General Morphological Analysis – An overview

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Modelling complex socio-technical systems and policy issues 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* (i.e. conscious, 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).

Finally, the extreme non-linearity of social systems means that literally everything depends on everything else. What might seem to be the most marginal of factors can, under the right historical circumstances, become a dominating force of change. All of this means that traditional quantitative methods, mathematical (functional) modelling and simulation, are relatively useless.

General Morphological Analysis (GMA) is a method for modelling complex social and organisational planning problems that are not amenable to quantification. It examines all the possible relationships between various social, political and organizational dimensions of a complex problem, and allows us to consider all potential outcomes. GMA produces *non-quantified, multidimensional inference models* unlike other mathematical or scientific models

Computer-aided GMA was originally developed at FOI (the Swedish Defence Research Agency) in the 1990s in order to better facilitate long-term defence and civil preparedness planning. It was specifically designed in order to deal with multi-stakeholder social and organisational policy problems and to facilitate collaboration between different disciplines and different societal sectors.

GMA is carried out in professionally facilitated modelling workshops populated by relevant subject specialists. The method involves a number of iterative steps or phases corresponding to *cycles of analysis and synthesis*, the basic process for developing all scientific models. The process is iterative and may be repeated several times. New knowledge and insight generated in the development of the morphological models is one of the important results of a GMA work session.

The iterative steps performed are:

Analysis phase

1) *Identify relevant variables*: Identify and define the main parameters, dimensions or problem variables that need to be considered within the complex problem or scenario (the shaded column headings in the figure below).

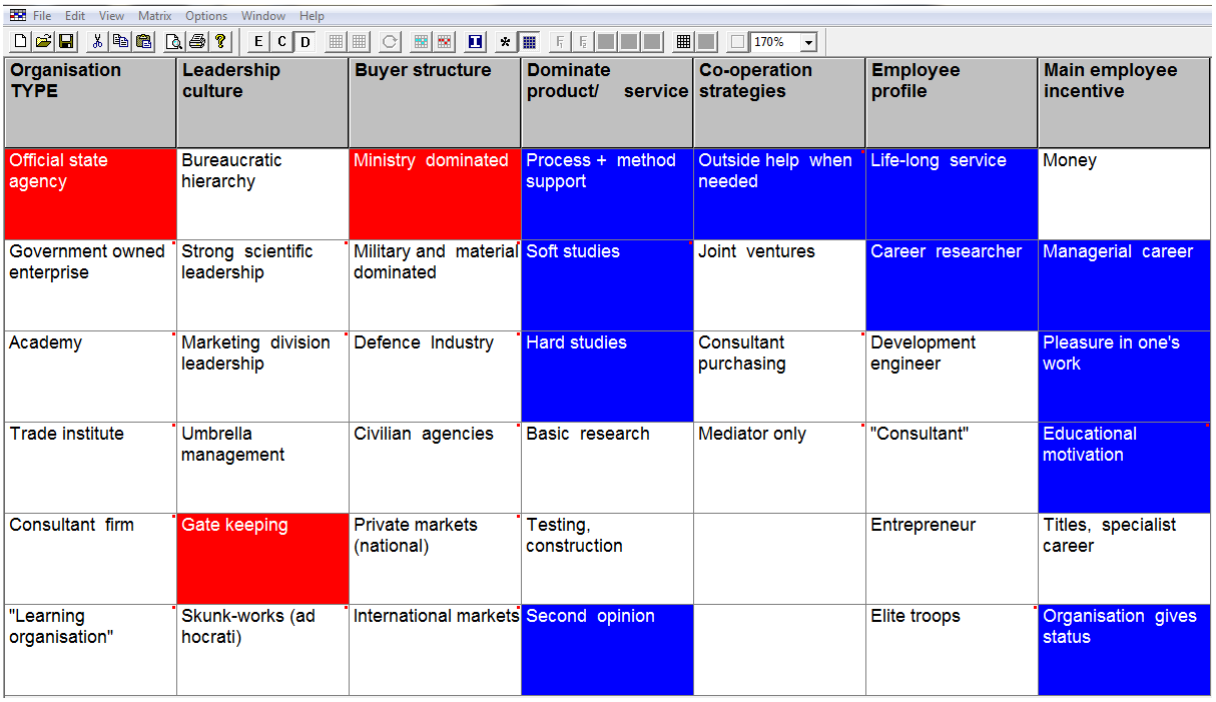
2) *Identify/define value ranges*: Each variable is assigned a range of relevant alternative values or conditions that the variable can assume (columns under each shaded heading).

Synthesis phase

3) *Relate all variable values to each other* and assess their mutual consistency. This is called a "Cross-Consistency Assessment" (CCA.)

4) *Synthesize mutually consistent configurations*. A "configuration" consists of one or more states in each of the variables (e.g. the marked cells in the figure below). The sum total of all internally consistent configurations makes up the *solution space* of the morphological model.

5) *Use the model interactively* to investigate and group all mutually consistent configurations in order to identify alternative scenarios and/or policy solutions. Iterate the whole process, if required.



Organisation TYPE	Leadership culture	Buyer structure	Dominate product/ service	Co-operation strategies	Employee profile	Main employee incentive
Official state agency	Bureaucratic hierarchy	Ministry dominated	Process + method support	Outside help when needed	Life-long service	Money
Government owned enterprise	Strong scientific leadership	Military and material dominated	Soft studies	Joint ventures	Career researcher	Managerial career
Academy	Marketing division leadership	Defence Industry	Hard studies	Consultant purchasing	Development engineer	Pleasure in one's work
Trade institute	Umbrella management	Civilian agencies	Basic research	Mediator only	"Consultant"	Educational motivation
Consultant firm	Gate keeping	Private markets (national)	Testing, construction		Entrepreneur	Titles, specialist career
"Learning organisation"	Skunk-works (ad hocrati)	International markets	Second opinion		Elite troops	Organisation gives status

Figure: A seven-dimensional organisational model showing one solution cluster based on three drivers.

Recent publications on GMA:

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

Ritchey, T.: "Wicked Problems: Structuring Social Messes with Morphological Analysis". Adapted from a lecture given at the Royal Institute of Technology in Stockholm (2004).
(Download at: http://www.swemorph.com/pdf/wp.pdf)

Ritchey, T.: "Modelling Alternative Futures with General Morphological Analysis". World Future Review, **World Futures Society**, Spring 2011, pp. 83-94.
(Download at: http://www.swemorph.com/pdf/wfr-ritchey.pdf)

BOOK: Ritchey, T.: Wicked Problems/Social Messes: Decision Support Modelling with Morphological Analysis. **Springer**: Berlin, 2011.

For more information and articles on GMA see: http://www.swemorph.com

The author: Dr. Tom Ritchey is a former Research Director for the Swedish National Defence Research Agency (FOI) in Stockholm. He is a methodologist and facilitator who works mainly with non-quantified modelling for strategic decision support – especially with *General Morphological Analysis* (GMA), *Bayesian Networks* (BN) and *multi-criteria decision support*. Since 1995 he has carried out more than 100 projects involving GMA for Swedish government authorities, national and international NGOs and private companies. He is the founder of the Swedish Morphological Society and Director of Ritchey Consulting LLC in Stockholm.

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