System Concept Definition

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Concept Definition is the set of systems engineering (SE) activities in which the problem space as well as the needs and requirements of the business (or enterprise) and stakeholders are closely examined. Concept definition begins before any formal definition of the system-of-interest (SoI) is developed.

The Concept Definition activities include Business or Mission Analysis and Stakeholder Needs Definition. Within these two activities the enterprise or project decision makers, as well as additional key stakeholders, describe *what* a solution should accomplish and *why* it is needed. Both *why* and *what* need to be answered before consideration is given to *how* the problem will be addressed (i.e., what type of solution will be implemented) and *how* the solution will be defined and developed.

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Concept Definition Activities

There are two primary activities discussed under Concept Definition: Business or Mission Analysis and the definition of Stakeholder Needs:

1. The Business or Mission Analysis activity defines the problem, threat, or opportunity being addressed which could result in a new or modified product or service. This process also includes identification of major stakeholders, the mission, goals, and objectives of the SoI, the measures of success, identification of business needs and requirements, and identification of the SoI life cycle concepts.
2. The Stakeholder Needs Definition activity uses the inputs from the Business or Mission Analysis effort to identify an integrated set of needs based on inputs from the major stakeholders, higher-level requirements, and an analysis of the life cycle concepts, drivers, constraints, and risks.

The products and artifacts produced during Concept Definition are then used in the System Definition process.

Drivers of Concept Definition

There are many considerations associated with concept definition activities, which are further elaborated below.

The Role of Architecture Development

The activities of Business or Mission Analysis and Stakeholder Needs Definition occur concurrently with the processes of System Architecture Design Definition. The activities to address a full set of needs includes identification of SoI life cycle concepts, external interfaces and constraints, as well as candidate solutions and an exploration of the architecture (logical and functional).

Drivers of Solution on Problem Definition

During Concept Definition, the problem definition and solution exploration depend on each other: solutions should be developed to respond appropriately to well-defined problems; and problem definitions should be constrained by what is feasible in the solution space. System analysis is used to provide the links between problems and solutions.

There are two paradigms that drive the ways in which concept definition is done: push and pull. The pull paradigm is based on providing a solution to an identified problem or gap, such as a missing mission capability for defense or infrastructure. The push paradigm is based on creating a solution to address a perceived opportunity, such as the emergence of an anticipated product or service that is attractive to some portion of the population (i.e. whether a current market exists or not). This can impact other life cycle processes, such as verification and validation, or alpha/beta testing as done in some commercial domains.

As systems generally integrate existing and new system elements in a mixture of push and pull, it is often best to combine a bottom-up approach with a top-down approach to take into account legacy elements, as well as to identify the services and capabilities that must be provided in order to define applicable interface requirements and constraints. This is discussed in Applying Life Cycle Processes.

New System or Modification of Existing System

The activities of concept definition determine whether the enterprise strategic goals and business needs will be addressed by a new system, a change to an existing system, a service, an operational change, or some other solution.

For a new system, the organization or customer has decided to start with a "blank piece of paper". This is often referred to as a green-field system, and analysis efforts during concept definition characterize the as-is or present-state of the SoI in terms of the problem, threat, or opportunity and then characterize the to-be or future-state of the SoI in obtaining the resolution of the problem, threat, or opportunity.

An existing system can be evolved or transformed into the desired system. This is often referred to as a brown-field system, and the data that has been established for

the original system can be used as inputs into the analysis efforts during concept definition activities. The existing system may have been developed for other purposes, the stakeholder needs or the operational environment may have changed, e.g., a change in threats. The analysis effort will explore the problem space and possible solutions to the gaps of the existing system to address the problem, threat or opportunity.

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