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IMPACT OF FUNCTIONAL COUPLING IN ACHIEVING RELIABILITY: EXTRINSIC AND INHERENT RELIABILITY

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ABSTRACT

In designing safety-critical systems such as manned space vehicles, nuclear power plants, military applications, or communication networks, it is difficult to meet their high level of reliability requirements by improving only the extrinsic reliability, i.e. increasing the overall reliability by adding protective barriers to a given design. The traditional Quantitative Risk Assessment (QRA) has focused on the design of safety features by increasing extrinsic barriers in a component domain. It is a common misunderstanding that arbitrarily high level of reliability can be achieved simply by increasing number of extrinsic barriers. Indeed, Axiomatic Design (AD) predicts the extrinsic barriers may even decrease the overall reliability if they create a functional coupling with other functional requirements (FRs). Thus, it is essential to consider the effect of the extrinsic barriers on the system's inherent reliability whenever those barriers are employed in a system. This paper proposes a method to address both extrinsic reliability and inherent reliability to achieve a required level of reliability. Improving a design itself will increase inherent reliability by eliminating the potential causes. The design improvement in this study is defined as an increase in functional independency. A few examples, drawn from the traditional QRA-based safety system design works, are discussed to validate the proposed method.