Chapter 2
Metrics of System Dependability

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ABSTRACT

During the last decades, the word 'mechatronics' has been widely cited. A mechatronic system is a multidisciplinary system requiring metrics to be accounted at the design, and uses stages in order to improve its dependability and achieve high performance. The latter involves several elements that should be considered, such as reliability, availability, maintainability, safety, and cost (RAMS&C). This chapter provides an introduction to various elements of dependability and reliability calculation based on system configuration.

INTRODUCTION

System dependability takes a very important place in the industrial design, which is a matter of concern for the last decade due to the growing complexity of modern engineering systems, and in the same way, their susceptibility to fail (Abdulgader, 2019).

Commonly defined as the science of failures proposing a solution to improve the reliability and safety of systems in a timely manner with taking to account numerous constraints, the definition of dependability may vary depending to the

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field of application (nuclear, automobile, rail, etc.). Jean-Claude Laprie defined dependability as the ability to deliver a service that can justifiably be trusted (Avižienis, Laprie, Randell, & Landwehr, 2004). In addition, the International Electrotechnical Commission standards (IEC) determined dependability as the ability to perform when and as required. It is a domain that requires global knowledge of the system like the condition of use, external risks involving the system, its functional and material architectures, structure and fatigue of materials. The majority of advances are the result of feedback and accident analysis reports. It is crucial when it comes to high-risk systems whose failure leads to catastrophic consequences on the safety of the system itself or user(s) and the environment. It may also increase the repair time and cost, inducing a significant loss of production.

Likewise, dependability includes principal fundamentals of availability, maintainability, reliability, efficiency of maintenance logistics, and in some cases, durability, safety, and security.

METRICS TO ACHIEVE DEPENDABILITY

There are four approaches to attain dependability, and are the following (Laprie, 1995):

- **Fault Prevention** is an approach to enhancing development processes aiming to detect and reduce the number of faults in the system and eliminate the causes via process variations;
- **Fault Tolerance** is when the system still provides the service to satisfy the system function in presence of faults;
- **Fault Removal** is decreasing the presence of faults;
- **Fault Forecasting** is an estimation of the current number, and the possible consequences of the faults.

Metrics of dependability are all the proprieties related to the system to be a dependable one. Again, a system is not dependable in proportion to the level of lowliness of these attributes. Moreover, and in the majority of cases, dependability is not a binary event but grounded on successions and acceptable approaches. These approaches are specific to infrastructures as well as applications. Among the dependability attributes, some need to be enhanced over others in specific system applications (Aqel, 2021).