagines a rectangular cuboid, the long dimension of which is the time axis—the ‘Z’ axis. The two other axes were used to represent extremes in two other meta-attributes of the social field being described: the degree of ‘openness’ in the sense of an ‘open’ society that allows personal freedoms; and the degree of ‘Faustian-ness’, which is a somewhat less familiar concept, and bears further explanation. As Rhyne describes the motivation for the name of this attribute, the literary figure of Faust thought it perfectly legitimate for himself to manipulate the world and people around him to the degree that he wanted to or was capable of.² Thus, the two extremes of Faustian-ness are ‘can and will’ and ‘cannot and will not’, with some intermediate values such as ‘could but will not’ and ‘cannot but would’ (Rhyne & Duczynski 2008, p. 56). For openness, the extremes are ‘open’ and ‘closed’. If we suppose, after Rhyne, that openness is the Y axis, and Faustian-ness the X axis, then by projecting the XZ plane, one obtains a ‘Faustian side view’ of the futures tree, while a projection of the YZ plane produces an ‘openness side view’. They each reveal a different layout of possible paths of future evolution.

One can get a sense of this from Figures 4, 5 and 6 in Rhyne (1995b).

Coyle's variant of FAR also uses a graphical layout, but does not use the concepts of Faustian-ness or openness. Instead, his use is more akin to a landscape map of a flood plain having several river channels, with time being the vertical axis. The implicit metaphor is one of logical-plausible 'flow' between configurations, beginning from the configuration at the bottom centre of the tableau, which should correspond to the present. The existence of this is a good check on the analysis conducted so far; if the configuration describing the present situation is missing, then clearly something has gone awry! Then, from this starting point, other plausible evolutionary developments are traced forward in time and up the page. Several distinct 'channels' can emerge, and these may be used as stepping stones to represent skeletal scenario narratives that can thereby be easily sketched in from the factor descriptors given in the configurations contained in them. One may recognise a resonance with the stepping-stones approach described by Willis Harman as 'divergence mapping' (1976, pp. 17-9), where he also alludes to the morphological approach, but does not name it as such.³ There is a certain intuitive attractiveness of this format, perhaps because it is more easily grasped at first than the somewhat less intuitive concept of Faustian-ness, and perhaps because it appeals to an inherent human propensity to construct narratives to make sense of the world.

One might perhaps be drawn into thinking that the formal and systematic nature of the morphological approach is somehow 'too' formal and rigid, and so might somehow constrain or not be conducive to creativity, imagination, intuition and insight. Nothing could be further from the truth—one need only look to the remarkable output of Zwicky's own life to see evidence of how fruitful it can be. On the contrary, it is the very structure and framework provided by the morphological approach that provides such excellent support for what some researchers have called 'disciplined imagination' (Chermack 2007; Schoemaker 1997; Weick 1989). As peculiar as it sounds, it is precisely the systematic discipline of the approach that provides such freedom to imagine.

4 Practical uses of morphological methods in strategy and policy

Even from this brief sketch of their attributes, it should be clear that morphological approaches can be used to systematically examine an organisation's present and future strategic context in terms of the major sectors/parameters of interest to the organisation. But they can also be used to frame and focus intelligence-gathering activities to aid in strategic analyses and to assist in the development of policy. Let us briefly note some ideas here.

4.1 Intelligence scanning and monitoring

One immediate off-shoot of such a schematic 'map' of the possible 'shapes' of the future context is that any intelligence-monitoring activities can therefore be clearly and explicitly framed around precisely the key themes and issues that are of strategic interest to the organisation. Thus, one aspect of any intelligence scanning system would be to undertake continuous monitoring to track how the external context may be shifting from one configuration to another (e.g., Rhyne 1981, p. 354-6). This could therefore provide one type of 'early warning system' to decision-makers that the organisation's strategy may need re-orienting or reviewing for relevance and 'fit' to the newly-emerging context. Using the established sector/factor array as a basis, such a scanning function could operate with a relatively small core team of staff, with quarterly (or perhaps more frequent) oversight meetings with decision-makers, in order to do a strategic 'check-in' for any needed 'course corrections'. The

use of what effectively amounts to a ‘strategic intelligence control room’ (see later) would aid and streamline this process immeasurably.

Besides this, there are several other enhancements to the method that can be introduced to strengthen an organisational or governmental foresight capacity.

4.2 Internal strategy configuration

One very interesting extension to the method as described above is the inclusion by Ritchey (2006; 2009) of an internal organisational ‘strategy space’ to be matched against the morphological solution space of the external organisational environment. In this view, a separate morphological analysis is conducted of different possible configurations of various aspects of corporate strategy which could be undertaken by the organisation. As usual, certain configurations of this internal space would be ruled out on the basis of inconsistency, and a reduced solution space would remain. Then, the two distinct solution spaces are themselves compared, to see what configurations of the internal strategy space are properly consistent with different configurations of the external contextual space. If a diagram has been constructed to map developmental streams in the external space, then it is possible to see what changes to the organisation’s strategy might become necessary ‘down the line’ as the context changes, thereby allowing for decision-makers to think about such changes before they become pressingly urgent. Such analyses could also guard against being caught by surprise, through undertaking formalised monitoring of the external environment, as described above. They would reduce the threat of ‘strategic drift’, while at the same time allowing the leadership team to consider what new organisational competences might become necessary in order to retain strategic advantage.

4.3 Assessing policy responses

Similarly, one imagines that an analogous ‘policy space’ could also be developed for governmental agencies or public-sector organisations, which would be used in much the same way as the internal strategy space just described. For these types of organisations, the contextual environment would likely be much more broadly defined than would usually be the case for private-sector organisations. Nonetheless, the same basic idea holds of developing a morphological solution space for the external contextual environment, and then assessing possible configurations within an ‘internal’ policy space for both their own self-consistency and for consistency and ‘fit’ with the conditions in the external environment. In this way, policies would automatically have a built-in indicator of their timeframes of utility—namely, for as long as they are consistent with and ‘matched’ to the social conditions in which they are intended to operate. Rhyne has often noted that policies and plans should be ‘contingent’ in just this way, rather than simply having arbitrarily-fixed timeframes (see, e.g., 1994, p. 291; 1995b, p. 672), and his work has also occasionally mentioned the related use of a secondary solution space (e.g., 1995b, p. 665). One imagines that a diagrammatic map of potentially changing societal conditions could aid in the continuing development and refinement of government policy in much the same way as such a diagram would, as described above, aid in the development and refinement of organisational strategy. In each case, the risk of a ‘mismatch’ of strategy or policy to external conditions may be reduced, and timelier adjustments could be prepared for and made in response to the changes occurring in the contextual environment.

4.4 Nested contextual fields

Another extension to FAR as described above has been mentioned by Rhyne himself in several places in his writings (e.g., 1995b, p. 662), and has to do with defining different ‘fields’ of interaction. In its original form, FAR was usually concerned with the social field of most direct interaction with the organisation. But it is also possible to consider different nested levels of ‘scope’. He suggests, for example, that different sector/factor arrays be constructed for major types of social fields, such as the world as a whole, and different national and intra-national regions (1981, p. 357). In this view, the set of allowed configurations at one level of scope would be assessed against the range of allowed configurations at the next higher level of scope. This leads to the idea of a nested set of contextual levels within which to undertake strategic or policy analysis, something which has been explored elsewhere for its utility in futures work using a different framework (Voros 2006b). Indeed, this idea of nesting levels of contextual scope is analogous to the nesting by Ritchey of the organisational strategy space within the organisational contextual space described above except, of course, that it extends outward rather than inward.

In fact, this realisation immediately leads to the further idea of a generalised system of nested contextual levels—ranging from, for example, individual to group to organisation to industry to nation to region to planet—which could form the basis of a general theory of multi-level morphological analysis and the design of associated intelligence-gathering systems (this framework is now under development and is something for another time). In the first instance, though, it should be possible to consider this general concept of nesting contexts from the particular point of view of an organisation situated within a market context, which is situated within an industry context, which is situated within a societal context. FAR or GMA projections of the future evolution of the wider society would then be used as contexts for and constraints upon considerations of plausible FAR/GMA evolution of the industry context, and thence similarly the market context, and thus finally the choice of context-appropriate strategy configurations within the organisational strategy space, as described above.

4.5 Context-specific intelligence scanning

The discussion above has described a more determined approach to strategic foresight than many organisations consider or undertake. But, in so doing, it clearly makes provision for the development of a much more robust set of futures assessments upon which to base corporate organisational strategy—or, indeed, for government policy, using the societal level of scope as the basis—than is usually encountered. It also allows the task of intelligence scanning to be divided more effectively into the key contexts of importance and interest. Thus, some scanning would be focussed on monitoring and assessing possible changes in contextual configurations of an organisation’s market; some would be focussed on the wider industry, and some could be focussed on the wider society. The use of global and regional futures assessments by other research groups—such as, for example, the US National Intelligence Council (2000; 2004; 2008), the Stockholm Environment Institute (Gallopín et al. 1997; Raskin et al. 2002), or the World Business Council for Sustainable Development (1997), to name just a few—could therefore also be undertaken to ‘situate’ the national, industry and market contexts being considered by an organisational strategic leadership group. This, in principle, allows different groups of experienced and expert scanners and intelligence analysts to undertake more targeted scanning and analysis, while nonetheless allowing the results produced to be integrated into a coherent ‘big picture’ of shifts in the organisation’s environment. The existence of a wider framework of interpretation helps to prevent the fragmentation and consequent incoherence of intelligence that is so common in much of

contemporary intelligence-gathering activity. Of course, this approach could also be used for public-sector (and non-profit and civic sector) organisational strategy and for governmental intelligence scanning for reasons of national security and policy planning (e.g., Habegger 2009; Schultz 2006).

5 Adapting to novelty — scanning for ‘emerging issues’, ‘wild cards’ and ‘black swans’

One of the key concerns that strategists and policy makers rightly have is the emergence of new issues that may impact on the effectiveness of organisational strategy or governmental policy. In futures research as a field, we have developed many methods and techniques to probe for the emergence of novelty in social systems. The technique of ‘emerging issues analysis’ developed by Graham Molitor is one such approach (Molitor 1977, 2003), and tracks the emergence of new issues over a possible lifespan of decades, from totally unknown to mass media visibility. Another approach is the search for so-named ‘weak signals’, ‘wild cards’, ‘discontinuities’ or ‘shocks’ (e.g., Ansoff 1975; Hiltunen 2008; MacKay & McKiernan 2004; Mendonca et al. 2004; Petersen 1999; van Notten et al. 2005; Wygant & Markley 1988). More recently, the metaphor of a ‘black swan’ (Taleb 2007)—which overturns the conventional wisdom of what is considered possible, founded upon past-based knowledge—has gained some currency, even making it into popular discussion in the mass media. All of these methods, and others similar, are predicated upon the idea of an *active* search for signs of novelty emerging in social systems rather than a passive receptive posture. With a bit of extension, we can build into the morphological methods we have been discussing a pro-active stance with respect to seeking out novelty and emerging issues. These ideas are preliminary at present, but they serve to show the potential utility of prospectation based upon a morphological perspective and approach.

One can imagine at least two extensions to the Sector/Factor arrays of FAR, or to the parametric tableaux of GMA:

1. Extend the possible range of sectors/parameters by including a non-specific ‘placeholder’ value whose sole purpose is to serve as a constant reminder to ‘think outside the (morphological) box’.
2. Extend the possible range of values/factors for each parameter/sector, in a similar way and for a similar reason—there may be ‘black swan’, ‘wild card’ or ‘emerging’ values which have not been considered or imagined in the analysis and development of the field description.

In practical terms, this could be accomplished by introducing a new index value for the parameter values/factors, as well as a new ‘blank’ parameter/sector name. These additions would be made *after* the array had been formulated, since their role is by definition to provide placeholders for novelty or change which, in principle and in practice, have not and could not have been anticipated.

It is straightforward to achieve point (1). We can simply introduce into the Sectorial ACRONYM a ‘blank letter’—an underscore character, perhaps, or a hyphen, thus: ACRO_NYM or ACRO-NYM, for example, which might also serve to ease the pronounceability of the constructed mnemonic. The ‘blank letter’ notational device simply acts as a constant reminder that there *could be* other sectors of importance which have not been considered so far. How much use is made of that reminder is a point of further process design and a matter for each team of analysts and decision-makers to determine.

Point (2) can be achieved by using a technique similar to one frequently employed in relativity mathematics. In relativity theory, it is usual in some conventions to represent the spatial coordinate components of space-time objects using lower-case subscript (or superscript) Latin letters, thus: $ijklmn$ and so forth. It is then conventional to use the subscript $_0$ ('zero') to represent the temporal component, and to represent the combined case—time and space components considered together rather than separately—by a lower-case Greek letter, thus: $\mu\nu\alpha\beta\lambda\sigma$ and so on. The point is that the temporal component is singled out in this form of notation owing to its distinctive character compared to the others. Similarly, we might label the distinctive 'unknown/wild card/black swan/emerging' placeholder value in any set of factors in a sector by the label '0'. Thus, in a sectorial array denoted by ACRO-NYM, we would label the 'unknown' placeholder value for the sector Y as Y_0 (or $Y0$). Its other known values remain denoted by Y_i and the whole set of factors—the known and the 'unknown' together—might then be rendered as Y_μ (although, this extended form of notation is also something for another time).

All zero-index placeholder factors in all sectors would be, by definition, consistent with all other factors in all sectors, until such time as a distinctly new factor actually emerges into consideration. In that case it would then become factor $k_i + 1$ in that sector, whence it becomes subject to the same cross-consistency assessments as all other factors. That is to say, if, in scanning (say) sector Y for any potential as-yet-unknown novel factors—generically denoted by Y_0 —we do indeed find a genuinely new factor, it would then take the new value of Y_7 in the ACRO-NYM array. That is, since Y has $k_6 = 6$ known factors, Y_1 to Y_6 , a newly-emergent factor should take the next available factor label, in this case $6 + 1 = 7$. It would then be possible to conduct a restricted set of pair-wise consistency evaluations with the extant configurations to see what new ones might survive into further assessment. And so the newly-found factor would enter the processes of morphological prospection for further consideration.

6 Imagine strategy and policy with foresight and intelligence...

The intelligence-scanning function should be the primary responsibility of a dedicated high-level executive in corporate private-sector organisations, similar to the role described by Little and Fahey (2006) as the 'Executive Intelligence Officer'. An analogous position should exist in public-sector governmental organisations or agencies. This function should be guided by the practical requirements of setting strategy and/or developing policy, enhanced with the ability to search for and detect novelty and emerging issues, as described above. But how should the results of this intelligence work be made available to executives, decision- and policy-makers? Space has not permitted a detailed description of such a system (which could easily verge on science-fiction). Nonetheless, a few ideas should suffice to give a flavour of how this might be done, now that computing power has become so pervasive and affordable.

Most of the researchers who have contributed to the recent work on FAR/GMA have noted the need to find better ways of presenting the findings. Rhyne suggested (1995b, pp. 663-4) that "presentation is important" in order to "stimulate insightful discussions". He noted the attempted use of various mechanical models, but observed that computer graphics could do it much better and cheaper. Coyle and Yong also noted (1996, p. 277) that the tree diagram should be used, in part, as a "stimulant to thought", with a dedicated room set aside for it, and those involved in developing policy would be required to study both it and the supporting documentary materials, as well as speaking with the team responsible for maintaining and updating the chart. They even suggested that having such a chart located in the Prime Minister's office would be helpful. Ritchey (2009, p. 1) has remarked:

morphological analysis would never reach its full potential without *dedicated*, well-thought-out computer support. The system we began developing . . . makes it possible to create morphological inference models. Such models allow us to hypothesize varying initial conditions, define drivers, and generate solutions or decision paths.

Let us take these statements to heart as broad design principles for a strategy/policy intelligence system.

One imagines that there would be large, high-definition, high-speed graphical displays located in both a restricted-access decision-maker meeting room, as well as where the morphology/strategy/intelligence team undertake their work. With computer support, it would be possible to operate upon the very latest real-time data and up-to-date intelligence from the intelligence database. Configurations displayed in the tree diagram would be linked with their array layout, and the supporting information ‘behind’ this layout would be available at the tap of a finger on the wall-screen surface. Postulated changes could be displayed instantly to allow for strategic or policy-oriented ‘what-if?’ discussions. Such wall-surface computing is now being developed and concept videos of how these might look in common use can be found in many places on the Internet.⁴ Once such pervasive and highly-intuitive ‘invisible computing’ matures, the complexities of re-drawing morphological analyses can be delegated to computers while expert human judgement takes its rightful place in the higher-order function of developing and assessing the morphological framework, evaluating futures contexts, and deciding upon strategic actions and policy options. Such a ‘strategic intelligence control room’ (as it were) would most likely provide an inestimable strategic advantage for any organisations that seriously adopted this approach and fully endeavoured to develop “foresight as a core competence” (Major et al. 2001). An analogue of such a system, for ‘policy intelligence’, could also be developed for governmental organisations or agencies in order to facilitate timelier and potentially more effective horizon scanning (Habegger 2009; Schultz 2006).

7 Concluding remarks

This article took as its starting point an observation from recent empirical psychological research that being asked to systematically examine the possible future contexts of decisions usually leads to better assessments and better decisions, something futurists have always argued. The nature and design of morphological analysis is perfectly suited to this type of systematic exploration of possibilities, and would therefore seem to be an excellent foundation for undertaking systematic foresight work. The article consequently sought to introduce the reader to the potential utility of morphological approaches in futures work: by providing a brief history of their use; by showing an outline of their basic structure; by describing several extensions to the approach; and by making some specific suggestions on ways to use them in practical decision-making settings, such as for organisational strategy or in governmental policy. It is hoped that readers have thereby come to appreciate the potential power of undertaking foresight activities and prospection using a morphological approach, and that their interest has been so piqued as to encourage them to further investigate for themselves whether and how such an approach may be of use to them. ‘Morphological prospection’—profiling the ‘shapes’ of ‘things to come’—would seem to be another potentially very powerful tool in the ever-expanding toolkit of futurists and practitioners of foresight.

Notes

1. A common term used in the neuropsychological literature is ‘mental time travel’. Futurist Oliver Markley (2008) has been using an approach along these lines in futures research for some decades.
2. See, for example, the epic poem *Faust* by Goethe, or the play *Dr Faustus* by Christopher Marlowe.
3. From the nature of the discussion found there, it would seem that Harman was referring to FAR, or at least something very like it, as he mentions a ‘code-word’ ESTCAP with numerical subscripts. Comments by Rhyne (1994, p. 287) suggest that Harman was familiar with FAR in the early 1970s.
4. For example, Microsoft has made public several concept videos of visions of productivity in 2019; see <<http://www.officelabs.com/Pages/Envisioning.aspx>>. Bill Gates himself even demonstrated a prototype of such a wall-surface computing interface at a Microsoft CEO summit <<http://www.officelabs.com/projects/touchwall/>>.

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