JAIST
JAPAN
ADVANCED INSTITUTE OF
SCIENCE AND TECHNOLOGY
1990

# COE NEWS

Newsletter of the Center for Strategic Development of Science and Technology, Japan Advanced Institute of Science and Technology (JAIST)

Vol. 2 No. 2 Autumn 2005

## Technology and Change – the Role of Technology in Knowledge Civilization Era

*Andrzej P. Wierzbicki*
*Research Professor at COE-Center, JAIST*
*andrzej@jaist.ac.jp*

A paper under this title, presented at the I-st World Congress of IFSR in Kobe, November 2005, described both a contemporary definition of technology (acceptable to a technologist – there are many definitions of technology in the literature, but most are not acceptable to practitioners of this field) and a reflection on the future role of technology. However, we present here only some selected topics from this paper: the relation of technology proper to hard science and to socio-economic applications of technology and the renewing and strengthening of Heidegger's warning about social fascination with technology.

Hard, basic science and technology influence each other through the intellectual heritage of humanity. But this influence forms a *positive feedback loop*, see Fig. 1; technological development stimulates basic science, scientific theories are applied technologically.

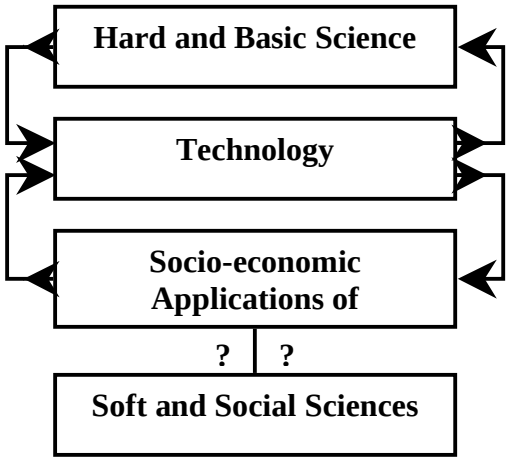


**Fig. 1. Two positive feedback loops**

*Continued on page 2*

Guest Column:

## What are the Goals of the Decision Making Process?

*Mordecai I. Henig*
*Professor at Faculty of Management*
*Tel Aviv University, ISRAEL*
*henig@post.tau.ac.il*

Have you ever thought profoundly why a method to handle the process of decision making is needed? Probably not. And the reason seems obvious. A method is required to facilitate the location of the best alternative. What else?

You are probably not the only one who has not given a thought to this matter. To my best knowledge, no discussion on such goals exists in the literature. Several paradigms for the decision making process are suggested; Normative (von Neumann-Morgenstern) and prescriptive. Soft systems (Checkland) versus hard systems. From one objective to multi-criteria (MCDM), with or without certainty. Some of the paradigms are represented by a fair number of methods. A small sample from the MCDM literature includes Goal Programming (Charnes & Cooper), Interactive Programming (e.g., Zionts-Wallenius), Compromise Programming (Zeleny), Reference Point Optimization (Wierzbicki), AHP (Saaty), Decision Aid (Roy), and Value Focused Thinking (Keeney).

*Continued on page 4*

### Inside this Issue

*Technology and Change … (con't)*

The positive feedback loop between technology and science works slowly: technological stimulations are analyzed by science with much delay, technology also does not reply instantly to new scientific theories.

The second positive feedback loop is between technology and the systems of its socio-economic applications. The distinction between technology proper and its socio-economic applications is not stressed sufficiently by social sciences, though it should be obvious for at least two reasons. The first is that technologists often work on a technological problem quite long (e.g., almost fifty years in the case of digital television) before their results are broadly socially applied. The second is simple: *technologists do not make much money, technology brokers do,* similar as art brokers make more money than artists. By *technology brokers* we understand here entrepreneurs, managers, bankers, etc.: all our socio-economic systems turn around applications of technology. If a technological product or service, such as mobile telephony, produces much revenue, then more money is available for its further technological development; this leads to truly *avalanche-like processes of social adoption of technological hits.*

But these processes have also strange dynamic properties, socio-economic acceptance of novelties is slow, there is usually a large delay time between purely technological possibility and the start of an avalanche of its broad socio-economic applications (this delay time amounted also to almost 50 years in the case of cellular telephony). This delay has many causes: the necessity to develop such technological versions that are inexpensive enough for an average customer; an initial social distrust turning into a blind social fascination once a technological hit becomes fashionable. Once it starts to work, the second positive feedback loop is much stronger and faster than the first one.

*This blind social fascination is actually the autonomous force incorrectly attributed by social philosophy to technology proper,* it is precisely the source of the Heideggerian danger that *man exalts himself and postures as the lord of the earth.*

For example: how many people are aware that mobile telephony makes it very difficult to practice radio-astronomy from Earth surface, that it is the reason of moving radio-telescopes into cosmic space? And this is a relatively modest adverse effect; what if an avalanche-like adoption of a technological hit would result in truly disastrous effects? After all, a nuclear power station is also based on avalanche-like processes that must be carefully controlled – by negative feedback systems of control engineering – to be safe; but if such systems fail (or are tampered with for fun by irresponsible people, like in the Chernobyl case), the disaster can have no limits.

The answer to the question of Mesthene: *why it is so that many people perceive technology as an alienating force, enslaving, degrading, and destructive of man's most cherished values,* might be the following: *the essential reason of it is the intuitive perception of such danger of a social infatuation with technology leading to avalanche-like process of adoption of technological hits with diverse resulting threats and possible catastrophic results.*

Being intuitive, the perception needs not be rationally correct and the diagnosis can be wrong; we must analyze it critically. Thus, we encounter here crucial questions:

1) What mechanisms limit and stabilize the avalanche-like processes of socio-economic adoption of technological hits?
2) Who is responsible for overseeing that these mechanisms work effectively?

The one mechanism that at least safely prevents any economic excesses is the market economy; people tried to replace market by human intervention in the communist system without success. However, it is only a robust mechanism, it does not solve many problems. For example, because knowledge-based economy sharply decreases marginal production costs, prices on high technology markets have today no relation to (actually, are over hundred times higher than) marginal production costs; an ideal, free market simply does not work in knowledge-based economy, an monopolistic or oligopolistic behavior is typical. Who will oversee such globalized markets?

As to the responsibility, obviously it should be borne first by the *technology brokers*. However, to be effective on the market, they must be motivated by profit, let us only hope that the motivation will be tempered by ethics. Ethics results from education; *who educates*

*technology brokers?* Not technologists proper, but social, economic, management scientists. They should not only educate well technology brokers ethically, but also help them to understand their future jobs by analyzing the mechanisms of social demand for technology, of infatuation with technological hits, together with their dangers.

> Thus, *the responsibility for socio-economic applications of technology, for overseeing the effective limitations of blind social fascination with technological hits lies at technology brokers, but also at social sciences.*

Unfortunately, they do not perform well in this respect. This is indicated by the question marks in Fig. 1: while the role of hard, basic sciences and technology proper versus its socio-economic applications is clear, social sciences do not seem to even understand their role.

This does not mean that technology proper is not co-responsible and should not at least try to work together with social scientists on limiting such dangers. However, a technologist usually considers carefully possible future impacts of technology developed by him; moreover, he knows that the blame for any possible misapplications will be put on him. On the other hand, the responsibility of technologists will not prevent all misapplications of technology. Human creativity of misapplications is boundless (*against stupidity, the gods themselves contend in vain*).

As perceived by Martin Heidegger already in *Die Technik und die Kehre* (1957), the danger lies in us, humans fascinated by the possibilities of technology and not understanding the threats of such fascination. In all the possibilities, complexity and diversity of the beginning knowledge civilization era, there is also a general danger and we must thus also repeat a renewed version of Heidegger's warning. In particular, the seemingly unbounded technological possibilities might suggest to people – particularly to *technology brokers* – that human intellectual heritage is rich and boundless enough to privatize it without restraint. The modified Heidegger's warning is:

> *In the industrial civilization era, people have became blinded by their seemingly unlimited power over nature given to them by the industrial technology, what has led to many degradations of natural environment. We must take care in the knowledge civilization era not to become blinded by the seemingly unlimited possibilities of products and services offered by technology, in particular –we must take care to preserve our intellectual environment, the intellectual heritage of humanity.*

---

## Introducing the On-going Research by Research Assistants at the COE Center

**1. Locharoenrat Kitsakorn** (PhD candidate at the School of Materials Science; kitsakor@jaist.ac.jp)

**Title**: Motivation: International Students versus Japanese Students at JAIST

**Abstract**: Career goals can be realized when we understand and take control of the forces that resides within us. This case study aims at obtaining insights of the difference in motivation between Japanese students and foreign students.

**2. Masaya Arai** (PhD candidate at the School of Materials Science; m-arai@jaist.ac.jp)

**Title**: Control of Metal Elemental Composition in Nanometer-sized Metal Coordination Polymers Stabilized with Alkylamino Ligands

**Abstract**: This work focuses on synthesizing nanopolymer of Prussian blue analogue (Fe/Cr-CN-Co) by water-in-oil microemulsion technique, and investigating its physical and chemical properties.

*What are the Goals… (cont'd)*

You would presume that every method will start off with a declaration of its goals but they do not.

Why declaring the goals is important? To me it is clear that the quality of the proposed process can be judged only vis-à-vis its goals, if they are achieved and how efficient are the method to get them implemented. Many methods require, and are used by, analysts to assist in operating them. Thus, such goals are related to the analyst's tasks in advising decision makers.

My claim that no goals are mentioned is somewhat exaggerated. The main exception is the literature in decision theory where the traditional goal is a mathematical representation of the preferences. But does representation have any practical goal in decision making? Other methods, mainly in MCDM are frequently compared according to speed of convergence, ease of operating and other technical features. However, these, clearly, are not the goals. Some methods indicate what seems to be a worthy goal: satisfaction, or even happiness related to the decision maker (and that is partially attained by ease and speed). This goal can be understood as satisfying the preferences of the decision maker. This is an abstract and not an operational goal. Scientists need objective goals to direct them in designing methods to handle the decision making process. Indeed there exists no method that explicitly describes it as its goal. Notwithstanding, many applications end with a statement that "the decision maker was satisfied with our method". To me, it indicates, usually, another ad hoc method in decision making.

Nevertheless, one can infer from the methods about their goals. In fact, most of them conclude with ranking the alternatives or selecting a "preferred" alternative. Hence, as stated in the opening paragraph, we can infer that this is the goal. This includes, in my opinion the representation methods as well; the utility function (which is the ranking of all hypothetical alternatives) is maximized to obtain the optimal alternative.

Another, and more practical question is; do these methods achieve the goal? Is indeed the selected alternative (and there is always one) the best? The answer to this question is, clearly, not so simple. There are apparent signs that the answer is negative. Many researchers (cf. Nutt) noticed that these methods are not adequate for the decision makers' needs and their behavior. Most practitioners do not use any normative or prescriptive method and revert to, what is termed as, descriptive methods which are context-dependent, tend to be holistic and non-compensatory. In other words, practitioners do not buy scientific methods either because they do not like their (implicit) goals or they are convinced that they do not attain them. More scientifically, rationality of common procedures for making decisions has been found (Tversky & Kahneman) to be inconsistent with human behavior. Some researchers (Roy) even argue that preference system does not actually exist.

Above all, why do we need a method for selecting the "best" alternative, in the first instance? As Descartes indicates in his Discourse: "*… the power of judging aright and of distinguishing truth from error, which is properly what is called good sense or reason, is by nature equal in all men…*". We do not need a method. Imagine you have two clear alternatives (a method may be required to make the alternatives with all the outcomes and chances clear to you). Do you need a method to select one of them? So, it seems that a method is needed solely when there are many alternatives, but this is a technical issue.

Buchanan, Corner and the undersigned (see references below) believe that the decision making process is not about selecting an alternative but about facilitating comprehension of the preferences and expansion of the set of alternatives.

Comprehension is much more than representation which is only a mathematical image of one's mind concerning preferences. These methods are useful only when there are many similar decisional problems in a short time and we want to be consistent and efficient. Operations research methods and most MCDM approaches tend to simplification and compactness: concealing preferences rather than confronting them and closing the set of alternatives rather than opening it.

"Why the goals of comprehension and expansion?" was the question I was asked frequently. I used to say that these goals are postulates devoid of explanation. Neither I nor the asker was satisfied by this answer. I was looking for some super-goal from which the

goals can be derived. At least to satisfy my curiosity, as a scientist, and not, necessarily, as an operational goal.

Recently I came to the conclusion that the super-goal is, perhaps, "satisfying the decision maker preferences". The reader may wonder now. Is it not the goal which many methods assume, perhaps implicitly, in the first place, and even mentioned in the fourth paragraph above? Though the wording may be the same the meaning is avowedly different and is rooted in the meaning of "preferences".

My understanding of "preferences" is not something related to the wishes of the decision maker but a word used to express the knowledge related to the decision opportunity (or problem) s/he is facing. So the preferences are not those interpreted by the decision maker and certainly not those "photographed" by representation methods. It is assumed that before applying the process the decision maker "does not know" what s/he wants and what s/he is able to get. It is the process that assists the decision maker in attaining the goal of satisfying the preferences. The process overrules what the decision maker "may think" as his or her preferences. Only by applying the process, the consultant and the decision maker can be sure, to some degree, that the preferences were satisfied.

Explaining all this I still face the question: why will the operational goals of "comprehension and expansion" attain the abstract super-goal of "satisfying the decision maker preferences"? For now the only explanation is my belief.

---

The references mentioned above can be found in my following papers:

1. Solving MCDM Problems: Process Concepts. Journal of Multi-Criteria Decision Analysis 5, 1996, (with J. Buchanan).
2. Objectivity and Subjectivity in the Decision Making Process. Annals of Operations Research 80, 1998, (with J. Buchanan and E. Henig).
3. Dynamic Decision Problem Structuring. Journal of Multi-Criteria Decision Analysis, 10, 2001, (with J. Corner and J. Buchanan).

## A Bird's Eye Report of the IFSR

In order to promote the synergy between Knowledge Sciences and Systems Sciences, the IFSR - the International Federation for Systems Research, with the support from numerous international organizations and universities have convened in the First World Congress of the International Federation for Systems Research took place from November 14-17, 2005 in Kobe Convention Complex located in Port Island, Kobe, Japan.

A total of 180 papers authored by some 330 authors from 21 countries have been presented during the proceeding of the Congress, followed with discussion on concrete research topics including knowledge management, technology management, various technologies of information, communication networking, etc. in search of ways to achieve sustainable economic and ecologic development, which is an urgent need common to all human beings. Many of the papers also addressed the interplay between technology, human individuals and the impact on our society.

At the end of the gathering, the audience has greatly accepted the generous offer from Polish delegation to organize the Second World Congress of the International Federation for Systems Research scheduled for 2007.

**Best Paper Awardees:**
Five student's papers representing five out of seven Symposia have been chosen as Best Paper. They are:

*Continued on page 6*

*A Bird's Eye … (con't)*

1. **Takashi Yoshinaga**; E-mail: tyoshina@jaist.ac.jp

**Institution:** School of Knowledge Science, Japan Advanced Institute of Science and Technology

**Topic:** Organizational R&D Concept Creating Activities Using Six-Lenses Model

**Category:** Technology Creation Based on Knowledge Science

2. **Norimasa Kobayashi;** E-mail: nkoba@valdes.titech.ac.jp

**Institution:** Graduate School of Decision Science and Technology, Tokyo Institute of Technology

**Topic:** Consulting as Outsourcing of Decision Making

**Category:** Creation of Agent-Based Social Systems Sciences

3. **Xuan Hieu Phan;** E-mail: hieuxuan@jaist.ac.jp

**Institution:** School of Knowledge Science, Japan Advanced Institute of Science and Technology

**Topic:** Co-training of Conditional Random Fields for Segmenting Sequence Data

**Category:** Data/Text Mining from Large Databases

4. **Tomohiro Hayashida;** E-mail: hayashida@hiroshima-u.ac.jp

**Institution:** Hiroshima University

**Topic:** Network structures in a society composed of individuals with utilities depending on their reputation

**Category:** Vision of Knowledge Civilization

5. **Vesna Kolenc**; E-mail: vesna.kolenc@iedc.si

**Institution:** Postgraduate Studies, IEDC-Bled School of Management, University of Maribor

**Paper Title:** Holistic approach to Innovating and Excellence - Application to Business School

**Category:** Foundations of the Systems Sciences

**Faces in the Congress**

## COE Center News

- *Dr. Boumsoung Kim* left the Center to join Kobe University as postdoctoral researcher as of December 1, 2005.
- *Dr. Quamrul Hasan* left the Center as of November 2005
- *Dr. Saburo Ogata,* Senior Researcher at the Institute for Future Technology joined the Center for a 2 years term until March 2007.
- *Dr. Kosaka Michitaka,* Senior Researcher at Hitachi System Development Research Center joined the COE Center as Visiting Professor from June 1st 2005 and will stay until March 31, 2006.

**JAIST-COE News** is published by the Center for Strategic Development of Science and Technology, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan.

Questions, comments, article proposals and for more information about the JAIST-COE News, contact Totok Hari Wibowo at totoku@jaist.ac.jp, tel. +81-761-51-1790 or go to the link: www.jaist.ac.jp/coe/index.htm