

Sensitivity Analysis on System Complexity Index: Considering system architecture and different levels of system granularity

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Abstract

In system design, understanding system architecture is an important part of complex system management. System architecture can be properly modeled through decomposition of a system into smaller subsystems, through different level of granularity. Until now, few researchers explored the effect of system granularity on complex systems and its necessity for analyzing the relationship between system granularity and system attributes.

There are various system attributes, such as complexity, modularity and so on. In this paper, system complexity was selected as a system attribute, which will be analyzed in context of system granularity. Overall system structure and inter-relationship between various system elements can be explained through this attribute. In this paper, the term ‘level of granularity’ means the configuration of system elements after system is decomposed. We will focus on the effect of architecture changes.

Various types of system architectures (324 idealized matrices) were created using Design Structure Matrix (DSM) to analyze the effect of system granularity on system complexity. Based on literature reviews of various complexity concepts, system complexity index was selected and verified. Modeled architectures were analyzed to assess their system complexity at two levels of granularity using system complexity index. As a result, it was observed that modular system is less sensitive to architectural changes than integral system at the first level of granularity. To verify the results of theoretical works, a complex printing system was analyzed. It was observed that the printing system has similar properties of the ideal integral matrices at the first level of granularity.

Keywords: system architecture, system complexity, system granularity