

Uncertainties in Decision Making in Production and Logistics

Prof. Dr. Jutta Geldermann

Chair of Production and Logistics
Georg-August Universität Göttingen, Germany
efzn (Energieforschungszentrum Niedersachsen)

Background and Motivation

Imprecision and Uncertainties



Current Research Projects of the Chair of Production and Logistics

- Optimization and its Applications in Learning and Industry (**OPTALI**) (EU)
- DFG Research Training Group 1703 "**Resource Efficiency in Corporate Networks**"
- **Sustainable use of bioenergy** – Bridging conflicting demands of climate stabilization, resource conservation, society and economic (Ministry for Science and Culture of Lower Saxony) ; (International Collaboration with the University of Concepción (**Chile**) ; (Ministry of Agriculture of Lower Saxony)
- **CO₂-Reduction Potentials and Costs** (several Ministries of Lower Saxony)
- **e-Home** Energy Project 2020 (E.On Avacon AG , Energy Reseach Center Lower Saxony (EFZN)
- **IT-for-Green**: Next-Generation Environmental Management Information Systems (EU-EFRE)
- **Socio-Economic Analysis (SEA)** for the Registration and Restriction according to **REACH**: Assessment of the Abatement Costs of Chemicals– ex ante und ex post
- **Chemical Leasing** as a Model for Sustainable Development (German Federal Environmental Agency)



Logistics

[http://en.wikipedia.org/wiki/Logistics#Production_Logistics]

- Logistics is the management of the flow of resources, between the point of origin and the point of destination in order to meet some requirements, i.e. of customers or corporations.
- The resources managed in logistics can include physical items as food, materials, equipment, liquids and staff as well as abstract items as information, particles and energy.
- The logistics of physical items usually involves the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing and oftentimes security.
- Furthermore the complexity of logistics can be modeled, analyzed, visualized and optimized by dedicated simulation software.
- The term **production logistics** is used to describe logistic processes within an industry. Its purpose is to ensure that each machine and workstation is being fed with the right product in the right quantity and quality at the right time.
- The concern is not the transportation itself, but to streamline and control the flow through value-adding processes and eliminate non-value-adding ones.



Prof. Dr. J. Geldermann, Optikt 2012, Göttingen

3

SAP BUSINESS MAPS

[[HTTP://SOLUTIONCOMPOSER.SAP.COM/](http://solutioncomposer.sap.com/)]

Human Capital Management	Talent Management	Workforce Process Management	Workforce Deployment	Travel Management			
Financials	Financial Supply Chain Management	Treasury	Financial Accounting	Management Accounting			
Product Development & Collaboration	Product Development	Product Data Management	Product Intelligence	Product Compliance	Document Management	Tool and Workgroup Integration	
Procurement	Purchase Requisition Management	Operational Sourcing	Purchase Order Management	Contract Management	Invoice Management		
Operations: Sales and Customer Service	Sales Order Management	Aftermarket Sales and Service					
Operations: Manufacturing	Production Planning	Manufacturing Execution	Manufacturing Collaboration				
Enterprise Asset Management	Investment Planning & Design	Procurement & Construction	Maintenance & Operations	Decommission & Disposal	Asset Analytics & Performance Optimization	Real Estate Management	Fleet Management
Operations: Cross Functions	Quality Management	Environment, Health, and Safety Compliance Management	Inbound and Outbound Logistics	Inventory and Warehouse Management	Global Trade Services	Project and Portfolio Management	



Prof. Dr. J. Geldermann, Optikt 2012, Göttingen

4

Imprecision of non-stochastic nature in the application of optimization in industry

Imprecise Relations:

Statements without dichotome comparisons, as in the case of weak preference

Example: „approximately equally important“, „Alternative a is slightly preferred to alternative b“

Intrinsic Vagueness:

Boundaries between scores can only be set in a subjective manner; mostly with linguistic variables

Example: „ecological relevance“, „sufficient operation experience“

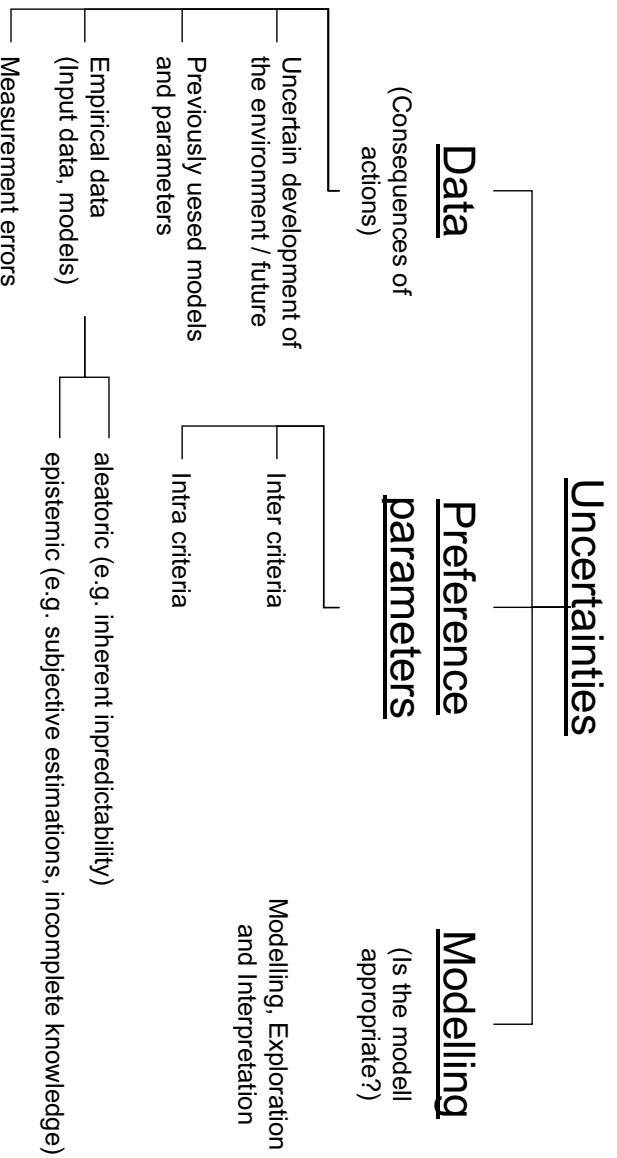
Informational imprecision:

The term is defined, but an exact measurement of the score is impossible.

- Imprecise criteria scores
 - because of hardly quantifiable errors or impossibility of measurement
 - Example: Measurements within the Blast furnace are impossible.
 - because of the variation of the underlying data
 - Example: varying composition of input materials
- Imprecise description of the future economic development
- Example: future development of the prices of primary energy sources or products
- Imprecision concerning regional differences and peculiarities of the location
- Example: spatial and temporal influences causing differing environmental impacts

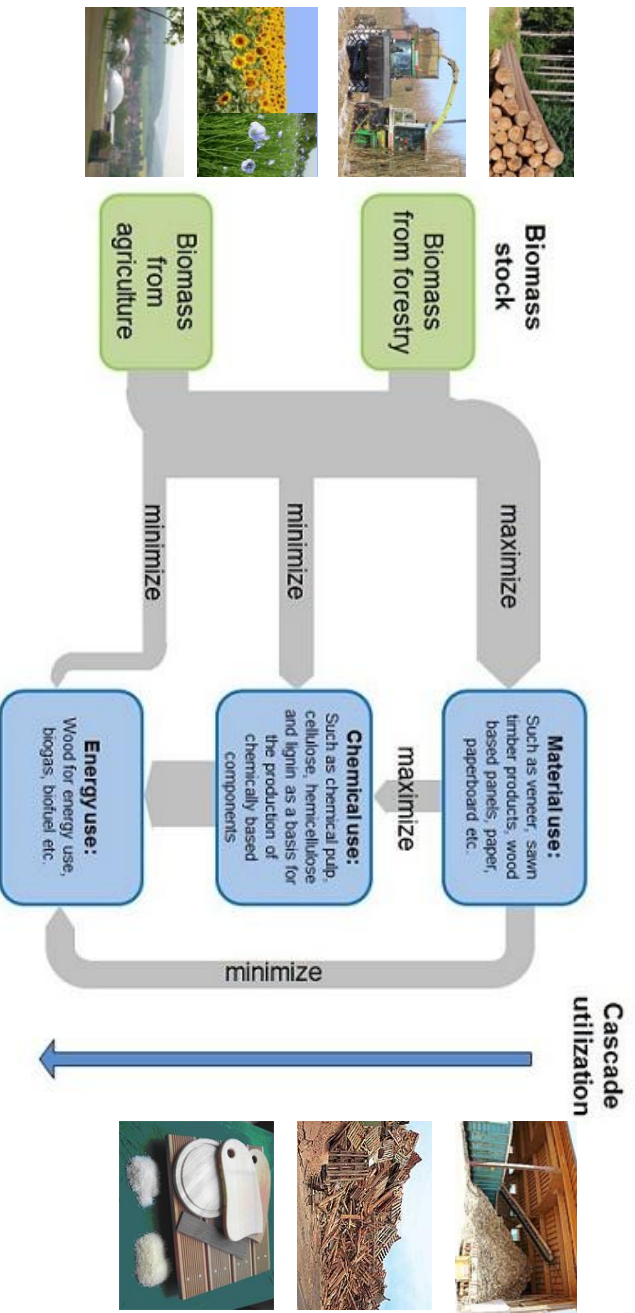


Uncertainty in MCDA



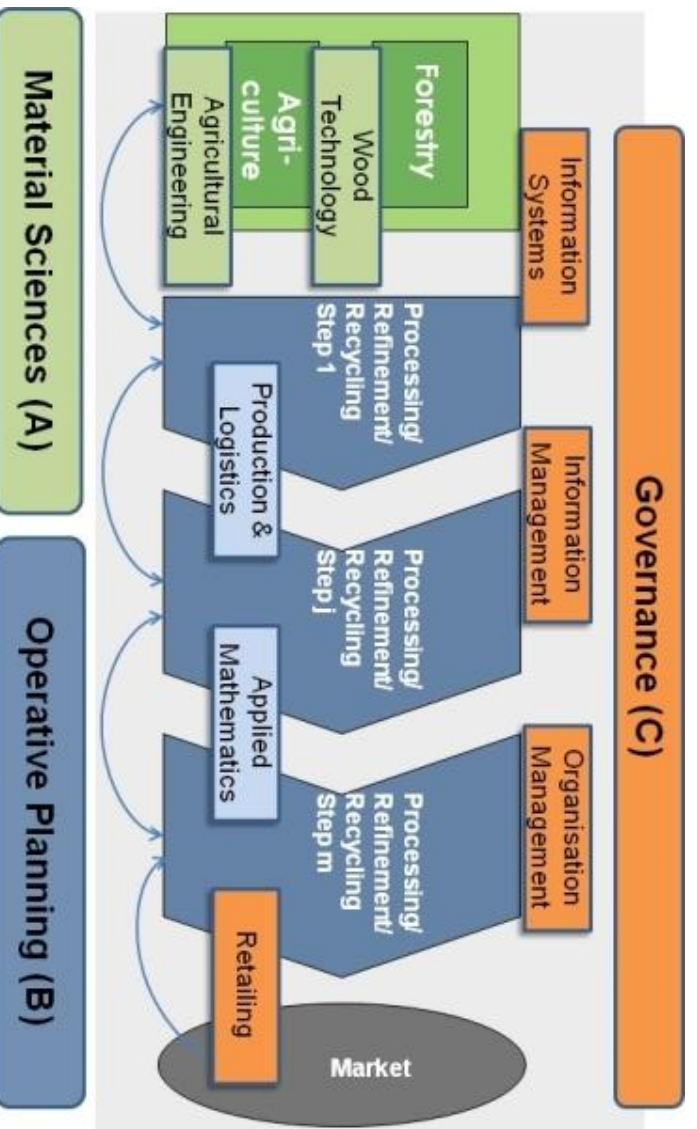
Conceptual diagram of optimised cascade utilisation

DFG Research Training Group 1703 "Resource Efficiency in Corporate Networks"

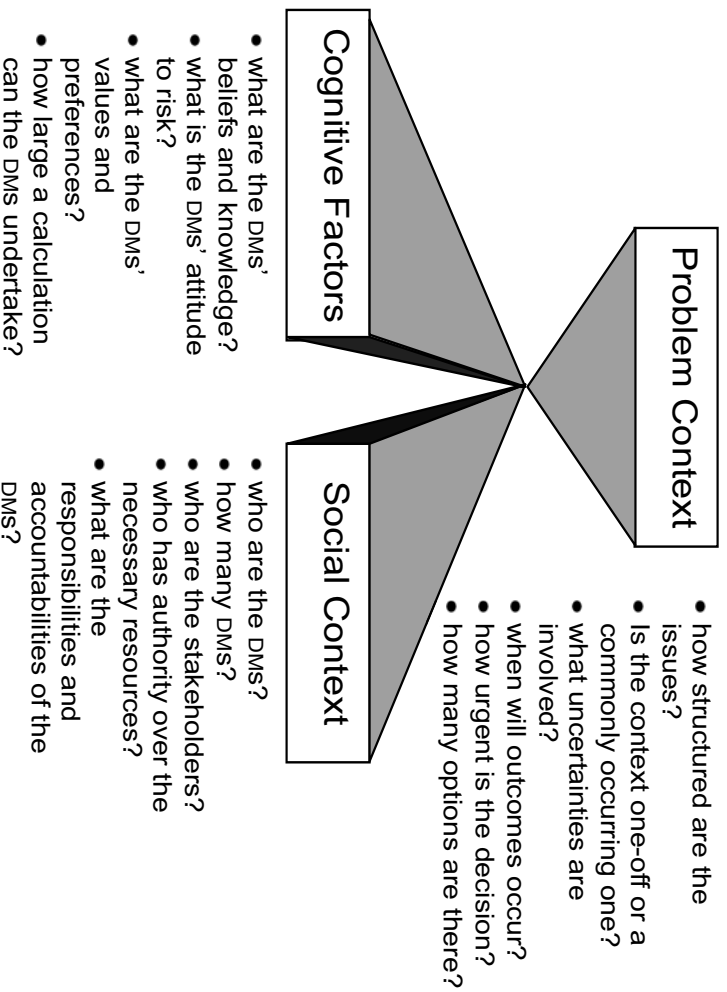


Prof. Dr. J. Geldermann, OptKli 2012, Göttingen

Supply Chain Management for Ressource Efficiency



Factors that affect decision making (after (Payne & Johnson 1993))



Prof. Dr. J. Geldermann, OptKall 2012, Göttingen

Payne, J.W., Bettman, J.R., Johnson, E.J.:
The Adaptive Decision Maker. Cambridge University Press, Cambridge (1993)
French, S.; Geldermann, J.: The varied contexts of environmental decision problems and their
implications for decision support. Environmental Science & Policy 8(4), pp. 378-391

9

Factors that affect decision making:

Cascade utilisation of renewable resources in innovative products and processes

Problem Context:

- Very many technical options are feasible (new materials and products)
- Uncertainties concerning quality, quantity and time of availability of renewable resources and demand

Cognitive Factors:

- Small and medium sized enterprises might lack the capacities for sound planning
- Attitudes towards sustainability and „green production“
- Who is able to judge all relevant ecological, economic, social and technical criteria?

Social Context:

- Emerging enterprise networks (between farmers/forestry and industry)
- Who are the stakeholders?

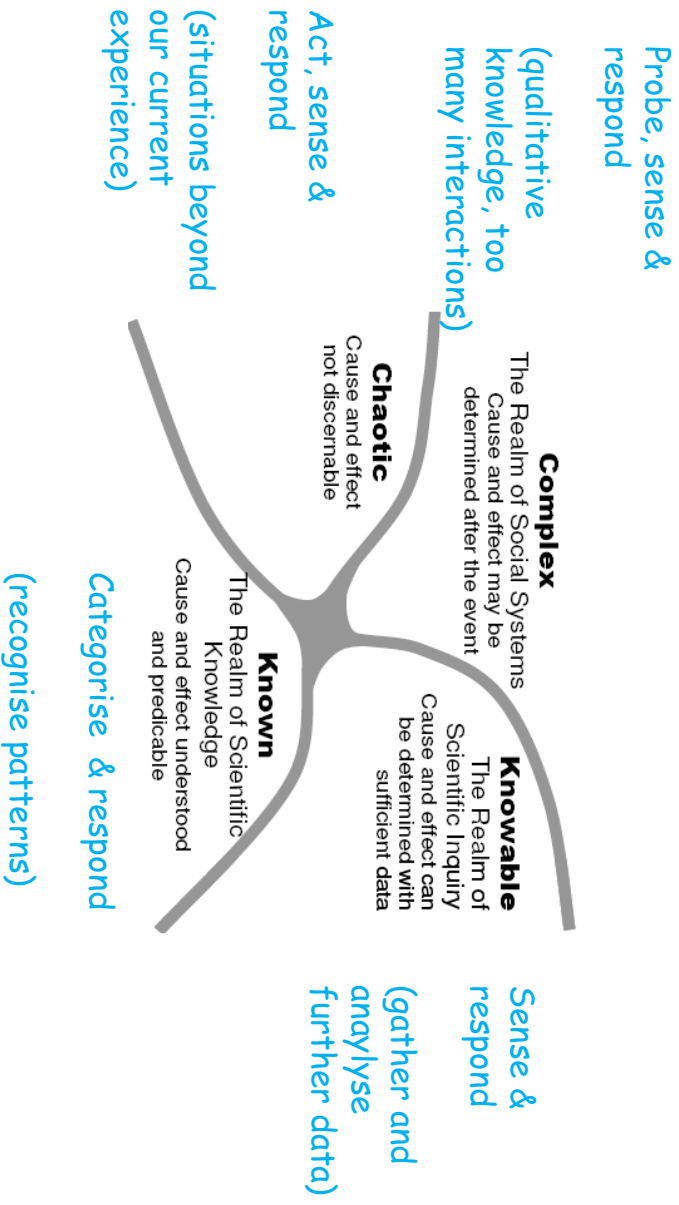


Prof. Dr. J. Geldermann, OptKall 2012, Göttingen

10

Cynefin means 'habitat' and has been used as a concept in knowledge management by Snowden (2002)

[<http://www.inescc.pt/~ewgmcdal/OpFrench.pdf> by S. French: Cynefin: repeatability, science and values]



Prof. Dr. J. Geldermann, OpKAI 2012, Göttingen

11

Cynefin means 'habitat' and has been used as a concept in knowledge management by Snowden (2002)

[<http://www.inescc.pt/~ewgmcdal/OpFrench.pdf> by Simon French]

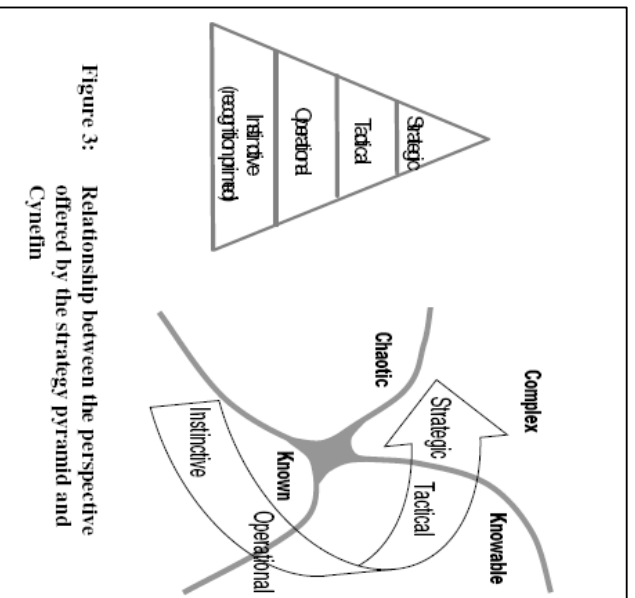


Figure 3: Relationship between the perspective offered by the strategy pyramid and Cynefin

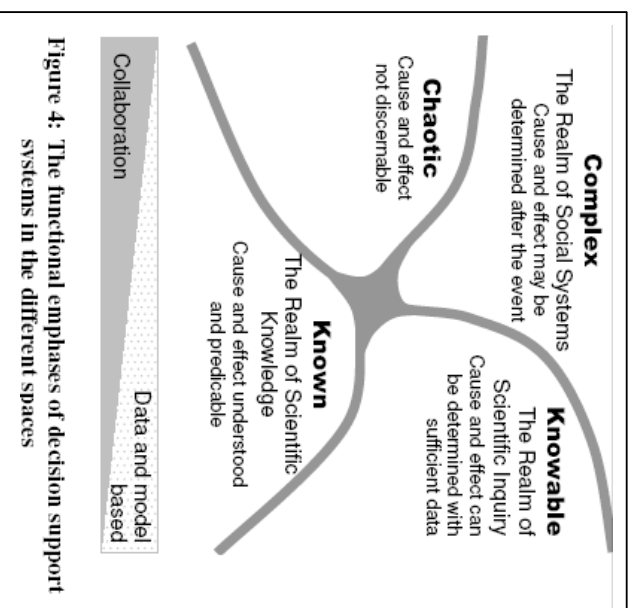


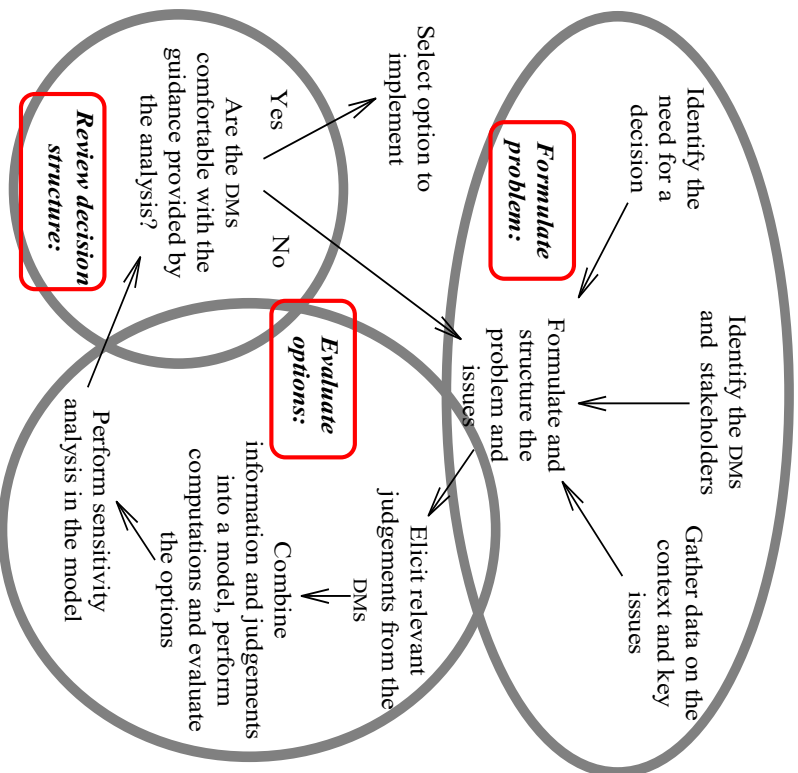
Figure 4: The functional emphases of decision support systems in the different spaces



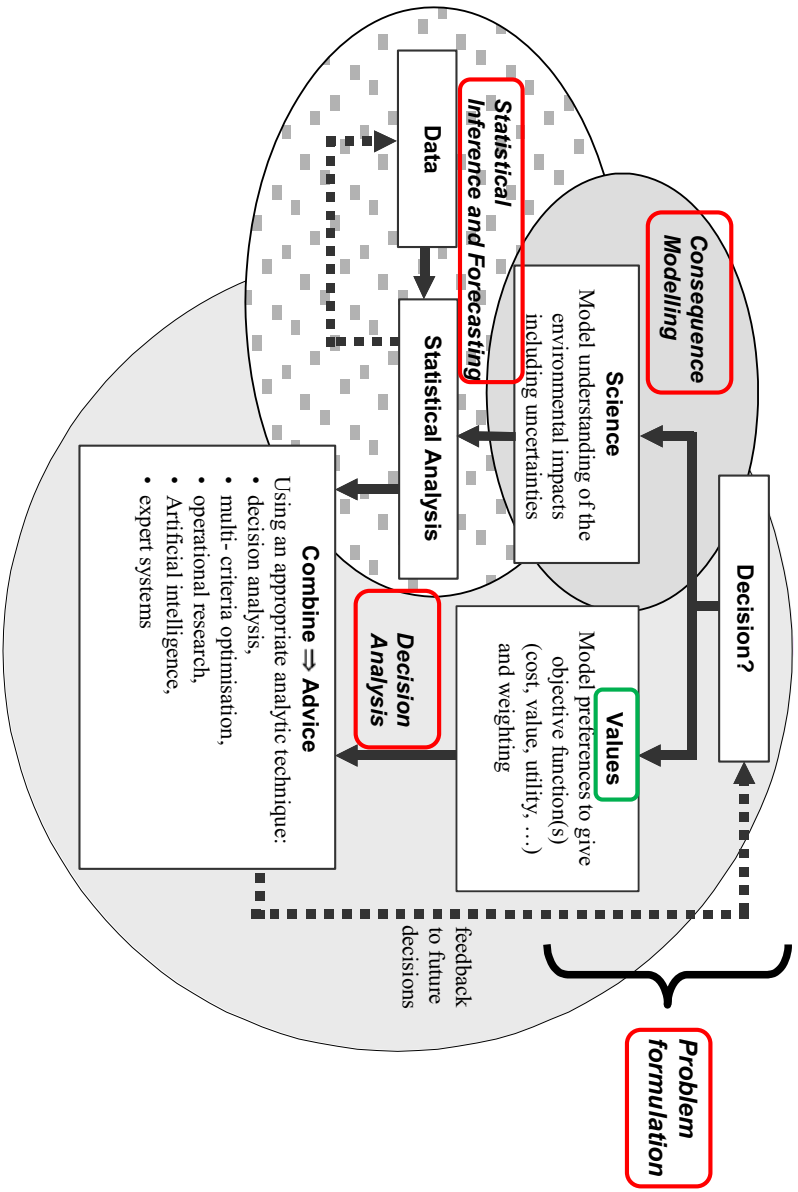
Prof. Dr. J. Geldermann, OpKAI 2012, Göttingen

12

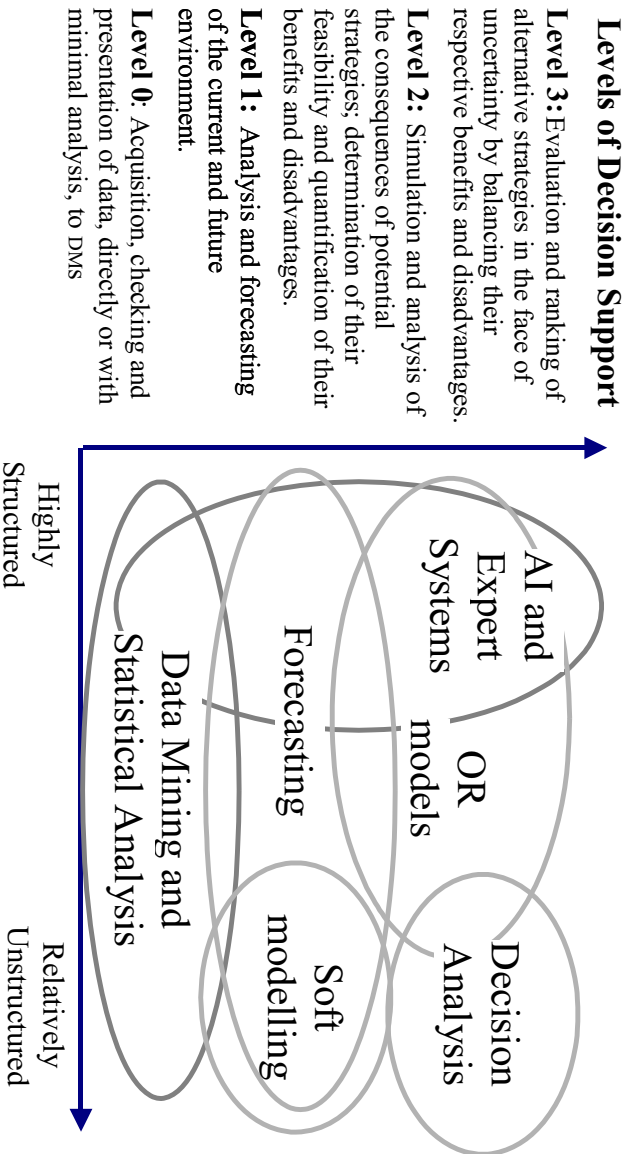
Overview of the Decision Process



The analysis underpinning the stage “evaluate options”



Categorisation of a variety of methods according to the degree of structure assumed in the problem and the level of decision support provided.



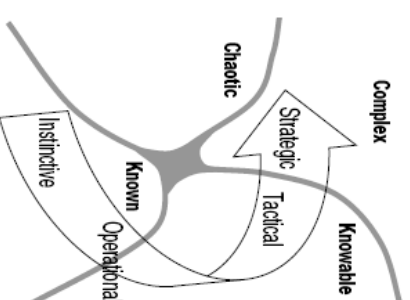
Prof. Dr. J. Geldermann, OptAll 2012, Göttingen

French, S.; Geldermann, J.: The varied contexts of environmental decision problems and their implications for decision support. Environmental Science & Policy 8(4), pp. 378-391

15

Uncertainties in Decision Making in Production and Logistics

- Uncertainties and imprecisions occur in industrial applications
- Decisions on instinctive, operational, tactical and strategic levels have many interlinkages and are intertwined
- Before, during and after modelling, keep factors that affect decision making in mind
- Collaborate with the problem owners



Prof. Dr. J. Geldermann, OptAll 2012, Göttingen

16