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SUPPLEMENTAL WAYS FOR IMPROVING INTERNATIONAL STABILITY SWIIS

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Abstract: The IFAC TC on "Supplemental Ways for Improving International Stability – SWIIS" is one of the longest situated in IFAC. According to first ideas during the IFAC World Congress in Kyoto 1981 this IFAC – at that time - Working Group organised in 1983 the first Workshop in this highly interdisziplinary field in Austria. Meanwhile a Technical Committee in IFAC, SWIIS was always a bridge between (control) engineers and various other disziplines to open IFAC to other related fields. Because of the 25th anniversary a short history of SWIIS as well as a outlook in the future, emphasising new topics, will be given in this paper

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1. INTRODUCTION

Throughout history nations have thought to improve the national security by increasing the military forces. Cybernetics and especially control theory and engineering including the related fields of research indicate that there maybe alternative supplemental methods employed for improving the solution of various conflict situation.

Today in conflict resolution we have approaches with less theoretical background without any applications. Furthermore we have only verbal descriptions of the phenomenon without mathematical and control engineering background. Therefore is absolutely necessary to introduce cybernetical and system theoretical concepts especially control theoretical methods as role of a direct connection to the reality. Dynamics of nations and the interactions between nations are highly non-linear and also strongly coupled. From the view point of control theory this is a non-linear, time varying multi variable System. For such complex systems we have to deal with states base approaches, observers, we have determine optimal control parameters probably by adaptive control. Another approach coming from adaptive control is that the model will be able to learn intelligent behaviour.

2. THE ROOTS

First ideas to install a IFAC Working Group on "Supplemental Ways for Improving International Stability - SWIIS" cames up in 1981 during the IFAC World Congress in Kyoto initiated by Hal Chestnut. As a result the first IFAC SWIIS Workshop was held in Laxenburg, Austria, Sept. 13 – 15, 1983. It has greatly benefited from some of the international and interdisciplinary co-operations that were suggested in several of the presentations and discussions during the workshop (Chestnut et.al, 1984). The major sessions of the workshop included the following topics: Cultural, Political, Educational, Behavioural, and Legal Aspects of International Stability; Techno-Economic Conditions for International Stability; System Analytical Approaches to International Stability; Negotiation and Mediation in Conflict Resolution; Decision-Making Processes.

The Second Workshop of the IFAC Working Group on SWIIS took place in Cleveland, Ohio, USA June 3-5, 1986 (Chestnut, 1987). This workshop considered a most important question of our time - how can nations function without the need to go to war to settle international disputes?

In 1989 the IFAC/SWIIS Workshop, "International Conflict Resolution using Systems Engineering", was organised by the Computer and Automation Institute of the Hungarian Academy of Sciences in co-operation with the Austrian IFAC NMO (Chestnut et.al., 1990). This theme thus continued a focus on the interrelationship between technology and conflict resolution that had been established at the previous workshop held in Cleveland USA in 1986.

One of the most important activity was the SWIIS' 92 Workshop. It was held in Bolton (Toronto/Canada), September 21-24, 1992 and was organised by "Science for Peace" on behalf of Canadian National Committee for IFAC. The program of SWIIS'92 contained over 20 technical papers from eight different countries.

The changes affecting the SWIIS Working Group that arose from the 1993 Congress in Sydney present a useful and welcome opportunity to structure and focus the SWIIS activities for the coming years.

3. CONSOLIDATION

While the indicated and probable elevation from WG to Technical Committee status is in fact mainly just part of a general IFAC restructuring that is taking place, the modified

scope suggests some opportunities for new activities and possible changes in direction for SWIIS and its members.

The IFAC event on „Supplementary Ways for Improving International Stability“ - SWIIS'95 was held in Vienna, Austria from September 29th to October 1st, 1995. This fifth event in the SWIIS series was organised by the Institute for Handling Devices and Robotics of Vienna University of Technology. Meanwhile the working group SWIIS was a Technical Committee (TC) in IFAC and the triennial workshops were appointed as regular conferences.

International stability refers to conditions in which nations, in an interdependent way, interact with one another in ways, which permit gradual changes with time in a mutually acceptable scale and direction. This development under stable conditions is considered with respect to social, political, ecological, national and international, regional and global aspects.

The conference continued the tradition set in the earlier four SWIIS meetings. The goal was the beneficial application of systems engineering methods onto description of conditions, in which nations or groups interact with one another. Scientists from other fields such as political science, economics, social science, and international studies should have a platform to present and discuss their ideas. Perhaps, this SWIIS event differed from earlier SWIIS meetings in the efforts to attract a younger generation to the work in the framework of this TC.

Organised by the Technical Committee, a SWIIS session entitled „Supplemental Ways for Improving International Stability“ was scheduled by the organisers of the IFAC World Congress in San Francisco, 1996. All five presented papers gave an excellent survey of the scope of our committee.

According to the SWIIS TC meeting in San Francisco 1996 the 7th SWIIS conference was held in May 14-16, 1998 in Sinaia/ Romania. Papers were given in the following areas: methodological analysis investigation of development: stability, sustainable development**;** modelling of stability**;** **a**pplication of control principles to international Stability**;** East/West/North/South relationships**;** International policy co-ordination**;** global development: regional impact**;** cultural and political aspects in International Stability**;** educational and behavioural aspects**;** negotiation and mediation in conflict**;** applicability of the systems concept.

On the IFAC World Congress 1999 in Beijing the TC SWIIS was responsible for the organisation of two technical sessions. Both had with approximately 40 a very high attendance. The trend, inclusion of more economical and historical topics, started at the two last SWIIS events in Vienna and Sinaia was continued. Examples were the presentations from Dimirovski and from one Institute of the University of Klagenfurt. Starkermann gave very exciting speeches on application of multivariable systems theory to conflict situations.

On the TC meeting it was decided to have an intermediate SWIIS workshop in Macedonia. One of the reasons was the actual political situation in this region. Therefore we had, at the first time in the SWIIS history, contributions of colleagues from Macedonia. This Workshop was very successful and on the TC meeting it was decided to co-operate closer with the the IFAC TC`s on “ Social Effects of Automation” and “ Developping countries”. As a first result of this decision SWIIS was responsible for the organisation of two invited sessions on the DECOM event 2001 also in Macedonia.

The next IFAC Conference was organised in Vienna in 2001 attended by colleages from SOCEFF and DECOM as well as a large number of scientists from Russia. At the IFAC World Congress 2002 in Barcelona SWIIS was responsible for the organisation of an invited session. On the TC meeting it was decided to have the next SWIIS conference in Waterford (Ireland) in 2003 and a “Multitrack Conference” in September 2004 in Vienna.

This anniversary conference in Waterford (Kopacek, Stapleton, 2004) marks twenty years since the SWIIS technical committee was established. It is held at a time of great trouble and uncertainty in the world, a time in which it is difficult for engineers and systems researchers to come together and share ideas, insights, dreams and vision. Barriers are being erected and finances are becoming more difficult to secure. People in many countries are afraid or unable to travel to meet their colleagues elsewhere in the world in events like SWIIS.

In these difficult times the work of SWIIS was more important than ever. It brings together researchers from many countries interested in understanding how technology can be used to benefit people across the globe. A series of papers with a unique variety of perspectives were presented dealing with issues as varied as globalisation, education, unemployment and economic systems. There were also two special sessions. One of these deals with the pressing need to revitalise the debate on engineering ethics, raising questions and providing new insights into how ethical issues can and must be addressed in a ‘global village’ and in the context of the geo-political structures of the twenty-first century. In the second special session the conference also brings together a series of contributions from the Russian Federation. It is now over ten years since the fall of communism in Russia and this session brings together unique perspectives from across the spectrum of current Russian intellectual activity in engineering and systems science. The contributions showed that there are still so many opportunities for researchers as they attempt to harness technology for the benefit of all people of the world. The commitment to the original vision of the SWIIS committee remains as alive as ever.

The contributions to the “Multitrack” Conference in Vienna, 2004 (Kopacek, 2004). covered the whole field of more than 5 IFAC TC’s, like managing the introduction of technical changes, technology and environmental stability, socially appropriate guidelines for control design, socio-technical

systems as complex composite systems, ethics, effects of automation in engineering, upgrading the industrial control systems, decision and control in economics of developing countries, network economics and networking the national economics, e – Business, artificial intelligence for social/economic systems, control of chaos in social/economic systems.

4. RENIEWING

At the IFAC World Congress in Prague, July 2005, the TC SWIIS was represented with one invited session.

On the TC meeting the scope of the TC SWIIS was revised. "To identify, define, and improve factors that significantly influence international stability. To outline ways in which IFAC can use its own systems and control capabilities to enhance international stability and build a more peaceful world. To interact with other organisations having similar goals. To cooperate with other IFAC TCs regarding SWIIS activities".

Furthermore two new Working Groups were created: Working group on " Ethics in Control Engineering" chaired by M. Hersh (Scotland) and a Working group on "Automation in End of Life (EoL)Management" chaired by B. Kopacek (AUT) with the following scope: End of Life Management (EOL) is currently a hot topic not only in the electronics industry. Currently mostly IT equipment and goods of consumer electronics are considered. In the nearest future automation equipment has also to be taken into account. There are three possibilities depending on the age and kind of the device: Resell – Reuse – Recycle called the "3R`s".For recycling fully or semi-automated disassembly will gain in importance in the nearest future especially for automation devices. Developers of automation devices have to take into account EoL because of regulations and laws as well as according to ethical codes contributing to protection of the environment. Automation can contribute to EoL by automate and humanize the recycling process.

The technological development has caused profound changes and social stability. Regions which have stable populations for centuries have experienced enormous population growth leading to the emergence of sometimes unmanageable megaplex cities as well as bringing about macroscopic environmental change. Therefore the scope of the IFAC SWIIS Conference in Prishtina; Kosovo (Kopacek, 2006) was to offer insights into mitigating unwanted side-effects of rapid development and to share methodologies for appropriate ways of managing the introduction of technologies which will alter social stability.

Therefore the contributions covered a very broad field of interest for those subjects like social aspects of technology transfer, managing the introduction of technological change, ethical aspects, technology and environmental stability, and anticipating secondary and tertiary effects of technological development.

The session commenced with a review of the broad range of serious problems facing humanity. Many of these problems can be addressed using control theory and are affected by a range of different automated and semi-automated systems. Systems approaches can help us to understand both the processes and underlying problems, as well as the interrelationships between different problems in the complex underlying systems. Modelling can be used to understand regulation and control issues and consequently to describe possible approach to system stabilisation. The types of control strategies required for an analysis of human systems are in many cases different from those used in industrial engineering. Open systems approaches which have been used to illuminate, for example, technology-driven innovation, were discussed. Typically open system models can cope with both the quantitative and qualitative data needed to describe and understand human activity systems. They can then be used to derive control strategies for human activity systems.

The world is currently facing a number of very serious crises which could lead to potentially catastrophic instability. These crises include the following:

- Environmental crises, including global warming, destruction of the ozone layer, acid rain and atmospheric and water pollution.
- Social crises, including serious poverty with half the world's population living on less than the United Nation minimum to meet basic needs of $2 a day, widespread human rights violations, discrimination, injustice and unequal access to the world's resources.
- Resource crises, including energy and water shortages and an imbalance between population, consumption and resources, so that human activity has outstripped the planet's source capacity to provide resources and sink capacity to absorb wastes.
- Political crises, with excessive influence by the industrial-military complex and the one remaining superpower, which seems to have embarked on a policy of invading other states for reasons other than the officially stated ones.

This list is by no means exhaustive. One of the important questions for the control community is the role of control and systems approaches and trying to resolve these and other potentially catastrophic problems in order to stabilise the system. One way to approach this problem is to use multi-loop action learning, a model of which presented below. This model involves the addition of quadrulple loop action learning to existing methods. It therefore considers the levels of the individual, the organisation and the wider society. Howevever, further levels could be added to give greater specificity about the wider society by representing, for instance, the local, national and global contexts.

One of the important features of multi-loop action learning is that it has both forward and feedback paths. The forward path shows that actions at the individual level are sited in and influenced by the organisational and wider (local, national and global contexts). In addition, actions by individuals have a feedback effect and can therefore influence their organisations and the wider (local, national and global contexts). Similarly actions by organisations have a feedback effect on the local, national and global contexts. This means that change is possible, but not that it is easy, due to pressures to conform on the forward path. This model also shows the value of individuals wishing to achieve change and social stability joining together to form organisations. In this case the organisational context is supportive of change towards social and environmental and social stability and this has a positive effect on the individuals. Similarly the feedback path from the individual to the organisation has a reinforcing effect. These effects have some impact on countering the ethos of the wider social context and supporting the individuals and organisation in working for change.

Thus one of the important roles of systems and control techniques is in analysing and modelling complex problems and showing that individuals, actions and consequences are situated in a wider context which has an impact along the forward path, at the same time as the individuals, actions and consequences are able to influence this wider context along the feedback path.

The work of the Supplemental Ways for Improving International Stability (SWIIS) Technical Committee involves the application of control strategies to non-technical problems, including conflict resolution.

Conflict resolution issues are particularly important in Kosovo: A situation of significant ethnic conflict has existed for a considerable period of time and talks have recently started to try and resolve the status of the territory in such a way as to reduce the likelihood of further conflicts. Control theory can help model, and identify pathways through and beyond inter-ethnic conflict. For example, at the most basic level, positive feedback loops indicate the potential for an exacerbation of problems and negative feedback mechanisms (calming) may be required in order to ensure a controlled and stable path through difficult negotiation periods.

In Northern Ireland, another conflict zone, this was the case in the late 1990s. During this period, while important negotiations were underway, extremist nationalist elements in society planted a massive bomb in Omagh which killed and maimed scores of people and potentially destabilised a delicate negotiations process. Kosovan delegates at the panel session noted that in the current Kosovan negotiations there is a distinct lack of conflict management and control strategies which could be used to help to calm the situation in the context of an atrocity committed by extremist elements. It was recognised that control strategies could be crucial in identifying solutions and potential problems before they appeared.

Control strategies for a sustainable future need considerable attention and this should include consideration of open systems models and the identification of feedforward paths. The systems models will need to be highly dynamic and focus upon navigation paths rather than solely predictive and deterministic mechanisms. The systems involved are emergent and holistic in nature and futures methods might be useful.

One of the classical approaches in SWIIS is modelling a conflict situation as a stability problem in one or between more dynamic systems.

For this we have first to define some similarities between control engineering terms and terms of conflict solution. With corresponding terms (Erbe, Kopacek, 2006) conflict situations can be described by various types of dynamic equations, well known from control engineering. Therefore the classical methods from control engineering can be applied.

From the point of view of theoretical and engineering systems, SWIIS has focussed on the application of continuous time approaches which are well known from the field of process automation (Kopacek et. al., 1990). These approaches have been particularly important in SWIIS work on sustainable future. However, the fields of production automation and systems engineering have advanced over the past few years, giving rise to new methods which SWIIS could usefully apply.

These new approaches (Kopacek,2001). include “Multi Agent Systems” (MAS). These systems have been very well known in software engineering for more than 20 years. More recently, a number of publications have been produced about their application in production automation. A multi agent system consists of a number of intelligent, co-operative and communicative hardware agents, such as robots, which are working on a common task. They can use their intelligence to divide the whole task into subtasks, as long as each subtask can be carried out by at least one of the agents. This procedure can be repeated to solve the common task. The most recent research is focussing on MMAS – Multiple Multi Agent Systems, in which different multi agent systems are used to solve different aspects of a complex task.

SWIIS models for the dynamic behavior have similarities to multi agent systems (MAS). The actors are people with a distinct degree of intelligence and the ability to communicate and cooperate with others. A conflict could be defined as a competition between two or more multi agent systems, or as a multi multi agent system without co-operation between the different multi agent systems. This is very different from the case of production engineering, where the different multi agent systems co-operate with each other rather than acting counterproductively. Thus, the new approach of MMAS could provide a useful additional tool for the work of SWIIS.

5.CONCLUSION AND FUTURE DEVELOPMENTS

In the 25 years history of SWIIS , 11 events – conferences or workshops – were organised and several other IFAC events cosponsored. The contributions to the IFAC World Congresses consist of 7 invited sessions and a lot of technical papers. Furthermore members of SWIIS presented papers on non IFAC events.

As pointed out earlier one of the original ideas of SWIIS was to contribute with system theoretical and systems engineering methods to conflict solution. The SWIIS community started with the classical approaches of control engineering especially control of time continuos systems like theory of linear or some times non-linear systems, modelling, stability, optimisation. In the history of SWIIS there were some new approaches presented on several events for application of new methods from control engineering to SWIIS problems. Examples are multivariable and timevarying systems as well as fuzzy and neuro methods (Kopacek, 2000),.

Another new approach to the SWIIS problems is the use of methods from manufacturing automation – time discrete systems – as well as the improvement of the interdisciplinarity.

Furthermore ethics becomes more and more interest in control engineering, the classical IFAC topic on social effects is moving more and more to human machine cooperation, new automation technologies requires more interdisciplinary educated people and developing countries need the newest technology for an efficient improving of the industry.

The influence of the conflict factor "energy" on stability will be studied by a new approach (Erbe, Kopacek; 2006).

These are the tasks for the future.

6. LITERATURE

Chestnut, H.; R. Genser; P. Kopacek and A.P. Wierzbicky (1984) Editors: Supplemental Ways for Improving International Stability. *Proceedings of the IFAC Workshop, Laxenburg, Austria, September 1983, Pergamon Press, 1984.*

Chestnut, H. (1987) Editor: Contributions of Technology to International Conflict Resolution. *Proceedings of the IFAC Workshop, Cleveland, Ohio, USA, June 1986; Pergamon Press, 1987.*

Erbe, H.H. and P.Kopacek (2006): Energy Providing and Consumption can cause Instability. *Proceedings of the IFAC Conference "Improving Stability in Developing Nations through Automation", Prishtina, Kosovo, June 2006;* Elsevier 2006, p. 21-29.

Chestnut, H., P. Kopacek and T. Vamos (1990) Editors: International Conflict Resolution using Systems Engineering. *Proceedings of the IFAC SWIIS Workshop "International Conflict Resolution using Systems Engineering"*, Budapest, 1989. Pergammon Press, 1990.

Kopacek,P., F.Breitenecker and A.Frotschnig (1990): Control Engineering Methods for International Stability; *Proceedings of the IFAC SWIIS Workshop "International Conflict Resolution using Systems Engineering",* Budapest, 1989, Pergamon Press 1990. pp. 35-38.

Kopacek P., H.Chestnut, J. Scrimgeour and F. Kile (1992): A Review of the Activities of the IFAC SWIIS Working Group 1983-1989. *In: Proceedings of the SWIIS`92 Workshop*, Toronto, Canada.

Kopacek, P.: Preprints der IFAC-Konferenz „Supplementary Ways for Increasing International Stability - SWIIS", Wien, Oktober 1995.

Kopacek P. (2001): Proceedings of the *8th IFAC Conference on Social Stability: The Challenge of Technology Development – SWIIS´01*, September 27-29, 2001, Wien.

Kopacek, P.(2001): SWIIS – An important expression of IFAC Commitment to Social Responsibility. *Proceedings of the IFAC Workshop "Instability Resolution in Regions of long confronted Nations – SWIIS 2000"*, Ohrid (MAC), May 2000, p.17 – 21.

Kopacek,P and L.Stapleton, Editors (2004): Technology and International Stability. *Proceedings of SWIIS 2003, Waterford, Ireland. Elsevier, Oxford, UK.*

Kopacek, P. (2004): Proceedings of the *IFAC Multitrack Conference on Advanced Control Strategies for Social and Economic Systems,* September 2-4, 2004, Wien, Österreich, Elsevier, Oxford, UK..

Kopacek, P. (2006) Editor: Improving Stability in Developing Nations through Automation. *Proceedings of the IFAC Conference, Prishtina, Kosovo, June 2006; Elsevier, Oxford, UK.*