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Traceability – A vision for now and tomorrow

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Traceability

"the ability to trace the history, application or location of an object/entity/item" (ISO 9000:2015)

"domain of consideration encompassing the process for determining the provenance of an item. (also referred to as tracking)" (NIST 2022)

Item - "a nonspecific term used to denote any product, including systems, materiel, parts, subassemblies, sets, accessories, etc." (MIL HDBK 61B)

Provenance - "The chronology of the *origin, development, ownership, location and changes* to a system or system component and associated data." (NIST 2022)

Requirements

Standards and regulations for **various industries** require traceability to be established across the lifecycle of the product/system;

ARP 4754A
Section 5.3.1.1

"uniquely identified and traceable" to "ensure visibility of the safety requirements at the software and electronic hardware design level."

ISO 13485
Section 7.3.2

"methods to ensure traceability of design and development outputs to design and development inputs."

ISO 26262
Section 6.4.3.2

safety requirements shall be traceable with a reference being made to: source; derived safety requirement or design and verification specification

USC Title 21
Part 820

develop and maintain a Device History File (DHF) that "shall contain or reference the records necessary to demonstrate that the design was developed in accordance with the approved design plan and the requirements of this part.

Traceability can be…

Vertical traceability

most often referred to in the context of levels of organization and architectural levels of the system or product under development

Horizontal traceability

the forward and backward traceability between entities across the SoI lifecycle (from concept to retirement).

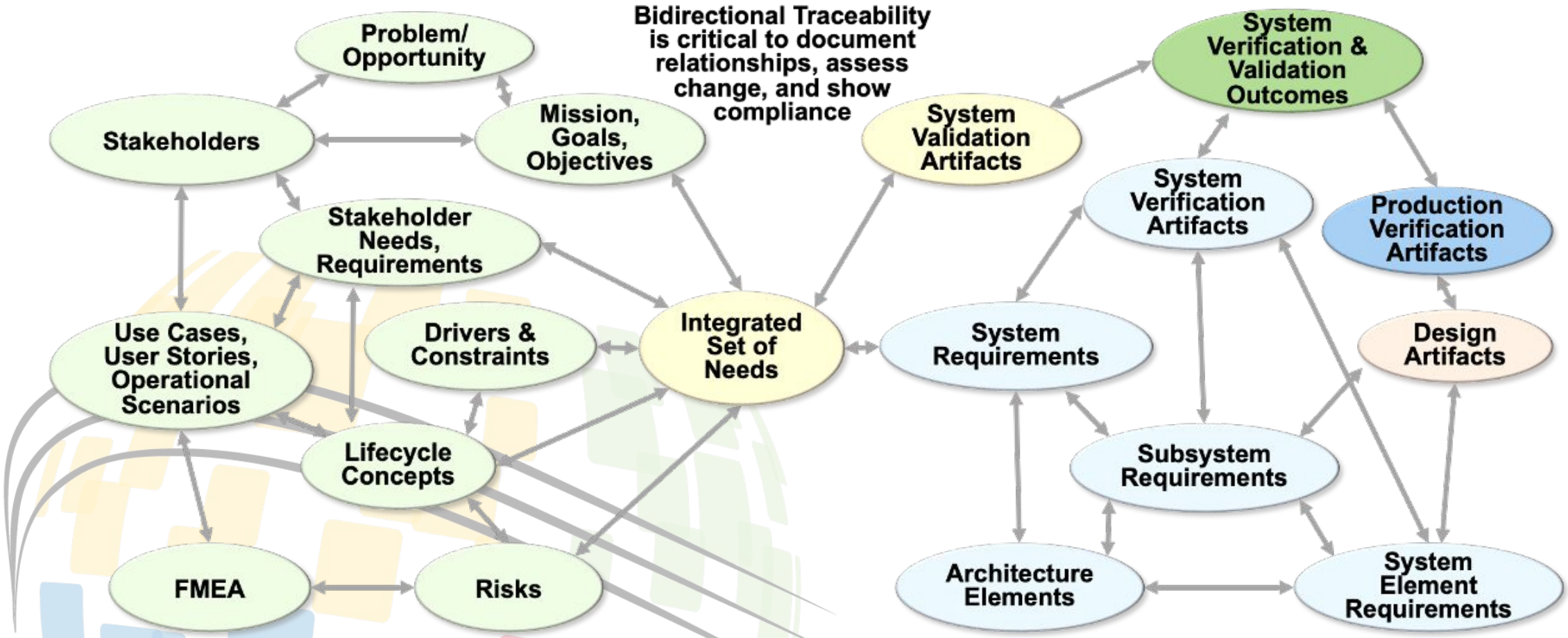
Bidirectional traceability

is the ability to establish a two-way link between entities such that each has knowledge of the other.

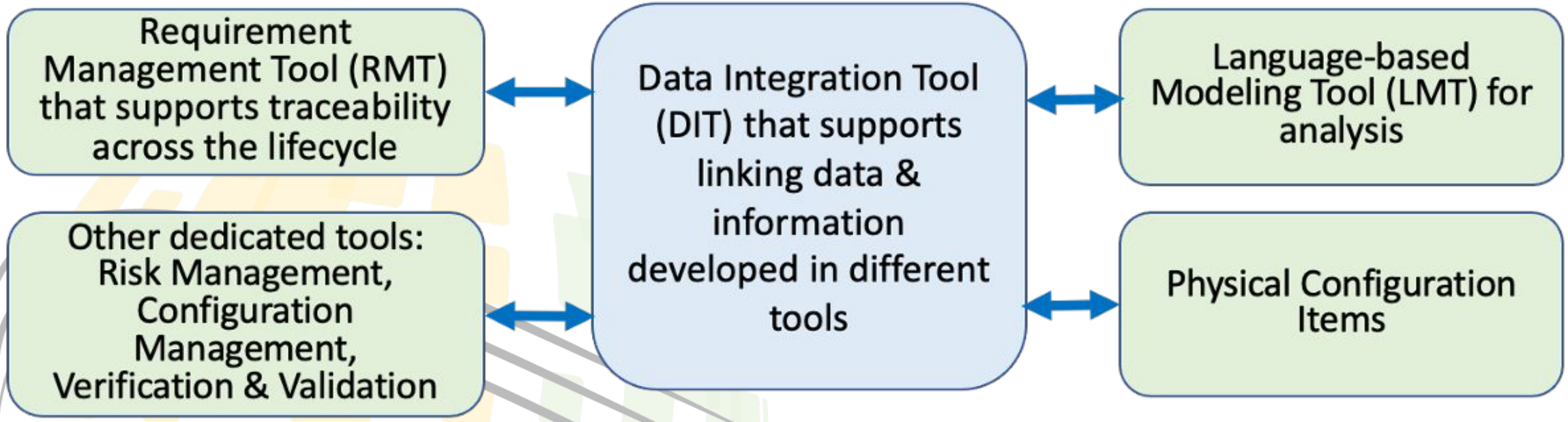
Unidirectional traceability

the ability to establish a one-way trace from one entity to another, where the receiving entity has no knowledge of the source entity.

Example Traceability Relationship Model

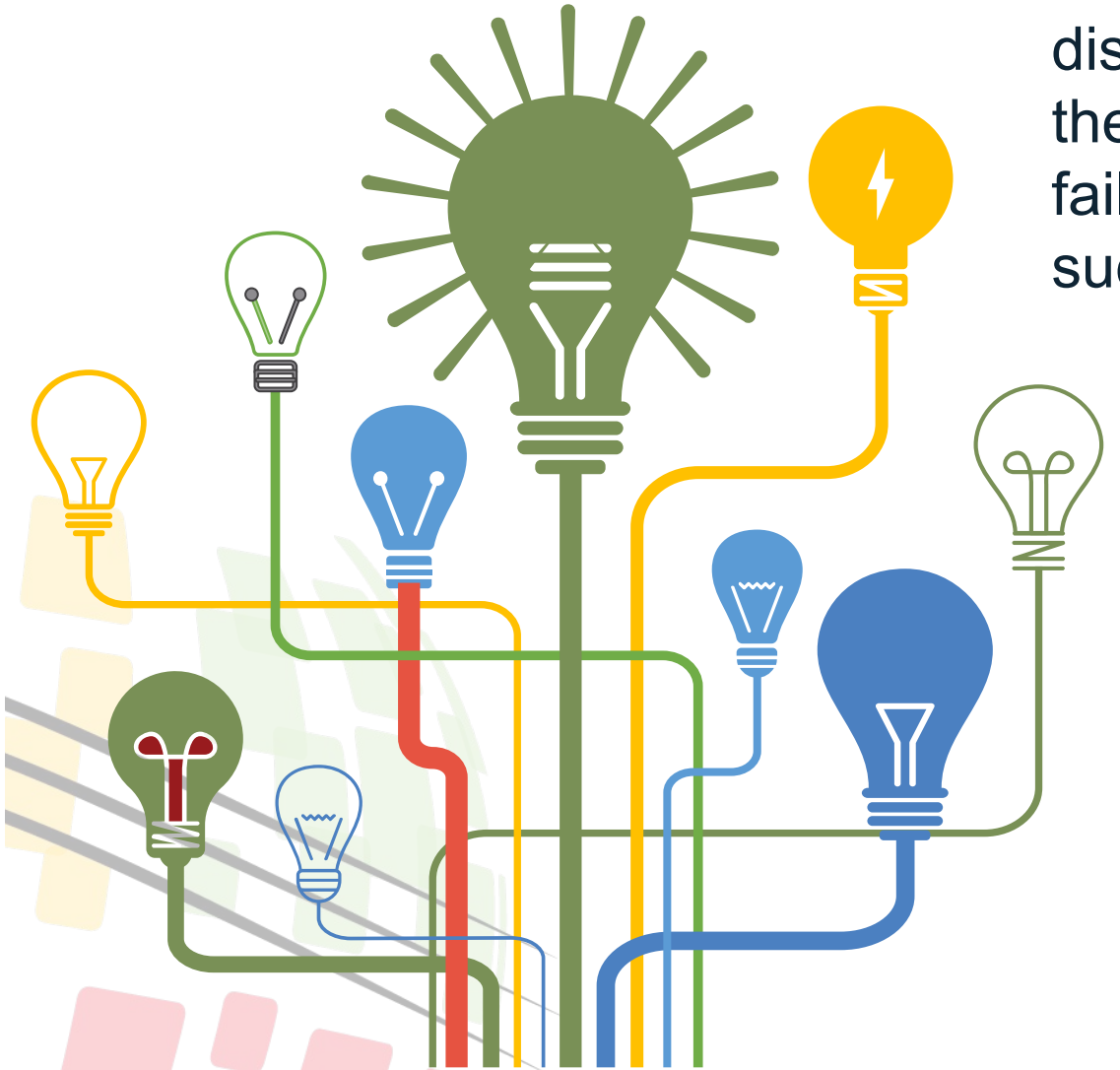


Example Establishing Traceability between data and information from different tools within a projects SE toolset.



Configuration Management

discipline came about in the **1950s** when industry failed to reproduce a successful prototype



rooted in the need to manage changes to an item so that **reproducibility** is enabled

focused on providing enduring **truth, trust and traceability** to enterprises and their supply base.

Traceability in Configuration Management

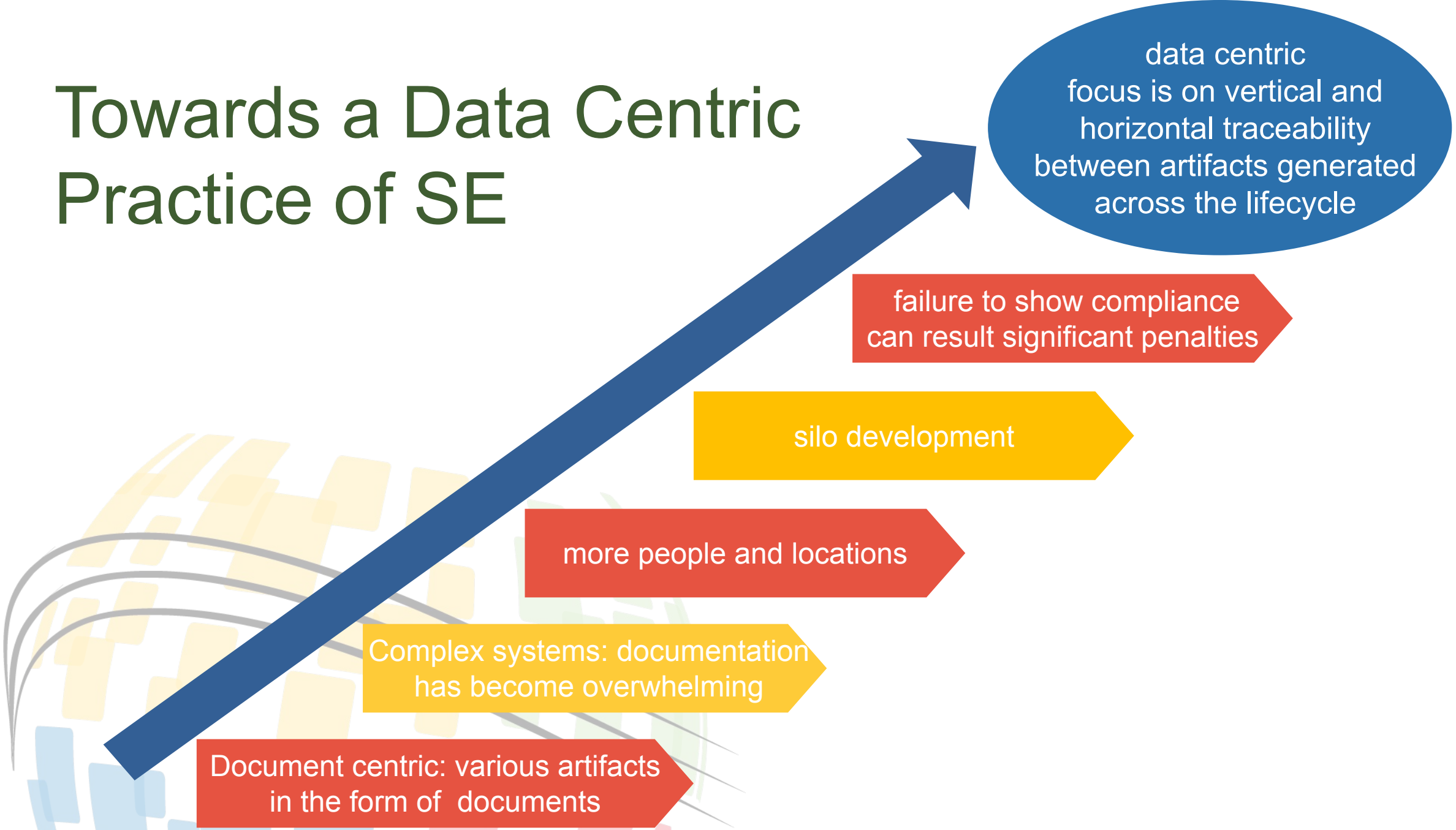
Truth allows a path to be chosen.

Traceability representing both relations and provenance, is facilitated through the appropriate application of CM

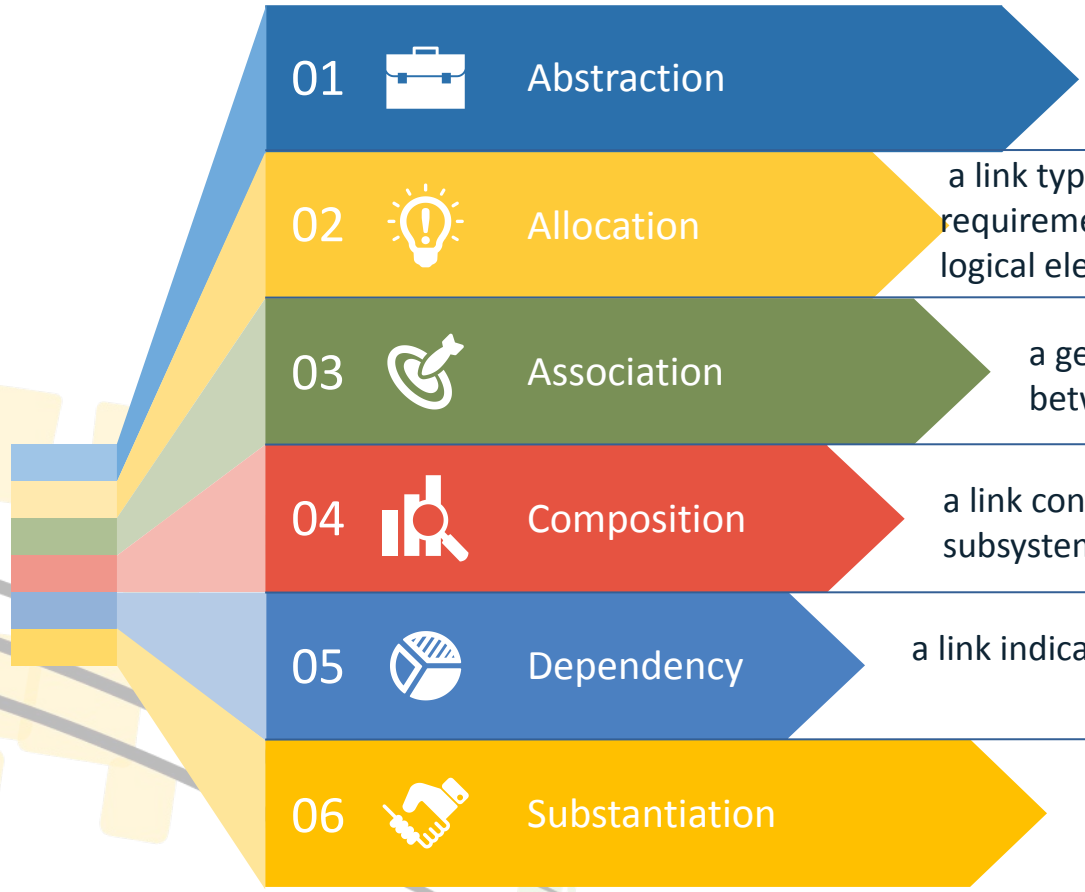
Trust allows practitioners to go down a path with others.

Objective: establishing an authoritative source of truth (ASoT) (i.e., provenance, traceability, pedigree, and non-repudiation leading to incontrovertibility)

Towards a Data Centric Practice of SE



Types of traceability links



a link connecting representations of a concept at different levels of detail.
Subtypes of abstraction include derivation, refinement, decomposition, elaboration.

a link typically connecting elements across two domains (a requirement allocated to a function, a function allocated to a logical element, or a logical element to a physical part)

a generic purpose relationship establishing a link between two elements.

a link connecting an assembly to its parts, a system to its subsystems, a function to its sub-functions etc.

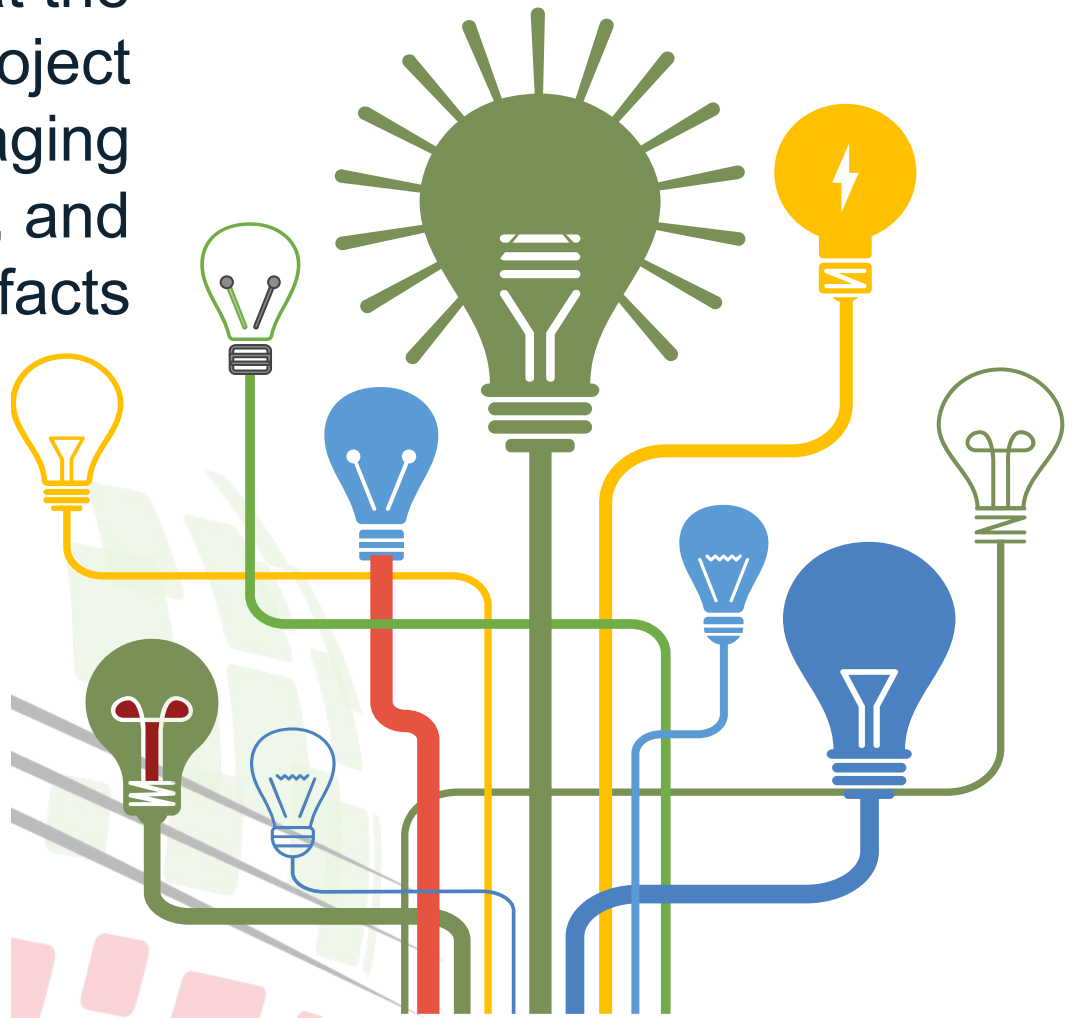
a link indicating an impact to the dependent element.

a link connecting rationale (e.g., an analysis artifact) to a statement (e.g., a requirement being satisfied).

Establishing traceability

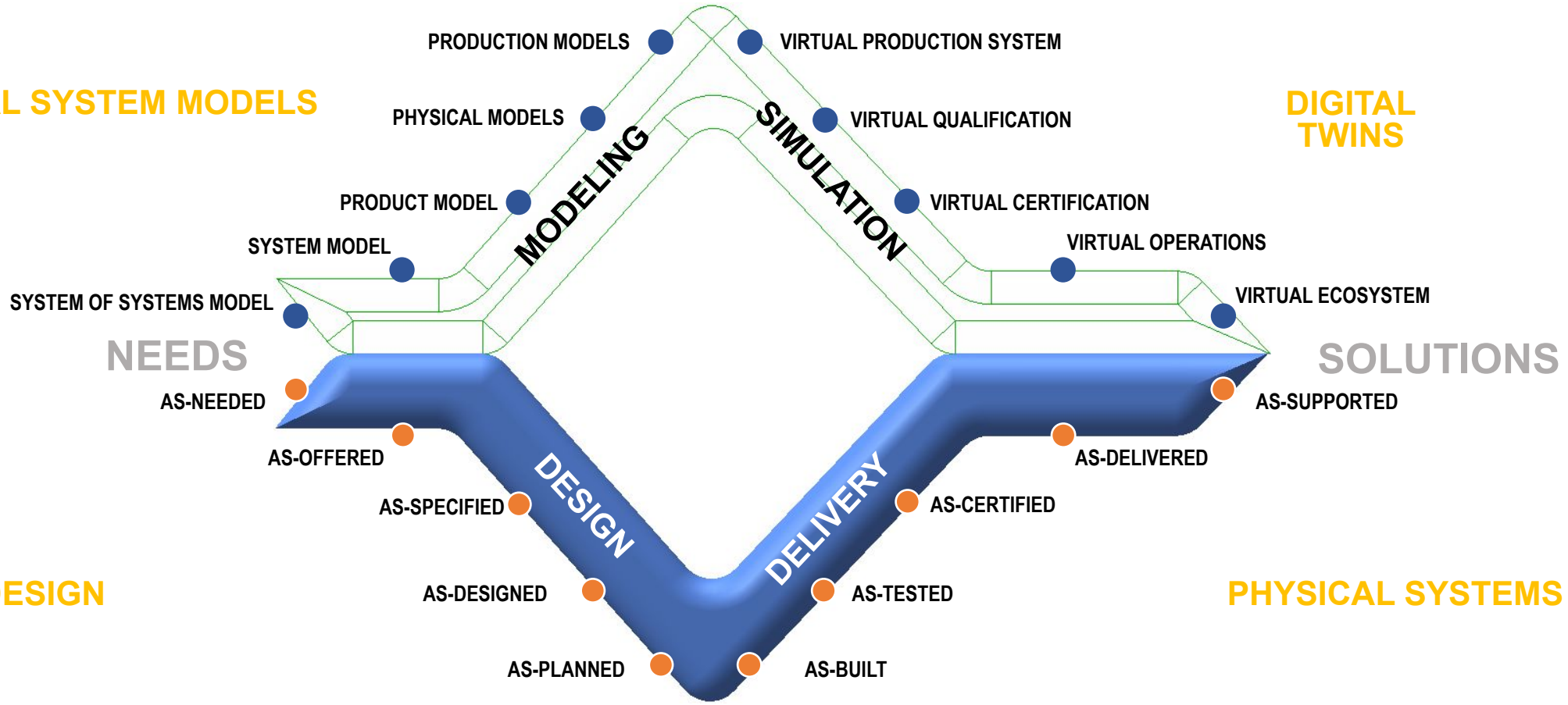
Planning. define at the beginning of the project the approach to managing data, information, and artifacts

Implementation. Within the ASoT enabling capability (people, process, and tools), the traceability and dependence meta-model must be implemented.



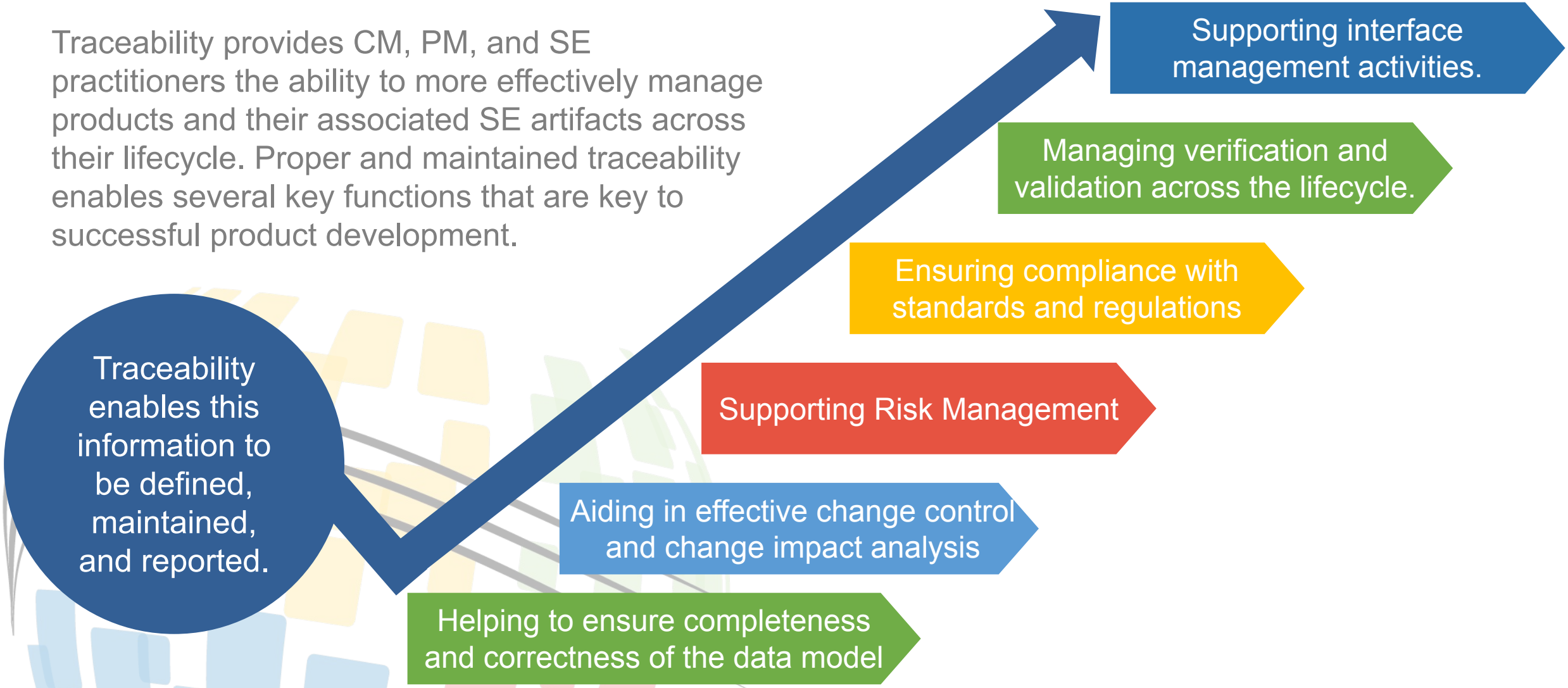
Management. It is extremely important that traceability is established and maintained properly per the established traceability rules

Digital Thread



Capitalizing on Traceability

Traceability provides CM, PM, and SE practitioners the ability to more effectively manage products and their associated SE artifacts across their lifecycle. Proper and maintained traceability enables several key functions that are key to successful product development.



01

vision about how traceability can aid PM and SE practitioners

02

role that traceability and the digital thread have in project management and systems engineering is discussed in practical terms

03

the need to establish traceability between digital artifacts

04

how to capitalize on the traceability

Thank you
Q&A

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