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Abstracts

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Contents

Note: The abstracts have been processed automatically using the abstract forms e-mailed by the authors. Only one substantive type of modification has been applied, i.e., in a few cases the co-author has been named first, if only he/she will participate in the Workshop.

A view on modeling paradigms: a prerequisite for Good Modeling Practices

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Keywords: paradigms, distributed systems, hybrid DSS

1. Introduction

If we reflect on experiences with model based Decision Support Systems (DSS) and the way these systems are currently designed, built and maintained, we soon arrive at many questions associated with good modeling, design and building practices for these systems. We all know from own and reported experience that it is still very difficult to build and implement this type of systems that are really used and support actual decision making.

As a consequence, we feel it is appropriate at the beginning of a new century, in a conference on Methodologies and Tools for Complex System Modeling and Integrated Policy Assessment, to draw your attention to many problems with the design, construction and implementation of successful hybrid, model based DSS. Problems with Good Modeling Practices will be discussed here along 4 dimensions:
1. Processes and process management
2. Modeling paradigms
3. Hybrid DSS environment
4. The human factor

2. Processes and process management

The process of building DSS is a complex process possibly involving many participants and stakeholders, of which many have a different role and different interests. As a consequence we need process and project management with associated methods, tools, data and meta-data.

3. Modeling paradigms

Many of us also have experienced the need to use a variety of types of models and associated solvers in DSS to allow us to solve the practical problem at hand. Examples are combinations of for example MILP, simulation models and associated databases with their incorporated data models. In this context we have to do with questions associated with:

1. Which paradigms to use? Each modeling paradigm is connected with a way of thinking, theories, ontology, examples of use, tools and techniques. As a consequence such a paradigm has a certain representation power.

2. What is the fitness for use of a paradigm in relation to problem/domain. In a practical problem situation we are confronted with the question to find appropriate paradigms to provide us with the necessary modeling or representation power.

3. Which alternative paradigms may be used that have to be combined in models and sub-models?

4. How to manage and control the relationships and data exchange between (sub-) models? In a network of sub-models we have to be able to work with a variety of precedence relations.

5. If there are paradigms with more or less equal representation power related to the problems to be modeled, then we have to make choices. This choice may depend for example on the familiarity of the modeler with the paradigms, the availability of easy to use generators and solvers and finally the appropriateness of the paradigm in relation to the problem.

6. How to deal with the body of semantic knowledge associated with the problem domain, which the paradigm and its ontology allow us to capture in models.

7. How to use various data sets with their explicit data models as input and or output of (sub) models and for process control in DSS. In this context it may be mentioned that each type of data model has its own associated ontology and semantics.

4. Hybrid DSS environment

In the previous section it has already been described that many practical DSS involve the use of a variety of (sub) models where these models may be of different types. Types of models with their associated model generators and solvers lead to hybrid DSS environments. In a practical context many questions are associated with bringing about these hybrid DSS environments and in turn instantiated hybrid DSS. Some of these have to do with:

1. How do you design and build a coherent network of models and how do you couple these models using different data sources?

2. How do you control and manage the generating and solving process in such networks and how to make use of process management with its connected meta- database to do this?

3. How do you do this in a heterogeneous distributed environment?

4. How do you deal in this context with questions related to issues such as:
   - validation
   - calibration
   - expertise
   - fitness for use?

5. The human factor

Finally we have to deal with the people involved in modeling and the use of DSS. In this context we may distinguish the roles of problem owner, modeler and builder of DSS, user of DSS and technical infrastructure specialist. These all have to work closely together and be knowledgeable in the areas described above in order to realize effective and efficient evolving hybrid DSS. In practice it still turns often out that it is not easy to bring together an adequate 'palette' of knowledge and infrastructure (generators, (sample) models, databases, and solvers) components necessary to solve the problems at hand.

In addition to problems with realizing an optimal mix in human-based knowledge and infrastructure components, we may also be confronted with ethical aspects. Are we for instance aware

of the possible practical consequences of the choice of a less appropriate modeling paradigm and or the consequences of models that don't have a required quality (regardless the fact that this may be hard to measure)?

6. Conclusions

At the start of this century, confronted with the previous problems, we feel it is important to clearly express the issues involved and describe research topics to be dealt with in the near future. We hope to be able to have a fruitful discussion in the conference about the questions raised.

Exploiting Imprecise Information in Multicriteria Decisions

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Keywords: Multicriteria Analysis, Additive Value Function, Imprecise Information, Decision Support System

Multicriteria analysis methods base their results on the value of several parameters. We consider the case where the decision-maker is unsure of which values each parameter should take, because of insufficient, imprecise or contradictory information. We consider the aggregation of multicriteria performances by means of an additive value function under imprecise information. The problem addressed here is the way an analysis may be conducted when the decision-makers are not able to (or do not wish to) fix precise values for the importance parameters. These parameters can be seen as interdependent variables that may take several values subject to constraints: First, we brief classify some existing approaches to deal with this problem. We will argue that they complement each other, each one having its merits and shortcomings. Then, we present a new decision support software - VIP (meant to deal with Variable Interdependent Parameters) Analysis - which incorporates approaches belonging to different classes. It proposes a methodology of analysis based on the progressive reduction of the number of alternatives, introducing a concept of tolerance that lets the decision makers use some of the approaches in a more flexible manner. VIP analysis fosters the adoption of this methodology by offering a user-friendly interface. It accepts variable values for the scaling constants as well as fixed values. Variable interdependent importance parameters may be constrained by bounds, linear inequalities and linear equalities. The software computes the range of value for each alternative, the Pairwise Confrontation Table, the maximum regrets and the graphical display of optimality domains when adequate. It is shown that both the Pairwise Confrontation Table and the optimality domains are powerful tools to analyze the problem, in particular when the DM's consider a tolerance and the concepts of quasi-dominance and quasi-optimality. This type of analysis may provide sufficient arguments for the DM's to agree on a best alternative or at least on a short list of interesting alternatives, before having to reach exact values for each parameter. Moreover, it may provide them with the insight that will help them in the process of agreeing on these values. Finally, the usefulness of VIP Analysis package in Group Decision Support is discussed. The communication is concluded with a software demonstration.

Modeling Service Level Agreement via Mobile Code

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Keywords: mobile code, service level agreement

Modeling mobile environments is a challenging problem due to unexpected changes in end-user profiles. Managing service level agreement (SLA) in the context of mobility becomes a complex task requiring adequate measurement, prediction, and quick reaction tools. A model used by such tools must cover mobility from the perspective of end-users, hosts, services, active packets, and nomadic code. As an emerging paradigm, the nomadic code could be used as a design methodology, programming style, communication alternative, negotiation mechanism, or management polices, as e-move-for-any-problem solution. Despite of potential claimed advantages (reduced network traffic, concurrency for cloning and aggregation), client-server asynchrony, remote testing and deployment, dynamic interfaces upgrades), the most evoked problems are not minor (security and robustness concerns).

Revised classical management functions (reconfiguration, fault, security, performance, accounting, user profiles, service interaction) must be re-evaluated to detect potential failures. Some of them are obvious, other less evident. Among the possibility to introduce new protocols dealing with remote control of mobile processes, more concrete management issues are related to: uncontrolled behavior self-destruction guarantee, destruction procedures-, bi-directional security, rendezvous service, performance negotiation. However, most of scientists championing this avenue have seen in it new ways to optimize or solve yet unsolved problems; improving the polling process, enhancing end-to-end QoS (Quality of Service), improve authentication procedures, etc.

With the advent of many and diversified players in service forestry, it became too complex for the users to decide themselves on the best choice. Therefore, mobile code has been seen as a solution to for improving on-site negotiation performance loops-, to load balance task allocation in distributed environments, or to manage policy conflicts among competitive tasks allocated to distinct nomadic processes. The notion of service level agreement (SLA) covers these mechanisms of facilitating a user to take a decision on the level of service she/he will be using according to the price to be paid. Creating enhanced SLA features, can offer new added value for any service provider.

The following five subtopics are stand-alone added-value features to a SLA system. This will allow a service provider to commit on contracts across many service providers, considering various types of networks, both internal to a given service provider and across many service providers, and to use a new advanced negotiation-based commitment with penalties for both domestic and business customers:

- Multilevel specification
- Heterogeneous networks (internal to a service provider)
- SLA translation across various types of networks (ATM, IP, SONET, Wireless, etc.) and Service providers (AT&T, MCI, Sprint, etc.)
- SLA negotiation and re-negotiation (enhanced negotiation mechanisms allowing users be clusterized)

• Negotiation penalties/credits (QoS pricing mechanisms)
• Support a single mechanism to glue together the QoS offered
by different bearer services as can be done with the GPRS PDP Context in wireless (General Packet Radio Service (GPRS) for gsm, and Packet Data Protocol (PDP).

For solving this, SLA models and QoS pricing mechanisms must be innovated for the purpose. The model must gradually consider the features enumerated above. We will present several attempts to reach an acceptable solution.

Economic growth under shocks: path dependencies, traps, and stabilization

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Keywords: Economic growth, risk management, stagnation, stochastic optimization

In this talk we analyze effects of shocks on economic growth and stagnation. The economy is a complex system constantly facing shocks and changes with possible catastrophic impacts. A shock is understood as an event removing from the economy a part of the capital. We show that even in the case of well-behaving economies defined by the Harrod-Domar model, persistent in time shocks implicitly modify the economy and may lead to various traps and thresholds triggering stagnation and shrinking. The stabilization of the growth must then rely on ex-ante risk reduction and risk transfer options, such as hazard mitigation and the purchase of catastrophic insurance, as well as ex-post borrowing. The coexistence of ex-ante (risk averse) and ex-post (risk prone) options in the proposed model, in contrast to the traditional expected utility theory, generates a strong risk aversion even in the case of linear utility functions. The model assesses and explains trade-offs and benefits of ex-ante and ex-post growth stabilization options.

Services on Services based on Global Computing Idea: ADSS (Autonomous Decentralized Service System)

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Keywords: Electronic Commerce, Service Systems, Flow Control, Dynamic Brokering

1. Background

In every country, the network revolution is expected to appear as B2B and B2C commerce at first. In Japan, contribution of mobile Internet systems as well as digital TV will be prominent to B2C. In these systems, present providers deliver mutually independent services, but within very short time, these services will be combined and collaborated over the network into single services. In future, the services will be self-organized for pursuing human needs in communities and cultures.

2. Basic Concept for ADSS

We are developing an information service system named ADSS (Autonomous Decentralized Service System). The basic concept of ADSS comes from an idea of global computing and a knowledge creation model.

The Internet can be seen as a globally connected computing system with million servers; however, the present use of the Internet is limited to remote job entries and remote database/meta-database accesses. An idea of service flow control with dynamic brokering over the network is introduced for integrating complex business processes which will be required in near future.

We can foresee the knowledge creation for community and culture services is also required in future. In order to respond to this requirement, a model for social knowledge creation processes, SECI (Socialization, Externalization, Combination, and Internalization) model , is very useful. In the present situation, we can interpret the SECI model as follows; Externalization implies each service delivery; and Combination implies service integration. These processes can be directly employed in the service systems. Socialization and Internalization shall be conveyed by human, but can be supported by producing suggestive information.

3. Composition and Behavior of ADSS

In ADSS, three players model with Mediation Ba, which means place in Japanese, is introduced including requesters, mediators, and providers. The requesters are actors requesting and consuming services; the providers are actors providing services; and the mediators are actors providing services that mediate requesters and providers. The Mediation Ba is a federation of mediators and can be seen as a working place for knowledge creation in the SECI model, where the mediators provide mediation services to the other mediators.

Based on the definition of the players, we assume the following basic service provisioning and delivery process.

1. The requesters register their request profiles with personal information as well as terminal capability to the mediators; and then the providers register their service profiles to the mediators. These profiles consist of attribute names and values. It is assumed that the mediators advertise a set of attribute names before the registration.
2. After the registration, the mediators make matches between the requesters and the providers according to distances between the request and service profiles.
3. The mediators initiate and control service delivery among the requesters and the providers according to definitions of prescribed composite services. There are two key components in the mediators; a flow controller and a broker. The flow controller in the mediator works as a coordinator of services and the broker dynamically finds out the best suitable services according to the requesters' and the providers' profiles.

ADSS is implemented on CORBA and XML technologies for gaining easily connectivity over the network. International standardizing efforts for ADSS interfaces are now being worked in the OMG (Object Management Group).

Handling of Fuzzy Informations in Complex Systems

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Keywords: Fuzzy information, fractales, dynamic objectives, pattern recognition, object- oriented approach, competition, transportation systems

The occurrence of vagueness is shown, like the dynamics of objectives, fractales [1], soft data [2] and weak cause effect connections.The handling of fuzziness of verbal communication [3] shows the limitations of fuzzy sets (membership functions). Pattern recognition should be more than common used neural networks.

Approaches for handling fuzzy situations are pointed out, for example:

- multi-step decision processes with information feedback [4]
- freedom for adaption (dynamic planning, robust solutions [5])
- object oriented approaches [6, 7, 8]
- evolutionary optimization (competition) as well as epistemic utility theory [9], anti-optimization [10] or gap metric [11].

Examples from transportation systems are given. The need for further development of stability analysis for self-organizing systems is stressed.

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Multicriteria Routing using the Reference Point Method

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Keywords: multicriteria routing problem, reference point method

Multicriteria routing problem in communications networks is considered. Traditionally, the problem of finding the optimal route from a specified origin node to another node has been considered in the framework of the single objective optimization. Usually, the hop count or delay was considered as a single metric, which is optimized. The routing algorithms that are most widely used in today's computer networks belong to the class of quasi-static distributed shortest-path routing algorithms. However, in modern communications network it is often found that a single objective function is not sufficient to characterize adequately routing problems. Many applications requires not only a route between source and destination but a route which satisfy the quality of service (QoS) requirements. Therefore, the several metrics should be considered simultaneously such as delay, cost, delay variations, loss probability etc. In recent years a significant research effort has been devoted to formulating and solving multicriteria routing problems. We will present an interactive method of analysing this problem by the reference point approach.

Distributed solution of optimization problems based on scalable isoefficient algorithms

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Keywords: distributed computation, optimization, scalable algorithm

The paper deals with distributed solution concepts for simulation-based optimization problems which arise in the fields of product design, manufacturing and production planning. For these types of problems it is typical that the tasks under consideration are described by simulation systems based on Finite-Element-Methods (FEM). This requires the time-consuming solution of non-convex and non-smooth constrained nonlinear optimization and control problems. Due to the large computational effort in solving these optimization problems the concept of coarse-grained parallel (distributed) solution on a cluster of workstations will be introduced. Starting with speedup and efficiency analysis for the distributed algorithm the concept of scalability and isoefficiency for parallel algorithms will be discussed and demonstrated by numerical results. The new solution concept is scalable in the dimension of the optimization problem (n) and the number of processors (p) of the available parallel computing system and leads not to a unique algorithm like in the sequential case but to a set of so called isoefficient algorithms for each pair (n, p).

The distributed solution concept will be demonstrated by results from projects with the automotive industry (optimal design and manufacturing of metal-forming processes), aircraft industry (multidisciplinary airplane design) and water management (optimal control of groundwater level stabilization).

An Advance Logistic Control in The Waste Personal Computer Withdrawal System

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Keywords: Waste Personal Computer, Lifecycle Management, Radio Frequency Identification Technology, Logistic Control, Simulation

The disposal problem of personal computers(PCs) clearly exists as a social problems. One of the solutions for this problem, a PC lifecycle management system which not only conducts production, distribution and consumption of PCs, but also covers whole PCs lifecycle activity, such as recovery, scrapping/disposing and recycling/reuse of PCs, has been experimentally developed.

Features of the system are centralized management of PCs lifecycle status using a communication network and applying the radio frequency identification(RF-ID) tags. The system able to bring participants of PCs lifecycle activities following benefits:

1. correctly management of PCs lifecycle status from recovery to recycle using a communication network
2. optimization of recovery distribution by knowing correct transportation demand using a communication network
3. proper operation in PCs disposing and recycling by referring product information stored in RF-ID tags attached to PCs
4. saving and simplifying handling operations of slips for proper management of spent PCs with paperless.

The PCs lifecycle management system has been developed and tested in a field for evaluation. This test was conducted in 1999 as part of the project for the Advanced Information System Development Testbed Projects sponsored by the Japan Information Processing Development Center (JIPDEC).

The withdrawal system of waste PCs consists of retail stores, corporations, withdrawal dealers, disposal dealers and the local government. The withdrawal service is generally carried out by following sequence.

- Withdrawal by retail stores and corporations
- Withdrawal by withdrawal dealers

- Request of disposal to disposal dealers
- Temporary storage of withdrawal dealers
- Request of disposal to the local government

The local government will dispose of them in method of combustion and reclamation which brings about a high environmental load.

By using an information of disposed PC's position in the life-cycle, several logistic control methods can be considered. In this presentation, ten logistic scenarios of disposed PCs are established by combining with some withdrawal policies;

- a disposal dealer selection ('adjustment by LP' or 'contract'),
- the use of future waste PC number information ('use' or 'no use'),
- the adjustment of the stock between withdrawal dealers ('adjustment' or 'no adjustment'),
- the transportation timing for disposal dealers ('constant quantity', or 'constant interval').

In order to evaluate these logistic scenarios of the withdrawal, firstly, a PC withdrawal system is modeled. Then, each scenario is evaluated by simulation.

This evaluation method has been applied to a withdrawal model which has six withdrawal dealers and three disposal dealers. All parameters in the model are determined by referring to a withdrawal system in a certain area in Japan. The withdrawal model has been simulated for 1000 days to compare and analyze the features of each scenario and to inspect the effects of information using an RF-ID tag.

By simulation, the most cost-effective and lowest environmental load scenario is a combination of 'adjustment' for the disposal dealer selection, 'use' of future waste PC number, transportation timing by 'constant quantity', and 'adjustment' of the stock. And, this scenario makes a 3 percent improvement of the scenario 'best contract' and 'best interval' which can be considered. Especially, the use of information from a PCs life-cycle management system gathered by an RF-ID tag has a great effect on the decision of disposal dealer selection and transportation timing.

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Supporting financial analysis of innovation activities

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Keywords: modeling, decision support, negotiations, innovations, financial analysis

A research project is considered aimed to construct an innovative product. The project requires resources concentrated within the time T to finish the investment and start selling the product. The project can succeed or not. Longer the time T results in greater probability of success but in lower financial return. The innovative product is in this case selling on the market later and is less competitive to other products. From the point of view of decision-maker that invests, the project can be evaluated by expected capital return and by a measure of risk involved.

In the paper a model and a simple computer-based system which can be used for project evaluation are presented . The model utilizes and develops ideas proposed by Kulikowski (2000a). In the model two scenarios are considered. First, when the research will accomplish with success and second - the failure case. Using the model various quantities describing the project can be analyzed, including mentioned time T of the project accomplishment, investment costs, yield in case of success and probability of success in the time T, yield in case of failure and respected probability, expected yield, deviation. In the model different risk measures can be taken into account.

In the classical approach, as taught in business schools, the risk is proxied by the standard deviation, a measure of spread in a distribution. However in risk management practice another measure called Value at Risk is frequently used to measure financial risk (Hendricks 1966, Schachter 1998). In portfolio analysis, Value at Risk is defined as an estimate of the level of loss of a portfolio which is expected to be equaled or exceeded with a given, small probability. Ogryczak and Ruszczynski (1998) have originally proposed so called semideviations as risk measures based on stochastic dominance analysis.

In the first calculation experiments with use of the system, Value at Risk and related so called "Safety index" proposed by Kulikowski (2000b) have been derived. In further analysis also Ogryczak Ruszczynski semideviations will be considered. The expected yield and assumed measure of risk are treated as the investor objectives in financial analysis of the project. Multicriteria analysis and decision support problems regarding these objectives are discussed.

Further analysis will include the case of two decision-makers involved. Let us consider a great firm selling information technology products on the market. The firm orders new innovative software in a research institute. The software preparation requires some new theoretical achievements. The director of the firm and the director of the institute negotiate the contract. How to divide investment costs, future yield, risk of the project? On this example, problems of decision support in negotiations will be discussed using ideas presented in (Krus 1996)

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My Two Cents to the Good Modeling Practices

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Keywords: modeling paradigms, decision support systems, object-oriented programming, robustness, multi-criteria model analysis, model management, distributed systems.

1. Background

A critical element of model based decision support is obviously a properly developed model that adequately represents a part of decision making process. Such a part typically involves analysis of complex relations that cannot (or should not) be done based only on an experience or intuition of a decision maker or his/her advisors. There are hundreds of books and articles on various modeling issues. For the purpose of the CSM'2000 workshop presentation we will mention here only few of them that are most closely related to the discussion planned to be held during this workshop.

A recent comprehensive overview of model-based decision support methodology, tools and environmental applications is provided in [8]. It contains also a detailed discussion on modern decision making process, and guidelines for model development and analysis, focusing mainly on multicriteria model analysis.

Another perspective on modeling is presented in [7]. This is a handbook on good modeling practices which provides a step-by-step guidelines for model development. One of the authors of this book co-authors a presentation on Good Modeling Practices therefore some key elements of this handbook will most probably be discussed also on the CSM'2000 workshop. However, the presentation on Good Modeling Practices by A. Beulens and H. Scholten will have a much broader scope than the handbook on Good Modeling Practices. While all the elements of this presentation (processes and process management, modeling paradigms, hybrid DSS environment, the human factors) are of critical importance for the model-based decision support, there are some other issues which are also require further development. Moreover, illustration of some points to be raised by A. Beulens and H. Scholten by experiences from other modeling approaches and applications may contribute to a more complete view on modeling paradigms and environments.

2. Modeling paradigms

We will outline some of the modeling paradigms (presented in [4]) applied to a complex modeling problem, namely European air quality model. We will show, how for this complex problem three models of different scale and methodology (described in [4, 5, 6], respectively) can be used in a complementary way. Moreover, we will outline modeling techniques and tools that have been successfully used for generation and analysis of such a large model.

One typically distinguishes two types of model-analysis methods, which are conventionally called simulation and optimization. The simulation and optimization methods can be characterized as follows:

- In simulation, decision variables are inputs and goals are outcomes. Therefore this technique is good for exploring the intuition of a DM, not only for verification of the model, but also for providing a DM with information about the consequences – typically represented by values of goals and constraints – of applying certain decisions. One can also consider simulation as an alternative-focused method of analysis that is oriented towards examining given alternatives.
- Optimization can be considered as a goal-oriented (value-focused) approach that is directed towards creating alternatives. Optimization is driven by formulating a single objective in single-criterion optimization, or several objectives in multi-criteria optimization, and looking for values of decision variables that optimize the value of the specified objective(s). Therefore, goals are the driving force and the values of decision variables are the outcomes.

Traditional approaches to model analysis have been based either on simulation or on classical formulations of single-criterion optimization. A summary of these approaches and their limitations is helpful for understanding the advantages of modern decision-support methods which extend and combine these approaches.

However, in order to exploit such advantages one needs to rethink also approaches to modeling techniques. This in turn requires a shift from traditional modeling, which typically focuses on specific type of problems and related modeling paradigms, to creating advanced modeling environments which will enable use (and reuse) of various modeling methods and tools, which can be available on heterogeneous hardware located in any place, which is connected to the Internet.

3. Advanced modeling environments

Many successful model-based decision support applications illustrate well advantages of this approach. However, everybody involved in the research and applications in this area knows that there is still a number of problems and opportunities. Geoffrion spelled out in [3] two problems: (low productivity of model-based work, apathy on the part of analysts, designers, decision- and policymakers). In addition to the two opportunities continuously growing since they have been formulated by Geoffrion (progress in database management and in the foundations of modeling) there are new opportunities emerging from the network-based platform independent technologies. The new opportunities offered by the World Wide Web for management, policy makers, research and education are not yet efficiently exploited, see e.g. [1, 2]. There is a need to use all these opportunities to improve the low productivity of model-based work by unifying various representations of a model, facilitating the standardized interfaces to various solvers that support different paradigms of models analysis.

Finally, one should stress a need for a common representation of a model. The example of almost 50 years old MPS standard for a representation of LP problems clearly shows advantages of an agreed representation of a problem: there are dozens of tools (that can be used on heterogeneous hardware) for analysis of problems that are specified in the MPS standard. Such problems come from many areas of applications, and therefore many various tools for analysis of LP problems can be widely reused. Unfortunately, MPS standard is restricted to a specific type of models, and to single-criterion optimization-based approach to model analysis. However, its wide range of applications shows also a great potential for an agreed common representation of a much wider class of models that call for a more comprehensive analysis based on various paradigms and using resources available on heterogeneous hardware connected to the Web.

Models and databases differ greatly, however, in the availability and maturity of system software for managing them. In the case of databases, database management systems are mature and well established. There is broad agreement on the definitions of the abstract data models and on the operations to be supported for working with these data models (e.g., those featured in SQL). Commercial DBMS products of high quality are available and are widely used by organizations. This is not the case for tools supporting the full cycle of modeling activities (which is more complex than data management). Although considerable progress has been made

in this area during the past decade, and impressive prototypes have been built and tested, there is a wide gap between research findings and functionality actually available to organizations.

4. Conclusions

Modeling of complex systems is, and will remain (at least for a foreseeable future) both art and craft (see e.g. [8] for a collection of arguments that supports this statement). Therefore development and comprehensive analysis of a complex model requires and will continue to require substantial amount of time and resources. While each model-based decision support has to be problem specific, the efficiency requirements calls for reusability of modular tools for the whole modeling cycle. This in turn requires substantial change of modeling practices. We need to move from problem or paradigm specific *closed* tools to modular tools that will allow for their application to a much wider range of problems. Moreover, we need to use the opportunities provided by the Web for sharing resources (heterogeneous hardware available in distant locations, software, and knowledge represented by template or illustrative models) for much more complete and efficient development, maintenance and analysis of models that are used for supporting decision making processes.

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Estimating chronic natural disaster risk in developing countries based on World Bank's revised Minimum Standard Model (RMSM)

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IIASA

Keywords: Macroeconomic Modeling, natural catastrophes

1. Background

Each year, more than 700 major natural catastrophe events shatter lives, destroy assets, and disrupt communities across broad geographic regions, particularly in developing countries. Over the last decade, direct losses from natural disasters in the developing world averaged 35 billion USD annually. These losses are more than eight times greater than the losses suffered over in the decade of the 1960's. What impact do these natural disasters have on the development of poor countries?

A number of studies have examined the impact of catastrophes on a specific countries after an event occurred (Benson and Clay 2000). Alone, however, a post-event analysis cannot capture the impact of chronic exposure to catastrophic events in that area. The CAT project at IIASA in collaboration with World Bank and Swiss Reinsurance Company designed a methodology to integrate direct loss estimates with estimates of expected macroeconomic conditions at the time of the events.

This process provides a tool to understand the potential chronic impact of catastrophes on the long-term development of a country and to incorporate catastrophes in the planning process both on a national and project level basis. The World Bank has expressed the need for disaster planning to be incorporated at the country assistance strategy level, as part of the benefit/cost analysis at the project approval level, and in formulating long-term strategy for integrating climate change vulnerability into World Bank work (Burton and van Aalst 1999).

2. Methodology

To estimate the economic impact of chronic exposure to natural disasters, one must first measure both the expected severity and the expected frequency of catastrophic events. One must then develop a methodology to integrate this loss exposure with the expected macroeconomic conditions of the country when the catastrophes strike. For the research partnership's evaluation of hazard risk in Honduras, Swiss Re conducted studies to estimate the country's potential losses from hurricanes, floods, earthquakes, and landslides. Swiss Re derives its estimates of potential losses using geological and meteorological models and its extensive databases of historical catastrophic events and resulting economic losses. The annual expected loss is the sum of all the possible losses weighted by the probability of each loss occurring in any given year. The annual expected loss represents the amount of money that on average will need to be set aside every year to fund catastrophic losses when they occur.

Swiss Re's loss figure estimate the direct costs of natural catastrophes. Long-term development impacts of catastrophes depend on how direct stock losses lead to indirect and secondary flow losses depending on the country's economic capacity to absorb losses. IIASA developed a catastrophe module to incorporate Monte Carlo simulations sampling from Swiss Re's loss-frequency distribution into the World Bank's macroeconomic projection model RMSM-X. In this national accounting framework, the IIASA module analyses sources and uses of financing post-catastrophe reconstruction. In order to shock the capital stock and effective labor force with simulated catastrophe events, the module contains a Cobb-Douglas production function with both capital and labor inputs.

3. Application and results for Honduras

Integrating loss exposure with macroeconomic projections for Honduras shows that planners in Honduras should expect an average of 170 million USD annually in additional external funding requirements to meet expected direct and indirect losses, or nearly twice the cost of the annual expected loss. For a poor and highly indebted country like Honduras there is a high probability that this foreign funding is not available post-catastrophe which could flat-line growth estimates for Honduras over the next 8 years.

Developing countries can improve their ability to absorb the cost of natural disaster events if they incorporate an analysis of the chronic economic impact of catastrophes into their planning process. The methodology created by the IIASA, World Bank, and Swiss Re partnership represents one tool to measure the long-term impacts of catastrophic exposure and macroeconomic vulnerability and identify those countries for whom focused attention on disaster planning should be a significant tool in promoting economic growth and reducing poverty.

Development of a Clinical Algorithm for Emergency Abdominal Pain Management

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Keywords: Rough Sets, interesting rules, emergency care, abdominal pain management

Objectives: The paper deals with the triage of the child with abdominal pain. The central difficulty of the triage is the identification of clinical symptoms and signs that in combination contribute the most to the diagnostic and management process. In this paper we discuss how to identify such information, and how to develop a clinical algorithm that should facilitate the triage of a child with abdominal pain.

Methods/approach: A retrospective analysis of 175 patients emergency records collected in 1997 at the Children's Hospital of Eastern Ontario in Ottawa was conducted using knowledge discovery methodology called the Rough Sets analysis. The patients were classified into two distinct groups relative to their diagnosis on discharge from the Emergency Room (final diagnosis). The appendicitis group included patient with acute appendicitis at varying pathological stages, and the discharge group included patients where resolution of all clinical complaints and physical findings with no pathological diagnosis and no operative procedure was possible. For each patient we attempted to collect information on 12 clinical attributes. Subsequently, we developed a clinical algorithm describing causal dependencies in a data set.

Results: The clinical algorithm represents a medical knowledge associated with the diagnosis of the appendicitis. This knowledge is expressed using the conditional statements of the type: the diagnosis is appendicitis and the management is appendectomy when right lower quadrant abdominal pain combined with white blood cell count above 20000/mm3 is experienced by a male patient.

Conclusions: The clinical algorithm discussed in the paper reflects the physicians inductive reasoning while diagnosing a patient with an abdominal pain. It asks primarily for the evaluation of the abdominal pain site and type, together with the white blood cell count, further supported by the information on pain duration, vomiting, patients sex etc. The sensitivity of a clinical algorithm may be less than that of ultrasonography or computer tomography. However, our study indicates that with appropriate methodology, clinical data might be efficiently used in at least the triage, if not the final diagnosis of the patients, without resorting to expensive diagnostic procedures.

Methodology of Knowledge Integration and Creation for Environmental Issues

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Keywords: Methodology, Environment

Environmental issues are those which we have to imagine beyond the limited time span we are allowed to exist and beyond the bounded spatial region we can look around. In this presentation, we consider problems about evaluation of environment, integration of information, and creation of knowledge.

The necessity of comprehensive studies is widely recognized nowadays to solve environmental problems. It is, however, not easy to fulfill a trans-disciplinary research. Rather, specific environmental studies have progressed recently to a great extent. These studies provide us useful information as data, models or wisdom, but cover only respective small research fields. We are irritated against the difficulty of getting integrated knowledge, or if we borrow words from Nonaka, justified true belief.

Cynically, the explosion of information makes it difficult to understand the whole. The development of a methodology to provide people, including researches and decision makers, with integrated knowledge is now a quite important task to overcome the environmental crisis.

The purpose of this study is to develop a methodology and methods of knowledge science, which could support us to understand the inseparable whole and to make decisions socially as well as individually for the creation of suitable environment. First, a systems-theoretical framework will be formulated for problem recognition. The framework model proposed by the Environmental Agency of Japan will be used as its core. The framework model is an integrated model consisting of a number of sub-processes related to environmental problems and human activities.

Then, some methods will be developed in order that the framework model grows up to be a viable knowledge model. In addition to the traditional statistical analysis, a newly developing knowledge management technique will be used to deal with knowledge that is not necessarily explicit. Here, implicit knowledge has two meanings: one is the so-called personal tacit knowledge that is difficult to explain with words, the other is the individual explicit knowledge that has not yet acknowledged socially.

Finally, the discussion will be extended to the applicability of a new discipline, complex systems analysis, to cope with the complexities existing in both environmental problems and human behaviors.

As a concrete example, this study treats environmental problems and their management in Ishikawa prefecture where our JAIST is located. A careful investigation has been carried out to know what kinds of environmental problems exist in the prefecture, how these problems are related to regional economy and policies enforced in the past, and what kinds of systems are required to integrate environmental knowledge in the prefecture.

The paper consists of investigation of past and current environments in the prefecture, introduction, identification of the framework model, findings obtained by consideration on model parameters, proposal of an environmental management system, summary and future works.

Based on the investigation of past and current environmental problems in the prefecture, the Ishikawa version of framework model has been developed. However, because of the limitation of data, parameter identification is executed only for the first four processes, which are related to basic productions, production factors, wastes, and measures. The rest of processes concerned with environmental changes, environmental interactions, environmental impacts, and adjustments are treated in the context of knowledge management.

As to the process of environmental measures, since there is no available numerical data, some text data and human knowledge have been used to analyze the relations between productions, measures, and wastes. The text data used here is the set of time series data of implemented policies. The knowledge data has been obtained by the interview to local government officers. Based on the analysis on the relations between productions, measures, and wastes, the paper considers the effectiveness of policies on environmental problems.

For environmental knowledge management, the knowledge creation theory for organizations is extendedly used to design an environmental knowledge management system that integrates environmental knowledge. If this system is completed, it will create new knowledge from data or information, integrate new and existing knowledge, and provide useful knowledge to policy makers, researchers, and citizens. The parameter identification method in the processes of environmental changes, environmental interactions, environmental impacts, and adjustments in the framework model is discussed in the context of using expert knowledge as data for identification.

This study helps us to understand the environmental problems in Ishikawa prefecture, especially, the relations between the wastes problem and regional economy and policies. This study is one of the few investigations that treat the environmental problems in Ishikawa prefecture. Moreover, the consideration of environmental management offers a useful guide for the future studies on the creation of our environment using explicit as well as tacit knowledge. After the completion of the framework model, it could contribute to the effective policy-making, creation of new industries, and information disclosure to citizens.

There are many problems left for future study. It is quite difficult to identify the complex relations between individual environmental problems, and to develop statistical models expressing the complex effects of those problems on human activities. One of the challenging problems is to design a multi-agent simulator that could be an engine of the framework model. This is a bottom-up approach that constructs models on the computer and evaluates them comparing simulation results with the real world.

This study is an implementation of Sawaragi's shinayakana systems methodology in the field of environmental science.

LP solvable models for decisions under risk

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Keywords: Decisions under risk, risk measures, stochastic dominance, linear programming

Comparing uncertain outcomes is one of fundamental interests of decision theory. Our objective is to analyze relations between the existing approaches and to provide some tools to facilitate the analysis. We consider decisions with real-valued outcomes, such as return, net profit or number of lives saved. A leading example focusing our attention, originating from finance, is the problem of choice among investment opportunities or portfolios having uncertain returns. Although we discuss in details the consequences of our analysis in the portfolio optimization context, the theoretical analysis itself is valid for the general problem of comparing real-valued random variables (distributions), assuming that larger outcomes are preferred. The only restriction we impose is that all the random variables X under consideration satisfy the condition $E\{|X|\} < \infty$ (which is certainly true in the portfolio optimization context). Owing to that, our analysis covers a variety of problems of choosing among uncertain prospects that occur in economics and management.

Two methods are frequently used for modeling choice among uncertain prospects: *stochastic dominance*, and *mean–risk analysis*. The former is based on an axiomatic model of risk-averse preferences: it leads to conclusions which are consistent with the axioms. Unfortunately, the stochastic dominance approach does not provide us with a simple computational recipe—it is, in fact, a multiple criteria model with a continuum of criteria. The mean–risk approach quantifies the problem in a lucid form of only two criteria: the mean, representing the expected outcome, and the risk: a scalar measure of the variability of outcomes. The mean–risk model is appealing to decision makers and allows a simple trade-off analysis, analytical or geometrical. On the other hand, mean–risk approaches are not capable of modeling the entire gamut of risk-averse preferences. Moreover, for typical dispersion statistics used as risk measures, the mean–risk approach may lead to inferior conclusions.

The seminal Markowitz [1] model uses the variance as the risk measure in the mean–risk analysis. Since then many authors have pointed out that the mean–variance model is, in general, not consistent with stochastic dominance rules. The mean–variance approach applied to the portfolio optimization results in a formulation of a quadratic programming model. Following Sharpe's [2] work on linear approximation to the mean–variance model, many attempts have been made to linearize the portfolio optimization problem. Yitzhaki [3] introduced the mean–risk model using Gini's mean (absolute) difference as the risk measure (hereafter referred to as GMD model). Konno and Yamazaki [4] proposed the MAD portfolio optimization model where risk is measured by (mean) absolute deviation from the mean. One may be interested in mean absolute deviation around the median rather than around the mean. The reason for this is that the mean absolute deviation around the median is less that around any other value. In other words, the median minimizes the sum of the absolute and this, in fact, the appropriate definition of the median. All these models are computationally attractive as (for discrete random variables) they result in solving linear programming (LP) problems. If the returns are multivariate normally distributed, then the models are equivalent to the Markowitz mean–variance model. However,

these mean–risk models do not require any specific type of return distributions.

Recently, it has been shown [5] that the standard semideviation (square root of the semivariance) or the mean absolute deviation (from the mean) as the risk measures make the corresponding mean–risk models consistent with the second degree stochastic dominance, provided that the trade-off coefficient is bounded by a certain constant. In this paper we analyze the dual (quantile) model of the stochastic dominance which allows us to show similar consistency results for the mean absolute deviation from the median and to enhance earlier results for the Gini's mean difference as risk measures. The analysis is graphically illustrated within the framework of the absolute Lorenz curves.

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Modeling the Process of Resolving Conflict with an Arbitrator Involved in Infrastructure Development

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Keywords: Sequential Decision Making, Game Theory, Incomplete Information, Arbitrator

Large scale infrastructure projects, such as water resources developments usually require a form of joint project involving multiple participants (players). In the process to determine the project to be carried out, players repeat proposals and responses. Such a process can be interpreted as the sequential transition between states defining the project. Then, the transition finishes when a path of the process (conflict) reaches the state where both players do not try to move from. When the information on players' preferences is shared, Pareto efficient state may be achieved through the communication between players. However, if players do not know about the preferences of their counterparts, it becomes difficult to find the state appropriate to compromise. In this case, the neutral arbitrator can play a role in collecting the information and initializing the conflict with the alternative state that is stable and Pareto efficient. In this paper, role of the arbitrator in the conflict on large scale infrastructure projects with sequential decision making process is defined and modeled. First, a sequential decision making process is formulated based on the graph model for conflict resolution by Fang et. al. Then, a methodology to specify necessary conditions that the concerned alternative is stable and Pareto efficient is proposed based on Sakakibara et al. (1999). This method is constructed by extending "robustness analysis (Okada, et al, 1995, Sakakibara et al., 1998)", which specifies necessary conditions for stability. Finally, the effectiveness of presenting alternatives is discussed. If the state satisfy the conditions, the arbitrator can judge the state is appropriate as the compromise. However, it is not obvious if players accept the compromise or not. When the alternative for compromise is presented by arbitrator, players can select whether they accept the alternative or not. If players reject to accept the presented alternative, the negotiation on projects is continued and converge to a state. The state may be worse than the presented alternative for both players. Consequently, players' forecasts on convergence state play critical roles in sequential decision making. In this study, it is shown that the provision of information specified by robustness analysis promotes players' acceptation of the presented alternatives.

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The descriptive power of continuous simulation models estimated in calibration

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Keywords: simulation, calibration, Simulation Model Acceptability Criterion Approach, uncertainty

1. Introduction

The obvious purpose of simulation is emulating the behavior of an object system. A key-step in reaching this goal is determining to which extent the model mimics the system. The process of modeling and simulation consists of a series of steps. In several of these steps model results are compared with system observations, i.e. in calibration, in validation and in using the model to answer questions about the object system. In model validation a model is applied to another system, just by using the other system's input, in order to find out, if the model has some generic values. The objective of calibration is improving the capability of the model to simulate the behavior of the object system, for which it was developed. In calibration some model parameters are regarded as 'estimated', whether derived from a series of experiments or from literature. During the calibration process these estimated parameters are changed, based on all available knowledge on these parameters, in such way that some predefined distance between model results and system observation are reduced. In this way simulation model calibration is just an ordinary optimization problem.

Some aspects of simulation models from softer domains of application, ranging from ecology and environmental science to economics and social sciences, hinder a strait forward approach. This type of models are often based on a body of knowledge, which consists of not generally accepted theories, debatable or controversial hypotheses, questionable simplifications and a bundle of implicit or ambiguous assumptions. The result is uncertainty in the model outcomes, which can be traced back to the structure of the model, input uncertainty and uncertain parameters (O'Neill & Gardner, 1979) and this type of models is often classified as 'ill-defined'. The problems caused by this model uncertainty make any comparison with direct system observations difficult, especially when these observations are not very precise either.

Models are often developed or used to solve a problem for someone else. Communicating uncertainties in that case is both important and difficult (Reckhow, 1994). Often any analysis of the model uncertainties evaporates in the process of decision making. Therefore uncertainties in model results should be presented in an understandable and intuitive way.

The last problem with this kind of models (continuous simulation of ill-defined systems) is related to the multivariate character of these models. Some variables are simulated with high

accuracy, while others are rather uncertain and imprecise. This hinders a balanced calibration significantly, as some variables are over-calibrated in an attempt to calibrate others sufficiently.

In this study an attempt has been made to solve the above problems simultaneously, both in calibration as well as in other simulation model evaluation activities. Three basic concepts have been used in this approach: usefulness, adequacy and reliability. *A* model is useful if it accurately represents some of the system behavior and useless if it does not (Mankin et al., 1975). This is an alternative for Popper's validity. The usefulness can be expressed in terms of *m*odel adequacy (which part of a system can be adequately simulated by an accompanying model) and *m*odel reliability (which part of the model results has been observed in the accompanying system). Scholten & Van der Tol (1994a, 1994b, 1998) used these concepts to design a new model evaluation approach, which is now called the Simulation Model Acceptability Criterion Approach.

2. Methods and models

2.1. Model evaluation

Using observations of the object system means dealing with large uncertainties of various causes. Many of these are related to errors due to the bare modeling process itself. Averaging over space or time, aggregating processes, lumping and leaving out insignificant entities and processes are examples of simplification, which is the implicit backbone of modeling. The complexity of these sources of error and uncertainty hinders a strait forward error analysis. In this study a user-centered approach has been chosen, in which a user defines some acceptability criterion (allowed inaccuracy and its statistical distribution) for each observed variable, which has to be used in a model evaluation. Using this acceptability criterion means that the evaluation does not merely refer to technical potentials of a model to describe system behavior, but also the expert's perception on these potentials.

If a model is not evaluated, based on single trajectories of variables, but based on a set of trajectories for each variable being generated by a set of parameter vectors, than these set of variable trajectories can be assumed to represent model uncertainty. A model evaluation has to compare these uncertain model results with the user-defined uncertainty in the accompanying observations.

In a model evaluation three subsequent steps have to be taken. First for every variable (with observations) the adequacy and reliability has to be calculated. Next these have to be averaged for each variable over time (and/or space). Finally the variable adequacies and reliabilities can be averaged over the variables to get a model adequacy and reliability. Scholten & Van der Tol (1998) have defined the calculation of the adequacy and reliability at each observed data. The user-defined acceptability criterion (a statistical distribution) is used to draw a set of observations $\boldsymbol{O}$ (at that point in time and for that variable). The set of parameter vectors and the accompanying model results for that variable represents the set of model outcomes $\boldsymbol{M}$ (of a variable at a point in time). Normally before calibration the intersection of $\boldsymbol{M}$ and $\boldsymbol{O}$ is not empty. The adequacy is now defined as the fraction of elements of $\boldsymbol{O}$ in the intersection and the reliability as the fraction of elements of $\boldsymbol{M}$ in the intersection.

When $\boldsymbol{M}$ and $\boldsymbol{O}$ do not overlap, adequacy and reliability is 0 and the model 'fits' very badly with the observations. A perfect model has an adequacy and a reliability of 1. Before calibration the uncertainty in model results is large, which means that the adequacy is high (almost 1) and the reliability low (hardly larger than 0).

In addition to the concepts of adequacy and reliability one can define the descriptive power of a model as the ability to describe the object system, observed in the past, with a high adequacy and a high reliability. Not discussed in this paper is the predictive power, being the ability of a model to predict the systems behavior with high adequacy and high accuracy. Unfortunately, a model has often a high descriptive power for some variables, but fails to describe the behavior

of others accurately.

Models have to be evaluated during calibration, in uncertainty analysis and validation and for any other use of a model, except predicting. The latter cannot be done, before the predicted phenomena have been observed in the object system at hand.

2.2. Calibration

As engine for the calibration procedure, Controlled random Search (CRS), the optimization algorithm of Price (1977) was adopted. This is a very robust, but not very efficient algorithm. It stores a set of solutions (parameter vectors), which are initially random (within the knowledge represented by the parameter distributions) and which converge to a set of parameter vectors with more or less equally 'good' model outcomes. The latter property, i.e. working with a set of solutions instead of single trajectory, can easily used in the Simulation Model Acceptability Criterion Approach:

1. first step: the user has to define for each observed variable an acceptability criterion;
2. initial (random) step: Monte-Carlo runs with parameter vectors drawn from probability distributions, which represent the knowledge on the parameters;
3. optimization step: improving the adequacy and reliability by
3.1. generating a new parameter vector with CRS
3.2. evaluating adequacy and reliability for all variables and for the model
3.3. evaluating a stop criterion: stop if model adequacy ¡ model reliability
3.3.1. if stop continue with 4;
3.3.2. else repeat 3;
4. post-calibration optimization step.

Before a calibration the adequacy is usually high and the reliability low. During calibration both adequacy and reliability have to be maximized, but often the increase in reliability will be realized at the cost of the adequacy. In the end the sum of the adequacies and reliabilities of all variables have to be maximized. When the model adequacy becomes equal to the model reliability, the calibration/optimization has to stop, but this does not mean that all variables have adequacies equal to the reliability of that variable. So this stop criterion is appropriate for the model, but sub-optimal for the separate variables. To deal with this problem a post-calibration optimization step is proposed here, which adapts the user-defined acceptability criterion of each variable in order to minimize the differences between a variable's adequacy and reliability.

With this post-calibration optimization step the descriptive power of the model can be evaluated, as the new acceptability criteria of the variables reflect the accuracy of the model to simulate observed system behavior.

2.3. Models

The Simulation Model Acceptability Criterion Approach has been tested with three different models with increasing difficulty to deal with the various descriptive powers of the models for the various variables.

BAY is a simple ecosystem model with 3 differential equations for dissolved nitrogen, algae biomass and dead algae, 11 parameters and 3 observed variables, which have more or less equal descriptive power.

COCO (COmputermodel COckle) is a new ecophysiological model of growth and reproduction of a single cockle over its lifetime under seasonal variations in temperature, food availability and metabolic demands. It contains feedback loops in the uptake and metabolism of food and in the partitioning of carbon to the internal state variables somatic tissue, storage, organic shell matrix and gametes. Some of the observed variables are rather hard to measure, while others are easier to describe by the model with higher accuracy.

SMOES (Simulation Model Oosterschelde EStuary) has 4 spatial compartments, 11 state variables (2 nutrients, salt, oxygen, 3 groups of algae, zooplankton, 2 types of particulate organic

carbon and particulate silicon), many forcing functions for some ecological groups, hydrological and climatic conditions (time series), as well as thousands of input data and observations. The major shortcomings of the model is that it describes some variables (nutrients, oxygen, POC, etc.) with much more precision than others.

3. Results

All 3 models are recalibrated with the proposed method (including the post-calibration optimization step) and the major results will be presented in terms of model adequacy and reliability and the effects of the post- calibration optimization step on the descriptive power of the various variables with observations.

4. Discussion

Many open ends are left. How does the method handle hard to find global optima in the presence of (many) local ones? How consistent are the solutions of the method to deal with extreme differences between variables in the descriptive power?

The concept of Pareto-optimality is a complete different approach to treat trade-off between objective functions. It may be an interesting question whether combining this concept with the Simulation Model Acceptability Criterion Approach.

Further the effect of the optimization algorithm (here Price's CRS) has to be investigated by using other methods, e.g. genetic algorithms.

Finally, there may be a difference in final results between the case in which an expert defines the acceptability criteria for all variables and the case in which post-calibration optimization does the job.

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Business Operations Centers in the Transportation Logistics Area

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Keywords: Logistics, Transportation, Operations Centers

The concept of an Operations Center (OC) is a familiar one, particularly in military environments. The NASA Space Center for monitoring space flights perhaps best embodies the notion of what an OC looks like.

Private companies have similar needs with respect to their day to day operations. Although the cost of failure may not be so severe as in the case of NASA, it is nevertheless vital for many businesses to track as closely as possible their daily transactions in order to measure how well they are doing in the corresponding marketplace. Telecommunication companies, for example, must keep a very close eye upon the performance of their networks, for even a small, or temporary, interruption of service can have a major impact upon customer service and satisfaction. Similarly, postal companies must manage elaborate transportation networks in order to deliver mail to their customers within stringent error bounds. A half-day, or more, delay in mail delivery can generate a destructive ripple of customer discontent.

The resources needed to build an Operations Center as elaborate as the NASA Space Center exceed what most enterprises are able, or choose, to support. However, the recent emergence of powerful distributed computing has made the implementation of Operations Centers a feasible undertaking for many enterprises. For example in the transportation logistics and telecommunication area large enterprises start to develop their Operations Centers. Those centers typically perform the functions: performance measurement and continuous improvement of the networks, real- time control of operations and complex processes, customer care and marketing. This multiple functionality is the reason why we propose to call such centers *Business Operations Center* (BOC) rather than OC.

Business Operations Centers, in general, provide a fertile testbed for the confluence of Operations Research applications, model integration and distributed information technology. We present a case study of the Deutsche Post BOC which is under development to support the management of complex transportation networks operated for mail delivery within Germany. The Deutsche Post Case amply demonstrates the integration challenges an undertaking of this magnitude encounters. Many complex optimization models were built, solved, and integrated, and sophisticated information delivery mechanisms were subsequently required to make the model results useful for management decision analysis and support. The unifying theme in this development is the use of decision metrics as the drivers for organizational requirements, model objective functions and database architecture. We describe the modeling, data, and information system architecture dimensions and the decision metrics that underlie them.

During the presentation we will focus on the concepts of the implementation of the BOC functionality illustrated using the business process "LetterMail" of Deutsche Post. The key

ingredient in the deployment is derivation of the associated decision metrics, which drive the data, models, user interface, and indeed the requisite DSS architecture itself. The metrics can be meaningfully displayed on map interfaces and, through the use of OLAP tools, analyzed multi-dimensionally at many different levels of aggregation. We will show how metrics serve as catalysts for the development and integration of complex OR models such as the transportation network optimization models which are used for the design of the Global Area Transportation Network (GAN) for letter mail within Germany.

Finally, we will show a video which illustrates key functions of a BOC by animation of transportation processes and comparison of scheduled and real data.

Modeling and Policy Assessment of Carbon Tax on the Competitiveness in International Market

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Keywords: Carbon tax; competitiveness in international market; input-output analysis; international input-output table; duality in linear programming

In this presentation we attempt to evaluate the impact of carbon tax on the international competitiveness. For this purpose we use international input-output table as an economic system and make a carbon tax model. To make the model we use a primal problem and its dual in terms of linear programming. To evaluate the direct and indirect effects, we use an input-output model. In particular we try to adopt price-competitiveness as the indicator of the competitiveness, because competitiveness can be strongly influenced by the price-up and it can be measured quantitatively. In actual international market, competitiveness is also influenced by wages and exchange rates. However, since it is difficult to measure the changes in wages and exchange rates because of the existence of carbon tax, we assume that wages and exchange rates are constant. We show a numerical example consisting of available real data and we evaluate the change of competitiveness between Japan and each major country in Europe.

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Interpreting and Extending Conventional Cost Allocation Methods for Multipurpose Reservoir Developments by Use of Cooperative Game Theory

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Keywords: Game Theory, Conflict Analysis, Multi-purpose Reservoir

In multi-purpose reservoir developments, a conflict arises in such a manner that joint costs need to be allocated among participating uses such as flood control and municipal water supply. This conflict which is called a cost allocation problem is commonly resolved by using a mutually acceptable cost allocation method which should satisfy the conditions of economical efficiency and fairness among uses. In addition, it is necessary for a practically applicable (conventional) cost allocation method to be simple in calculation formula. As a conventional cost allocation method, SCRB (Separable Cost Remaining Benefits method) has been used in U.S. and Japan. ENSC (Egalitarian Non-Separable Cost method) is another promising conventional cost allocation method. These conventional cost allocation methods are recognized as practical and time-tested allocation methods and will continue to be the most effective cost allocation methods for the time being. However, there are criticisms that the allocation is ad hoc and has no sound theoretical ground.

Previous studies pointed out the allocation by conventional cost allocation method may coincide with one by cooperative game theory-based cost allocation method numerically. This suggests that conventional cost allocation method holds game theoretic reasoning through the coincidence. However, the condition of coincidence has not been derived yet. If the condition of coincidence is derived, we can specify the extent to hold the reasoning of the allocation by conventional method. Using this result, we can evaluate which conventional method is justifiable to apply.

In this study, we examine the conditions of coincidence between conventional cost allocation method and cooperative game theory-based cost allocation method. We deal with both core-based allocation concepts such as Nucleolus, Weak-nucleolus and propensity to disrupt and another type of allocation concept.

The condition of coincidence can be related to the cost game characteristics such as convexity. We show that SCRB has theoretical reasoning in convex cost game while ENSC has theoretical reasoning in one-convex cost game. In addition, we examine the typical cost game characteristics of multi-purpose reservoir development. As a result, convexity may hold for most realistic reservoir developments.

We conclude that SCRB may well be more justifiable than ENSC, assuming that cost game characteristics tend to hold for multi-purpose reservoir development.

Multi-Objective Stochastic Dynamic Programming Model with Partially Observed States for Operation Design of Urban Drainage Systems

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Keywords: partially observable Markov decision process, stochastic dynamic programming, urban drainage dystems, dperation design

Major issues of urban inner-basin drainage are to cope with flooding caused by torrential downpour and water pollution caused by washing load from non-point sources. Large-scale trunk sewer and pump stations are constructed in Japanese large cities. As to reduce both types of damages due to floods and water pollution, these sewerage systems should have additional functions of storage and treatment of the washing load. In such a case, pump operation has key roles for reduction of damages. However, perfect observation of state of the system is difficult since continuous observation of water levels and/or water flows in all the point of sewer are necessary. Hence, we cannot use operation optimization techniques that require perfect observation of the system.

The paper focuses on this partial observablity of states for pump operation problems in sewerage systems. In the first part of the paper, the rigorous formulation of the problem is described and it is shown that the optimal operation policy takes the form of mapping from finite a point in state space to release volume. In real world problems, dimensions of state vectors tend to large enough as to prohibit direct application of the model. In order to cope with this problem, the paper presents an approximate method as to obtain sub-optimal operation policy under partially observable state information. This method contains an observation equation, which is formulated by considering hydrological characteristics. Numerical examples are also provided as to demonstrate its applicability to large-scale real world problems.

Soft sensoring with support vector machines

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Keywords: soft sensors, statistical learning theory, adaptive modelling, support vector machines

Chemical plants rely increasingly on information from measurements in the plants to ensure quality of products and enable control. Off-specification processes can result in poor product quality, lead to plant shut-downs, environmental contamination, or even be a hazard to human life.

Therefore, there is a need for real-time analysis in process plants. Hardware on-line analysers are able to measure a wide variety of properties. However, they are in many cases impractical due to costs, corrosion, maintenance, or other factors. Inferential models can be used in many cases to substitute hardware analysres. These inferential models are sometimes called software sensors or virtual on-line analysers. They are in fact computer programs that calculate the analyser value or laboratory value as a function of some more easily measurable process values.

As recent as 1993, a new type of learning machine , called Support Vector machines became available. Support Vector Machines make use of the Structural Risk Minimisation Principle and behave non-linearly. A difference with neural nets is that support Vector Machines can be used in small sample learning problems. Support Vector Machines are being used mostly for classification problems. In the present application they are used in a regression mode.

In the presentation it will be indicated how Support Vector Machines may be used for building soft sensors in a process-industrial environment where adaptive modelling is necessary.

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