Chapter 103
Target Evaluation and Correlation Method (TECM) as an Assessment Approach to Global Earth Observation System of Systems (GEOSS)

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ABSTRACT

The Global Earth Observation System of Systems (GEOSS) is a ten-year-long Implementation Plan, which commenced in 2005 as a group effort by numerous participating countries and organizations to build a large-scale network to effectively monitor and respond to the increasingly complex web of global environmental and socio-economic issues. This paper proposes the Target Evaluation and Correlation Method (TECM) as an assessment approach to GEOSS with its 241 Targets across the nine "Societal Benefit Areas," along with a method to identify Target Correlation Levels (TCL). Applying TECM allows concluding whether the chosen targets within the GEOSS fall into the domain of System of Systems (SoS), while using TCLs delineates the extent of inclusion for these targets in the form of a system. Furthermore, this research investigates the possible ways of raising the correlation levels of the targets for the cases in which TCLs are low.

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INTRODUCTION

According to the United Nations Millennium Declaration, the key obstacle that humanity is facing today is finding a more sustainable and cooperative approach to addressing worldwide needs while adapting to globalization (UN, 2000). Furthermore, "with the evolution of technology and globalization, the machinery of mankind has become more complex. To manage this new development complexity, engineers must have available more detailed and comprehensive systems engineering processes and tools" (Butterfield et al., 2008). To move forward in a more encompassing and constructive direction, it is essential that we are able to monitor and predict global changes.

In order to cope with the ever-evolving complexity of the planet, a new initiative was launched on February 16, 2005 called the Group on Earth Observations (GEO) as a coordinated international alliance formed to devise a Global Earth Observation System of Systems (GEOSS) (Shibasaki & Pearlman, 2008). The main vision of the partnership is to help humankind tackle more productively worldwide ecological problems and the ensuing socio-economic challenges. As of March 11, 2009, GEO's members include 76 countries and the European Commission (GEO, 2009). There are also 56 Participating Organizations (GEO, 2009) and seven observers (two countries and five organizations) (GEO, 2009). GEO is constructing GEOSS on the basis of a 10-Year Implementation Plan for the period of 2005 to 2015. The Plan defines a vision statement for GEOSS, its purpose and scope, expected benefits, and the nine "Societal Benefit Areas" of *disasters*, *health*, *energy*, *climate*, *water*, *weather*, *ecosystems*, *agriculture* and *biodiversity* (GEO, 2005). At the end of the Plan, GEO is expecting to have a fully developed System of Systems (SoS), which will serve as a readily accessible and comprehensive worldwide network of information, "in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system" (GEO, 2005).

The Plan includes 241 targets based on two, six and ten-year phases (GEO, 2005). It was agreed from the start of the undertaking that the Group would reconvene to assess the progress of the set targets after each of the two, six and ten-year periods (GEO, 2005). According to the evaluation of the first phase in the 2007 Progress Report, only one third of the targets have demonstrated success while one fourth were not as effective, with an additional eight percent indicating limited progress (GEO, 2007).

There has been several attempts to assess the GEOSS and evaluate its associated societal benefits (Fritz et al., 2008; Martin, 2008). However, to achieve the long-term forecast Targets, we propose evaluation of the GEOSS Targets using Target originated correlations between GEOSS organization forms and system characteristics that are most likely to emerge. The proposed method and the corresponding analytical algorithm will be referenced as the Target Evaluation and Correlation Method (TECM). The proposed method is developed based on Target inferred correlation and compatibility of the four types of system organizations, namely: "Assembly," "Traditional System," "System of Systems," and "Chaotic Form," with five distinguishing system characteristics that have been defined in (Boardman & Sauser, 2006; Gorod et al., 2008) as "Autonomy", "Belonging", "Connectivity", "Diversity", and "Emergence".

This paper will introduce the system organization types and their relation to the system characteristics just mentioned, and how these relations could be 'measured'.

Next, the paper presents the proposed TECM method and its application to a set of GEOSS Targets selected from three different societal benefit areas.

It offers specific evaluation of the GEOSS Target compatibility levels (TCL) between the selected Targets and the TECM identified 'optimum' system organization types, both individually