Aalto University
School of Science
and Technology

SYSTEEMIANALYYSIN LABORATORIO

henkilökunta

perustettu v. 1984

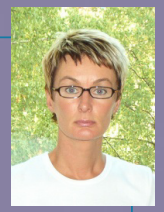
HARRI EHTAMO
Professori

RAIMO P. HÄMÄLÄINEN
Professori
Laboratorion esimies

ESA SAARINEN
Professori
Systeemiälyryhmä
2003-7 SAL, 2007- TUTA

AHTI SALO
Professori

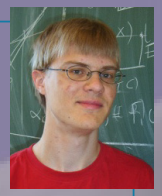
LEENA PORRASKORPI
Sihteeri



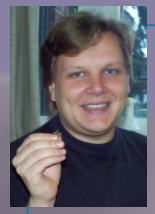
MINNA WESTERLUND
Sihteeri, Virkavapaa

DOSENTIT

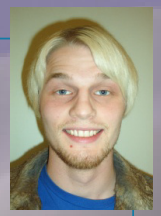
Elja Arjas, Helsingin Yliopisto
Jari J. Hämäläinen, VTT
Veijo Kaitala, Helsingin yliopisto
Markku Kallio, prof., HSE
Pertti Lounamaa, Nokia
Jukka Ruusunen, Fingrid
Leena Suhl, Paderbornin yliopisto
Kyösti Tarvainen, Stadia
Markku Verkama, Nokia
Tuomas Raivio, Gaia
Kai Virtanen, SAL



KIMMO BERG
Tohtoriopiskelija
TkL



KAI VIRTANEN
Opettava tutkija
TkT

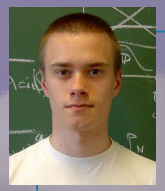


JIRKA PÖRÖPUDAS
Tohtoriopiskelija, DI

VILLE MATTILA
Tohtoriopiskelija
DI

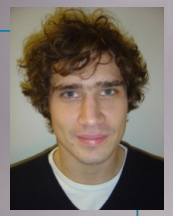
JUUSO LIESIÖ
Opettava tutkija
TkT

ANTTI PUNKKA
Tohtoriopiskelija
Tutkijakoulun koordinaattori
TkL



JUSSI KANGASPUNTA
Tohtoriopiskelija
OR-seuran sihteeri, DI

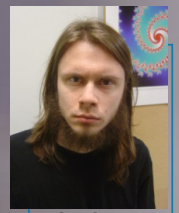
SIMO HELIÖVAARA
Tohtoriopiskelija, DI



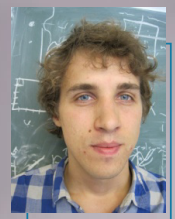
JUHA-MATTI KUUSINEN
Tohtoriopiskelija
DI

SANNA HANHIKOSKI
Tohtoriopiskelija, DI

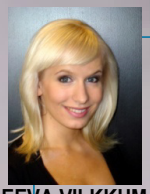
JOUNI POUSI
Tohtoriopiskelija,DI



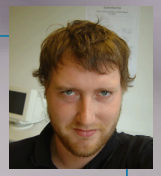
JUHO KOKKALA
tekn. yo.



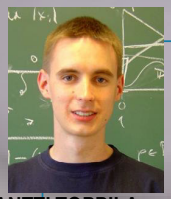
ANSSI KÄKI
Tohtoriopiskelija
DI



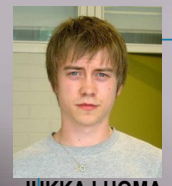
EEVA VILKKUMAA
Tohtoriopiskelija, DI



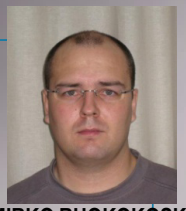
VILLE BRUMMER
Tohtoriopiskelija, DI



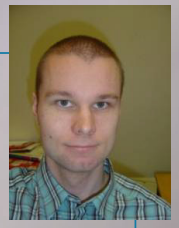
ANTTI TOPPILA
Tohtoriopiskelija
OR-seuran taloudenhoitaja
DI



JUKKA LUOMA
Erikoisopettaja,DI



MIRKO RUOKOKOSKI
Tohtoriopiskelija, DI

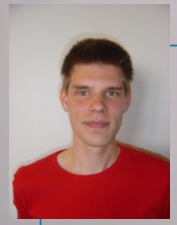


ARTTU KLEMETTILÄ
Webmaster, TkK

MIKKO MARTELA
Tohtoriopiskelija
DI,VTM

ILKKA LEPPÄNEN
Tekn.yo

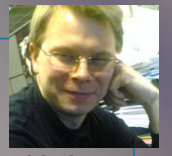
HEIKKI PUUSTINEN
Tekn. yo.



PEKKA LAITILA
Tekn. yo.

EERO RANTALA
Tekn. yo.

MITRI KITTI
Erikoisopettaja, TkT



JANNE SORSA
Erikoisopettaja, DI

Systeemianalyysin laboratorio

Päivitetty 11.5.2010

Systems Analysis Lab...

http://www.sal.hut.fi/

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- Web-activities
- DECISIONARIUM
- Society of Dynamic Games - ISDG
- Job Openings
- Net-surfing
- Suomeksi

Systems
Analysis Laboratory

Systems Analysis Laboratory

Systems Analysis Laboratory was established in 1984 within the professorship of applied mathematics. The founder and director of the laboratory is Professor Raimo P. Hämäläinen. The team of professors also includes Harri Ehtamo and Ahti Salo. Professor Esa Saarinen continues with us as a co-director of the Systems Intelligence Group. In the new Aalto University we are in the School of Science and Technology (Formerly HUT) and part of the Department of Mathematics and Systems Analysis in the Faculty of Information and Natural Sciences.

The research interests of the laboratory cover the area of systems science comprehensively ranging from the mathematical theories and algorithms of optimization, control, decision making to the practical interactive computer modeling and decision support systems and risk and technology assessment. The focus of the applications is in complex energy, production and environmental systems. The problems are analyzed with a balanced engineering-economic systems approach. We also have a long tradition in biological modelling. Currently we have a growing effort in studying systems intelligence and applied philosophy in human organizations.

As an university institution the laboratory is unique in Finland. It is responsible for the undergraduate program in *Systems Sciences* and for the graduate specialty of *Systems and operations research* in the Engineering Physics and Mathematics program. We also give basic courses in *systems sciences* and *applied mathematics* for all students. The laboratory is in charge of the national Doctoral Program in Systems Analysis, Decision Making, and Risk Management.

The Board of Finnish Operations Research Society nominated Professor Raimo P. Hämäläinen the Honorary President of the society for his contributions in developing the field of OR in Finland. In the picture Professor Raimo P. Hämäläinen (left) and Professor Risto Lahdelma, President of FORS (right) in the award ceremony on the 13th of November, 2008.

How to contact us
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Principia Cybernetica: What is Systems Analysis?
Suomeksi
På Svenska

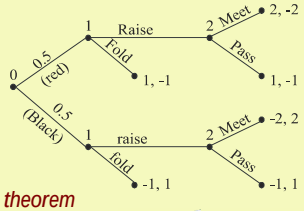
GAME THEORY AND INCENTIVES

the field and our contributions

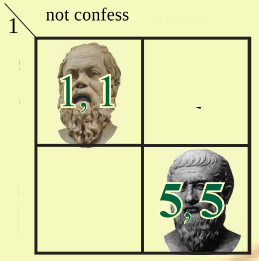
history of game theory

folk wisdom the Holy Bible, Talmud
combinatorial games Pascal, Bernoulli *(16th century)*

1913 Ernst Zermelo
chess as a zero sum game
1921 Emile Borel minmax games
1928 John von Neumann minmax theorem
1942 the Michael Curtiz film Casablanca
an example of real life games
1944 John von Neumann & Oscar Morgenstern
Theory of Games and Economic Behavior
1950 John Nash introduces Nash equilibrium concept
1953 Lloyd Shapley introduces Shapley value for cooperative games



1953 prisoner's dilemma game
Harold W. Kuhn & Alan W. Tucker



Nobel laureates in 1994

John Nash
Nash equilibrium

John Harsanyi
incomplete information, Bayesian games, 1967

Reinhard Selten
dynamic games
subgame-perfect equilibrium, 1965
prisoner's dilemma revisited

2000 Game Theory Society is founded
2002 the film Beautiful Mind about John Nash's life

the International Society of Dynamic Games

ISDG

founded in Otaniemi 1990

Nash equilibrium

players 1 and 2,
actions x,y and
profits $\pi_1(x,y)$, $\pi_2(x,y)$

reaction curves $R_1(y)$, $R_2(x)$

$$\pi_1(R_1(y),y)=\max_x \pi_1(x,y)$$

$$\pi_2(x, R_2(x))=\max_y \pi_2(x,y)$$

Nash equilibrium x^N, y^N

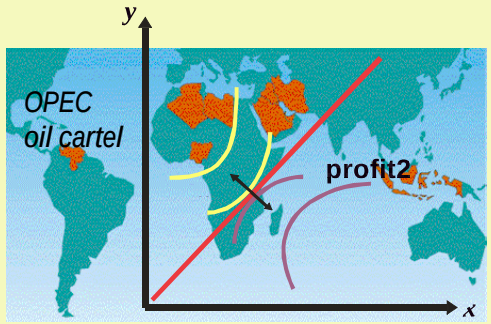
$$x^N = R_1(y^N),\ y^N = R_2(x^N)$$

computation of x^N and y^N

an adjustment process to reach the equilibrium

$$\begin{cases} x_{k+1} = R_1(y_k) \\ y_{k+1} = R_2(x_{k+1}) \end{cases}$$

Osborne's quota rule makes the joint optimum an equilibrium

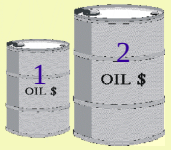


cartel example

two countries, joint optimum x^0,y^0

line of constant market shares
$x/y = x^0/y^0$

maintaining their market shares keeps the countries at x^0,y^0



Osborne's rule is an example of an incentive equilibrium in our research the rule is generalized to dynamic games

incomplete information and Bayesian games

players with unforeseeable behaviour enter the scene

nobody knows
the other players'
true intentions,
their types...
yet, they must
play the game

in SAL we study tariff design in buyer-seller games and develop practical schemes to compute the Bayesian-Nash equilibrium

selected publications

K. Berg and H. Ehtamo: Continuous learning dynamics in two-buyer pricing problem, Manuscript, 2010
K. Berg and H. Ehtamo: Interpretation of Lagrange multipliers in nonlinear pricing problem, Optimization Letters, 2010
H. Ehtamo, K. Berg and M. Kitti: An adjustment scheme for nonlinear pricing problem with two buyers, European Journal of Operational Research, 2010
M. Kitti: Convergence of iterative tatonnement without price normalization, Journal of Economic Dynamics and Control, 2010
M. Kitti and H. Ehtamo: *Osborne's cartel maintaining rule revisited*, Manuscript, 2009
M. Kitti and H. Ehtamo: *Adjustment of an Affine Contract with Fixed-Point Iteration*, Journal of Optimization Theory and Applications, 2009
H. Ehtamo, R.P. Hämäläinen, P. Heiskanen, J. Teich, M. Verkama and S. Zionts: *Generating Pareto solutions in two-party negotiations by adjusting artificial constraints*, Management Science, 2000
M. Verkama, H. Ehtamo and R.P. Hämäläinen: *Distributed computation of Pareto solutions in N-player games*, Mathematical Programming, 1996
H. Ehtamo and R.P. Hämäläinen: *A cooperative incentive equilibrium for a resource management problem*, Journal of Economic Dynamics and Control, 1993
H. Ehtamo and R.P. Hämäläinen: *Incentive strategies and equilibria for dynamic games with delayed information*, Journal of Optimization Theory and Applications, 1989

Systems
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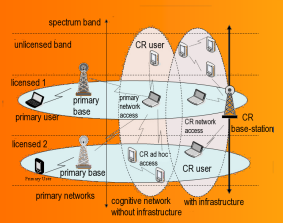
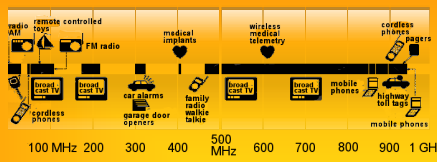
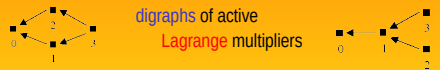
COMPUTATIONAL ECONOMICS
EXPERIMENTAL GAME THEORY



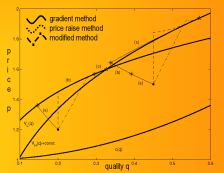




digraphs of active Lagrange multipliers

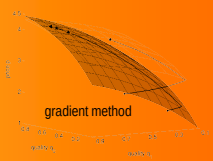
Nonlinear Pricing

application of mechanism design



buyers' preferences unknown to seller

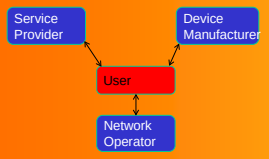
learning under limited information



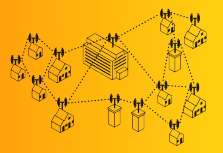
Cognitive Radio

spectrum efficiency
sensing technology
flexible spectrum use

A^1, B^∞ (*sensing*)
A^1(*DB*), B^1, C^∞ (*sensing*)



identify possible roles
study incentives
scenarios and mechanisms



mesh networks

Theory behind computational models

$$\sum_e r^s(e) = 1$$

e cycle
r(e) similarity of e
s Hausdorff dimension

Hausdorff dimension to digraphs (Mauldin and Williams 1988)

Incentive compatibility (Hurwicz 1972)

$$U_i(x_i) - p_i \geq U_i(x_k) - p_k$$

Nash Equilibrium (1950)
fixed point of best-response correspondence

$$s \in BR(s)$$

Fractals by iterated function systems (Hutchinson 1981)

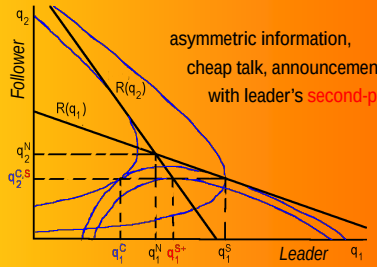
$$S = \bigcup_{i=1}^{N} f_i(S)$$

$$W = co\left(\bigcup_{a \in A} B_a(W)\right)$$

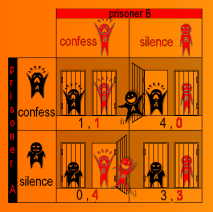
Subgame perfect equilibrium payoffs (Abreu 1988)
fixed point of iterated function system

Experiments with a duopoly game

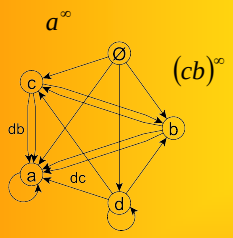
the evolution of cooperation in repeated strategic interaction



Collusion: (q_1^C, q_2^C) Cournot-Nash: (q_1^N, q_2^N)
Stackelberg: (q_1^S, q_2^S) Second-play: (q_1^{S+}, q_2^S)



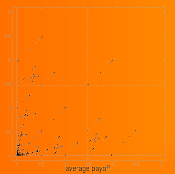
Prisoner's Dilemma (1950)



multidigraphs to represent equilibrium paths

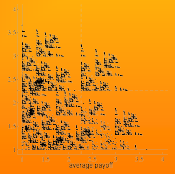
Repeated Games

algorithms to compute strategies and payoffs



Hausdorff dimension increases

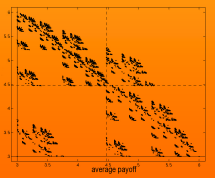
more ways to cooperate



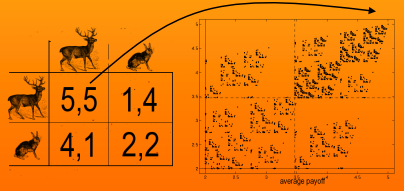
low discount

high discount

Hawk-Dove or Chicken (Russell 1959)
anti-coordination game
Cuban missile crisis 1962



Stag Hunt (Rousseau 1754)
cooperation and coordination game



selected publications

K. Berg and M. Kitti: *Equilibrium paths in discounted supergames*, Manuscript, 2010
K. Berg and M. Kitti: *Computing equilibria in discounted 2x2 supergames*, Manuscript, 2010
K. Berg and H. Ehtamo: *Learning in nonlinear pricing with unknown utility functions*, Annals of Operations Research, 2009
K. Berg and H. Ehtamo: *Multidimensional Screening: Online Computation and Limited Information*, 10th Int. Conf. on Electronic Commerce, 2008

Systems Analysis Laboratory

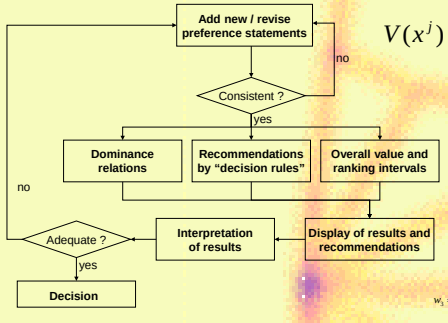
19.5.2010

DECISION THEORY

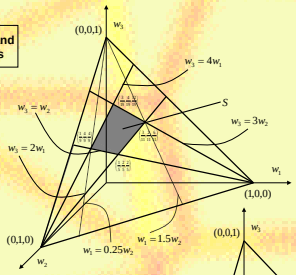
Preference Programming

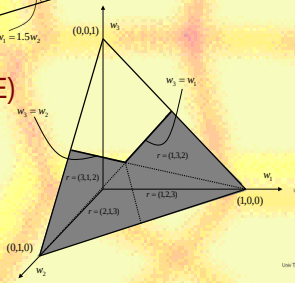
incomplete information

in value tree analysis



$$V(x^j) = \sum_{i=1}^{n} v_i(x_i^j)$$





interval methods:

Preference Assessment by Imprecise Ratio Statements (PAIRS)

Interval AHP

Preference Ratios in Multiattribute Evaluation (PRIME)

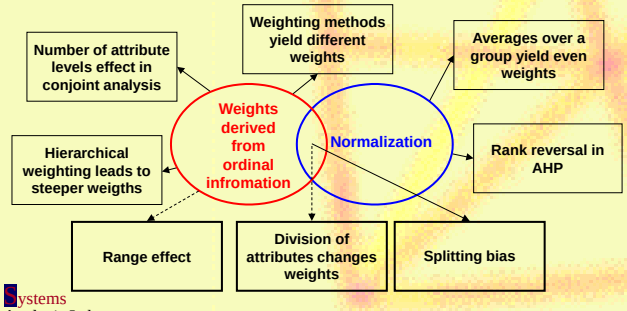
Interval SMART/SWING

incomplete ordinal information:

Rank Inclusion in Criteria Hierarchies (RICH)

RICHER = RICH with Extended Rankings

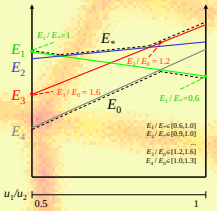
origins of procedural and behavioral biases



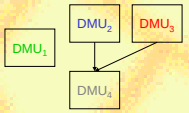
Ratio-based Efficiency Analysis

comparison of DMUs under incomplete information about the output and input weights

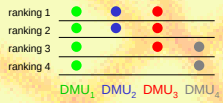
$$\text{Efficiency of DMU}_k = E_k = \frac{\text{value of outputs}}{\text{value of inputs}} = \frac{\sum_{n=1}^{N} u_n y_{nk}}{\sum_{m=1}^{M} v_m x_{mk}}$$



efficiency bounds



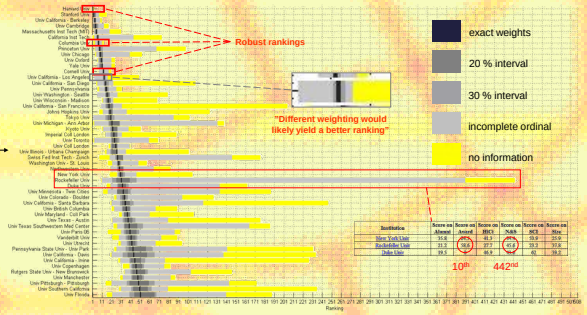
dominance relations

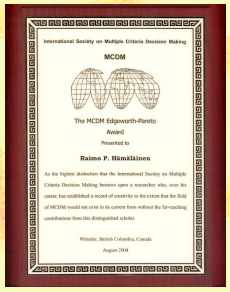


attainable rankings

sensitivity of university rankings

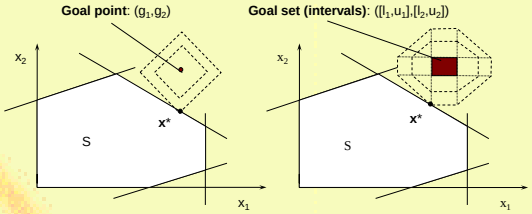
- what if slightly different weigths were applied?



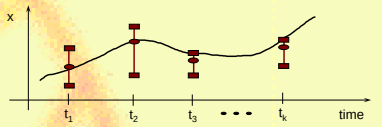


Interval goal programming

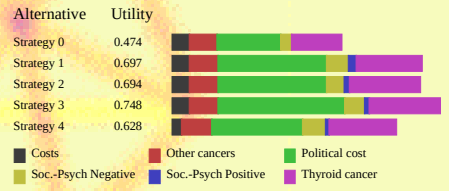
extension of a goal point to a goal set



new flexibility in dynamic problems



global sensitivity analysis



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A. Salo and A. Punkka: *Rank inclusion in criteria hierarchies*, EJOR, 2005

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A. Salo and R. P. Hämäläinen: *Preference ratios in multiattribute evaluation (PRIME)*, IEEE Syst. Man Cybernetics, 2001

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A. Salo and R. P. Hämäläinen: *Preference assessment by imprecise ratio statements*, Operations Research, 1992

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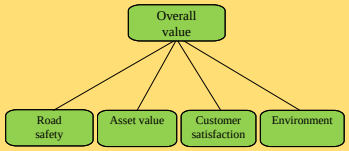
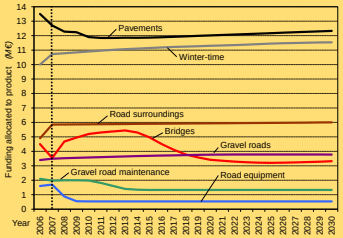
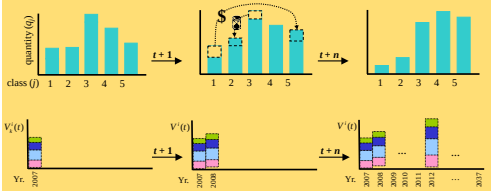
PORTFOLIO DECISION ANALYSIS

methods, models and software for resource allocation and portfolio management

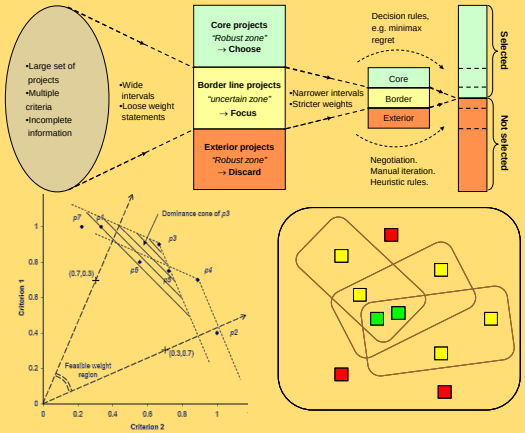
infrastructure asset management



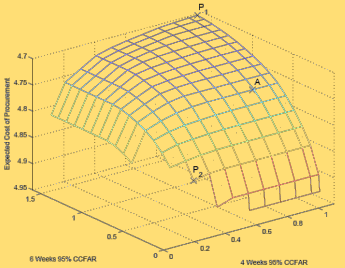


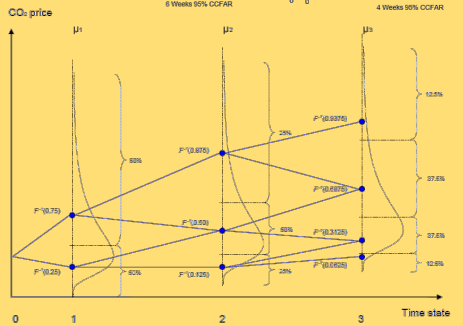


Robust Portfolio Modeling (RPM)

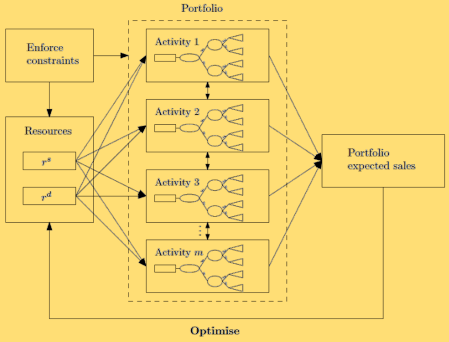


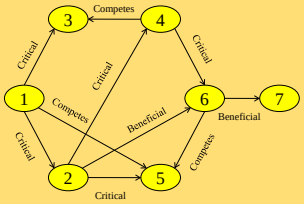
energy and natural resources

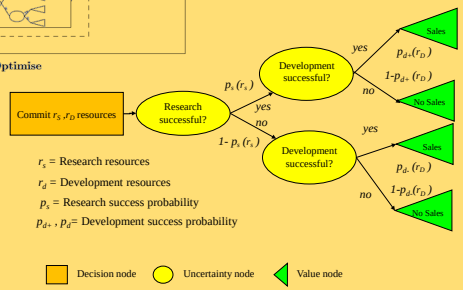




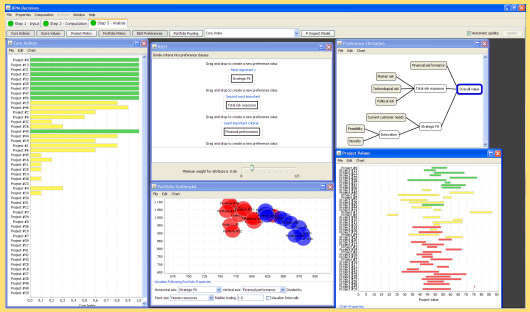
technology management







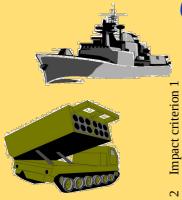
RPM-Decisions software

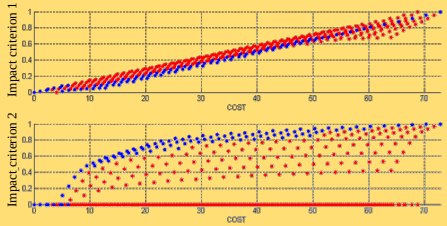


robust combinatorial optimization

3. **For** $k = 1, \ldots, m$ **do**
   (a) $P^k \leftarrow \{(p \cup \{x^k\}) | p \in P^{k-1}\} \cup P^{k-1}$
   (b) $P^k \leftarrow \{p \in P^k | \sum_{i \in I^0} a_i^l + \sum_{i=k+1}^{m} \min\{0, a_i^l\} \leqslant b_l \ \forall l \in \{1, \ldots, q\}\}$
   (c) $P^k \leftarrow \{p \in P^k | p' \not\succ^U p \ \forall p' \in P_D\}$
   (d) $P^k \leftarrow \{p \in P^k | p' \not\succ^U p \ \forall p' \in \{p' \in P^k \cap P_E | p'' \not\succ p' \ \forall p'' \in P_D\}\}$

cost-efficiency analysis of weapon systems





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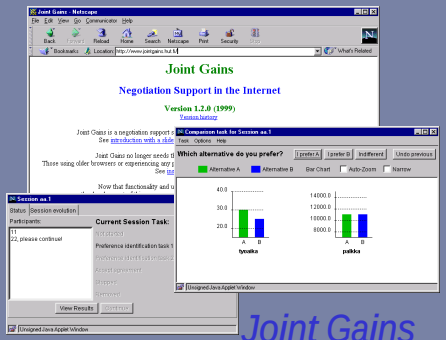
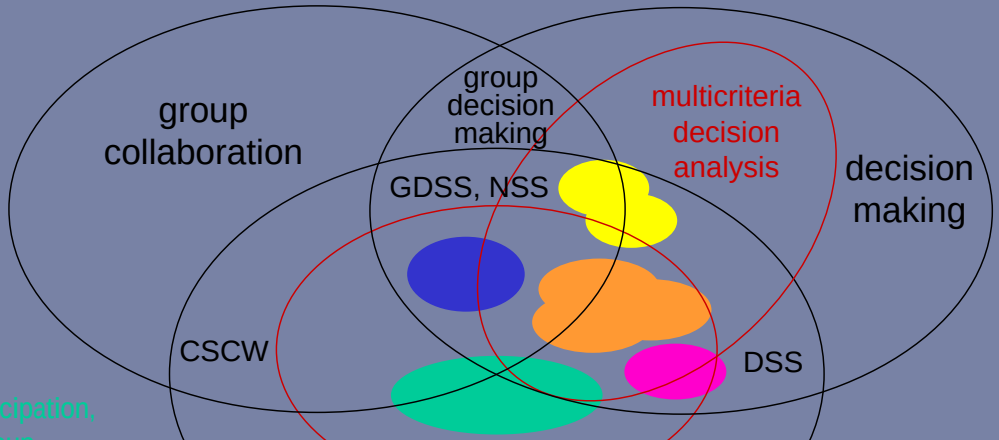
DECISIONARIUM

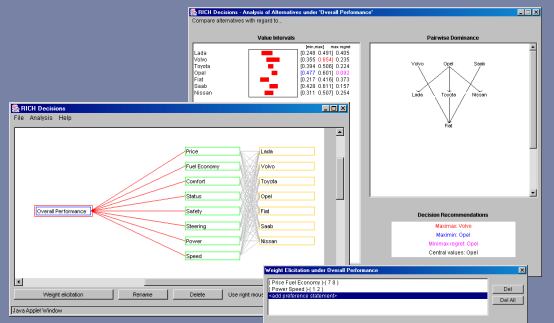
global space for decision support



Joint Gains

multi-party negotiation support with the method of improving directions



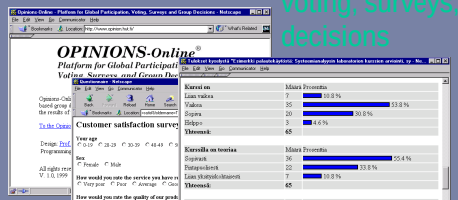


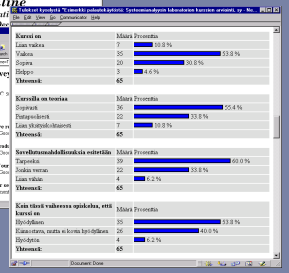
RICH Decisions

rank inclusion in criteria hierarchies

Opinions-Online

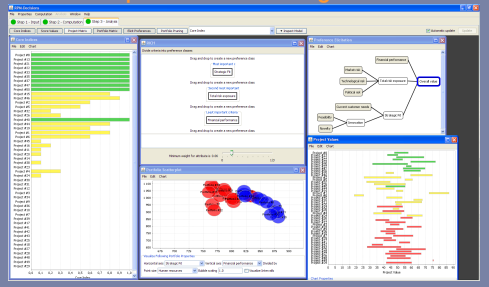
platform for global participation, voting, surveys, and group decisions





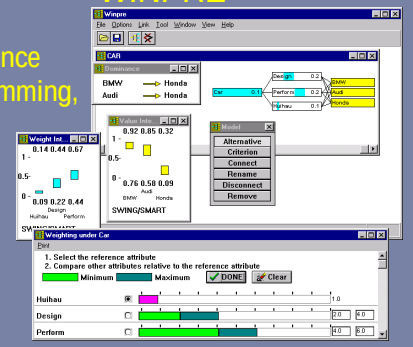
RPM-Decisions

robust portfolio modeling



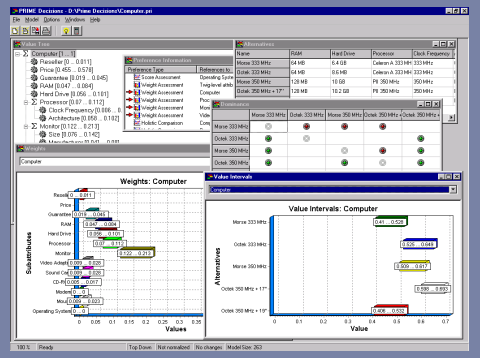
WINPRE

preference programming, PAIRS

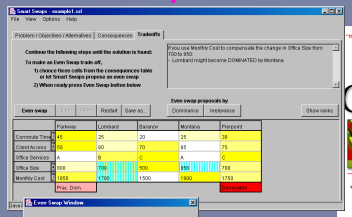


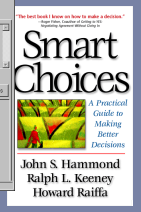
Windows software for decision analysis with imprecise ratio statements

PRIME Decisions



Smart-Swaps

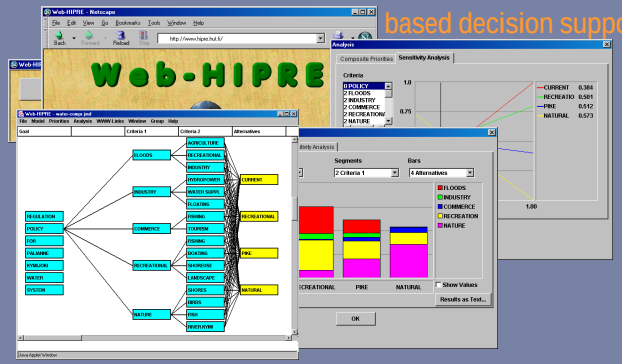




elimination of criteria and alternatives by even swaps

Web-HIPRE

value tree and AHP based decision support



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web-sites

www.decisionarium.hut.fi www.dm.hut.fi
www.hipre.hut.fi www.jointgains.hut.fi www.opinions.hut.fi www.rich.hut.fi www.smart-swaps.hut.fi www.rpm.hut.fi
PRIME Decisions and WINPRE downloadable at www.sal.hut.fi/Downloadables

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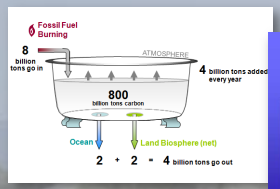
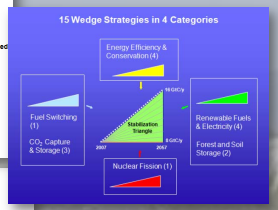
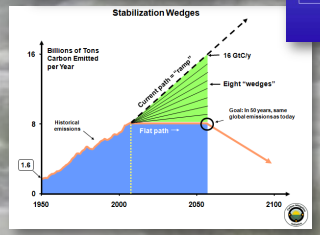
ENVIRONMENTAL DECISION MAKING and CLIMATE POLICY

decision analysis in climate change mitigation

portfolio modeling in environmental decisions







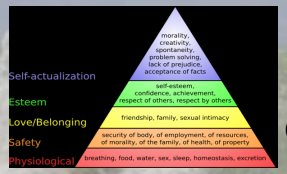
testing portfolio decision analysis with the stabilization wedges of PRINCETON UNIVERSITY

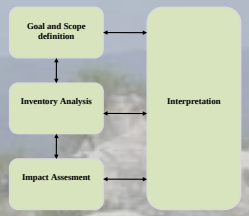
strategies to reduce carbon emissions

LCM - life cycle management

a systems intelligence approach

shifts the focus from products to people





Can we see the drivers of our needs related to our consumption?

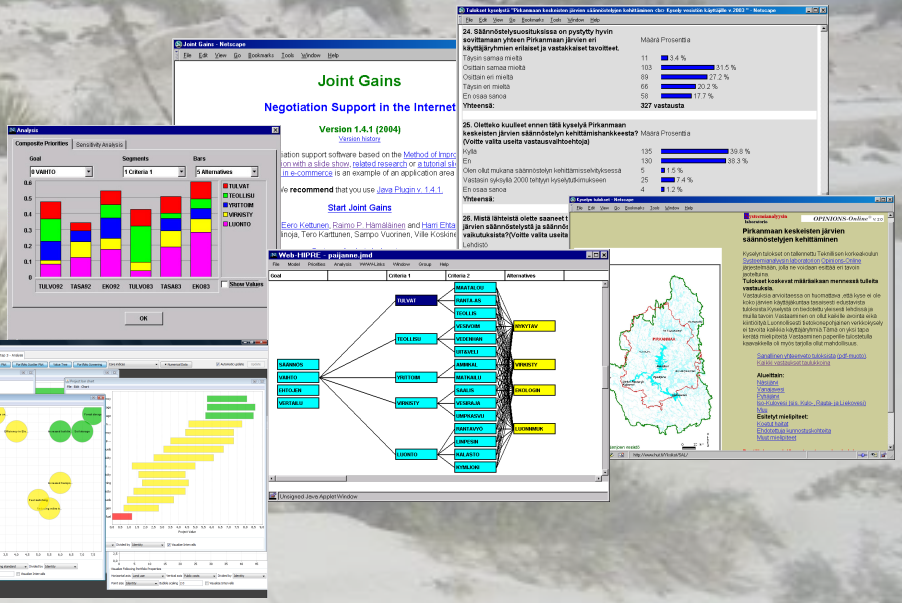
decision modeling tools for structuring, values and public participation

Web-HIPRE : individual and group decision support in stakeholder prioritizations by decision analysis

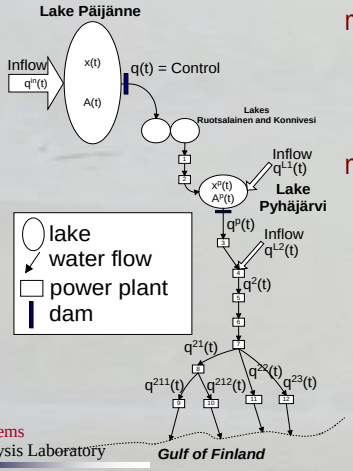
Joint Gains: bargaining efficient compromises

Opinions-Online: public participation on the internet

RPM – robust portfolio modeling : multi criteria problems



lake regulation projects in Finland



multiple interests: power production, environment, agriculture, fishing, recreation, transportation

new participation methods:

decision analysis interviews

decision structuring dialogue

teledemocracy by Opinions-Online image theory

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web-sites and selected publications

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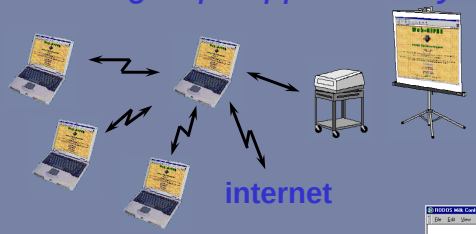
GROUP DECISION MAKING AND ELECTRONIC DEMOCRACY

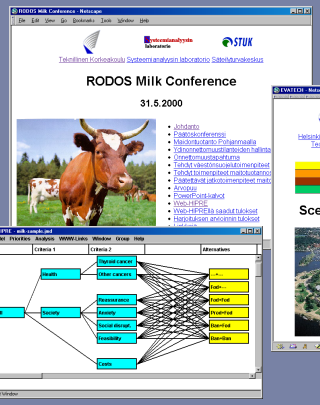
decision conferencing in nuclear emergency management

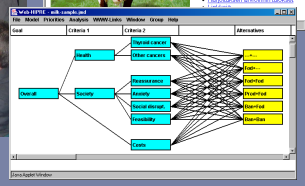
mobile group support facility

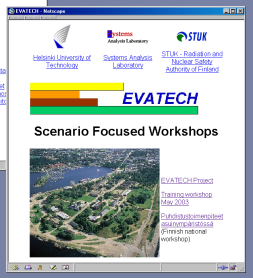


notebooks in a wireless LAN

- intensive facilitated decision workshops
- spontaneous decision conferencing
- planning of countermeasures in nuclear accidents
- individual use of advanced multi-criteria software



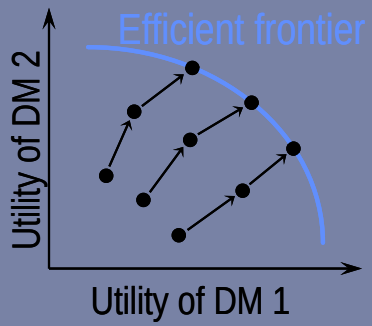




searching for joint gains in multicriteria negotiations

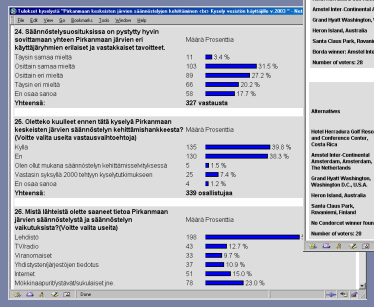
method of improving directions

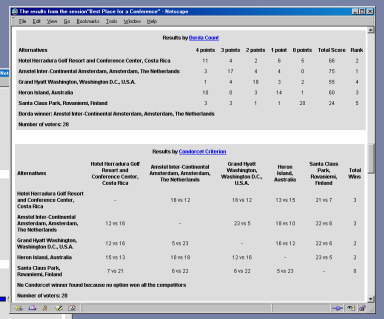
- interactive method for reaching efficient alternatives
- search of joint gains from a given initial alternative
- solution evolves through jointly improving directions



opinions-online.com

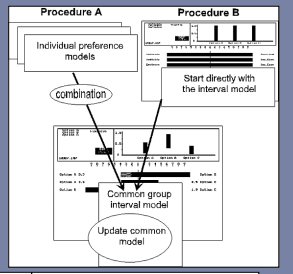
- platform for global participation, voting, surveys, and group decisions
- multi-criteria voting
- opinions-online – vote
  - advanced version of opinions-online providing different voting rules

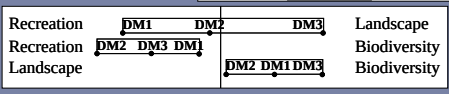




preference programming in group decision support

- intervals representing the ranges of preferences within the group
- a new way to a concensus process





TED – towards electronic democracy

- european network for internet based complex decision support
- funded by the European Science Foundation

TED objectives

- promote rational and participative approaches to societal decision making
- develop methods and software to enable decision analyses to be communicated, explored and built over the WWW

web-sites and selected publications

The scenario focused workshops: www.evatech.hut.fi, www.riihi.hut.fi/stuk/.
TED – Towards Electronic Democracy: http://infodoc.escet.urjc.es/ted/.

A. Salo and R.P. Hämäläinen: *Multicriteria decision analysis in group decision processes*. In: D.M. Kilgour and C. Eden (eds.), Handbook of Group Decision and Negotiation, Springer, New York, 2010.

V. Brummer, A. Salo, J. Nissinen and J. Liesiö: *A methodology for the identification of prospective collaboration networks in international R&D programs*, International Journal of Technology Management, 2010.

K. Sinkko, R.P. Hämäläinen and R. Hänninen: *Experiences in methods to involve key players in planning protective actions in the case of a nuclear accident*, Radiation Protection Dosimetry, 2004.

H. Ehtamo and R.P. Hämäläinen: *Interactive multiple-criteria methods for reaching pareto optimal agreements in negotiations*, Group Decision and Negotiation, 2001.

R.P. Hämäläinen, M.R.K. Lindstedt and K.Sinkko: *Multi-attribute risk analysis in nuclear emergency management*, Risk Analysis, 2000.

R.P. Hämäläinen and O. Leikola: *Spontaneous decision conferencing with top-level politicians*, OR Insight, 1996.

R.P. Hämäläinen and M. Pöyhönen: *On-line group decision support by preference programming in traffic planning*, Group Decision and Negotiation, 1996.

R.P. Hämäläinen, A. Salo and K. Pöysti: *Observations about consensus seeking in a multiple criteria environment*, Proc. of HICSS-25, 1992.

Systems Analysis Laboratory

Updated 25.10.2004

GROUP *PROCESSES* IN TECHNOLOGY ASSESSMENT AND *FORE*SIGHT

Timeline:

***1950s** Delphi method developed by the RAND Corporation*
***1962** Rachel Carson "Silent Spring"*
***1970** First Japanese Delphi Process*
***1972** Office of Technology Assessment in the U.S.*
***1990** European Parliamentary Technology Assessment Network*
***1995** First UK Foresight*
***2000** Permanent status for Committee for the Future of Finnish Parliament*

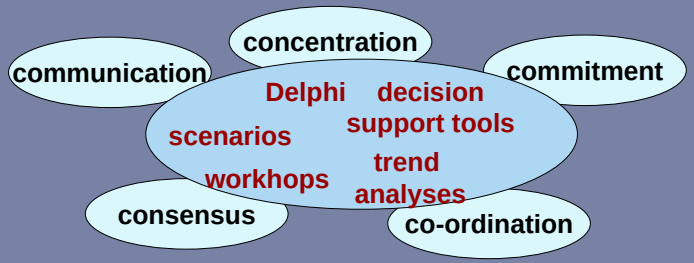
technology assessment

Anticipating the impacts of new technologies

Parliament of Finland
debates in the plenary session
nuclear power debate
assessment of plant gene technology
spontaneous decision conferences

technology foresight

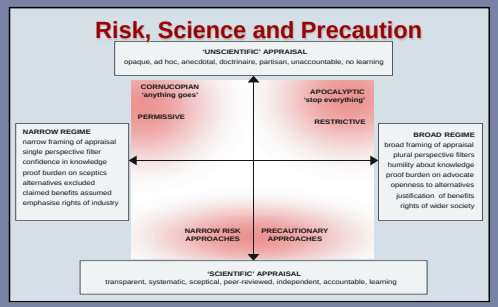
priority setting in science and technology



management of technological risks

acknowledging uncertainties

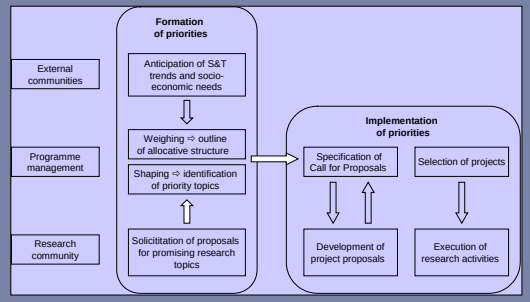
precaution - "look before you leap"
decision trees - multicriteria methods - consensus conferences



programme evaluation

improving the effectiveness of national technology programmes

with prospective evaluation and recommendations



web-sites and selected publications

www.eptanetwork.org/, www.cordis.lu/foresight/
Helsinki Institute of Science and Technology Studies: www.helsinki.fi/hist

Salo, A., V. Brummer and T. Könnölä, Axes of balance in foresight – reflections from FinnSight 2015, *Tech. Analysis & Strategic Man.*, 2009

Brummer, V., T. Könnölä and A. Salo: Foresight within ERA-NETs: experiences from the preparation of an international research program, *Tech. Forecasting & Soc. Change*, 2008

Könnölä, T., V. Brummer and A.Salo: Diversity in foresight: insights from the fostering of innovation ideas, *Tech. Forecasting & Soc. Change*, 2007

Salmenkaita, J.-P. and A. Salo: Emergent foresight processes: industrial activities in wireless communications, *Tech. Forecasting & Soc. Change*, 2004

Salo, A., T. Gustafsson and P. Mild: Prospective evaluation of a cluster program for Finnish forestry and forest industries, *Int. Trans. on Operations Research*, 2004

Salmenkaita, J.-P. and A. Salo: Rationales for government intervention in the commercialization of new technologies, *Tech. Analysis & Strategic Man.*, 2002

Bunn, D.W. and A. Salo: Forecasting with scenarios, *Eur. J. Oper. Res.*, 1993

R.P. Hämäläinen: Computer assisted energy policy analysis in the Parliament of Finland, *Interfaces*,1988

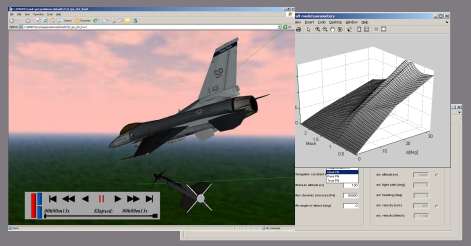
Systems Analysis Laboratory

Updated 12.10.2004

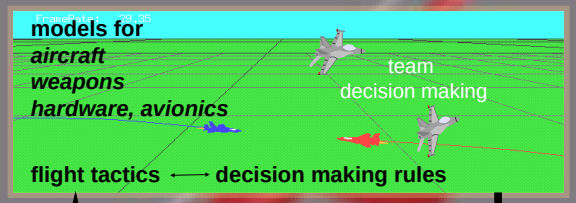
SIMULATION AND OPTIMIZATION OF OPERATIONS

aircraft trajectory optimization

missile avoidance
inverse *flight* simulation



discrete-event combat simulation



Simulation Input

Simulation Output

simulation *meta*modeling

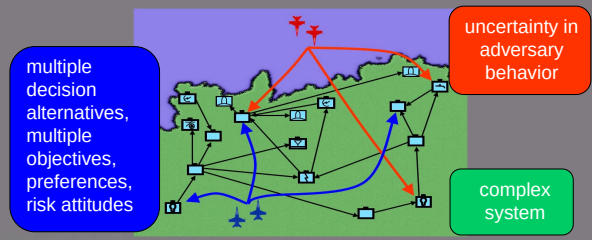
input-output models for simulation analyses

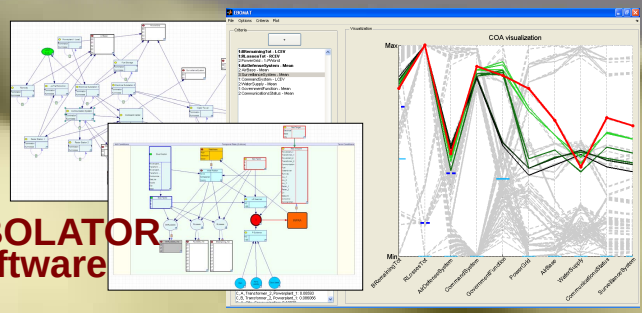
game theoretic approach
– action of adversary

dynamic Bayesian networks
– time evolution of simulation

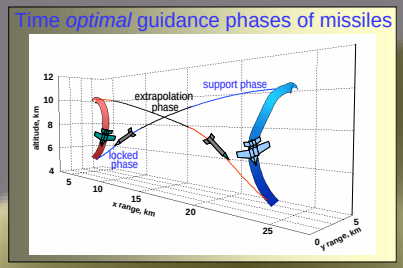
planning effects-based operations

multicriteria influence diagrams

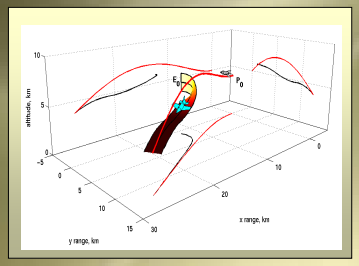




EBOLATOR software

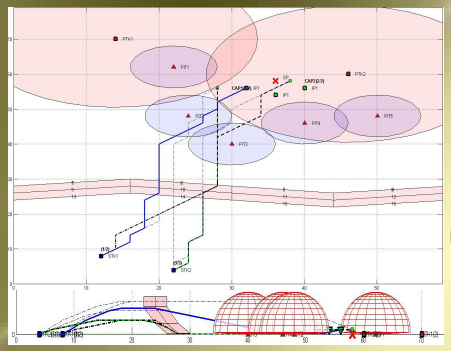


zero-sum pursuit-evasion game

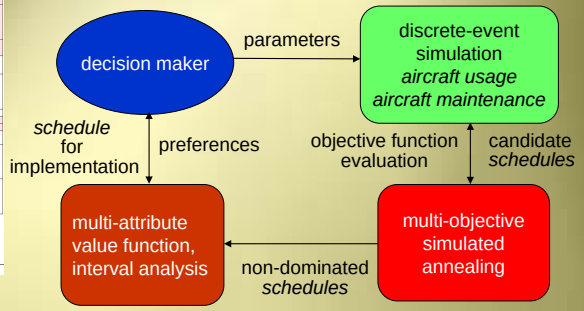


multicriteria network optimization

risk avoiding *flight* paths



maintenance scheduling multi-objective simulation-optimization



selected publications

Poropudas J. and Virtanen K.: *Game theoretic validation and analysis of air combat simulation models*, IEEE Syst.Man Cybernetics (SMC), 2010

Poropudas J. and Virtanen K.: *Influence diagrams in analysis of discrete event simulation data*, Proc. of Wint.Sim.Conf., (WSC), 2009

Mattila V., Virtanen K., and Raivio T.: *Improving maintenance decision-making in the Finnish Air Force through simulation*, Interfaces, 2008

Karelahti J., Virtanen K., and Öström J.: *Automated generation of realistic near-optimal aircraft trajectories*, J.Guid.Cont.Dyn. (GCD), 2008

Karelahti J., Virtanen K., and Raivio T.: *Near-optimal missile avoidance trajectories via receding horizon control*, GCD, 2007

Poropudas J. and Virtanen K.: *Analyzing air combat simulation results with dynamic Bayesian networks*, WSC, 2007

Virtanen K., Hämäläinen R.P., and Mattila V.: *Team optimal signaling strategies in air combat*, SMC, 2006

Karelahti J., Virtanen K., and Raivio T.: *Game optimal support time of a medium range air-to-air missile*, GCD, 2006

Virtanen K., Karelahti J., and Raivio T.: *Modeling air combat by a moving horizon influence diagram game*, GCD, 2006

Virtanen K., Raivio T., and Hämäläinen R.P.: *Modeling pilot's sequential maneuvering decisions by a multistage influence diagram*, GCD, 2004

Raivio T. and Ehtamo H.: *Discretization, nonlinear and bilevel programming in pursuit-evasion games*, Game Theor.Appl., 2002

Virtanen K., Raivio T., and Hämäläinen R.P.: *Decision theoretical approach to pilot simulation*, J.Aircraft, 1999

Virtanen K., Ehtamo H., Raivio T., and Hämäläinen R.P.: *VIATO - visual interactive aircraft trajectory optimization*, SMC, 1999

Raivio T., Ehtamo H., and Hämäläinen R.P.: *Aircraft trajectory optimization using nonlinear programming*, IFIP Syst.Model.Optim., 1996

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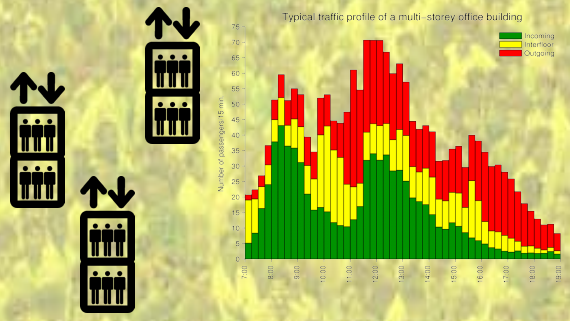
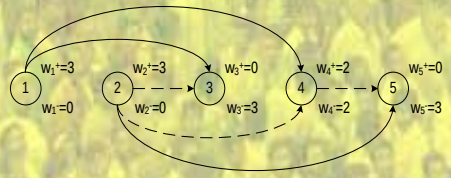
Updated 18.5.2010

ELEVATOR TRAFFIC OPTIMIZATION
CROWD DYNAMICS SIMULATION

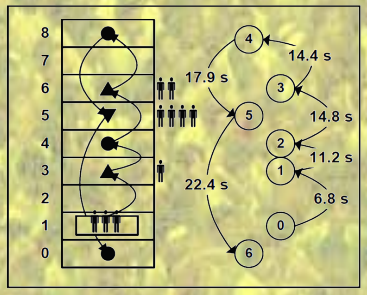
Analysis of passenger traffic



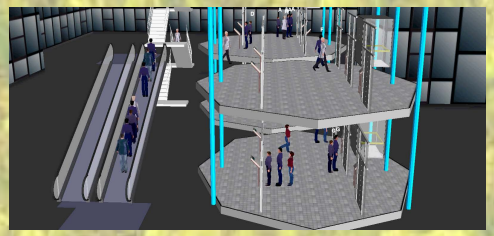
Modeling and forecasting elevator usage



Optimal allocation of elevators to passenger calls



Simulator for elevator system design



Computational models for the behavior and interaction of people in crowds

Best-Response reactions

$$BR_i(s_{-i}) := \arg\max_{s'_i \in S_i} u_i(s'_i, s_{-i}),$$

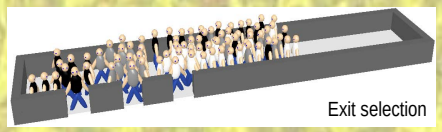
$$s_i^{(t)} = \begin{cases} BR_i(s_{-i}^{(t-1)}; \mathbf{r}), & i \in N_i \\ s_i^{(t-1)}, & i \notin N_i \end{cases}$$

Methods
-Agent-based modeling
-Game theoretic learning models
-Evolutionary game theory

Human behavior
-Psychology
-Observations on real crowds
-Experiments with students
-Similarities with animal swarms


Fire evacuation

FDS+Evac Simulation model
- Integration of crowd simulation and state-of-the-art fire simulation


Exit selection


Design of Helsinki Music Centre

Applications
Building design:
-Evacuation safety analysis
-Optimization of the usability of venues


Safety analysis of Porvoo Museum

Selected publications

H. Ehtamo, S. Heliövaara, T. Korhonen, and S. Hostikka: *Game Theoretic Best-Response Dynamics for Evacuees' Exit Selection*, Advances in Complex Systems 2010
T. Korhonen, S. Heliövaara, S. Hostikka, and H. Ehtamo: *Counterflow Model for Agent-Based Simulation of Crowd Dynamics*, manuscript 2010
S. Heliövaara, J.-M. Kuusinen, T. Rinne, T. Korhonen and H. Ehtamo: *Experimental Study on Exit Selection in a Corridor*, manuscript 2010
J.-M. Kuusinen, J. Sorsa, T. Susi, M.-L. Siikonen, H. Ehtamo, *A new model for vertical building traffic*, manuscript 2010
J. Sorsa, H. Ehtamo, M.-L. Siikonen, T. Tyni and J. Ylinen: *The Elevator Dispatching Problem*, manuscript 2010
T. Rinne, S. Hostikka, T. Paloposki, T. Korhonen, J. Saari and S. Heliövaara: *Application of RFID and Video Imaging on Evacuation Observations in Offices and Public Buildings*, Fire Safety Science 2009
T. Korhonen, S. Hostikka, S. Heliövaara and H. Ehtamo: *FDS+Evac: An Agent–Based Fire Evacuation Model*, Pedestrian and Evacuation Dynamics 2008

Systems
Analysis Laboratory

SYSTEMS INTELLIGENCE

The ability to connect with the complex interconnected feedback mechanisms and pattern structures of the environment from the

point of view of *what works*

Fundamental capacity that is action-oriented and adaptive, holistic, contextual and relational, and that links the subject to her environment succesfully

re-framing

striving towards flourishment

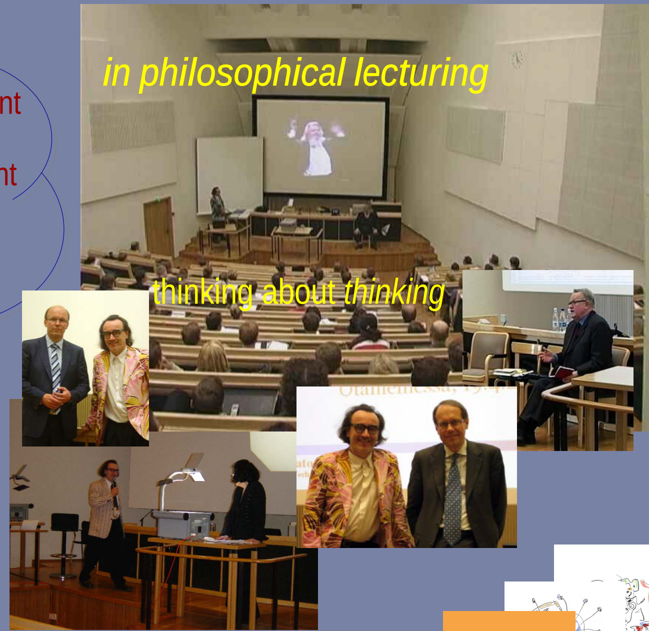
inquiring

thinking together

suspending judgement

in philosophical lecturing

thinking about thinking

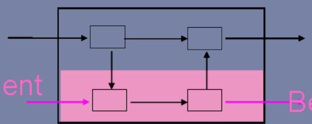


in leadership

strive towards improvement from within the system through cultivation of the human modes of interaction

in dialogue

new methods to improve conversation in communication and collaboration



Systems Intelligence looks for ways to observe and address the invisible subsystems and interactions of emotions and beliefs

micro-behaviours

connectivity

emergence

human in-between

web-sites and selected publications

as engineering philosophy

metaheuristic that puts the emphasis on improvement, action-orientedness, our embeddedness in systems, and our natural ability to act intelligently

[Helsingin Sanomat, 16.7.2006]

KOLUMNI

Reetta Meriläinen
reetta.merilainen@sanoma.fi
Kirjoittaja on Helsingin Sanomien päätoimittaja.

Systeemiälylle olisi kestotilaus

Ajatuksilla, toimintamalleilla ja ihmisillä on taipumus valua uriin. Siis urautua.

Parisuhde tai työyhteisö voi pahimmillaan olla kuin keskinkertaista, latteata näytelmää vuodesta toiseen esittävä teatteri. Innostunut ja uutta luova vuorovaikutus on voinut jähmääntyä annetuista ja otetuista rooleista heiteltyihin ankeisiin repliikkeihin.

Johtajuudesta puuttuu ideoita ja voimaa. Ihmisiltä puuttuu elämisen ja tekemisen riemu.

Kannattaisikohan elämää yrittää lähestyä systeemiälykkäästi?

Ehkä kannattaisi. Luin juuri Teknillisen korkeakoulun systeemianalyysin laboratorion julkaiseman kirjan Systeemiäly 2006. Kirjan ovat toimittaneet professorit Raimo P. Hämäläinen ja Esa Saarinen. Se on syntynyt professorien ohjaamien systeemiälyseminaarien seurauksena. Kirjaan kirjoittaneiden opiskelijoiden ja tutkijoiden taustat vaihtelevat. Systeemiälyä lähestytään monista kulmista, ja synnytetään runsaspiirteinen kuva.

Systeemiäly tarkoittaa kirjan määritelmän mukaan "älykästä toimintaa, joka haluaa hahmottaa vuorovaikutuksellisia takaisinkytkentöjä sisältäviä kokonaisuuksia tarkoituksenmukaisesti ja luovasti. Systeemiälykäs henkilö osaa toimia järkevästi monimutkaisissa systeemirakenteissa".

Jos systeemiälyä pitäisi selittää hyvin yksinkertaisesti ja konkreettisesti, määritelmä voisi kuulua: Systeemiälykäs ihminen toimii tietonsa ja intuitionsa avulla viisaasti ja rakentavasti.

Kirjassa käsitellään kiinnostavasti muun muassa avioliittojen vuorovaikutusta kuvaavaa John Gottmanin ja kumppaneiden "dynaamista epälineaarista" matemaattista mallia. Mallin muuttujia ovat esimerkiksi aviovaimon/miehen positiivisuus, inertia eli vitka, vaimon ja miehen keskinäiset funktiot, eli vaikutusfunktio, korjausfunktio ja vaimennusfunktio. Oma positiivisuus hetkellä t lisää puolison positiivisuuden muutosta hetkellä t+1 !

Ehkä moni riipivä kotoinen riita jäisi riitelemättä, jos osapuolet muistaisivat Gottmanin yhtälön ja tiedostaisivat, mikä kaikki riitelemisessä oikeastaan vaikuttaa. Yhtälö olisi hyvä teipata jääkaapin oveen.

Gottman ja kumppanit väittävät pystyvänsä ennustamaan avioliiton tulevaisuuden tarkkailemalla puolisoiden käytöstä kolmen minuutin ajan. No jaa, tiedä häntä. Gottman on malleja soveltaessaan päätynyt uuteen avioliittoteoriaan. Sen mukaisesti avioliiton menestymisen perusedellytys on ystävyys avioliitossa.

Jokaisen työstä, työyhteisöstä ja johtamisesta kiinnostuneen kannattaisi lukea, mitä kirjassa kerrotaan palkitsevuudesta ja systeemiälystä. Kirjassa esitellään Alfie Kohnin 13 vuoden takaiset, edelleen ajankohtaiset kriittiset näkemykset palkitsemisesta. Kohn väitti muun muassa, että palkka ei ole motivaatiotekijä; palkitsematta jättäminen rankaisee henkilöstöä, palkitseminen taas aliarvioi ihmisen luontaisen kiinnostuksen ja ahkeruuden. Hänen mukaansa palkitsemisjärjestelmät ovat työläitä ja kenties kannattamattomia, eikä palkitsemisjärjestelmän käyttö toimi johtamisen välineenä.

Arkikokemukset tukevat Kohnin väitteitä, ainakin osin. Vaikka ihmistä palkittaisiin palkitsemisjärjestelmän mukaisesti oikein, hän ei aina riemastu saati riehaannu. Sama henkilö voi kuitenkin liikuttua vahvasti, kun hänet pysäyttää käytävällä ja kiittää hienosti suoritetusta työstä.

Monet meistä ovat kokeneet myös huikaisevan kollektiivisen onnentunteen, kun jokin yhteinen suuri ponnistus on saatu loppuun. Työ kiittää silloin tekijäänsä.

En tarkoita, että lämmin tunne aina korvaisi konkreettiset eurot. Tarkoitan sitä, että olisi hyödyllistä ymmärtää paremmin, mistä ihminen loppujen lopuksi tulee hyvilleen. Palkitsemisen keinoja, sävyjä ja tilanteita olisi vara monipuolistaa.

Palkitsevuuskokemus eli ihmisen tunne siitä, että häntä palkitaan, nousee kirjassa tärkeänä esiin. Palkitsevuuskokemuksen edellytysten miettimiseen organisaatioiden sietäisi uhrata aikaa ja ajatusta. Samalla jouduttaisiin miettimään itse organisaatioita, niissä vaikuttavia muuttujia, voimia ja vuorovaikutussuhteita normaalia syvemmin. Sisäisen tarkastuksen voisi joskus tehdä ilman ainuttakaan kuittia ja tositetta.

Mitä kauemmin organisaatioita seuraa tai johtaa, sitä tietoisemmaksi tulee niiden monimutkaisuudesta ja -tasoisuudesta. Jokainen ihminen tuo organisaatioon persoonansa, asenteensa, toimintamallinsa ja historiansa. Muuttujia on liki ääretön määrä. Nämä mikromaailmat sovittautuvat toimimaan yhdessä. Hankauspisteitä on kuitenkin niin paljon, ettei ongelmien syntyminen ketään yllätä.

Organisaatio on kaikkea muuta kuin pysyvä, kiinteä, selvärajainen organismi. Mekaanisen toimintatavan saa unohtaa. Pyrkimys johtaa organisaatiota samalla logiikalla, jolla ajaa autoa, on tuhoon tuomittu.

Valtaakaan ei kirjassa ole unohdettu. Kirjan mukaan systeemiälyvaltaa ilmentävässä ihmisessä yhdistyvät nöyryys ja voimakas tahto käyttää valtaa koko systeemiä rikastuttavalla tavalla. Oleellista on myös kyky kommunikoida tavalla, joka sytyttää ihmiset ja saa heidät huikeisiin suorituksiin, kirjassa kerrotaan.

Systeemiälykkyydessä on vahva eettinen komponentti. Systeemiälykäs ihminen käyttää älyään, että muillakin olisi parempi olla.

in environmental decision making

from conflict management towards sustainable cooperation

www.systemsintelligence.tkk.fi

Jukka Luoma, Raimo P. Hämäläinen, and Esa Saarinen (2010): Acting with systems intelligence: Integrating complex responsive processes with the systems perspective. *The Journal of the Operational Research Society*.

Hämäläinen, Raimo P. and Esa Saarinen (2008): Systems Intelligence - The Way Forward? A Note On Ackoff's "Why Few Organizations Adopt Systems Thinking". *Systems Research and Behavioral Science*, Volume 25, Issue 6, pp. 821-825.

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Saarinen, Esa (2008): Philosophy for Managers: Reflections of a Practitioner. Philosophy of Management, vol. 7 Supplement.

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Hämäläinen, Raimo P. and Esa Saarinen (2006): Systems Intelligence: A Key Competence for Organizational Life. Reflections: The SoL Journal, vol. 7 no. 4.

SYSTEMS ANALYSIS LABORATORY

Doctoral dissertations


prof. Livio Narici, Kimmo Uutela


prof. Derek Bunn, Simo Makkonen


prof. Shmuel Oren, Erkka Näsäkkälä


Mari Pöyhönen, prof. James Corner

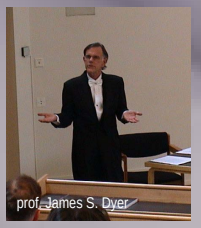

prof. Don Kleinmuntz, Juuso Liesiö


prof. Yves Balasko, Mitri Kitti


prof. Boleslaw Tolwinski, Harri Ehtamo

2009: Janne Kettunen, Jari Perttunen, 2008: Toni Jarimo, Janne Karelahti, Juuso Liesiö, 2007: Jyri Mustajoki, Kari Alanne, Mika Seppä, 2006: Albert Höglund, Mitri Kitti, Totti Könnölä, 2005: Simo Makkonen, Erkka Näsäkkälä, Janne Gustafsson, Kai Virtanen, 2004: Kari Sinkko, Jukka-Pekka Salmenkaita, 2003: Maria Holmberg, Anu Kettunen, Pauli Murto, Jukka K. Nurminen, Tony Rosqvist, Jyri Seppälä, 2002: Jouni Pyykönen, 2001: Arto Inkala, Heikki Lehtonen, Kimmo Uutela, 2000: Marko Lindroos, Tuomas Raivio, Janica Ylikarjula, 1999: Miika Linna, Kaisa Simola, 1998: Jussi Keppo, Mari Pöyhönen, Jukka Sinisalo, 1997: Jan Holmberg, Marja-Liisa Siikonen, 1996: Pertti Laininen, 1995: Osmo Jauri, Tatu Koljonen, Mika Räsänen, 1994: Risto Lahdelma, Urho Pulkkinen, Markku Verkama, 1992: Ahti Salo, 1991: Jukka Ruusunen, 1989: Harri Ehtamo, 1988: Leena Aittoniemi, Jari Hämäläinen, Veijo Kaitala


Dr. Neale Kelly, Kari Sinkko


prof. James S. Dyer


Janne Gustafsson

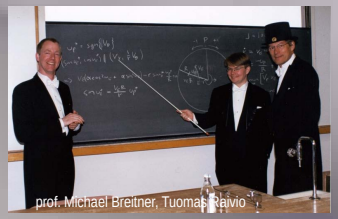

prof. Srinivas Talluri, Toni Jarimo

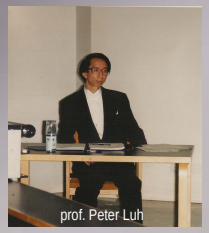

Ahti Salo, prof. Herbert Moskowitz


prof. Stephen Frolking, Anu Kettunen


Jyri Mustajoki, prof. Theodor J. Stewart


prof. Bernard J Cosby, Maria Holmberg


prof. Michael Breitner, Tuomas Raivio

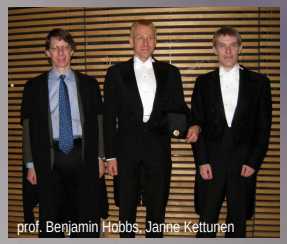

prof. Peter Luh


Jukka Ruusunen


prof. Chelsea C. White, Markku Verkama


prof. Luke Georghiou, Jukka-Pekka Salmenkaita


prof. Wayne M. Getz, Janica Ylikarjula


prof. Benjamin Hobbs, Janne Kettunen

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