SYSTEMS ENGINEERING AND MANAGEMENT DEFINITIONS

Acquirer: a party, commonly an organizational entity, that acquires an item from a supplier. (PPI)

Architectural Design Review (ADR): a review-based design verification activity that seeks to establish whether the proposed system architecture at the first physical level of solution elements, is both capable of meeting the system requirements and is the best of any alternatives in doing so. (PPI)

Architecture: the conceptual structure and overall logical organization of a system from the point of view of its design. (after OED)

Architecture Framework: defines how to organize the structure and views associated with an Architecture. (Wikipedia)

Artificial Intelligence (AI): The field of computer science concerned with creating systems that can perform tasks that normally require human intelligence, such as reasoning, learning, perception, decision-making, and language understanding. (John McCarthy (2007). "*What is Artificial Intelligence?*" via ChatGPT)

Attribute: a quality or feature regarded as a characteristic or inherent part of someone or something. (OED)

Availability: the quality of an item of being available for intended use with characteristics required to enable that intended use. (PPI)
Inherent availability takes in the time between failures and the time for corrective maintenance if failure occurs in service. (PPI)
Achieved availability also takes into account the time required to perform any preventative maintenance. (PPI)

Baseline: (1) an agreed-to description of the attributes of a product, at a point in time, which serves as a basis for defining change; (2) an approved and released document, or set of documents, each of specific revision, the purpose of which is to provide a defined basis for managing change; (3) the currently approved and released configuration documentation; (4) a released set of files consisting of a software version and associated configuration documentation. (EIA/IS-649)

Build Instructions: the set of information unambiguously identifying each element of a system/proposed system and describing in implementable detail the configuration of those elements with respect to one another, to comprise the system. (PPI)

Build Standard: the approved data that describes how a system is to be built from a structure point of view. *Note: Such data typically includes the identification and requirements specification of each system element, together with a description of how the elements are to be interconnected to constitute the correctly built system.* (PPI)

Build State: the actual structure, in all detail, of a built system. (PPI)

Capability: the ability to achieve a desired effect over a desired period of time under specific conditions. (after OED)

Capability System: the aggregation of resources over time that gives rise to a capability. (PPI)

Cognitive Systems Engineering (CSE): an approach to the engineering of systems containing humans. (Dr Gavan Lintern)

Composable Design: A system architecture concept focusing on composing new systems from existing components, designs, product lines, and reference architectures as opposed to allowing "blank sheet" design based solely on requirements without precluding the absence of reuse in solution. (PPI)

Concurrent Engineering: the concurrent, collaborative and balanced development of a System of Interest and one or more enabling systems. (PPI)

CONEMP - Concept of Employment: a CONEMP describes how a new capability will be employed within a range of operations or scenarios, and is primarily written by users for reference from a Business Case. It supports acquisition management, and provides context in the development of user requirements. It should not presuppose any specific solution. It is a limited form of an OCD. (edited version of UK MoD definition)

Alternative short version: a short user-prepared description of intended use; a limited form of an OCD that emphasizes users and uses, without the greater detail of a full OCD. (PPI)

Configuration Documentation: the technical documentation that identifies and defines an item's requirements and/or design. (PPI)

Configuration Item: an item, a set of characteristics of which is baselined (a reference set established at a point in time), and with reference to which, change is to be controlled. (PPI)

Configuration Management: a management process for establishing and maintaining currency and consistency of an item's requirements, design, operational management information, and actual characteristics throughout its life cycle. (PPI)

CONOPS - Concept of Operations: describes the concept of the solution to meet the subset of the requirements of a capability system that are directly use-related. An alternative name for an Operational Solution Description (OSD). (PPI)

Constraint: a limitation or restriction. (OED)

CONUSE - Concept of Use: a CONUSE describes the way in which a specified capability is to be employed in a range of activities, operations or scenarios. It is a developed CONEMP, remaining in existence throughout the life of a capability system or platform or equipment. (edited version of UK MoD definition)

Alternative short version: a description of intended users and uses suitable for use as a reference for validation; an alternative name for Operational Concept Description (OCD). (PPI)

Correlation Coefficient: a statistical measure of the degree to which changes to the value of one variable predict change to the value of another. In positively correlated variables, the value increases or decreases in tandem. In negatively correlated variables, the value of one increases as the value of the other decreases. (PPI)

Critical Design Review (CDR): a U.S. DoD-devised multi-disciplined technical status review that seeks to ensure that a system can proceed into fabrication, demonstration, and test and can meet stated performance requirements within cost, schedule and risk. (after U.S. DoD)

Critical thinking: is the disciplined process of actively analyzing, evaluating, and interpreting information or situations to form a reasoned judgment, solve problems, or make informed decisions, involving questioning assumptions, identifying biases, and considering different perspectives for clear and rational thought. (Google AI)

Data Item Description (DID): a requirements specification for a data item. A data item is any meaningful aggregation of recorded information. The typical scope of a DID is information content, language and possibly, how the information is to be organized.

Data Management: administrative control of project data. Administrative control involves such items as identification, interpretation of requirements, planning, scheduling, control, archiving and retrieval of project data. (after EIA/IS-731)

Decision Pattern: A structured decomposition of the problem domain into discrete, loosely coupled decisions (aka questions/issues that demand an answer/solution). Each decision in the pattern may also include a criteria pattern that includes the factors typically used to evaluate alternatives. (PPI)

Design (noun): the product of making a solution decision. (PPI)

Design (verb): the act of making a solution decision. (PPI)

Design Traceability: traceability from requirements and goals to information that explains how the requirements and goals are met in the design. (PPI)

Desire: (1) an unsatisfied longing or craving (OED); (2) an unsatisfied characteristic of an item (product or service) that is knowingly valued. (PPI)

Detailed Design: design of an object at an implementable level of detail. (PPI)

Detailed Design Review (DDR): a review-based design verification activity that seeks to establish whether a proposed detailed design of a system, at the first physical level of solution elements, will if implemented meet system requirements and is the best of any alternatives in doing so. (PPI)

Digital Engineering: digital engineering is the creation of computer readable models and other records to represent without duplication (single source of record) all aspects of the system or product throughout its lifecycle, including problem definition, solution development, manufacture or construction, distribution or commissioning, operation, evolution and retirement, as applicable. A digital thread integrates in a way that can be readily navigated, all the diverse stakeholders' recorded interests throughout the lifecycle of the system. (PPI)

Digital Thread: a digital thread is a linked set of digital artifacts whose consistency is actively managed over the life cycle of a product, process, or system. (OMG)

Digital Twin: the digital twin is a high-fidelity model of the system or product that can be used for a variety of purposes to emulate the actual system or product. Purposes may include design and development, communication and understanding, change control, replication, analysis, and support to maintenance and evolution. A digital twin may represent any combination of information on physical aspects of the system or product, such as structure, or information involving logical representations, for example, function or state. (PPI)

Enabling System: a system that is not the system of interest, but which enables a phase of the life cycle of the system of interest. *Note: a production system and a support system are examples of enabling systems for a system to be produced/supported.* (PPI)

Engineered System: a combination of interacting elements organized to achieve one or more stated purposes. (ISO/IEC 15288:2008 Systems and software engineering – System life cycle processes)

Engineering Management: the management of the engineering and technical effort to transform a need into an operational system. (after Consulting Industrial Engineers)

Engineering Speciality Integration: the effective integration of non-technology disciplines such as reliability, maintainability, supportability, human factors, safety, value engineering, standardization, transportability, etc., such as to ensure their beneficial influence on requirements, design and ultimately, the product or service. (PPI)

Expectation: an instance of expecting or looking forward. (OED)

Function: an action, a task, or an activity performed to achieve a desired outcome. (Hitchins, 2007)

Functional Analysis: examination of a defined function to identify all the sub-functions necessary to the accomplishment of that function; identification of functional relationships and interfaces (internal and external) and capturing these in a functional model; and flow-down of performance of the defined function to state the performance required of each sub-function. (after EIA 731-1)

Functional Design: with respect to a defined requirements-level function, decision as to all of the sub-functions to be used in accomplishment of that function; identification of functional relationships and interfaces (internal and external) and capturing these in a solution-level functional model; and flow-down of performance of the defined function to state the performance required of each sub-function. (after EIA 731-1)

Goal: (1) the object of a person's ambition or effort; a destination; an aim; (OED) (2) a desired characteristic of an item (product or service), usually for which a solution will be pursued, subject to trade-offs with other goals. (PPI)

Implementation: in a product life cycle context, the process of transforming a product design into the product. (after EIA 731-1)

Information Assets: knowledge or data that has value to the organization. (ISO/IEC 27000-2009)

Information Security: preservation of **confidentiality**, **integrity** and **availability** of information. In addition, other properties, such as **authenticity**, **accountability**, **non-repudiation** and **reliability** can also be involved. ISO/IEC 27000-2009

Integration: the merger or combination of two or more lower-level elements into a functioning and unified higher-level element with the functional and physical interfaces satisfied. (IEEE Std 1220-1994)

Interface Management: the management of an interface, from interface requirements to interface design to successful realization. (PPI)

Knowledge Management: efficient handling of information and resources within a commercial organization. (OED)

Large Language Model (LLM): A type of advanced AI system trained on massive datasets (often billions or trillions of words) to understand, summarize, and generate human-like text. (Stanford University - AI Demystified: Introduction to Large Language Models via Gemini)

Lean Six Sigma: a management approach for problem solving and process improvement based on a combination of the different tools of Six Sigma and Lean Manufacturing. (www.businessdictionary.com)

Lean Thinking: Lean Thinking is a methodology for improving cycle times and quality through the elimination of waste. (www.qualityamerica.com)

Life Cycle: the evolution of a system, product, service, project or other human-made entity from conception through to cessation of existence. (PPI)

Life Cycle Cost: the sum of all recurring and one-time (non-recurring) costs over the full life span or a specified period of a good, service, structure, or system. (www.businessdictionary.com)

Life Cycle Process: a process that is applied within the life cycle of a human-created system to contribute to the realization of that life cycle. (PPI)

Logic: reasoning conducted or assessed according to strict principles of validity. (OED)

Maintainability: the quality of an item that, having failed, the item can be repaired using a specified set of resources. (PPI)

Management: the process of dealing with or controlling things or people. (OED)

Measure of Effectiveness: a measure of property of an item for which more or less of that property, with respect to a threshold of acceptability, is better according to the values held by an applicable stakeholder. (PPI)

Measure of Performance (MOP): a measure of how well an action or function is performed. (PPI)

Mode: a particular functioning arrangement or condition. (Mirriam-Webster)

Mode Inactive Substate: a state division of a more broadly defined (parent) state, the substate being defined in terms of not being in a mode within the parent state, for example, “alarm mode inactive substate” of “on state” of a smartphone. (PPI)

Model: an informative representation, physically or logically, of something. (PPI)

Model-Based Systems Engineering (MBSE): An approach to systems engineering that uses modeling of logic or structure or both, typically with an emphasis on logic, integral to engineering practice in relation to one or more systems engineering activities, such as problem definition, solution definition, specification of solution elements, system integration, verification and/or validation (V&V). The application of MBSE to V&V may include V&V of requirements and/or design and/or solution elements and/or of the overall solution. (PPI)

Note: MBSE practice may, or may not, be associated with digital engineering (DE) practice. DE practice embodies the creation and maintenance of an evolving, lifecycle-based information model of broad scope comprising a single source of record relating to a given system. MBSE may be practiced without DE. DE may be practiced without MBSE.

Mode of Operation: an option allowing a change in the method of operation of a device. (OED)

Need: a condition of lacking or requiring some necessary thing, either physically or psychologically. (OED)

Net Present Value (NPV): NPV is an indicator of how much value an investment or project adds to the enterprise, discounting future costs and future income with respect to the present, to allow for inflation and costs of capital. Each future cash inflow/outflow is discounted back to its Present Value (PV). Then they are summed. (PPI)

OCD - Operational Concept Description: a system or software-centric description of who the users of the system or software are, what are their intended uses of the system or software, how and where the system or software is intended to be used, and a representative set of scenarios of use. These scenarios, each associated with a particular intended use (mission), are chosen to represent both typical and limit conditions of use. The OCD also describes the expected external conditions during use. (PPI)

OSD - Operational Solution Description: describes the concept of the solution to meet the subset of the requirements of a capability/enterprise/business system that are directly use-related. (PPI)

Performance: how well a particular function is performed. (PPI)

Principle: a fundamental truth or proposition that serves as the foundation for a system of belief or behavior or for a chain of reasoning. (OED)

Preliminary Design Review (PDR): a U.S. DoD-devised technical status review that system requirements, system preliminary design results of peer reviews, and plans for development, testing, and evaluation form a satisfactory basis for proceeding. (after U.S. DoD)

Process: a set of interrelated or interacting activities that transforms inputs into outputs. (PPI)

Producibility: a measure of the relative ease of manufacturing. (en.wiktionary.org)

Product Line: a family of related, similar products that are offered by the same organization, are priced differently, and vary from each other in ways that are meaningful to the user. (PPI)

Product Line Engineering: an approach to engineering a Product Line in a manner that takes advantage of the products' similarities while managing their differences, usually on a life cycle basis. The activities involved may include planning, developing, producing, delivering, deploying, sustaining, and even retiring products. (PPI)

Project: an undertaking with pre-specified objectives, magnitude and duration. (ISO 2382-20)

Project Breakdown Structure (PBS): a product-oriented family tree composed of hardware, software, services, data and facilities, as applicable, which results from project efforts and which defines the project at a selected level of detail. Displays and defines the product(s) to be developed or produced, and relates the elements of work to be accomplished to each other, and to the products. Also known as Work Breakdown Structure (WBS). (PPI)

Project Management: the application of knowledge, skills, tools, and techniques to the management of project activities in order to meet or exceed stakeholder needs and expectations. (after Project Management Institute, PMI)

Qualification: a condition that must be fulfilled before a right can be acquired. (OED)

Quality: fitness for intended use in an intended environment. (PPI)

Reliability: the quality of an item of being in a failure-free state, such that there are no externally observable changes to the functionality or other characteristics of the item as a result of failure. (PPI)

Requirement: a required characteristic of an item (product or service), usually for which a solution will be pursued. (PPI)

Requirement Owner: with respect to a specific requirement, a stakeholder who created the requirement or has the right to change the requirement. (PPI)

Requirements Analysis: the capture and validation of system or software-specific required characteristics based on analysis of stakeholder needs, requirements and objectives; mission/operation; projected utilization environments for people, products and processes; constraints; and measures of effectiveness for the system or software. The bridge between initial stakeholder expression of requirements for a system or software, and system or software requirements adequate to drive development of a solution. (after EIA 731-1)

Requirements Specification: the expression of one, or a set of required characteristics (requirements) to be possessed by an item. May include goals in addition to requirements. (PPI)

Requirements Traceability (in design): the record of an association between a requirement and its parent requirement or between a requirement and its implementation. (after EIA 731-1)

Risk: a measure combining the uncertainty of reaching a goal with the consequences of failing to reach that goal. (EIA 731-1)

Safety: a quality of an item of the degree of freedom of risk of physical injury to, or damage to the health of people either directly, or indirectly as a result of damage to property or to the environment. (after IEC 61508)

Simultaneous Engineering: see "Concurrent Engineering".

Six Sigma: Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving toward six standard deviations between the mean and the nearest specification limit) in any process – from manufacturing to transactional and from product to service. (www.isixsigma.com)

Specification Tree: a hierarchy of requirements specification elements and their interface specifications that identifies the elements and the specifications related to design elements and the system configuration, which are to be controlled. (after IEEE Std 1220-1998)

State: the particular condition that someone or something is in at a specific time. (OED)

Substate: a state division of a more broadly defined state, for example, "sleeping" and "awake" are substates of "alive". (PPI)

System: a combination of interacting elements organized to achieve one or more stated purposes. (ISO 9000:2000)

System Integration: the merger or combination of two or more lower-level elements into a functioning and unified higher-level element. (after IEEE Std 1220-1994)

System Integration Plan: a plan for building the system in development to achieve the configuration described by the build instructions for the system. (PPI)

Systems Engineering: an interdisciplinary, collaborative approach to the engineering of systems (of any type) that aims to capture stakeholder needs and objectives and to transform these into a description of a holistic, life cycle balanced system solution that both satisfies the minimum requirements, and optimizes overall project and system effectiveness according to the values of these stakeholders. Systems engineering incorporates both technical and management processes. (Robert Halligan, 2003)

Systems Engineering Management: the management of the technical scope of a project for which a systems engineering approach is being employed. (PPI)

Systems of Systems Engineering: the engineering of an integration of a finite number of constituent systems, each of which is independently managed and operatable, and which are networked together for a period of time to achieve a certain higher goal. (after Jamshidi 2009)

Systems Thinking: a holistic approach to analysis that focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems. (PPI)

Target: see "Goal".

Team: two or more people working together to achieve a common goal. (OED)

Technical Performance Measure (TPM): a measure of technical achievement that is planned, assessed and reported during development. (PPI)

Technology Readiness Level (TRL): a measure of the maturity of a technology, in general or in the context of a particular application. (PPI)

Tiger Team: a team of specialists in a particular field brought together to work on specific tasks. (OED)

Validation: confirmation by examination and provision of objective evidence that the specified intended use is accomplished in an intended environment. (after ANSI/EIA-632-1998)

Value: the regard that something is held to deserve the importance, worth, or usefulness of something. (OED)

Value (System Effectiveness) Model: a model of the values of one or more stakeholders, from which will be estimated the overall degree of satisfaction of the stakeholder(s) with a system, beyond the imperative of satisfaction of requirements. (PPI)

Verification: confirmation by examination and provision of specific evidence that specified requirements have been fulfilled. (ISO 9000:2000)

Verification Requirement: a requirement that defines the quality or strength of the evidence needed to satisfy a requirement owner that a specified requirement has been met. (PPI)

Want: wish for possession of. (OED)

Work Breakdown Structure (WBS): see Project Breakdown Structure.

Work Product: any product created through the performance of work (in this context, engineering work). (PPI)

Legend: OED Oxford English Directory Other suggested sources of definitions:

a. Other Dictionaries
b. The Authoritative Dictionary of IEEE Standard Terms, IEEE, 2007
c. SAE Dictionary of Aerospace Engineering, SAE, 1998
d. ISO standards
e. National standards