Strategy Foresight

Decision solutions for the 21st century

DECISION MAKING UNDER UNCERTAINTY AND COMPLEXITY
Bringing Morphological Analysis Out of the Shadows & into the Future

- WHAT IS MA & HOW DOES WORK?

- WHERE CAN IT BE USED?

- AWARENESS

- PROS & CONS

- IMPACT OF RECENT RESEARCH

- FUTURE ENHANCEMENTS IDENTIFIED

- INTEGRATING ANALYTICS & AI

- CONCLUSIONS

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WHAT IS MORPHOLOGICAL ANALYSIS & HOW DOES IT WORK?

- Morphological Analysis (MA) helps structure problems and support complex decision making, having high levels of uncertainty. "Totality research", "Idea factory", "Strategic Options Analysis".

- MA systematically structures and examines the total set of "possible relationships in a multidimensional, usually non-quantifiable, problem space.

- It helps to reduce the chance that events will play out in a way that the analyst has not previously imagined and considered.

- MA allows for all ideas to be considered as a first stage in the analysis process and as such is an exploratory method *par excellence* allowing us to identify all potential viable outcomes.

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UNDERSTANDING COMPLEX PROBLEMS WITH FIBONACCI MA

1. Articulate the Problem

- Identify a team of experts from the main internal & external stakeholders
- Formulate the focus question which encapsulates the problem
- Identify different states within each of the parameters which reflect the problem
- Record group's decisions
- This matrix is the Problem Space

Fibonacci Decision-support Software Platform

☐ De-constrained   ☐ Frozen Solution   **17**   **17**

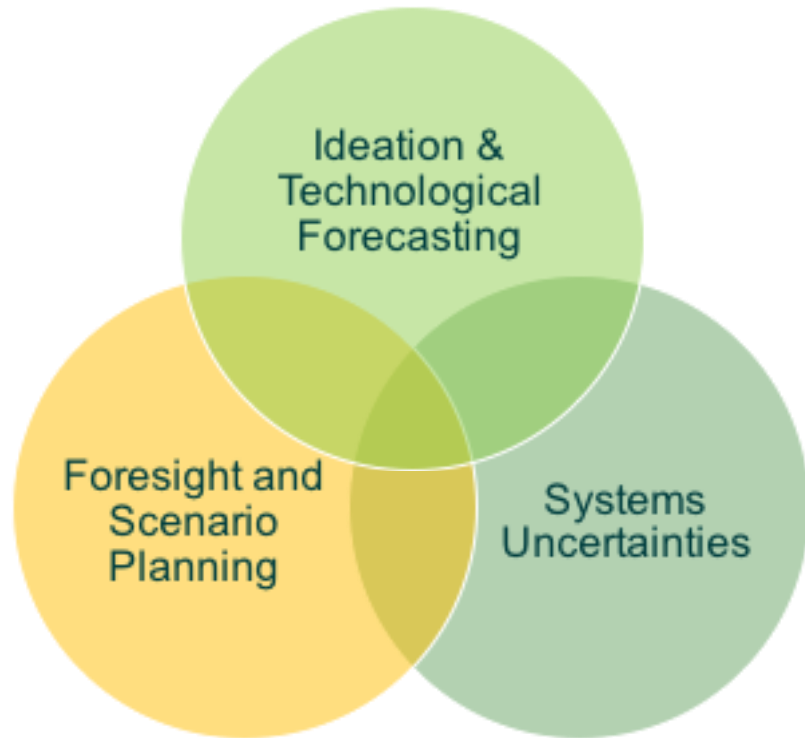| Planning	Training & Education	Personnel available	Equipment available	Leadership Level	Response to Chemical Release	Response:Info to Public	Response: Affected people
Full Prep Plan	Broad co-op training	11 or more	**Special equip for specific case**	level 4	Reduce by 80% within 15 mins	Warn involved within 5 mins	Help many within 30 mins
Response plan for specific case	**Training for specific case**	8–10	Basic equip for specific case	level 3	**Reduce by 80% within 30 mins**	**Warn involved within 30 mins**	**Help some within 15 mins**
Standard routine for specific case	Base education + regular training	**5–7**	Less than basic equip for specific case	**level 2**	Reduce by 50% within 15 mins	No warning within 30 mins	Help some within 30 mins
Standard routine for general case	Base education only	4 or less		level 1	Reduce by 50% within 30 mins		No help within 30 mins
Only alert plan					No measures within 30 mins		

2. Identify Problem Inconsistencies

- Convert Problem Space to a matrix of pairs.
- Determine whether every paired cells is consistent or not (i.e. can they work together). If not identify inconsistent pairs with an "X" (red indicator).
- Record Group's decisions
- Complete exercise and compile

3. Compiling the Solutions

- FMA software compiles results.
- The software extracts all those configurations in the Problem Space which contain at least one pair of inconsistent paired cells. Those configurations remaining (i.e. where no inconsistent pairings exist) are presented in the Solution Space Matrix.
- The team can now see what solutions exists by selecting any one cell or group of cells as either input or output. (What if?)
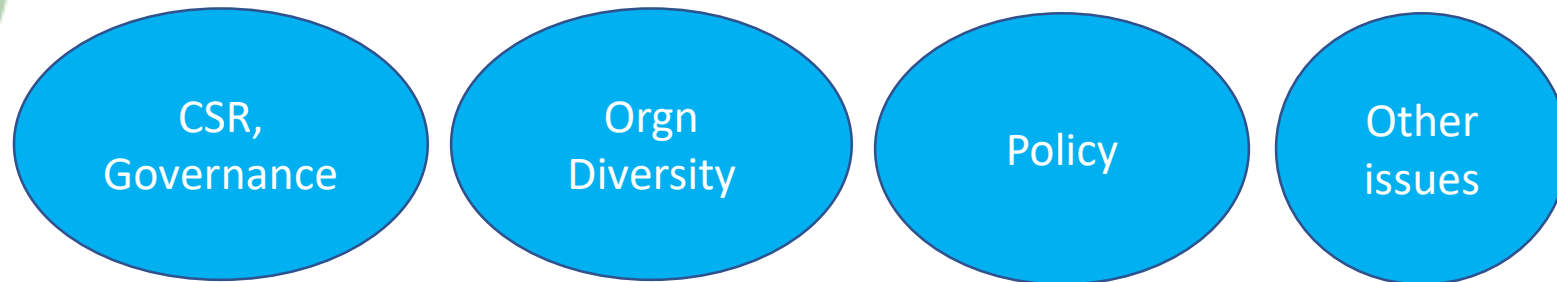
WHERE CAN IT BE USED?

APPLICATION AREAS

Ideation & Technological Forecasting

Foresight and Scenario Planning

Systems Uncertainties

SECTORS & INDUSTRIES

Defence & Security

Life Sciences/ Pharma

Engineering

Other sectors

ISSUE BASED TOPICS

CSR, Governance

Orgn Diversity

Policy

Other issues

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APPLICATION SEGMENTS

- *I & TF* – New types of combustion and jet engines, electrical torque devices, concept design for a new vacuum cleaner, etc.

- *F & SP* – Alternative, contingent, regional and national futures e.g. quality and nature of political integration, identifying weak signals relating to various technologies, criteria for military engagement in large urban conurbations in 2035.

- *W Ps (Systems Uncertainties)* – Developing policy to combat social exclusion, integrating organisations post merger or acquisition, how to embed diversity practices within organisations, immigration and integration, organisation transformation.

- *I & F* – How to develop a modular product that can be updated to reflect changing technological capabilities over the next 10 years, bio-mimicry and its future impact.

- *I & WPs* – How will humans adapt to and control technological advancement in AI? How will innovations in social media impact human behaviour and social responses?

- *F & WPs* – What are future options for the role of the state? What are the dangers of an over concentration of power in the hands of media conglomerates?

- *I, F & WPs* – What might be the unintended consequences on privacy of the "internet of things" by 2030?

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AWARENESS

- Over 50 years the number of dedicated books is sparse (4 books + 7 Book chapters). Very few of these studies actually present the outcomes using MA and how they are of value to the user.

- O'Brien's survey (135 practitioner respondents) in 2009, specifically addresses that area of OR/MS which supports strategic development of an organisation states *"the picture for soft OR/MS tools in the 'never heard of' category is perhaps the most bleak. Heading the list (of 12) tools) were morphological analysis of which 71.11% of respondents reported that they themselves had never heard …."*

- *BG's survey (2014)* 835 items were represented across 1079 identified sources. Only 23% of individual items appear more than once!

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PROS & CONS

- **PROS**

- Discover new relationships not readily identifiable or been overlooked by other – less structured – methods.

- In a multi-dimensional problem space – can identify un-intended consequences (good & bad) as well as feasible alternatives.

- Encourages the identification and investigation of boundary conditions, (Totality Research).

- Has definite visual advantages for communication & group work.

- Facilitates the identification of finding possible solutions to complex problems characterised by numerous parameters.

- Rich data – it can provide a multitude of configurations not yet explored.

- Systematic analysis – the technique allows for the analysis of viable options under conditions of uncertainty, complexity and connectivity.

- **CONS**

- **Epistemological**
  - Too structured
  - Prone to being too subjective
  - Overly generic
  - Issues emanating from the combinatorial explosion
  - No consistent terminology

- **Process**

- Rigidity and over prescription of method process

- Requires sequence process & participant number flexibility

- **Software**

- Accessibility

- Limited software development to date

- Platform constraints

- Licencing issues

- Feature limitations

- Integration with other methods

IMPACT OF RESEARCH (State of the Art 1)

IMPACT OF RESEARCH (State of the Art 2)

Main Features

Problem Space
- Import/Export (including audit notes for each cell)
- Add PS (Alternative scenarios)
- Copy PS
- Calculation of total dimensions (configuration) of each optional PS
- Improved zoom in/out functions

Cross Consistency Matrix
- Export (including audit notes for each cell in the matrix)
- Five levels of constraint identified (Consistent, Possible, Normative, Inconsistent, Different Universe)
- Improved zoom in/out functions

Solution Space
- Export of individual solutions
- Inclusive/Exclusive and Freeze scenario functions (as before)
- Presentation of selected solution by individual scenario with number of solutions
- Multiple states can be selected per parameter – allows for "AND" as well as "OR" selections

FUTURE ENHANCEMENTS & DEVELOPMENTS

- **Current short list**

- - Morphological Distance (identification of real innovation amongst solutions)

- - Large Configuration Problem Spaces (500k +)

- - Collaborative and Remote input processes

- - New Server based software platform

- **Future areas of engagement**

- - Introduction of hierarchy and weighting factors into the process

- - Integration with other methods across the Uncertainty/Risk spectrum (e.g. AHP, BBN, ACH, CLA, Scenario Planning, Red Teaming, IRMA, SCA, TRIZ, Functional Analysis etc.

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INTEGRATING ANALYTICS & AI

Current Process Issues

- MA is a sound method with proven supporting software.

 BUT populating the **problem space** and the **CCA** (pair-wise analysis), can be enhanced by reducing demand on resources (time, physical availability of expert team, geographic dispersion) us DA&AI.

- Does the expert team need to be challenged – quality of objectivity – too narrow an evidence base?

- Way forward is to integrate data analytic and AI methods into the process to:

o Speed up input into PS and CCA (pair-wise analysis) as well as Focus question qualification.

o Validate quality of expert/stakeholder team input

o Allow for increase volumes of topic analysis.

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CONCLUSIONS – THE WAY AHEAD

- MA provides an effective means for tackling issues where there are high levels uncertainty and complexity.

- Well suited to operate at the "fuzzy" front end of problems with long gestation periods, numerous inherent risks, (structural, regulatory, existential).

- Can operate to tackle complex areas such as Ideation, Futures and "Wicked Problems, across business sectors and issue driven topics.

- Accessibility and user friendliness key in on-going R&D

- Integrate MA within a broader toolkit of decision support methods.

- Integration of analytics and AI methods to broaden validation and hence support better decision making under uncertainty.

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ABSTRACT

- The rather complicated-sounding term Morphological Analysis (MA) is a particularly useful, albeit hidden, method for helping to structure problems and support decision making, notably when they are complex, "wicked" and inherently contain high levels of uncertainty. It has also been called "totality research", an "idea factory", and "strategic options analysis". Although introduced in its generalised form some 70 years ago it has lingered in the deeper recesses of the OR toolkit.

- Morphological analysis (MA) systematically structures and examines the total set of "possible relationships in a multidimensional, usually non-quantifiable, problem space. It helps to reduce the chance that events will play out in a way that the analyst has not previously imagined and considered. MA allows for all ideas to be considered as a first stage in the analysis process and as such is an exploratory method *par excellence.* Although the method is generic it works across three verticals the first addressing Uncertainty and Complexity namely: Ideation (Creativity & Innovation) and Technological Forecasting, Futures and Scenario Planning, and Systems Uncertainties (aka "wicked problems"). The second vertical specifically engages with Industrial and Organisation Sectors such as: Defence and Security, Life Sciences, Pharmaceuticals and Health and Engineering and Design Engineering. The third vertical addresses issues such as CSR, Governance, Diversity, Social Exclusion and Policy topics.

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