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Control system approaches for sustainable development and instability management in the globalization age

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To the memory of Michel Cuénod, Harold Chestnut, and John F. Coales.

Abstract

The civilization of mankind in the globalization age depends heavily on advanced information technologies emerging from automation and decision expertise and their respective scientific disciplines. The broad area of social systems, being essentially human centred systems, is a cross-, inter- and multi-disciplinary challenge to the control community. Social systems of contemporary civilization are reviewed from the systems science viewpoint and on the grounds of recent developments in control science and technology. Recent developments have emphasised the social responsibility of the control community during the on-going globalization and changes from the Cold-War bipolar world to a unipolar one, on the way to mankind's multi-polar world of the future.

Keywords: Developing countries; Human centred systems; Globalization age; Instability management; Knowledge and technology transfer

1. Introduction

In the year 2002, UNESCO (2002) announced its Encyclopaedia of Life Support Systems (EOLSS) as: "... a comprehensive, authoritative and integrated body of knowledge of life support systems. It is a forward-looking publication, designed as a global guide to professional practice, education, and heightened social awareness of critical life support issues...." The respective definition begins with "A life support system (LSS) is any natural or human-engineered system that furthers the life of the biosphere in a sustainable fashion." In this context, Earth is viewed as in Fig. 1. EOLSS has included, among its 21 main themes, 10 subject categories dealing with control, decision and management topics in systems engineering, and only one deals with Physical Sciences, Engineering and Technology Resources. Further, the quality of human resources, defined via education, health, poverty, and human resource management, are pointed out in particular.

It is well known, since the early days of cybernetics, that systems and control science can indeed be effectively applied to socio-economic and socio-technical systems (Cuénod & Kahne, 1973), which form a category of systems (Fig. 1) that are human and society centred. This is due to the applicability of systems and control science to solving diverse problems of decision and control, management and planning (Basar & Oslder, 1999; Gibson, Ivancevich & Donnelly, 1997; Vernadat, 1996), and of the stability of organizational systemic structures (Coales & Seaman, 1995; Ljungqvist & Sargent, 2000; Pete, Pattipati, Kleinman & Levchuk, 1998; Wagner, 1994).

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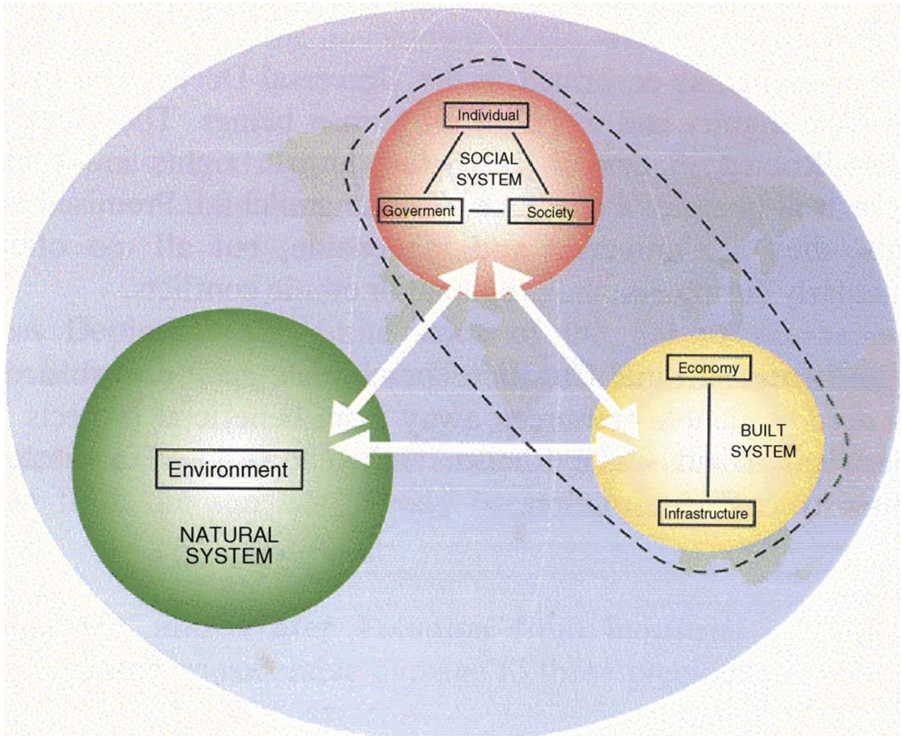

Fig. 1. Conceptual model of the Earth's global system (UNESCO, 2002).

However, it should be noted (Dimirovski, 2001b; Mansour, 2001) that this broad category of systems is not amenable to pure mathematical modelling and pure maths-analytical study but rather to a combination of methods and relevant scientific disciplines (also, see Bitanti & Picci, 1996; Goicoechea, Hanson & Duckstein, 1982; Kreps, 1995; Neck, 2005; Petit, 1990).

To this date, many system-science based studies related to social systems have assumed a fixed, stable background. This would imply that a number of society factors can safely be overlooked or cannot be accounted for by quantifiable methods. However, by implying a static model of the system and its proximity environment, these assumptions are contrary to the facts observed and thus *unsound*. *Sound assumptions* have to observe that (i) the global environment is changing (e.g., the per capita resource availability is declining); and (ii) if not addressed, these factors may exacerbate international instability and could trigger new forms and modes of global and regional instability. For instance, in the 20th century, a number of globally undertaken actions to reduce socio-economic imbalances in fact postponed problem solutions rather than creating alternative social behaviour likely to reduce the underlying problems. Such circumstances call for new paradigms for studying the social effects of technology, in general, and automation, control, and systems engineering technology, in particular.

Currently, the prevailing paradigm for studying the effects of technological change is based on the assumption of phenomena that have diminished in the recent past. At the same time, modern media has raised personal expectations for more people than ever before. Questions have arisen, as discussed further in the sequel:

- whether it is possible to distribute the perceived benefits of new technologies as rapidly as the demand for these benefits is increasing;
- since new technologies place new demands on the environment, can these demands be met, given the serious environmental and resource considerations?

Often the consequences accompanying each new advance have by far exceeded early expectations. Profound social developments have been created by advances once viewed as curiosities or even as ‘‘toys’’ of individuals.

The rest of this report is structured as follows. Section 2 describes some characteristics of contemporary social systems. Section 3 is devoted to the generic issues of modelling and control in such systems. Section 4 reports on recent trends in various social systems. Section 5 addresses some ethical issues. Conclusions and references follow thereafter.

2. Characteristics of contemporary social systems

The impact of technical progress on the modern civilization of mankind has been enormous during the past decades and considerable investigation of the subject has taken place (Brandt & Cernetic, 1998; Martensson & Cernetic, 2002). Nonetheless, while entering the 21st century and the globalization age, contemporary civilization has faced a remarkably negative civic reaction, which is growing and