WICKED PROBLEMS

Achieving clarity in complex pharmaceutical problems: from innovation to policy formulation

by Nasir Hussain and Tom Ritchey

In pharmaceutical and healthcare planning sectors, a modelling environment must interrelate diverse issues such as technology development, national policy directives, organisational structure, public perception, ethical issues and educational requirements. Furthermore, it should be able to take account of global forces shaping healthcare and novel emergent business models.

Analysing such complex socio-technical systems presents a number of problems. Firstly, many of the variables involved are not readily quantifiable, containing strong social, political and cognitive dimensions. Secondly, the uncertainties inherent in complex problems are in principle non-reducible, and often cannot be fully described or delineated.

Compounding this is the extreme connectivity of socio-technical systems that results in elements within the problem complex being inextricably linked to each other. What might seem to be the most marginal of factors can, under the right circumstances, become an overwhelming force of change (the so-called butterfly effect). In short, traditional quantitative methods, mathematical modelling and simulation simply do not suffice to tackle such complex issues which have been termed 'wicked problems'.

Wicked problems

Relatively unknown in the pharmaceutical sector, the term 'wicked problem' is transdisciplinary, cited principally in public planning, policy formulation and socio-political arenas. It describes a state of extreme complexity defined by criteria listed in **Table 1**.

Although sounding a touch comical, wicked problems are neither 'evil' in the traditional sense, or indeed even 'problems' as no stable problem statements have actually been defined. For this reason, Russell Ackoff in his book *'Redesigning the Future'* used the equivalent term *unstructured reality* to describe such 'social messes'. More recently, the uncertainties embedded within such conundrums have been (in)famously termed 'unknown unknowns' and the unintended consequences of ill-thought out decisions highlighted in the *Freakonomics* series of publications.

In short, wicked problems are ill-defined, ambiguous, and associated with strong moral, political and professional issues.

As they are strongly stakeholder dependent, there is often little consensus about what the problem is, let alone how to resolve it. Examples in the healthcare sector include end-of-life decisions, assessing the cost-benefit ratio for new drug approvals, the difficulty of integrating vast amount of disparate data into any meaningful outcome and the types of emerging business models for the pharmaceutical-governmental-private payer complex.

As an alternative to mathematical modelling and other 'hard' operational research methods, a number of non-quantified problem structuring methods (PSMs) have been developed during the past 40 years. One such method, Morphological Analysis, enables multi-dimensional problems to be analysed, structured and displayed in two dimensions.

Modelling wicked problems with morphological analysis

The kneejerk reaction that often befalls regulators, senior executives and politicians in tackling complex issues is most aptly summed up by Michael Pidd:

Table 1: The five principal criteria of a wicked problem as proposed by Rittel and Webber (1973).

Continually developing and mutating (no stable problem statement)
Full of ambiguities, contradictions and circular causality
Strongly stakeholder orientated
Associated with strong political, moral and professional issues
Reactive: the problem complex fights back

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"one of the greatest mistakes that can be made when dealing with a mess is to carve of off part of the mess, treat it as a problem and then solve it as a puzzle – ignoring its link with other aspects of the mess." And while one is busy solving the puzzle, the mess is still mutating – retrofitting the solution to the puzzle merely puts it into another state of flux. PSMs engage stakeholders of the wicked problem expressly at the level of the mess – this requires experienced independent facilitation to map the boundary conditions of the problem complex, as well as managing strongly held opinions and beliefs of the participants.

When dealing with complex planning problems, PSMs such as Morphological Analysis offer a number of distinct advantages. PSMs must be able to:

- Accommodate multiple alternative perspectives to deal with uncertainties
- Facilitate a process of collective creativity amongst the stakeholders to develop shared concepts, terminology and ownership of the problem formulation
- Generate, in real time, a visual representation of the problem space for the systematic and transparent group exploration of a solution space
- Focus on relationships between discrete alternatives
- Concentrate on possibility rather than probability.

Morphological analysis is fully attuned to meeting these criteria as it is an objective method for structuring and analysing wicked problems that are naturally non-quantifiable, contain ineradicable uncertainties and cannot be causally simulated or modelled in a meaningful way.

Computerised in the mid-90s, Morphological Analysis made it possible to create non-quantified multi-dimensional inference models that endeavoured to represent the total problem space, and as many of the potential solutions as possible. This, in itself, went a long way in satisfying the first – seemingly incredible – criterion concerning wicked problems: *'in order to describe a wicked problem in sufficient detail, one has to develop an exhaustive inventory for all the conceivable solutions"* ahead of time.

In complex, dynamic, planning problems, the concern is with form over function i.e. *forming* the hyperspace, the extreme boundary conditions to encompass the possibilities (and even absurdities) before developing any strategies. These possibilities arise from the interaction of the various states within multiple dimensions – a three dimensional typological construction and its equivalent morphological field is shown in **Figure 1**. Typologies of greater dimensions can be represented by placing the dimensions as columns beside each other as shown in **Figure 2**. In 1995, the Swedish Defence Research Agency developed a dedicated, highly flexible, workshop orientated computer support for Morphological Analysis that could incorporate multiple dimensions and millions of constructed configurations. What took researchers months to construct and model can now be done in

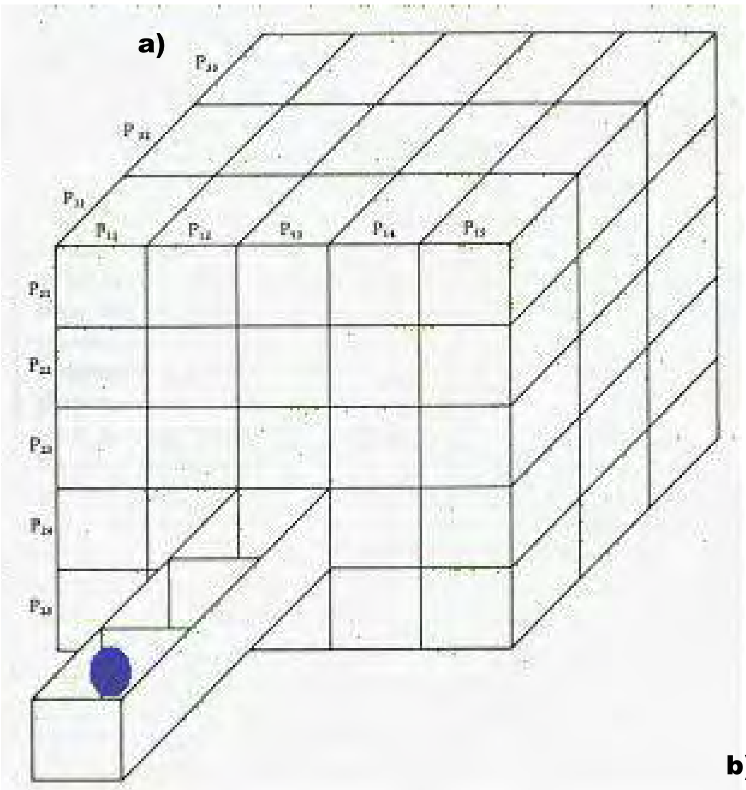
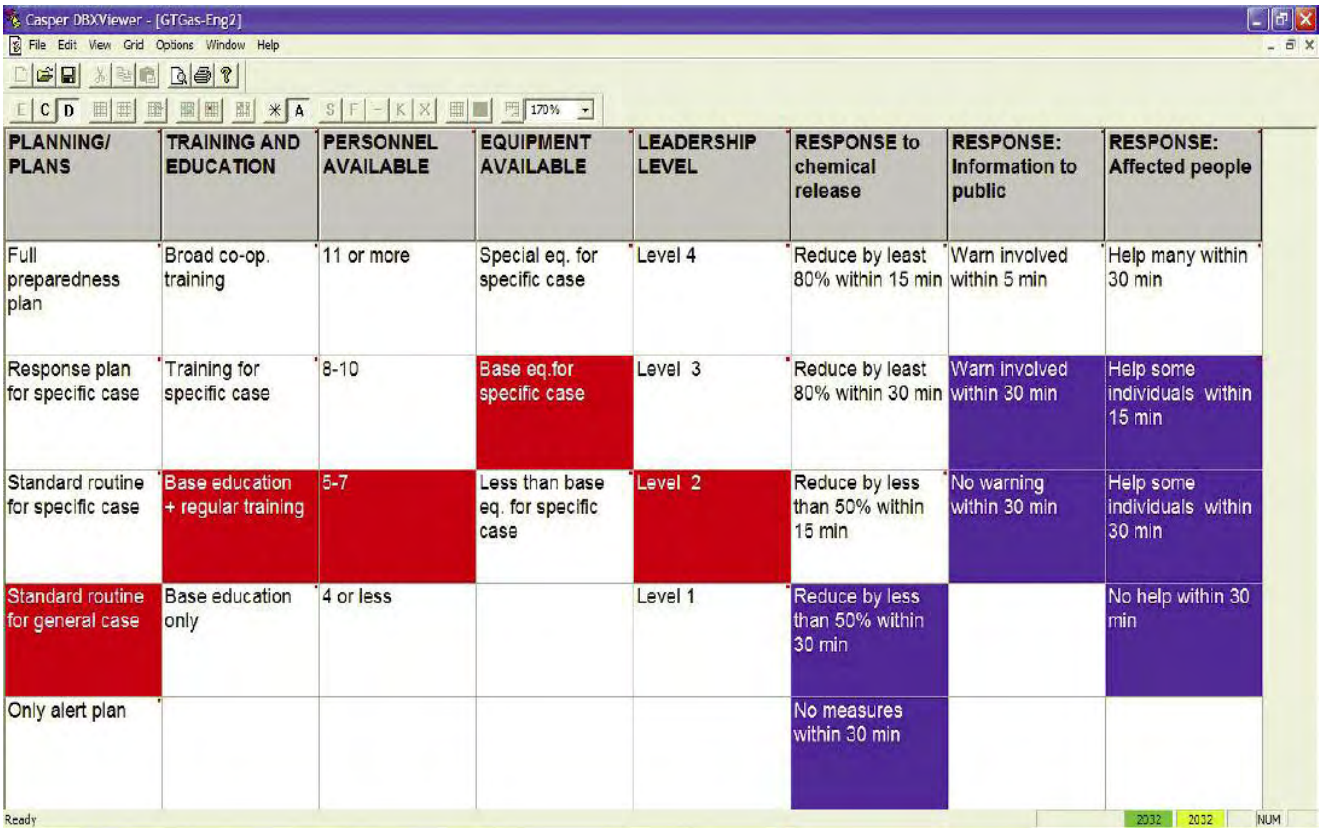


Figure 1: *Visually, a typology uses the (Cartesian) dimensions of a physical space to represent its dimensions – however this ends at three (a). Extra dimensions can be embedded as hyperspaces but visually this is not particularly appealing, prone to errors and merely adds another layer of complexity to an already complex situation. The equivalent 3D typological format can easily be represented as 3-columnar morphological table (b).*

b)

P (1)	P (2)	P (3)
P_{11}	P_{21}	P_{31}
P_{12}	P_{22}	P_{32}
P_{13}	P_{23}	P_{33}
P_{14}	P_{24}	
P_{15}	P_{25}	



PLANNING/ PLANS	TRAINING AND EDUCATION	PERSONNEL AVAILABLE	EQUIPMENT AVAILABLE	LEADERSHIP LEVEL	RESPONSE to chemical release	RESPONSE: Information to public	RESPONSE: Affected people
Full preparedness plan	Broad co-op. training	11 or more	Special eq. for specific case	Level 4	Reduce by least 80% within 15 min	Warn involved within 5 min	Help many within 30 min
Response plan for specific case	Training for specific case	8-10	Base eq.for specific case	Level 3	Reduce by least 80% within 30 min	Warn involved within 30 min	Help some individuals within 15 min
Standard routine for specific case	Base education + regular training	5-7	Less than base eq. for specific case	Level 2	Reduce by less than 50% within 15 min	No warning within 30 min	Help some individuals within 30 min
Standard routine for general case	Base education only	4 or less		Level 1	Reduce by less than 50% within 30 min		No help within 30 min
Only alert plan					No measures within 30 min		

Figure 2: *An 8-dimensional morphological field developed for the Swedish National Rescue Services on evaluating preparedness for chemical accidents, accidental or deliberate, for different municipalities. One possible configuration (out of 57,600) is shown – cells shaded in red are inputs while blue cells represent possible responses. Each and every pair of cells shown in the configuration below is mutually compatible. Any single contradictory pair knocks out the entire string (e.g. 'standard routine for general case' and the top three response cells are not highlighted as this was deemed contradiction in terms by the subject-matter specialist working group).*

matter of few days provided that facilitated, interactive group workshops are conducted.

Morphological analysis for the pharmaceutical and healthcare sectors

PSMs are uniquely equipped to model complexities and uncertainties that healthcare professionals, scientists and administrators face in healthcare systems planning, policy formulation and regulatory issues. **Figure 2** displays an 8-dimensional morphological field developed for the Swedish National Rescue Services for dealing with chemical accidents. This relatively small problem space of 57,600 possible configurations (fields of up to 10^5 to 10^6 configurations are frequently encountered) is an example of an input-output inference model that can be adapted for a variety of situations e.g. dealing with drug recalls, drug interactions, and Quality by Design issues.

To give decision support, the group must be facilitated to conduct a Cross Consistency Assessment, which is a pairwise comparison of every pair in the multi-dimensional field as shown in **Figure 3**. Analytical, empirical and occasionally normative "contradictions" between any two states results in the removal of any and all "strings" that contain that contradiction: the example shown in **Figure 2** displays a configuration that is entirely internally consistent i.e. every pair can co-exist as determined by the working group. This reduces the entire problem space to a workable solution or design space – *up to 99% of the configurations in the problem space can be removed* to yield an interactive inference model in which any dimension or multiple dimensions can be selected as input and any others as output. This resulting "design space" allows for exploring scenarios, testing assumptions and interventions and identifying unintended consequences – the principal considerations for engaging a wicked problem in the first instance.

Concluding remarks

The earliest known publication citing the use of Morphological Analysis for healthcare systems planning dates to the 70s in the design and evaluation of healthcare provision for a large metropolis. Here the authors stated that "modern day healthcare has become a highly complex system, having numerous components whose relationships are generally not well understood." They further cited problems that included i) the types of care rendered ii) access to healthcare for different populations iii) utilisation of scarce manpower and iv) structuring and evaluating the consequences of incentives in the health sector – does this sound familiar? In the current economic environment of austerity measures (a wicked problem in itself, particularly what to do with banker's bonuses) where the healthcare and pharmaceutical sectors are expected to "innovate with less", the industry is already in the midst of a wicked problem (the patent cliff) that has been brewing for at least a decade before the recent financial crash.

Receding drug pipelines, increased regulatory scrutiny, governmental pricing pressures, the rise of patient advocacy groups and how to (bio)ethically integrate emerging technologies are all but a few symptoms of the 'Kondratiev winter', the trough of the super-economic cycle, in which we find ourselves. A new line of questioning is needed in these post-normal times, defined as a line of enquiry *"where facts are uncertain, values are in dispute, stakes are high and decisions urgent."* Causal modelling, such as Bayesian Belief Networks, when applicable, can and should be used as an aid to judgement. However at a certain level of complexity i.e. social, political, cognitive processes, judgments must often be used – and worked with – more or less directly. PSMs such as Morphological Analysis allow judgmental processes to be placed on a sound methodological basis, with a digital audit trail, to give decision makers systematic support in identifying a consensual framework for engaging with their complex problems.

Further Reading

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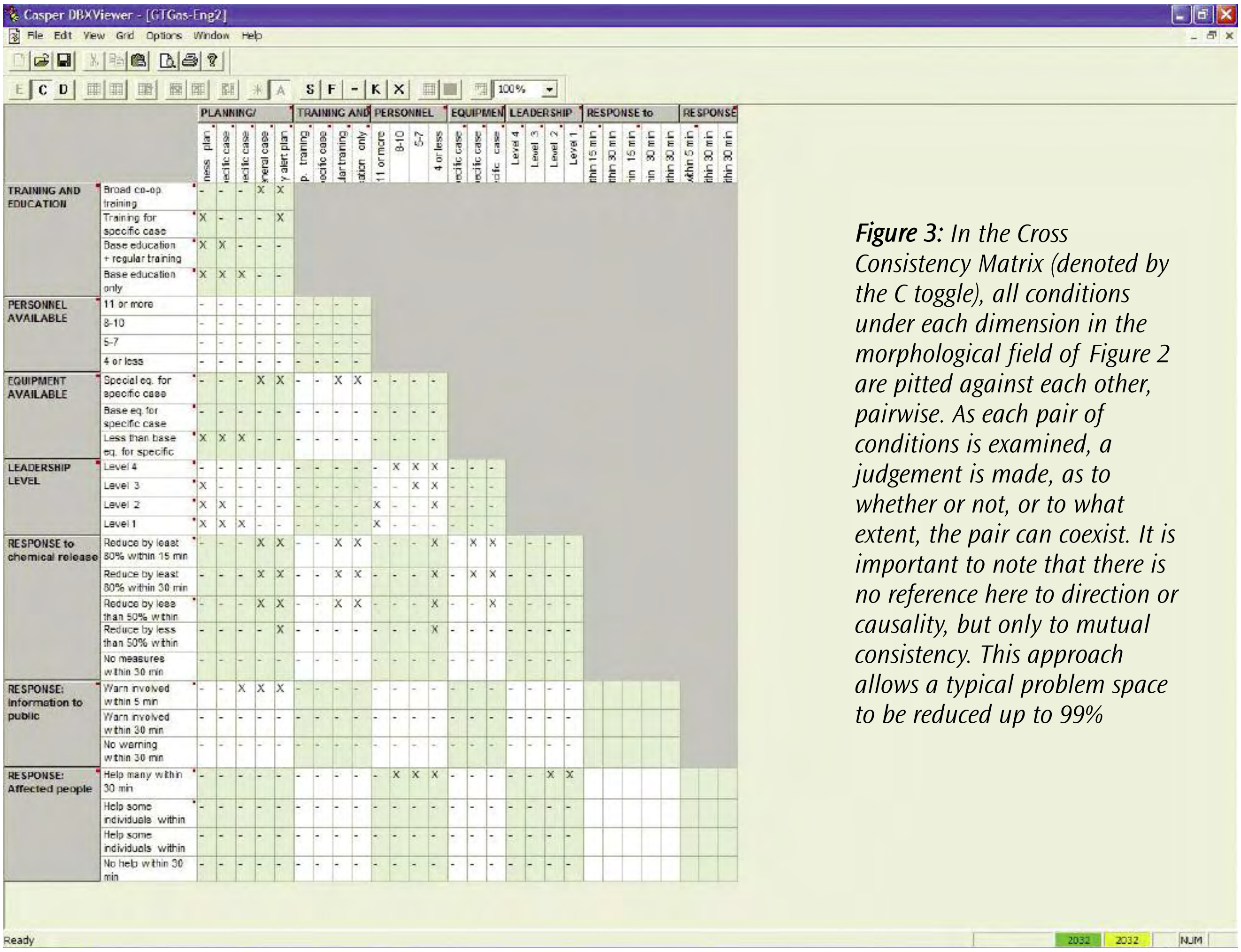

Figure 3: *In the Cross Consistency Matrix (denoted by the C toggle), all conditions under each dimension in the morphological field of Figure 2 are pitted against each other, pairwise. As each pair of conditions is examined, a judgement is made, as to whether or not, or to what extent, the pair can coexist. It is important to note that there is no reference here to direction or causality, but only to mutual consistency. This approach allows a typical problem space to be reduced up to 99%*