Design for X (DFx) Guidance Document

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Purpose

This document provides guidance on Design for X (DFx) with various examples for "X".

Introduction

Design for X refers to the use of a formal methodology to optimize a specific aspect of a design. The variable X represents the areas of focus. The design guidelines themselves usually propose an approach and corresponding methods that may help to generate and apply technical knowledge in order to control, improve, or even to invent particular characteristics of a product. Following is a table that defines the most common areas of focus and a brief description of these areas. This list is not meant to be all inclusive nor would all be required on a specific product. This is provided as assistance in defining a DFx program structure and content.

Definitions

Abbr.	Full name	Description
Design for Manufacture/Delivery		
DFD	Design for Deployment	This should include the structure to aid in delivery coordination, ease of installation and documentation readiness. Ensure the product is structured to be easy to identify upon receipt and order by the end user.
DFM	Design for Manufacturability	Guideline for designing new or revising existing designs of Printed Circuit Boards and Printed Circuit Board Assemblies and fabricated sheet metal piece parts during the product design phase, allowing potential defects to be identified prior to manufacturing. This methodology is focused on manufacturing cost and improved factory efficiency.
DFP	Design for Procurement	Design the product to ensure that both the initial cost and total cost of ownership are optimized. Design the product to ensure multiple sources of supply are identified for all components where possible. Perform risk assessments on single source items and long lead time items. Reduce components number and system complexity to minimize the product and maintenance cost while improving the reliability of the product.

DFSC	Design for Supply Chain	Design to improve the supply chain efficiency, inventory turn-over and reduce lead times. Design for high assembly and manufacturing efficiency. Design to improve the logistics efficiency, reduce the cost for product logistics (packaging, transport, etc.). The product should be designed to ensure full or maximum fault detection coverage at in-circuit, functional and system test where applicable.
DFT	Design for Testability	The group of design techniques used to add testability features to hardware product design. The premise of the added features is that they make it easier to develop and apply manufacturing tests for the designed hardware. The purpose of manufacturing tests is to validate that the product hardware contains no defects that could, otherwise, adversely affect the product's correct functioning.
Design for Evolution		
DFF	Design for Flexibility	Design the product to be scalable in capacity. The ease of expandability should be taken into consideration from both a hardware/software perspective. Design the product functions to be easy to modify or add new functionality. The design should take the extensibility of the product into consideration.
DFIN	Design for Inclusion	Design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference. Dimensions of inclusive design include recognizing diversity and uniqueness, inclusive process and tools, broader beneficial impact.
DFPO	Design for Portability	The product, both hardware and software, should be modular in design to allow for maximum design portability and to aid in the testability of future changes.
DFRU	Design for Reusability	Both hardware and software should be designed with the consideration for future reusability and optimization of the building blocks of the overall design. The product should be designed for new technology integration with minimal impact.

Design for Operation		
DFA	Design for Accessibility	Ensure that hardware and software design is accessible to and usable by people with disabilities to the extent that it is technically feasible.
DFI	Design for Interoperability	Design technique for products to ensure alignment and optimized functionality of co-dependent products and environments between various suppliers.
DFPR	Design for Performance	Consideration of delay, throughput, bandwidth utilization, resource utilization and all other defined performance characteristics should be included in design for best performance.
DFPY	Design for Privacy	Privacy including data protection and privacy compliance should be taken into consideration during the design phase of the development lifecycle. Privacy should be embedded into hardware, software and services starting with design and architecture.
DFRC	Design for Regulatory Compliance	Ensure that the design meets all regulatory requirements including technical requirements (EMI, RFI, Power, RoHS, etc.), safety requirements, accessibility requirements, materials and environmental.
DFR	Design for Reliability	Design reliability into products. This should consider both hardware and software reliability. This must consider MTBF rate maximization through designs that minimize stress while providing maximum operational margins. Both Hardware and Software fault tolerance should be design considerations. Fault detection coverage should also be a consideration.
DFSA	Design for Safety	Designing to eliminate or reduce risks in the final product or its operation involving safety.
DFSE	Design for Security	Minimize the security risks and vulnerabilities to the product and/or network operations through design to ensure end user and customer confidentiality, data integrity and network availability.
DFS	Design for Serviceability	Improving the capability of installation, commissioning, and maintenance through design. The product should be easy to use. Human Factors should be a consideration. The Telcordia specification GR-2914 offers design guidance in

		this area. Total Cost of Ownership should be included as a design consideration.
DFSU	Design for Sustainability	Design for high energy efficiency and low power consumption, ease of maintenance and ease of upgradability. The product should be designed with end-of-life in mind, a hierarchical focus on reusability, repurpose, recyclability and finally disposability of any non-recyclable elements. Minimization of impact on the environment through the manufacture of the product, component selection and the long-term operational and environmental resilience of the product.