

**BENELUX SD CHAPTER CONFERENCE on Safety, Security, and
Public Health in a Dynamically Complex World**

29 June 2012 @ Faculty of TPM, Delft University of Technology, Delft, The Netherlands

09:00-09:30	Registration (coffee and tea is available for free at two of the coffee machines)		
09:30-10:00	Plenary Welcome (Room A – Inge and Erik)		
10:00-10:30	Plenary 1 SECURING RESOURCES (Room A)		
10:30-11:00	Coffee/tea Break (included – in the TPM restaurant)		
11:00-12:30	Parallel 1A (room H) SAFETY, SECURITY & PUBLIC ORDER	Parallel 1B (room I) HEALTH POLICY	Parallel 1C (room J) WATER SAFETY
12:30-13:30	Lunch (included except for students without presentation)		
13:30-15:00	Parallel 2A (room H) SAFETY, SECURITY & PUBLIC ORDER	Parallel 2B (room I) HEALTH POLICY	Parallel 2C (room J) ENERGY SECURITY
15:00-15:30	Coffee/tea Break (included)		
15:30-17:00	Parallel 3A (room H) NATIONAL SAFETY & SECURITY and HEALTH POLICY	Parallel 3B (room I) STUDENT THESIS SESSION	Parallel 3C (room J) RESOURCE ISSUES
17:00-17:30	Plenary 2 WATER SAFETY AND SECURITY (Room A)		
17:30-17:40	Closing remarks (Room A)		
17:40-18:00	Drinks (included – TPM Restaurant)		
18:00-...	Dinner (TPM – TPM Restaurant)		
22:30	Faculty closes		

List of Accepted Presentations

Plenary 1 – Resource Scarcity (10:00-10:30)

Analysing the Uncertain Future of Copper with Three Exploratory SD Models

Willem Auping (TUDelft / HCSS), et al.

Abstract: *High copper prices, the prospect of a transition to a more sustainable energy mix and increasing copper demands from emerging economies have not led to an increased attention to the base metal copper in mineral scarcity discussions. The copper system is well documented, but especially regarding the demand of copper many uncertainties exist. In order to create insight in this systems behaviour in the coming 40 years, an Exploratory System Dynamics Modelling and Analysis study was performed on this topic. For this purpose three different models were developed representing different views on copper supply and demand. The behaviour of these models shows crisis-like behaviour for the copper price and often declining consumption of refined copper. Further, six different policy options have been developed and tested, individually and in combinations, for robustness in countering potentially undesirable behaviour of the copper models. The results of these tests are that emphasising on recycling and development of strategic re-serves for this metal are potentially helpful.*

PLENARY 2 – Water Safety and Security (17:00-17:30)

What a tangled web we weave – unraveling the strands of a South African water problem

Jill Slinger (TUDelft) and **Jai Clifford-Holmes** (Rhodes University, SA)

Abstract: *After nearly 20 years of democracy South Africa is plagued by pernicious problems in water service delivery. The Sundays River Valley municipality (SRVM) is a case in point. Tasked with the provision of potable water to her residents, this small, poor municipality in the Eastern Cape province has failed miserably, scoring less than 20% in the national Blue Drop evaluation of water services. Furthermore, the municipality is struggling to manage its finances appropriately, and has been placed under curatorship. The situation of the municipality and its people is aggravated by a lack of technically trained staff and capable managers. No-one appears to have an overview of the problem and many are blaming national administrative and water policies, saying that the policies are not amenable to implementation. The transdisciplinary research approach adopted in this study seeks to address the gap between policy and practice by identifying the strands of finances, water and knowledge making up the problem and then developing a System Dynamics model to explore the manner in which these strands tangle into the existing wicked problem. The initial model will be described and the process whereby the model is to be validated by people resident in the Sundays River Valley will be explained. Insights regarding potential solutions and their viability will be discussed. The role that System Dynamics plays as a knowledge intervention mechanism will be highlighted.*

Prostitution and Human Trafficking: A model-based exploration and policy analysis

András Kóvári (TUDelft)

Abstract: *The meeting of the oldest profession with modern slavery is the topic of this paper. After a brief introduction into the problem of prostitution-related human trafficking, this study focuses on the Dutch policy debate. A first dynamic simulation model is presented based on the problem situation in the Netherlands intended to explore the field and give more understanding about the effects of proposed policies. Using this simulation model a short policy analysis is carried out uncovering the dynamics of the system leading to some preliminary conclusions. Finally it is argued that deep uncertainties exist in this problem field and this is just the first model from various plausible models that are currently developed. An in-depth exploration of the uncertainties related to many of the parameters, functions and structural assumptions will be performed using Exploratory System Dynamics Modelling and Analysis (ESDMA).*

The Illicit Trade of Heroin to Europe: Evaluating Policies to Reduce the Heroin Market Size in Europe

Pouya Rahmati (TUDelft)

Abstract: *This research is focused on exploring the dynamics of the heroin market and evaluating the effectiveness of different policies aimed to reduce its size. A quantitative system dynamics approach is used, including modeling the heroin market, validating the model, and using it in order to explore the behavior of the system and evaluate the policies. Two policies that were evaluated in were focusing on heroin seizures and heroin distribution programs. The results of this research shows that focusing on heroin seizures cannot have any long term effect on the market while heroin distribution programs can solve the heroin problem in specific regions with reducing its profitability, but it makes the situation in other regions worse.*

A Bright Future for System Dynamics in National Safety & Security, and Health Policy?

Erik Pruyt et al. (TUDelft)

Abstract: *In an ever more complex and uncertain world, integrated risk-capability analysis methodologies that allow dealing with increasing degrees of complexity and deep uncertainty are needed more than ever before. Today, some governments and organizations use scenario approaches, risk assessment methods, and capability analysis methods, but few use truly integrated risk-capability approaches, and almost none use integrated risk-capability approaches that take deep uncertainty seriously into account. This paper presents and illustrates a novel integrated risk-capability analysis approach for dealing with deeply uncertain dynamically complex risks, and discusses near future developments related to integrated risk-capability analysis for such issues. As such, it illustrates a multi-method consisting of Exploratory Modeling and Analysis, Exploratory System Dynamics Modeling, Scenario Discovery and Selection, and Robustness Optimization for simultaneous all-hazard capability-based planning. The topics selected to illustrate this line of work in National Safety and Security (acute pandemic shocks,*

chronic pandemic shocks, latent societal risks related to societal aging) all relate to Health Policy: many important health issues are National Safety and Security risks too.

Parallel 2A – SAFETY, SECURITY, and PUBLIC ORDER

System Dynamics to Measure the Potential of Intelligence Led Policing

Mariëlle den Hengst (TUDelft / Police Academy) and Bart de Graaf (TNO)

Abstract: *Intelligence-led policing has been applied as policing concept worldwide. Despite some good stories, the effect of intelligence-led policing is unknown. This paper presents a method with which it is possible to measure the potential of intelligence-led policing in increasing the efficiency and effectiveness of policing. The method is based on system dynamics to take into account the complexities of intelligence-led policing. The method has been applied in a case study in the Netherlands for evaluation purposes. The case study shows that system dynamics can be used to gain insight in the effects of intelligence-led policing in a more structured way. With system dynamics it is possible to support the ‘good stories’ of intelligence-led policing with grounded argumentation that do not only take intelligence-led policing into account but look at a myriad of factors that might influence the performance of policing.*

Improving Police Effectiveness wrt Two Priority Crimes: A SD Approach

Rob van Waas (TUDelft), et al.

Abstract: *The Dutch police has committed itself to lower crime rates especially on so-called priority crimes housebreaking and robbery. In a dynamic and complex environment it is difficult to measure the effectiveness of a certain measure or intervention. For example, the number of committed crimes could lower because of both police measures as well as because of mental healthcare. On the other hand a successful, relatively crimeless, year could be offset by a single person or gang. For these reasons SD together with an uncertainty approach could be very useful. In the research done the Dutch police system is modeled in a broad sense using ESDMA in order to find robust policies for the Dutch police and allow them to experience policymaking virtually.*

Consensus-building in a problem neighbourhood: model building as an intervention method for improving safety

Etiënne Rouwette (Radboud University Nijmegen) and Inge Bleijenbergh (Radboud University Nijmegen)

Abstract: *Structural disturbances of public order were occurring in a number of streets in a neighbourhood in the outskirts of a Dutch city. There was nuisance and criminality, improper use of public space and new residents felt intimidated. When these problems escalated around the turn of the year, the municipality decided that it was time to intervene. The municipality invited researchers from Radboud University Nijmegen to group model building to help make an analysis of this problem. This intervention method requires intensive participation of the individuals directly involved. Representatives of the municipality, police, public prosecutor’s office, housing associations, schools and the planning office worked together on building a causal diagram with which they could*

attempt to explain the disturbances of public order. The researchers aided this process by facilitating model building sessions. The process of jointly building a model was intended to encourage the individuals involved to share their knowledge about various aspects of the problem and to create a complete overview. It also offered the possibility of formulating leverage points to improve the situation. This presentation describes the process and evaluates its results. We evaluate results based on the degree of openness in communication, whether the participants learn from each other and the quality of the conclusions that resulted.

Parallel 3A –NATIONAL SAFETY AND SECURITY and HEALTH POLICY

Developing Scenarios for Deeply Uncertain Dynamically Complex Risks: Exploring Plausible Futures of Lyme Disease

Erik Pruyt (TUDelft) and Jeroen Coumou (University of Amsterdam)

Abstract: *Lyme disease poses an uncertain dynamic threat to many people and public health systems. Thousands of plausible evolutions of lyme disease are generated using System Dynamics models and are studied in this exploratory study with new data analysis techniques in order to assess the risk posed by Lyme disease, in this case to the Dutch population and the Dutch health care system. The risk is scored in the Dutch National Risk Assessment framework adapted to deeply uncertain dynamically complex risks, and mapped in a new type of risk diagram developed for uncertain complex risks in order to compare the risk posed by Lyme disease to many other plausible risks. Scenario discovery techniques are used to identify a small set of representative scenarios that could be used in a capability analysis.*

Adaptive Policymaking under Deep Uncertainty: Optimal Preparedness for the next pandemic

Caner Hamarat et al. (TUDelft)

Abstract: *The recent flu pandemic in 2009 caused a panic about the possible consequences due to deep uncertainty about an unknown virus. Overstock of vaccines or unnecessary social measures to be taken were all due to uncertainty. However, what should be the necessary actions to take in such deeply uncertain situation where there is no or very little information available? For uncertain and complex future, adaptivity and flexibility should be the main aim for designing robust policies. Here, we propose an iterative approach for designing adaptive and robust policies in the presence of deep uncertainty. A crucial part of this approach is the use of monitoring systems that provide the adaptivity and flexibility of the policy design. In the monitoring system, signposts to track specific information are defined. Specific values of these signposts are called triggers and they are triggered when pre-specified conditions occur in the system. The specification of trigger values is crucial for the policy performance but has not been studied in depth. Here, we use robust optimization to optimize the trigger values. This paper shows that our proposed approach with robust optimization improves policy design in deeply uncertain and complex situations where very little information is available.*

The arms race of the 21st century

Tim Sweijts (HCSS) and Willem Auping (HCSS/TU Delft)

Abstract: *The key focus of this research project is whether and how time tested strategic concepts from the nuclear domain apply in strategic cyber space. More precisely, we will assess whether strategic concepts that emerged in the nuclear era and regulated the use (or rather the non-use) and proliferation of nuclear weapons, are valid for the cyber domain as well. These concepts include – but are not limited – to deterrence, offence-defence dominance, parity, vulnerability, and attribution. The examination of whether and how these traditional strategic concepts apply in cyber space will identify the key technological and social parameters associated with these strategic concepts. This in turn will add to a better understanding of strategic cyber space, make a contribution to the nascent strategic cyber paradigm, and shed light on the type of policies that are appropriate in this domain.*

Parallel 1B – HEALTH POLICY

Societal Aging in the Netherlands: Exploratory SD Modeling and Analysis

Tom Logtens (Initi8), et al.

Abstract: *Mismanagement of societal aging is an important threat to health care systems, social security systems, and the economy of many nations. A System Dynamics simulation model related to societal aging in the Netherlands and its implications for the Dutch welfare system is used here as a scenario generator for Exploratory System Dynamics Modeling and Analysis - a System Dynamics-based approach for exploring and analysing deeply uncertain dynamically complex issues and testing policy robustness many plausible futures. Key concerns derived from this exploratory research are (i) the existence of plausible futures with severe labour scarcity, especially in health care, (ii) unsustainable evolutions of health care costs, and (iii) insufficient labour productivity, especially in health care. Our analysis shows that labour productivity may be cause of and cure for many of the undesirable evolutions. We conclude that (i) sufficient increases in labour productivity in health care as well as labour productivity in general without pinching the necessary workers in care are needed, and (ii) sufficiently raising the retirement age only helps if both the willingness to work longer and the willingness to keep older employees increase. These conclusions are derived from systematic data analysis which is fully documented in the appendix.*

Societal Aging in the Netherlands: Societal Aging II

Willem Auping (TU Delft / HCSS), et al.

Abstract: *Een aangepaste versie van het vergrijzingsmodel uit de voorgaande abstract is in deze studie gebruikt om beleidsopties betreffende de vergrijzing in Nederland te testen onder diepe onzekerheid. Het bleek in deze studie dat geen enkelvoudige beleidsoptie op zich al voldoende effect sorteert om de kosten van de vergrijzing houdbaar te houden. Er dient daarom een combinatie van maatregelen te worden geïmplementeerd, die samen, onafhankelijk van de uiteindelijke toekomst, tot een*

houdbare vergrijzing leiden. Dit pakket aan maatregelen zou in ieder geval het volgende moeten bevatten: (1) De belangrijkste maatregel voor het betaalbaar houden van de vergrijzing is echter het verhogen van de arbeidsproductiviteit van de Nederlandse beroepsbevolking. Dit zal leiden tot een verhoging van het BBP die noodzakelijk is om de toename van de kosten als gevolg van de vergrijzing op te kunnen vangen; (2) Het verhogen van de pensioenleeftijd heeft vooral effect op betaalbaar houden van AOW. Daarvoor is de meest effectieve optie om de AOW-leeftijd op enige manier te koppelen aan de leeftijdsverwachting. Dit kan op twee verschillende manieren, namelijk volkomen adaptief, dus als de leeftijdsverwachting een nieuwe drempel overstijgt, wordt daarna de pensioenleeftijd verhoogt, of periodiek. Bij de periode variant wordt bijvoorbeeld eens in de 10 jaar de pensioenleeftijd aangepast aan de ontwikkelingen in de levensverwachting in de voorgaande periode. Overigens kan bij een pensioenleeftijd gekoppeld aan de levensverwachting ook omgegaan worden met het feit dat sommige, zwaardere beroepen een kortere (gezonde) levensverwachting tot gevolg hebben; (3) De effectiviteit van het verhogen van de pensioenleeftijd is het grootst als deze gecombineerd wordt met maatregelen die de arbeidsparticipatie van ouderen zullen vergroten en parttime werken door ouderen verminderen; (4) Voor het betaalbaar houden van de zorg is het vergroten van de productiviteit in zowel curatieve als langdurige zorg van belang. Dit heeft als bijkomend gevolg dat de potentiële arbeidstekorten in de zorg als gevolg van de vergrijzing kleiner zullen zijn.

Healthy Ageing and the Costs of Healthcare

Loes Koster, Paul van Hooff et al. (Significant and VWS)

Abstract: *The Dutch ministry of Public Health, Welfare and Sport has asked Significant to build a qualitative simulation model to shed light on the subject of healthy ageing and the costs of healthcare. Special attention is paid to the role of informal care.*

Because healthcare is now better and the post-war baby-boom generation is starting to retire, there will be increasing numbers of retired people who have many years of healthy living ahead. On the other hand, again because of better healthcare, elderly people with diseases will live longer with their diseases, while still needing care and medical treatment.

The main question to be answered was how we can use the increasing vitality of elderly to keep the Dutch healthcare system sustainable. How can the elderly who are still vital contribute to care and support others in their neighbourhood who need it? And how can we decrease the utilisation of publicly financed healthcare by encouraging self-help by elderly people with health restrictions?

Informal care can be divided into two categories: care given to your spouse (or child, partner, friend or neighbour) when he or she needs it, and care that is given by volunteers who (for a variety of reasons) help other people. We have used the Dutch word 'mantelzorg' for the first type of care; for the second type of care, the general term 'voluntary care' is used. A qualitative simulation model was built working with a group of experts in five group model building sessions. The important variables were discussed and grouped into three detailed causal loop diagrams. These diagrams were used to get

a first impression of the complexity of the system and the interventions that could be possible. Three topics emerged:

- 1. the amount of time that vital elderly have available for providing 'mantelzorg' and informal care;*
- 2. the vitality of people who provide informal care is influenced by doing so, sometimes negatively and sometimes positively;*
- 3. trends in the attitude towards providing informal care might change as baby-boomers replace the former generation of care providers.*

Parallel 2B – HEALTH POLICY

Revisiting the Levin-Roberts Patient Dropout Model

Vincent de Gooyert (Radboud University Nijmegen) and Christian Erik Kampmann (Copenhagen Business School)

Abstract: *We review an early system dynamics model of mental health care delivery designed to investigate the premature dropout of patients from therapy (Roberts & Levin, 1976). The purpose of our paper is to a large extent pedagogical: First, using the model as a case, we wish to demonstrate the application of current standards and methods of critical model analysis as an illustration of the development of our field. Second, we propose a series of revisions to the model that illustrate techniques for promoting consistency and stringency in modeling “soft” variables related to human emotions, perceptions and attribution of cause, while remaining as true as possible to the purpose and conceptual framework of the original model. Finally, we consider the implications of the revised model for the questions raised by original authors. Many of the conclusions of the original work remain intact, but we find that the revised model provides a more consistent explanation of the dropout phenomenon using concepts that are closer to those used in psychotherapy.*

Outpatient Treatment of Patients with Mental Health Problems

Rosa Remmerswaal, Paul van Hooff, et al. (Significant and VWS)

Abstract:

The Dutch ministry of Public Health, Welfare and Sport has asked Significant to build a simulation model to test a policy for Mental Healthcare. In the Netherlands, the proportion of patients treated in mental health institutions is larger than in the surrounding countries. This has consequences for the long-term costs of (mental) healthcare. There is also ample scientific evidence that treating these patients in their own home environment (outpatient treatment) has a more beneficial effect on wellbeing for many of them than treatment while staying in an institution. The questions asked by the ministry were (1) how many patients can be treated in an outpatient setting, (2) what are the consequences in terms of the flow of patients through other parts of the mental health system, and (3) how much money will be saved in the long run.

An initial version of a simulation model was constructed using System Dynamics and Group Model Building. The model was built in three sessions that captured the general

behaviour of the system. For this first model, it was assumed that all the actors involved in the system were cooperating fully.

A number of scenarios were tested in which changes in policies were compared against a scenario in which there was no policy change. Three variables were used to construct the scenarios: the proportion of new patients admitted for treatment while staying in an institution, the proportion of patients currently staying in an institution who could be treated at home, and the length of the period for which patients with severe psychiatric disorders are treated in an institution.

The experts all agreed on the idea that it is possible to reduce the number of patients in mental health institutions drastically, by at least 33% and maybe even by 50%. This will lead to more patients who have to be treated at home. In the case of a crisis in the development of the patient's condition, a number of beds have to be reserved for short stays in mental health institutions. The length of the short stay will be kept as short as possible.

The net effect in 2020 on the costs of mental healthcare shows a reduction of about 10%. A follow-up of the model being built would involve incorporating the behaviour of the actors and adding the effect of using an 'early warning system' in order to start treatment in the early stages of the condition.

3B – STUDENT THESIS SESSION

How to Explore and Manage the Future? Formal Model Analysis for Complex Issues under Deep Uncertainty

Bas Keijser (TUDelft)

Abstract: *This paper argues for a renewed interest in Formal Model Analysis, especially for dynamically complex issues under deep uncertainty. Formal Model Analysis is normally used to research structure-behaviour relations in case of dynamic complexity under relatively small amounts of uncertainty. When deep uncertainty starts to play a role, exploratory modelling is used. Formal Model Analysis can strengthen the exploratory modelling by assisting in generating plausible dynamics, analysing plausible dynamics, identifying plausible policy levers and exploring and comparing various policy options under deep uncertainty. An illustration of the proposed connection of methods is given by using Ford's Loop Deactivation Method to explore and analyse the behaviour patterns generated by a generic model of the scarcity of minerals and metals.*

Effects of information presentation on the choice of decision strategies and learning effects in a dynamic decision environment

Victor Alexiev (Radboud University Nijmegen)

Abstract: *This paper hypothesizes that the Misperception of Feedback in flight simulator experiments might arise not only from individual's inability to learn in dynamic and complex decision environments, but also from the chosen design and organization of the information display. Research in behavioral decision making suggests that information presentation has a strong influence on the choice of decision strategies. However, these effects have not been sufficiently researched from a System Dynamics Modeling*

perspective. An inquiry into the subject is critical as Interactive Learning Environments are an important communication channel and sometimes, a key delivery in System Dynamics interventions. To compare the effects of information presentation on performance and learning, this author has performed an experiment attempting to replicate the results from the original Boom and Bust paper of Paich and Sterman (1992). The control group was exposed to a simulation interface similar to the one used in the original paper, while the treatment group was exposed to an alternative interface, designed using Tufte's principles of good design of data displays (2001).

Modeling Movie Release Strategies

Hughes, C.R. (Ryan) (Radboud University Nijmegen)

Abstract: *This research examines the impact of distributor release strategies on the diffusion of motion-picture movies at the US domestic box-office. A model is developed that captures consumer choice as a behavioral process accounting for the movie's intrinsic attributes, consumer heterogeneity, network effects, word-of-mouth, seasonality, marketplace competition, and managerial inputs. The model estimates weekly box-office results for 137 movies and achieves a median r-squared of 0.98 and fits 91 percent of the movies with an r-squared of 0.75 or better. Managerial decisions regarding a movie's release date and distribution strategy are demonstrated to significantly impact box-office performance. The study demonstrates that accounting for this full range of factors not only improves the model's fit, but also leads to a parameter set that depicts a richer description of the movie industry.*

1C – WATER SAFETY

Exploratory system dynamics: a directed search for limits to global water use

Jan Kwakkel (TUDelft) and Jos Timmermans (TUDelft)

Abstract: *Rockström et al. (2009) introduced the concept of a safe operating space for humanity that will not push the planet out of the 'Holocene state'. These limits are being investigated for various earth bound systems. Estimates of these limits are plagued by uncertainty. In case of the limits to the world water system, these uncertainties arise out of conflicting models, regional variations, limitation of expansion of water use through financial and institutional capacity, uncertainty about the realization and efficiency of trans-boundary water transfers, and interdependency between the water system and other earth systems. This paper aims at investigating the limits to global freshwater use. To this end, the behavior of a System Dynamic model of the world water balance is explored across a wide variety of uncertainties. Active non-linear testing is used to identify the best case and worst case for water stress and world population. We find counter intuitive results related to the occurrence of maximum water stress, conclude that global limits can be investigated with a spatially aggregated model and are strengthened in our hypotheses that exploratory modeling adds to the understanding of complex and uncertain issues in a way that predictive approaches cannot.*

Searching for a safe operating space fo human water use: an exploratory anlaysis with WorldWater

Sebas Greeven (TU Delft)

Abstract: *Safe operating space for human activities that will not push the planet out of the 'Holocene state' that has seen human civilizations arise, develop, and thrive can be defined with respect to among others global freshwater use. Establishing such limits is a methodological challenge because they are critically depended on local conditions, the role of management, and financial and institutional capacity in magnifying or ameliorating problems. Moreover estimates of these limits are plagued by uncertainty arising out of conflicting models, regional variations, limitation of expansion of water use through financial and institutional capacity, and uncertainty about the realization and efficiency of trans-boundary water transfers. This research aims at investigating the limits to global freshwater use through exploratory modelling and analysis. To this end, the behaviour of a WorldWater, a water specific extension to World3, is explored across a wide variety of uncertainties. The resulting dynamics are analysed, dynamics indicative of water shortage are identified, and their causes established..*

2C – ENERGY SECURITY

Modelling Ethanol Supply, Demand and Price in the Brazilian Macro Economy

Erico santos (Radboud University Nijmegen)

Abstract: *The Brazilian program for sugarcane ethanol has been greatly successful since its inception about 40 years ago. But the road has been bumpy and today there are still major problems with price, supply and demand stability. This paper describes a research with the objective to propose policies by the government to stabilise and foster the Ethanol market in Brazil. The policies are tested by simulation. For that purpose a system dynamics model was built and calibrated to mimic the industry. Once the model is considered robust, it is used to test several proposed policies under different macroeconomic scenario forecasts. Historical evidence and the simulations suggest that the dynamics in the system are highly important in defining prices and other important variables. As one example, periods of high growth tend to negatively influence productivity after five to six years via a decreased investment in crops renovation which may create long term cycles. The effects of long term dynamics are mixed with several short and long term cycles typical of commodities markets and the combination increases complexity exponentially. Simulation can be a crucial tool for understanding causality and planning sound policies for the medium to long terms.*

Policy design for an uncertain power sector in the EU using ESDMA to assess policy robustness under deep uncertainty

Erwin Loonen (TUDelft)

Abstract: *Ex-post assessment studies show that most EU countries perform disappointing on effectively designing low-carbon power generation support policies. However, using ex-post assessment studies to learn from European best practices in designing energy policy support schemes do not assure robust policy design for the*

future. The reason is that these studies fail to incorporate the system dynamical behaviour in an uncertain future. This research uses Exploratory Modelling and Analysis in combination with a System Dynamics model (EMA+SD=ESDMA) for an ex-ante study on low-carbon energy generation support policies to decarbonize the EU power sector. Several sets of adaptive policy measures are designed and assessed at an EU and individual Member State level. The results of this study can be used to facilitate a transition towards carbon neutrality of the EU power sector in 2050 in an uncertain future world.

Adaptive Policymaking under Deep Uncertainty: Smart Energy Transition Management Caner Hamarat (TUDelft)

Abstract: *Uncertainty manifests itself in almost every aspect of decision making. Adaptive and flexible policy design becomes crucial under uncertainty. An adaptive policy is designed to be flexible and can be adapted over time to changing circumstances and unforeseeable surprises. A crucial part of an adaptive policy is the monitoring system and associated pre-specified actions to be taken in response to how the future unfolds. However, the adaptive policymaking literature remains silent on how to design this monitoring system and how to specify appropriate values that will trigger the pre-specified responses. These trigger values have to be chosen such that the resulting adaptive plan is robust and flexible to surprises in the future. Actions should be neither triggered too early nor too late. One possible family of techniques for specifying triggers is optimization. Trigger values would then be the values that maximize the extent of goal achievement across a large ensemble of scenarios. This ensemble of scenarios is generated using Exploratory Modeling and Analysis. In this paper, we show how optimization can be useful for the specification of trigger values. A Genetic Algorithm is used because of its flexibility and efficiency in complex and irregular solution spaces. The proposed approach is illustrated for the transitions of the energy system towards a more sustainable functioning which requires effective dynamic adaptive policy design. The main aim of this paper is to show the contribution of optimization for adaptive policy design....*

3C – RESOURCE ISSUES

Evolution of the Plastics Market in Europe

Bauke Buikstra (TUDelft)

Abstract: *Plastic is one of the growing topics of discussion in the Dutch media. The polluting ‘plastic soup’ in the Indian Ocean, the large amount of scarce fossil fuels needed for the plastics production and the carbon footprint of the plastic industry are some reasons for the growing criticism towards the current role that plastic plays in our society. Meanwhile, scientists are researching the possibilities of plastic consuming fungi and large companies worldwide are investing in different types of bioplastic. How do these developments influence the plastics market in Europe? Which scenarios are possible by 2060? Do the oil reservoirs and the crude oil price have a large influence in the plastic evolution? Using a System Dynamics model of the European plastic market,*

including oil prices, bioplastic evolution and sustainability awareness of consumers, an Exploratory Modeling and Analysis (EMA) study will be performed. With EMA, a number possible future scenario's for the European plastic market will be outlined, along with the consequences for society.

Long Term Dynamics of Recycling in the Netherlands

Joris Satolli (TUDelft)

Abstract: *The Dutch government wants to increase the percentage of Dutch waste recycled. This increase will harm the waste combustion sector. The initial plan of the government to undo this harm to the combustion industry by importing extra waste won't work because this will still cause a lot of CO₂ to be emitted. The government therefore needs to stimulate a transition from waste combustion to recycling by breaking down a lot of waste combustion plants. However the breaking down of combustion plants won't go very easy because they are locked-in by other investors, contracts and public interests like sustainability. The question that therefore rests is: What policy should the Dutch government (ministry of Infrastructure and environment) need to implement to assure a good long term transition in the waste industry towards (almost) full recycling?*

Dealing with uncertainties in the mining and consumption of niobium

Jasper Veldman (TUDelft)

Abstract: *Niobium is a metal that is widely used in steel applications due to his special properties. Most of the mining originates in Brazil while Canada is responsible for the remaining mining. In this paper Exploratory System Dynamics Modeling and Analysis is used to explore different uncertainties in the mining and consumption of niobium. Those uncertainties includes inter alia the growth of the consumption and possible export constraints of niobium. After the exploration of the uncertainties, scenarios are developed for dealing with them..*

For updates of this preliminary schedule, see: <http://simulation.tbm.tudelft.nl/BeneluxChapter/News.html>
For more information, please contact Erik Pruyt (E.Pruyt@tudelft.nl) or + 31 15 2787468 (office).