Morphologics

Decision Support with Morphological Analysis

Prospectus

Decision Support Modelling with General Morphological Analysis

Contents

1. What's the problem?

Analyzing and modelling complex social, organisational and technical systems presents us with a number of difficult methodological problems. Firstly, many of the factors involved are not meaningfully quantifiable, since they contain strong social, political and cognitive dimensions. Secondly, the uncertainties inherent in such problem complexes are in principle non-reducible, and often cannot be fully described or delineated. This includes both so-called *agonistic uncertainty* (conscious, self-reflective actions among competing actors) and *non-specified uncertainty* (for instance, uncertainties concerning what types of scientific and technological discoveries will be made in the future).

Complex policy and planning issues involving these types of uncertainties have been termed *wicked problems* or *social messes* (see the ten criteria for "Wicked Problems" at www.swemorph.com/wp.html). For these types of issues, quantitative methods, mathematical modelling and *traditional risk analysis* are relatively useless.

General Morphological Analysis (GMA) is a method for rigorously structuring and investigating the total set of relationships contained in multi-dimensional, non-quantifiable, problem complexes. Originally developed at the Swedish Defence Research Agency (FOI) by Dr. Tom Ritchey, it can be used for structuring complex policy and planning issues; developing scenario and strategy laboratories; analysing organisational and stakeholder structures; and creating business logic models.

GMA has been used for 20 years in more than 100 projects for:

- Developing virtual scenario and strategy laboratories
- Policy and stakeholder analysis
- Organizational development
- Market analysis and product design
- Technological foresight
- Crisis Management and Disaster Reduction Strategies

Clients include (see full client list at www.swemorph.com):

- Defence Science and Technology Laboratory (Dstl), England
- Organisation for Applied Scientific Research (TNO), Netherlands
- Center for Science, Policy and Outcomes (CSPO), Washington DC
- Center for Science and Industry Research (CSIR), Republic of South Africa
- Earthquake Disaster Mitigation Research Center (EDM), Kobe, Japan
- The Arlington Institute (TAI), Washington D.C.
- National Security Coordination Secretariat (NSCS), Singapore
- European Defence Agency (EDA), Brussels
- London City University, City Research and Enterprise Unit (CREU)
- EU 7th Framework Program (Social and cultural modelling)

2. How is GMA utilised?

GMA's principal strength is in structuring and analysing the internal relationships in complex, multi-stakeholder societal and organisational problem areas – often referred to as *wicked problems*. This can be done as an *initial phase for an entire project*, or as a *one-off problem structuring session* for an organisation or organisational unit. For more information on this type of problem structuring process, see:

Ritchey, T. "Problem Structuring using Computer-Aided Morphological Analysis". *Journal of the Operational Research Society (2006) 57, 792-801.* The article can be downloaded at: http://www.swemorph.com/pdf/psm-gma.pdf

There are *four main roles* that GMA can play in projects:

1) At the beginning of a project, to bring together the relevant competencies in the project group in order to create a *conceptual model* of the project's *total problem space*, and to map out all of the interconnections or relations between the different *parameters* of this space. This serves to carefully define the problem complex, to "bound" the problem area and to get all participating organisations "on the same page", i.e. to have a common terminology and common conceptual framework for the problem complex. This common framework can be returned to periodically as a reference to what one is doing, and can be up-dated if and when new discoveries are made about the problem area. It thus serves as a form of "audit trail" for the project as a whole.

2) During the project, to facilitate any non-quantified modelling that needs to be done. This includes scenario and strategy models, organisational structure/change models, and stakeholder-position models. Especially during longer (2-5 year) projects, it is often the case that a particular work-package needs its own initial "conceptual modelling" phase, as in point 1 (above).

3) At the end of the project, to create a number of *non-quantified inference models* representing those aspects of the *results* of the project, which cannot be (meaningfully) rendered as quantitative models. These morphological models are computer-based, and the recipients of the project's results receive software in order to run them.

4) For the dissemination phase, to demonstrate the results of the project in a graphical, interactive form. This type of demonstration has shown itself to be greatly appreciated by stakeholders, domain experts and potential end-users.

3. Benefits of employing GMA

Whether creating scenario/strategy modelling laboratories, policy analysis or any form of complex problem structuring, GMA offers the following benefits.

- GMA models define a project's **total problem space**, and can generate any number of alternative solutions in the form of scenarios, strategies or organizational structures.

- GMA creates an actual ***modelling laboratory*** and an (internally specified) ***parameter space*** in which single or multiple drivers can be assigned as inputs, alternative outputs obtained, and inferences ('what-if' assertions) made.

- GMA assures the ***internal consistency*** of all possible solutions (scenarios, strategies, etc.) through the process of Cross-Consistency Assessment (CCA).

- The Cross-Consistency Assessment (CCA) process creates "***inference by exclusion***": by excluding everything that is impossible, and including everything else which is possible, surprising events ("wild cards") are ***counted in***, rather than ***counted out***.

- The CCA also explicitly enables ***boundary research***, and thus helps a project group bound its problem area from the outset.

- The GMA process provides ***traceability and transparency*** – i.e. it leaves an "audit trail" showing what assumptions and decisions were made in defining the problem space and synthesising the outcome space. This "audit trail" is literally built into the method in the form of the internal consistency checks done by the CCA.

- GMA functions through ***group interaction and iteration***, rather than back office constructions. This provides a forum for collective creativity; it engenders out-of-the-box thinking; and it creates "smart teams".

- GMA facilitates a ***graphical (visual) representation*** of the problem area for the systematic, group exploration of a solution space. This graphic presentation is computer-based, and one of the *deliverables* – beside the chosen scenarios as such – is the complete modelling laboratory with software to run it.

- GMA concentrates on ***possibility*** rather than ***probability*** (for futures studies ranging more than 5 years in the future, ascribing probabilities is an act of self-delusion).

- GMA scenario models are **easy to update**. These are not "one-shot" solutions, but are ***living models*** which can be periodically updated and restructured without having to start all over again. This is the case even if a completely new group is employed in the update process.

- All GMA models are ***formally compatible*** with one another. A model from one sub-area in a study can be compared or merged with that of other areas within the study; and several sub-area models can be formed into a comprehensive model representing the total problem area.

4. GMA Workshop Process Description

1. **The establishment of contact with the "Principal client contact".** This contact person is usually the buyer or initiator of the GMA workshops. In any event, she/he has a vested interest in the success of the workshops for the client's decision support needs.

2. **Give one-two hour presentation of GMA as a scenario & strategy modelling technique**, preferably to a group of people supporting the principle contact person as well as potential workshop participants.

3. **Meeting with the *principal client contact*** to discuss the number of planned workshop days, dates, venue, "focus question(s)" and (crucially) group composition. The discussions must concern *at least* the following:

    - A preliminary, generic "focus question" for each modelling context is to be formulated, in the following form:

        > "What are the most important factors (parameters/variables) concerning ... [*the client's problem area*]... and how are these factors related to each other (how are they *entangled*)."

    - The venue should be a meeting room for at least 15-20 people, i.e. at least twice as many as the number of participants in a GMA workshop (6-7). GMA workshops require room for people to move around in.
    - No "observers" are allowed to be present during the group GMA working sessions.
    - GMA workshops are carried out in sequences of 2-day sessions. If several workshops are to be carried, these must have an agreed time-lap between them (days or weeks) in order that the process is allowed to mature.

4. **Group selection and composition is carried out collaboratively by the principal facilitator and the client. (**See separate document on "*Guidelines for selecting GMA workshop participants*".)

5. **Distribution of focus question**: A week before the first workshop is to take place, the "focus question", along with a suitable article on GMA, is sent out to the members of the SMS working group. They are encouraged to think about the focus question and formulate what they think are the most important factors (variables) in the problem area. They are also told that they need not otherwise prepare for the workshops.

6. **Beginning the first workshop day**: GMA as a method is presented in detail to the SMS group with examples/case studies close (but not too close) to the current problem area. The preliminary focus question is brought up and discussed, and the group is asked if they are satisfied with it, or if they want to adjust it.

7. **Analysis phase – Development of the initial *Morphological Field***: Using only a white board (no computer at first), the facilitator works with the group to identify the most important dimensions/parameters/variables in the problem complex. As each parameter comes up on the white board, one or two examples of its value range (conditions) are given, in order to help clarify the meaning of the parameter.

   This first phase of the MA process is the most important one, and often the most demanding one, since there can be uncertainty – or complete disparity – about what the most important parameters are, and how they are to be expressed. The process of "giving form/shaping" the initial morphological field is iterative and can take a full workshop day or more, depending on the size and nature of the problem complex. This initial field represents the total "problem space" and can contain hundreds of thousands of configurations, i.e. formal solutions. (This is the most demanding part of the GMA process for the facilitator. It can literally take years of experience to learn to be comfortable with this process.)

8. **Synthesis phase – Cross-Consistency Assessment (CCA):** The next step in the analysis-synthesis process is to reduce the total set of (formally) possible configurations in a "problem space" to a smaller set of internally consistent configurations representing a "solution space".

9. **Examine the *structure* and *coherence* of the morphological model**. When a prototype morphological model is completed and compiled, it must be examined carefully to establish its nature and properties – how it coheres and behaves. There are six steps to this examination (the details of which are available to clients and GMA workshop partners):

   - Model coverage/model linkage
   - Model coherence and Boolean analysis
   - Parameter Activity Check (PAC)
   - Identification of multiple boundary values
   - Identification of driver and multi-driver structure
   - Time-line analysis

10. **Define ranges of scenarios, strategies or other configurations.** Any number of configurations representing scenarios, strategies, structures or stakeholder positions can be generated and defined within the model and related to one another. The model allows the user to define configurations using initial inputs, desired outputs, and with clustered variations.

    The models belong to the client, who is supplied with dedicated software in order to run and maintain them.

    Six months "service" of the model(s) is included in the workshop package.

5. Testimonials

- "**Absolutely necessary for futures research**. This book presents the theory and process of how to use the computer to analyze very complex social situations that do not lend themselves to simplistic scenario analysis. It therefore provides an extraordinary view into a methodology that has great applications for very important situations, whether for governments, businesses or research institutes. … The principles and methodologies of this book have been practically used for developing national early warning systems for governments, so the approach is well tested and shown to be very effective." *Amazon Book Review by John L. Peterson (Director of The Arlington Institute) September 2011 of Wicked Problems - Social Messes (Springer, 2011)*

- "**How can businesses make rational strategic decisions** in a constantly changing marketplace? The answer is an extraordinary problem-solving technique called Morphological Analysis. ... Morphological Analysis can be used to tackle problems as varied as new product development, Corporate Social Responsibility policies, future scenario planning, organisational development, financial and investment planning, marketing, and staff development. *Cambridge Network: "Solving strategic business and organisational problems the Swedish way." (http://new.cambridgenetwork.co.uk/news/article/?objid=15506)*

- "**The workshop was attended by military and civilian representatives** from Dstl and the UK MoD, who all commented very positively on the potential of Morphological Analysis and said that they had learnt a great deal over two enjoyable and stimulating days. ... Dr. Ritchey's expertise and guidance were invaluable in enabling us to gain an understanding of how Morphological Analysis could be used by Dstl to support the UK MoD..." *Dr. Carl Stead, Defence Science and Technology Laboratory [Dstl], Farnborough, England.*

- "**Computer Aided Morphological Analysis** was used to understand the complex socio-political environment within which a Space Agency for South Africa is to be developed. A contextual map was devised that is open to inference, uses non-quantitative consistency links to allow for possible patterns to emerge and allows for diversity to be captured by insisting on a facilitated process of consensus." *Dr. Jan Roodt, Council for Scientific and Industrial Research (CSIR), Pretoria, Republic of South Africa*

- "**Although I have used Morphological Analysis very successfully** in my workshops as a creative problem-solving technique, the Swedish approach makes it dramatically more useful to large businesses & organisations ... to tackle problems as varied as new product development, Corporate Social Responsibility policies, future scenario planning, organisational development, financial and investment planning, marketing, and staff development". *Simon Middleton, The Branding Guru (http://www.simonmiddleton.com)*

- "**The workshop on disaster risk management was a remarkable success**, not the least for permitting cross-fertilization of ideas and knowledge between hard and soft sciences, and between theory and practice. Using morphological analysis, specialists developed shared concepts and a common working interface, and shared state-of-the-art knowledge from different fields". *Dr. Anthony Fernandez, Earthquake Disaster Mitigation Research Center (EDM), Kobe, Japan.*

6. Biography & Contact Details

Dr. Tom Ritchey
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Dr. Tom Ritchey is a former Research Director at the Institution for Technology Foresight and Assessment at the Swedish National Defence Research Agency (FOI) in Stockholm. He is a modelling theorist and facilitator who works primarily with non-quantified decision support modelling -- especially with General Morphological Analysis (GMA), Bayesian Networks (BN) and Multi-Criteria Decision support (e.g. AHP)

He has an MA including mathematics, computer science and the history of philosophy, and a PhD in Social Anthropology at Uppsala University, where he worked on theories and models of social evolution. He has been a senior lecturer at the University of Lund (Sweden) and at Copenhagen University, and has been a Research Fellow at the Department of Urban and Regional Studies at Sussex University in England.

Employed by the Swedish Defence Research Agency (FOI) from 1983 to 2006, he worked with strategic decision support modelling in the areas of crisis management, civil preparedness, risk mitigation, scenario development and strategy management. In 1995-96 he developed computer aided morphological analysis as a general method for non-quantified modelling. Since then, he has carried out more than 100 projects employing this method for structuring complex policy and planning issues, developing scenario and strategy laboratories, and analysing organisational and stakeholder structures. He has published internationally on its theory and applications. His latest book, "Wicked Problems/Social Messes", was published by Springer in 2011. He is the founder of the ***Swedish Morphological Society*** and Director of ***Morphologics*** (formerly Ritchey Consulting).

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7. Resources and links

Web Resources (HTLM)

Morphologics:	www.morphologics.se
Swedish Morphological Society:	www.swemorph.com
On "Wicked Problems":	www.swemorph.com/wp.html
GMA Reference List:	www.swemorph.com/references.html
GMA Client List:	www.swemorph.com/users.html
GMA Project List:	www.swemorph.com/projects.html
GMA Glossary:	www.swemorph.com/glossary.html
MA/Carma™ computer support:	www.swemorph.com/macarma.html

Selected articles (Download in PDF)

- *Problem Structuring using Computer-Aided Morphological Analysis*. Journal of the Operational Research Society (2006) 57, 792-801.
  http://www.swemorph.com/pdf/psm-gma.pdf

- *Modelling Alternative Futures with General Morphological Analysis*. World Future Review, Spring 2011, pp. 83-94.
  http://www.swemorph.com/pdf/wfr-ritchey.pdf

- *Morphological Analysis - A general method for non-quantified modelling.* Adapted from a paper presented at the 16th Euro Conference on Operational Analysis, Brussels, July 1998.
  http://www.swemorph.com/pdf/gma.pdf

- *Modelling Complex Socio-Technical Systems using Morphological Analysis.* Adapted from an address to the Swedish Parliamentary IT Commission, Stockholm, December 2002.
  http://www.swemorph.com/pdf/it-webart.pdf

- *Futures Studies using Morphological Analysis.* Article for the UN Millennium Project: Futures Research Methodology Series, 2005.
  http://www.swemorph.com/pdf/futures.pdf

- ***NEW BOOK***: Ritchey, T.: **Wicked Problems – Social Messes**: Decision support Modelling with Morphological Analysis. Springer, Berlin, 2011.

- **Special Issue of *Technological Forecasting and Social* Change: "General Morphological Analysis: Modelling, Forecasting, Innovation",** Fall 2017. **Editors:** Tom Ritchey & Thomaz Arciszewski