
# Technology Transition Assessment in an Acquisition Risk Management Context

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# Overview

- **Policy & Law**
- **Technology Maturity Assessment & Systems Engineering**
- **Metrics**
- **Process**

# 10 U.S.C. 2366b

- **(a) CERTIFICATION.— A major defense acquisition program may not receive Milestone B approval, or Key Decision Point B approval in the case of a space program, until the milestone decision authority—**
  - **(3) further certifies that—**
    - **(D) the technology in the program has been demonstrated in a relevant environment, as determined by the Milestone Decision Authority on the basis of an independent review and assessment by the Assistant Secretary of Defense for Research and Engineering**

# DoD Refinement

- **"A TRA is required by Department of Defense Instruction (DoDI) 5000.02 for MDAPs at MS B (or at a subsequent Milestone if there is no MS B). It is also conducted whenever otherwise required by the MDA."**
  - **States that for TMRR phase "There are a number of ways to structure this phase which should be tailored to reduce the specific risks associated with the product being acquired. Technology Readiness Levels, described in the Technology Readiness Assessment (TRA) Guidance (Reference (e)), should be used to benchmark technology risk during this phase; however, these indices are rough benchmarks, and not conclusive about the degree of risk mitigation needed prior to development. Deeper analysis of the actual risks associated with the preferred design and any recommended risk mitigation must be conducted and provided to the MDA."**

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TECHNOLOGY READINESS ASSESSMENT (TRA) | • | | | | | | | • | ✓ | • | | | SEC. 205, P.L. 111-23 (Ref. (an)) | ASD(R&E) |
| STATUTORY. A preliminary assessment is due for the Development RFP Release Decision Point. The Assistant Secretary of Defense for Research and Engineering (ASD(R&E)) will conduct an independent review and assessment of the TRA conducted by the Program Manager and other factors to determine whether the technology in the program has been demonstrated in a relevant environment. The assessment will inform the 2366b CERTIFICATION MEMORANDUM at Milestone B (in accordance with 10 U.S.C. 2366b (Reference (g)). The TRA at Milestone C is a Regulatory requirement when Milestone C is Program Initiation. | | | | | | | | | | | | | | |

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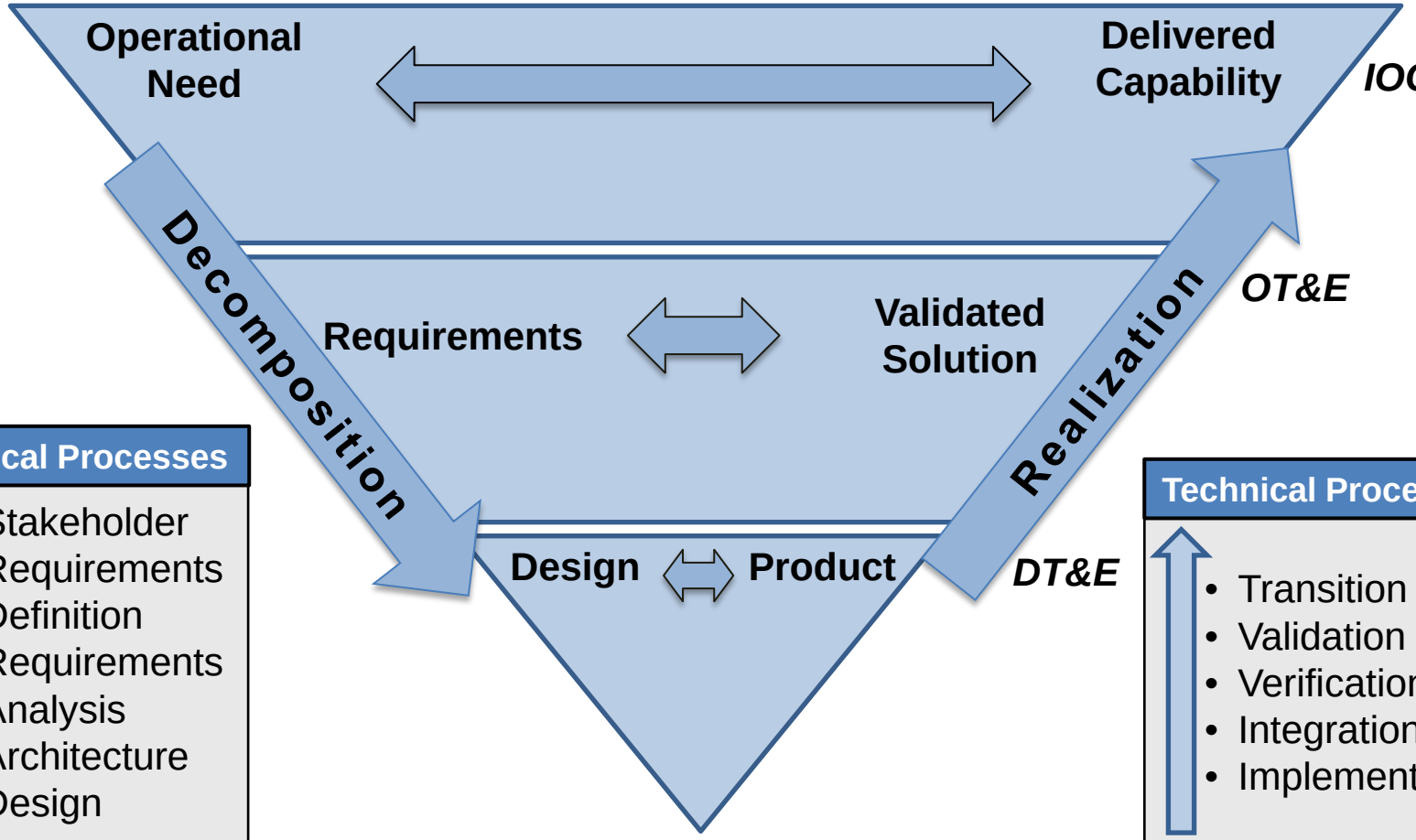
# Are we there yet?

- **U.S. Law requires testing in a "relevant environment"**
- **DoD further defines to mean must have a TRL of 6 for all critical technology elements by MS B**
- **Does this resolve all technology maturity issues?**
  - **Probably not…**
- **While a TRA resulting in a TRL is a requirement for all major programs, most program managers recognize a TRL is not a comprehensive technology assessment**

# DoD Systems Engineering

- **Defense Acquisition Guidebook**
  - **"Systems engineering (SE) establishes the technical framework for delivering materiel capabilities to the warfighter. SE provides the foundation upon which everything else is built and supports program success."**
  - **"Systems engineering (SE) is a methodical and disciplined approach for the specification, design, development, realization, technical management, operations, and retirement of a system. "**
  - **"The Systems Engineer balances the conflicting design constraints of cost, schedule, and performance while maintaining an acceptable level of risk."**
  - **Sec 2.8 (Technology Development Strategy/Acquisition Strategy (TDS/AS) Outline)**
    - **"List the key program technologies, their current technology readiness levels (TRL), the basis for including a technology (e.g., available alternative or low-risk maturation path) if it is below the TRL 6 benchmark for Milestone B, and the key engineering and integration risks."**

# DoD Systems Engineering




**Technical Processes**

- Stakeholder Requirements Definition
- Requirements Analysis
- Architecture Design

**Technical Processes**

- Transition
- Validation
- Verification
- Integration
- Implementation

**Technical Management Processes**

- Decision Analysis
- Technical Planning ★
- Technical Assessment
- Requirements Management
- Risk Management ★
- Configuration Management
- Technical Data Management
- Interface Management

Enables a balanced approach for delivering capability to the warfighter

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# Technology Assessment Challenge

- Technology and systems can be highly complex
- Subjectivity impossible to eliminate
- S&T and Acquisition have different perspectives
- Proliferation of new technology assessment / management metrics and processes in recent years
  - Address some issues but raise others
- **Need metrics and process that supports program and project management in assessing technology in an acquisition context and making acquisition decisions**

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# Technology Maturity Metrics

- Technology Readiness Level
- Manufacturing Readiness Level
- Hardware and Software Readiness Levels
- Integration Readiness Level
- System Readiness Level
- Advancement Degree of Difficulty
- Business Readiness Level
- Programmatic Readiness Level

and more…

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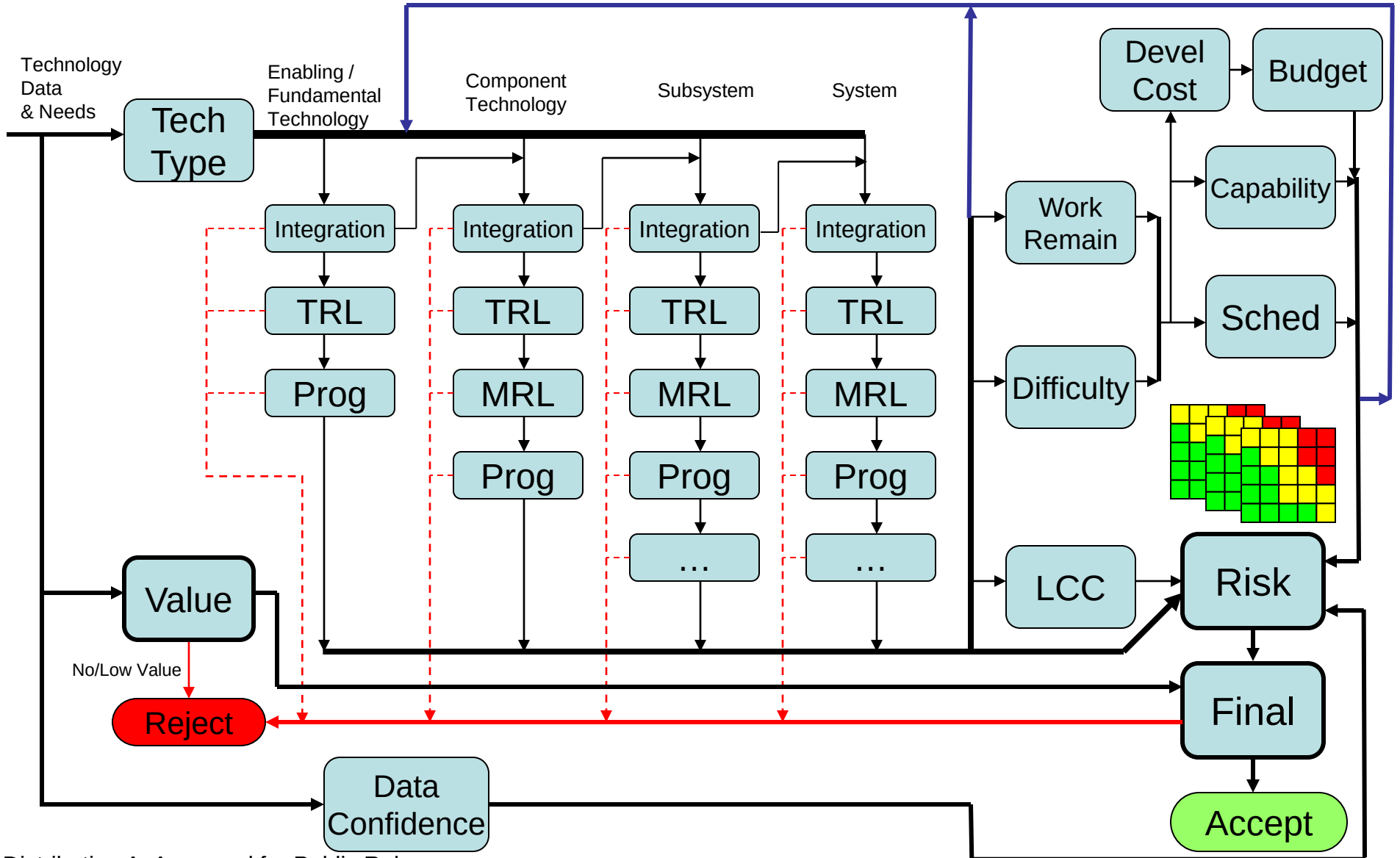
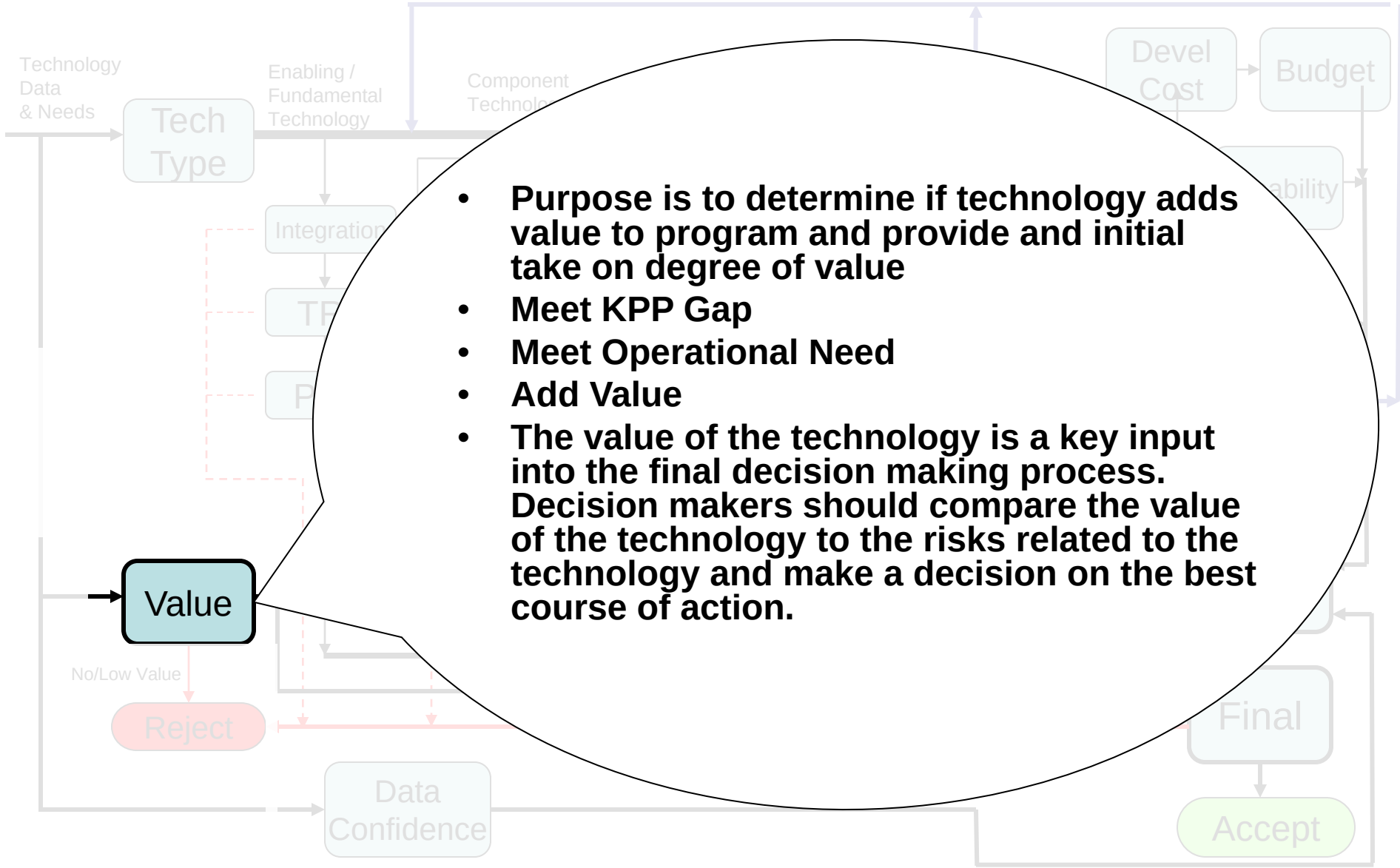
# Technology Assessment Process

- Driven from an acquisition perspective
- Objective is to provide a context for technology assessment / evaluation that feeds acquisition program / project management
- Not intended to reinvent the wheel
- Is a work in process

# Technology Assessment Process

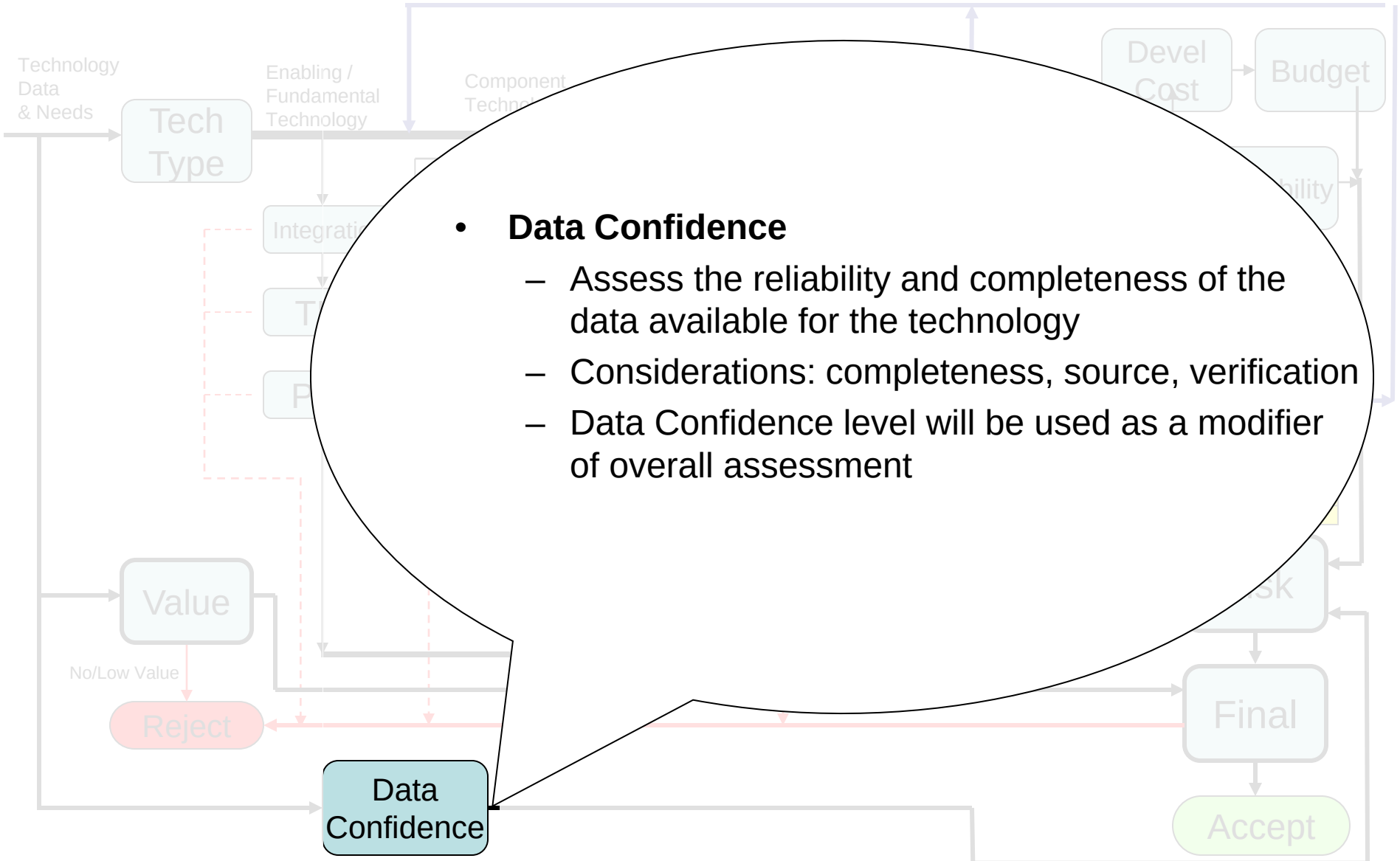


# Determine Value



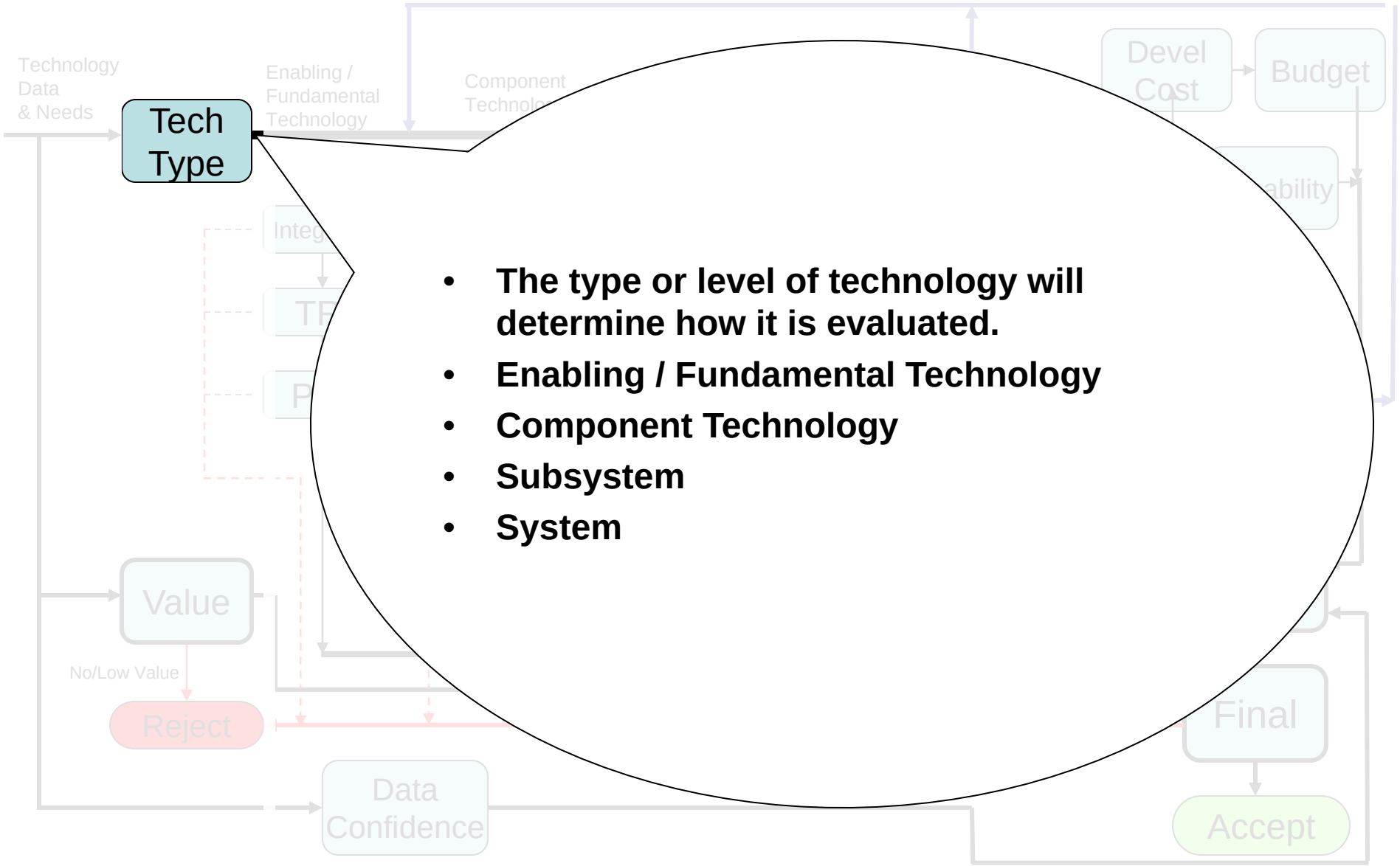

- **Purpose is to determine if technology adds value to program and provide and initial take on degree of value**
- **Meet KPP Gap**
- **Meet Operational Need**
- **Add Value**
- **The value of the technology is a key input into the final decision making process. Decision makers should compare the value of the technology to the risks related to the technology and make a decision on the best course of action.**

# Nature of Data




- **Data Confidence**
  - Assess the reliability and completeness of the data available for the technology
  - Considerations: completeness, source, verification
  - Data Confidence level will be used as a modifier of overall assessment

# Technology Type




- **The type or level of technology will determine how it is evaluated.**
- **Enabling / Fundamental Technology**
- **Component Technology**
- **Subsystem**
- **System**

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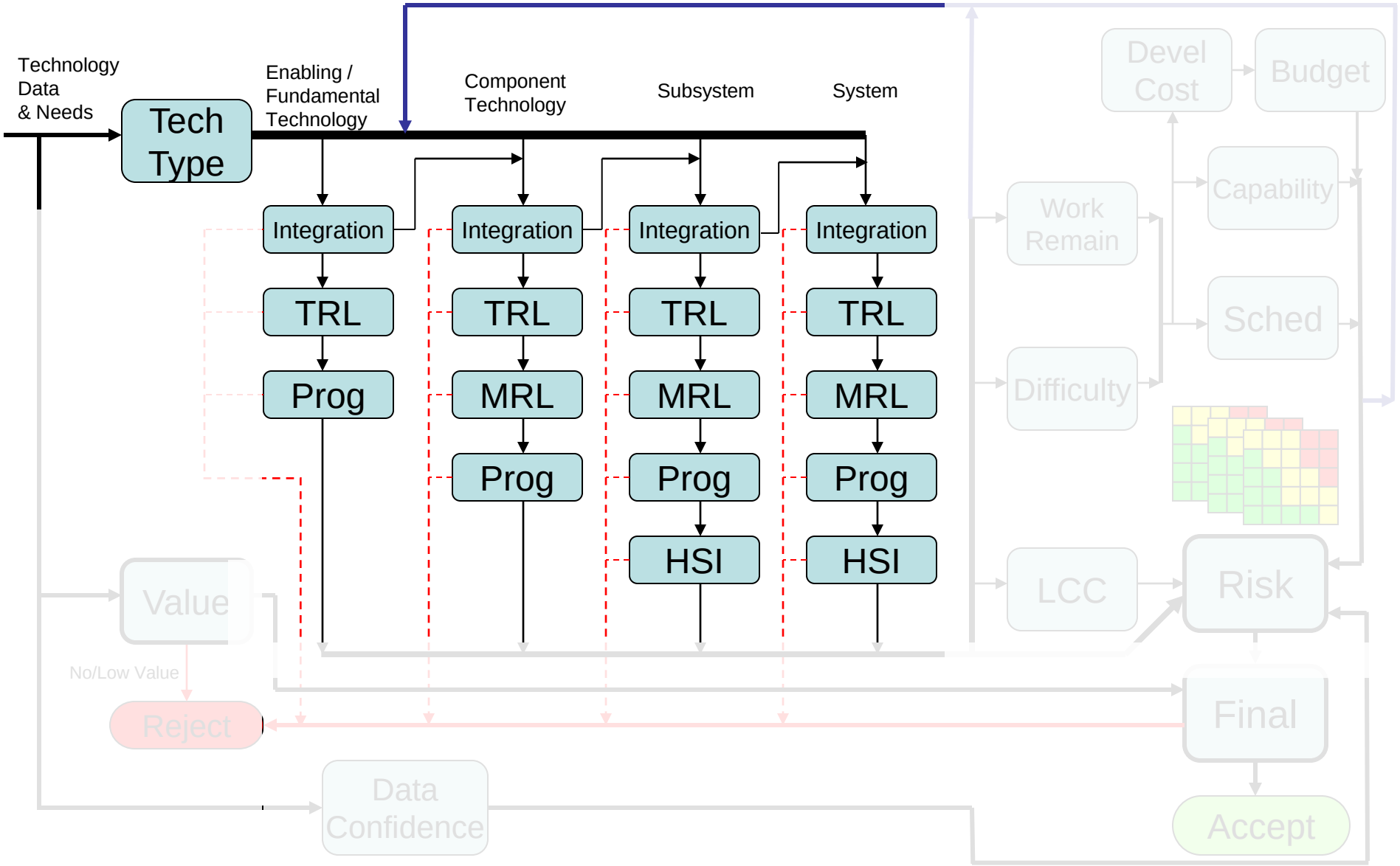
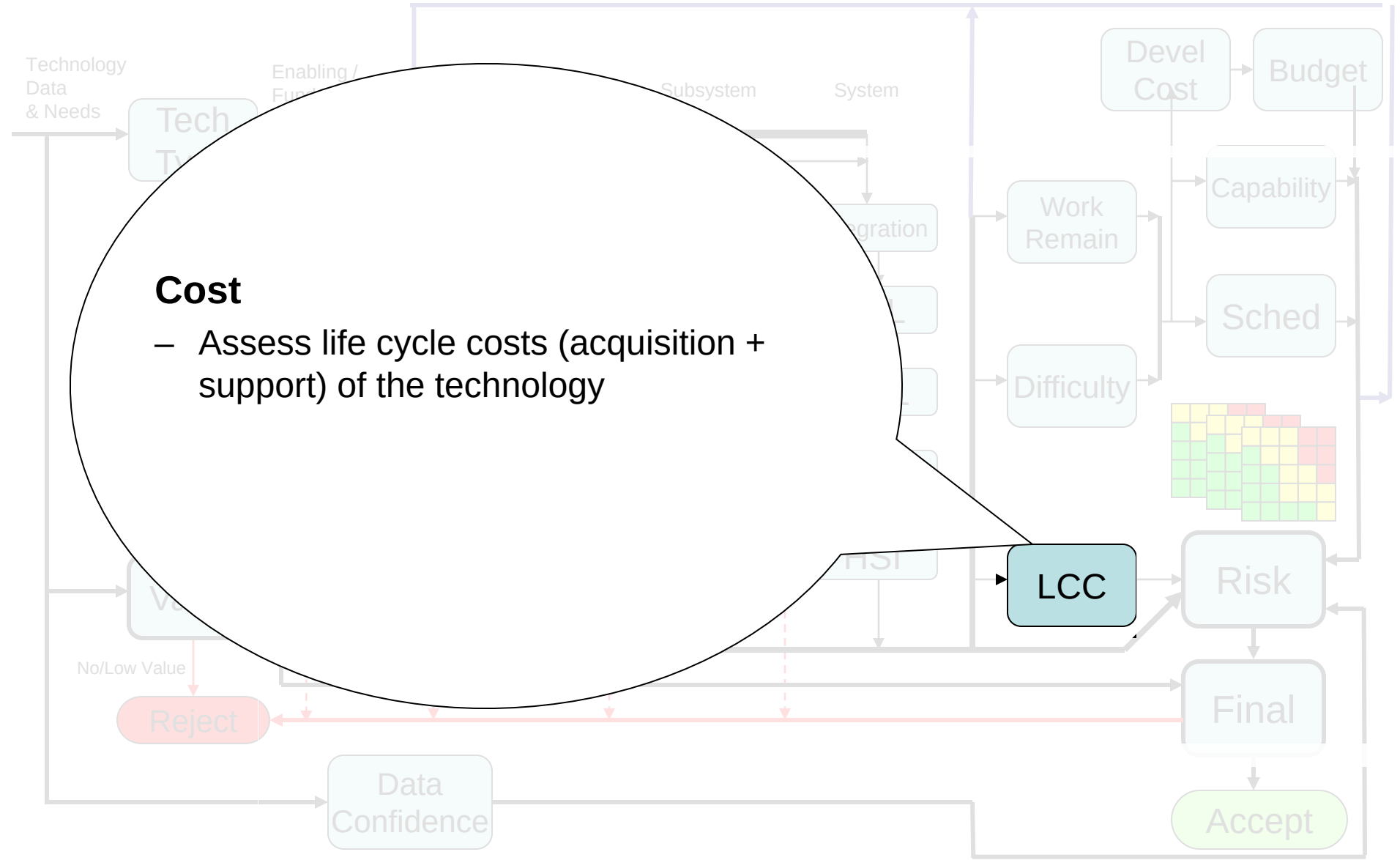
# Evaluation by Technology Type / Static Metrics



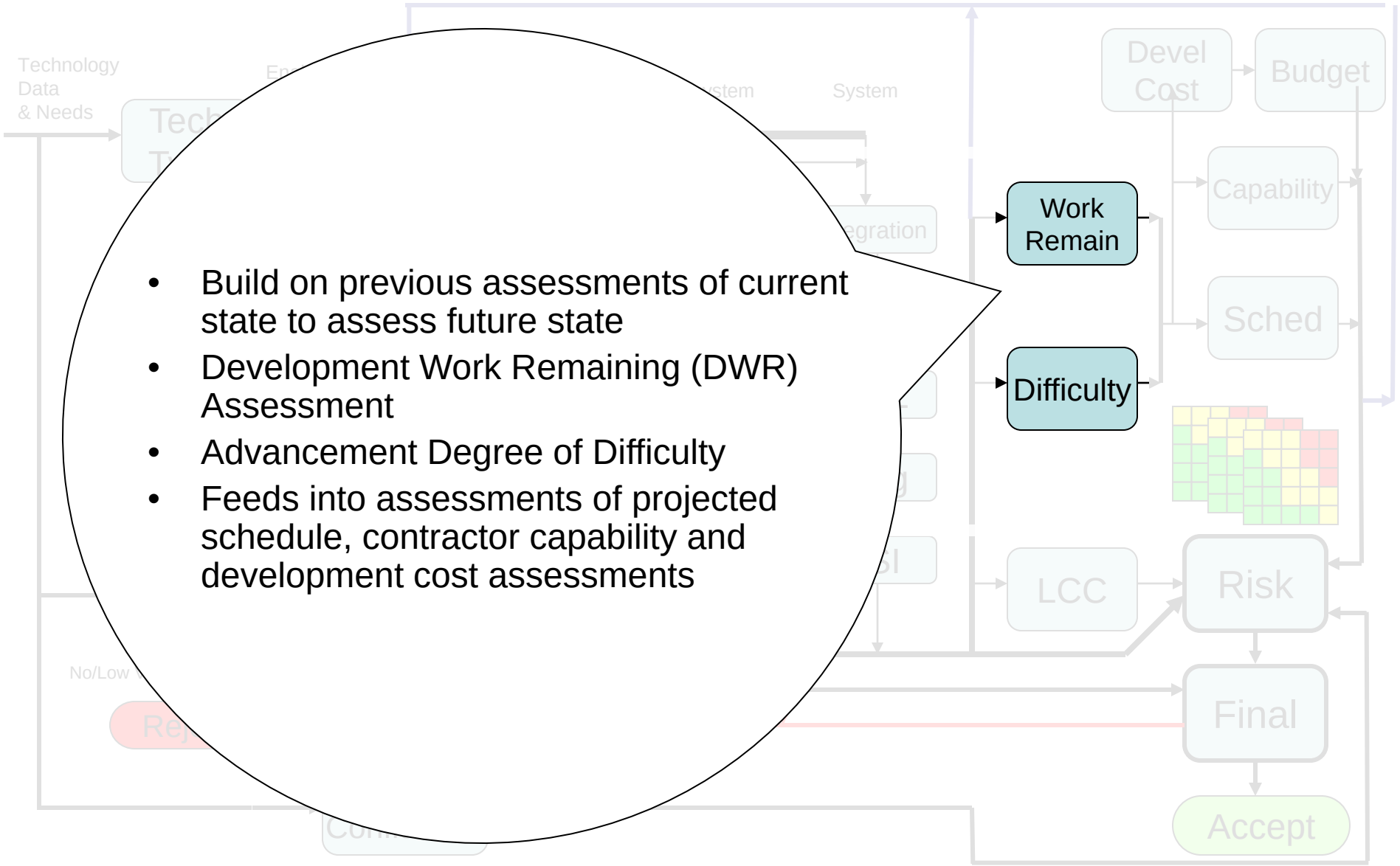
# Life Cycle Cost




**Cost**

– Assess life cycle costs (acquisition + support) of the technology

# Remaining Work




- Build on previous assessments of current state to assess future state
- Development Work Remaining (DWR) Assessment
- Advancement Degree of Difficulty
- Feeds into assessments of projected schedule, contractor capability and development cost assessments

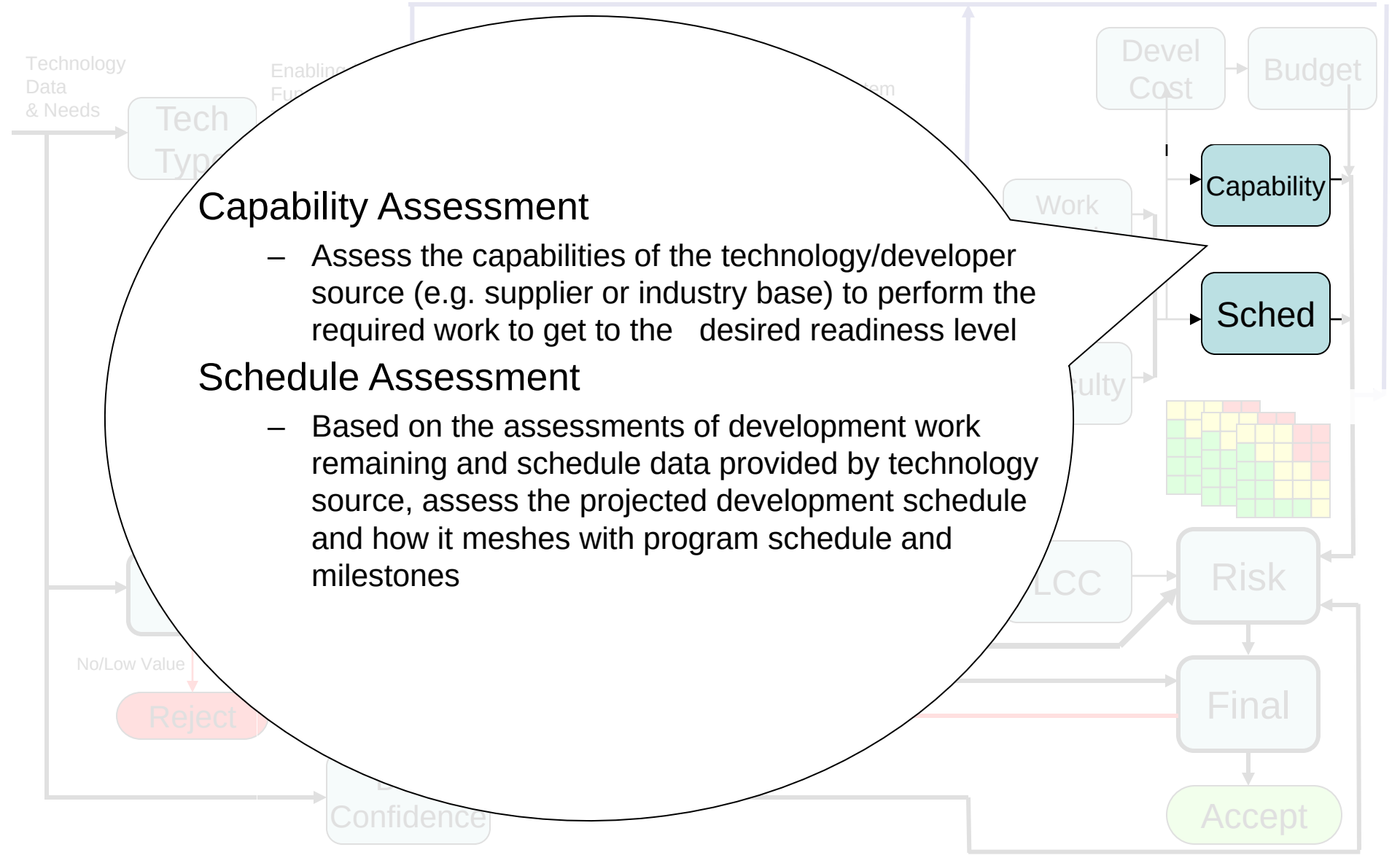
# Developer Capability & Schedule

## Capability Assessment

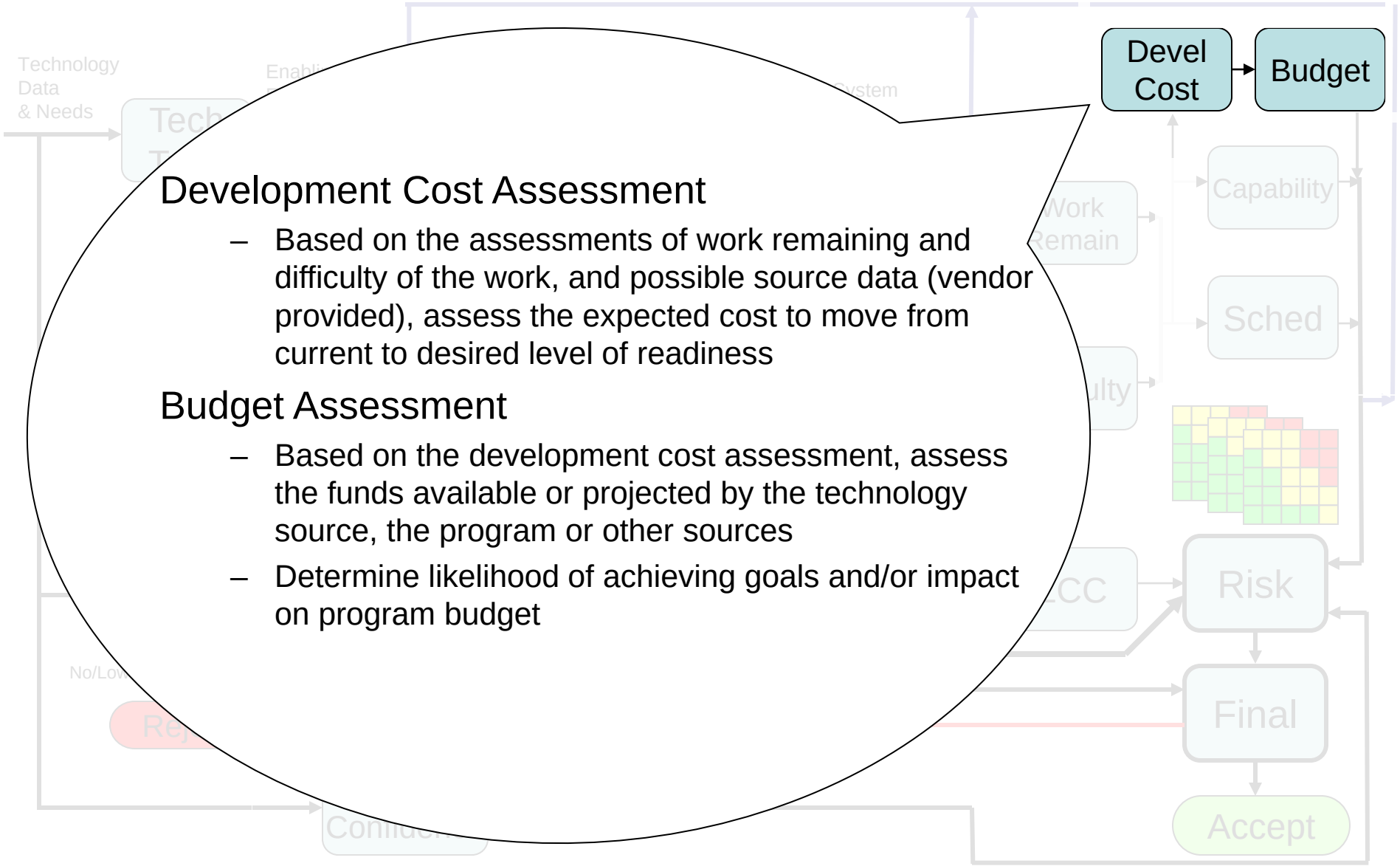
- Assess the capabilities of the technology/developer source (e.g. supplier or industry base) to perform the required work to get to the desired readiness level

## Schedule Assessment

- Based on the assessments of development work remaining and schedule data provided by technology source, assess the projected development schedule and how it meshes with program schedule and milestones



# Development Cost & Budget




## Development Cost Assessment

- Based on the assessments of work remaining and difficulty of the work, and possible source data (vendor provided), assess the expected cost to move from current to desired level of readiness

## Budget Assessment

- Based on the development cost assessment, assess the funds available or projected by the technology source, the program or other sources
- Determine likelihood of achieving goals and/or impact on program budget

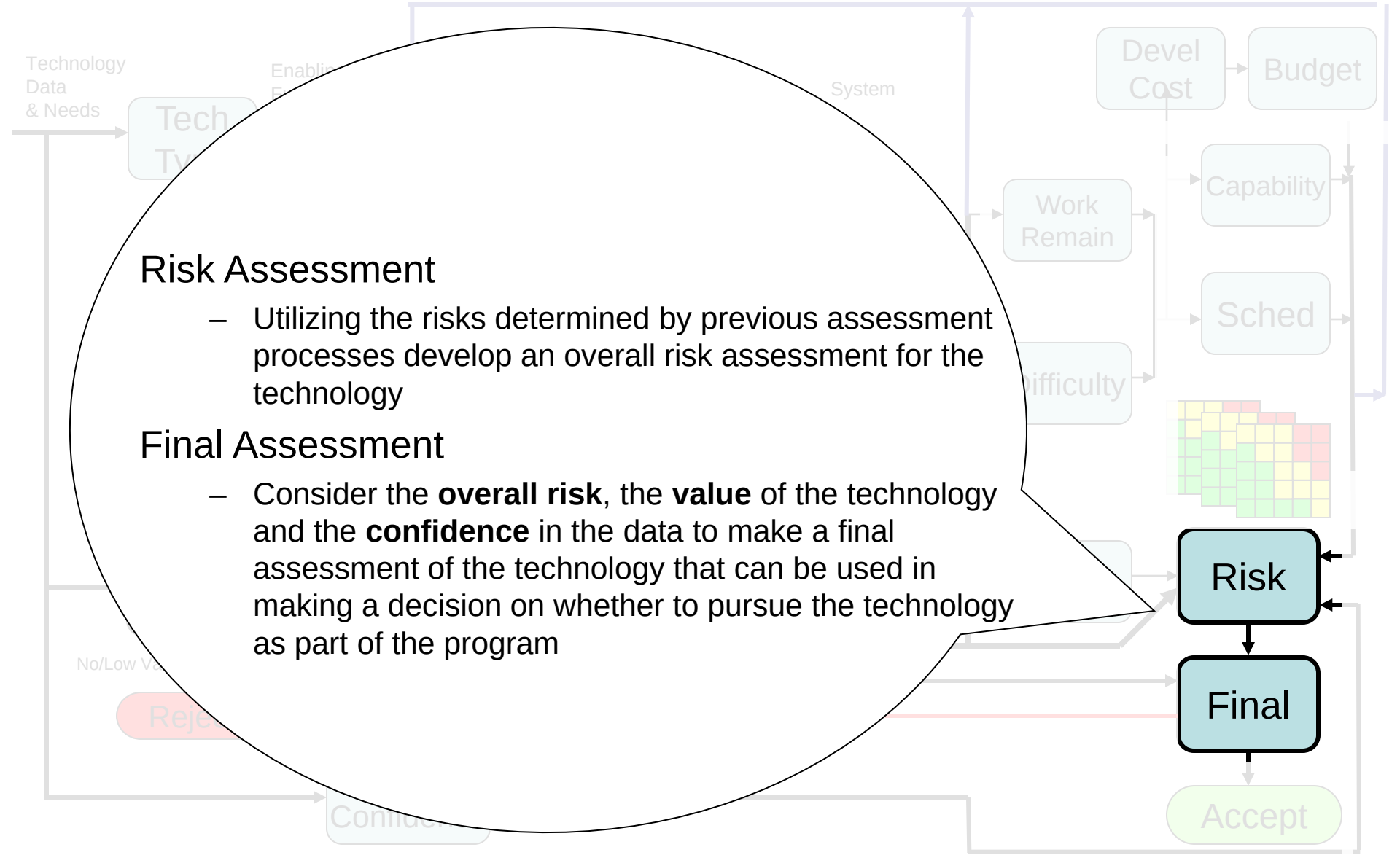
# Risk & Decision Making

## Risk Assessment

- Utilizing the risks determined by previous assessment processes develop an overall risk assessment for the technology

## Final Assessment

- Consider the **overall risk**, the **value** of the technology and the **confidence** in the data to make a final assessment of the technology that can be used in making a decision on whether to pursue the technology as part of the program



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# Summary

- Assessing Technology Maturity is required by law
- TRLs are well established but also well recognized as being limited in utility
- Many new metrics have been developed but not widely adopted
- Technology maturity assessment needs to be considered in the overall systems engineering context
- A framework for technology assessment was presented that considers different kinds of metrics and levels of technology in a systems engineering context supporting decision making

# BACKUP

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# Integration Readiness Level

- Measures the integration maturity of a developing technology with another technology, developing or mature
- Assesses risk of integration and provides direction for improving integration between technologies
- Evaluates interfaces, interaction, compatibility, assurance, control, translation of data, and validation of the functionality of combined technologies

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# System Readiness Level

- Serves as a function of individual TRLs and associated integration points (IRLs) within a system
- SRLs derive from the dynamic TRL-IRL-TRL relationship between different technologies
- SRLs evaluate system concept, technology development, system demonstration, production demonstration, and operations & support

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# Advancement Degree of Difficulty

- Evaluates the following criteria:
  - Design and Analysis
  - Manufacturing
  - Software Development
  - Test
  - Operations
- Asks about available resources – people, skills, tools, facilities, etc. to design, manufacture, test and operate the technology through a progression of TRLs and MRLs
- Implicates the fitness of the organization developing and manufacturing the technology or system

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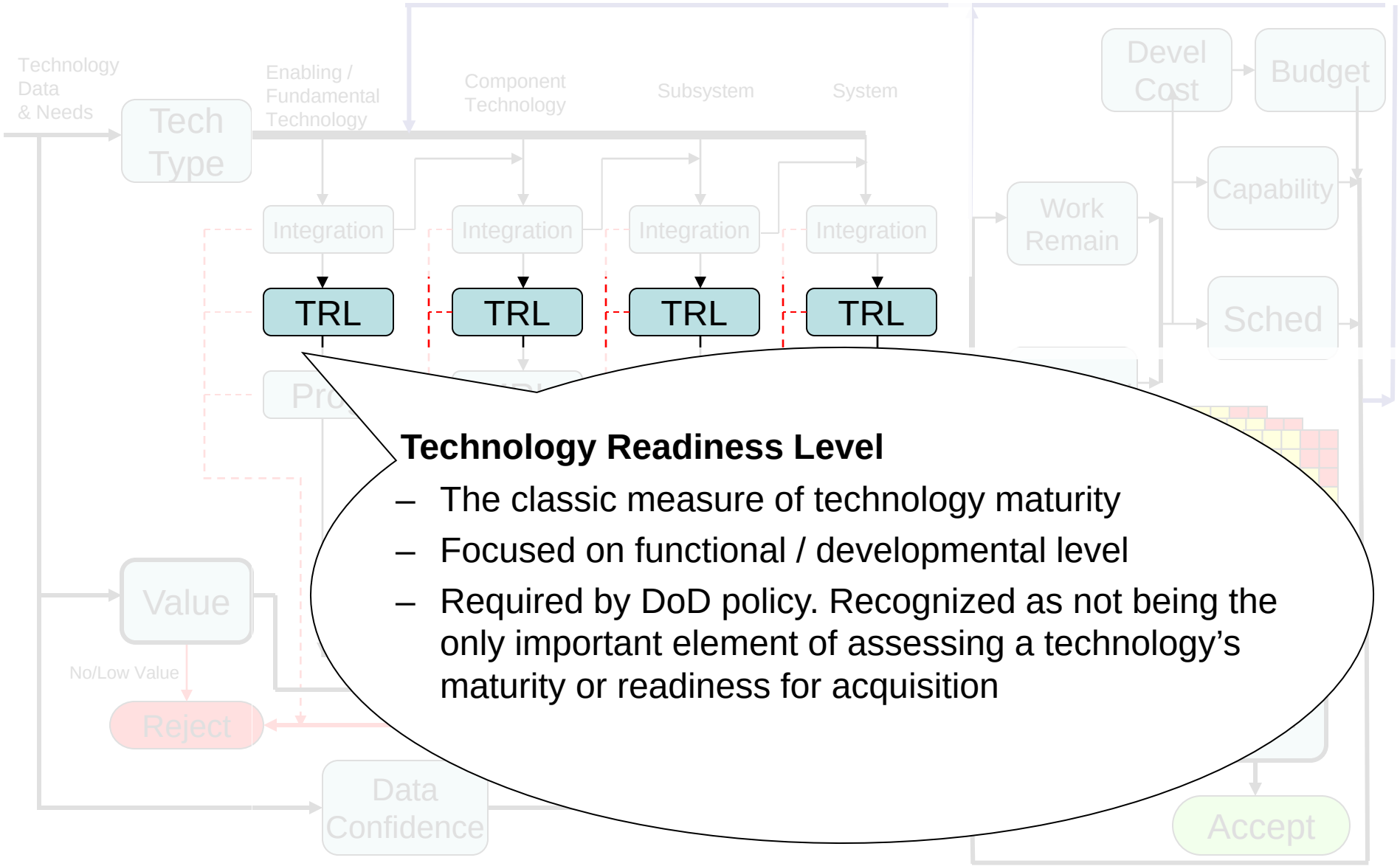
# Business Readiness Level

- Measures the fitness of a company to mitigate the risk of TRL and MRL transitions
- Fitness factors:
  - Commercialization Experience
  - General Management
  - Functional Management
  - Technical Sales & Support
  - Liquidity and Access to Capital
  - Competitive Position
  - Customer Knowledge
  - Customer Commitment
  - Affordability
  - Intellectual Property Mgmt.
  - Forecast of Sales
  - Forecast Uncertainty

**Human uncertainty makes business more uncertain and less controllable than technology or manufacturing**

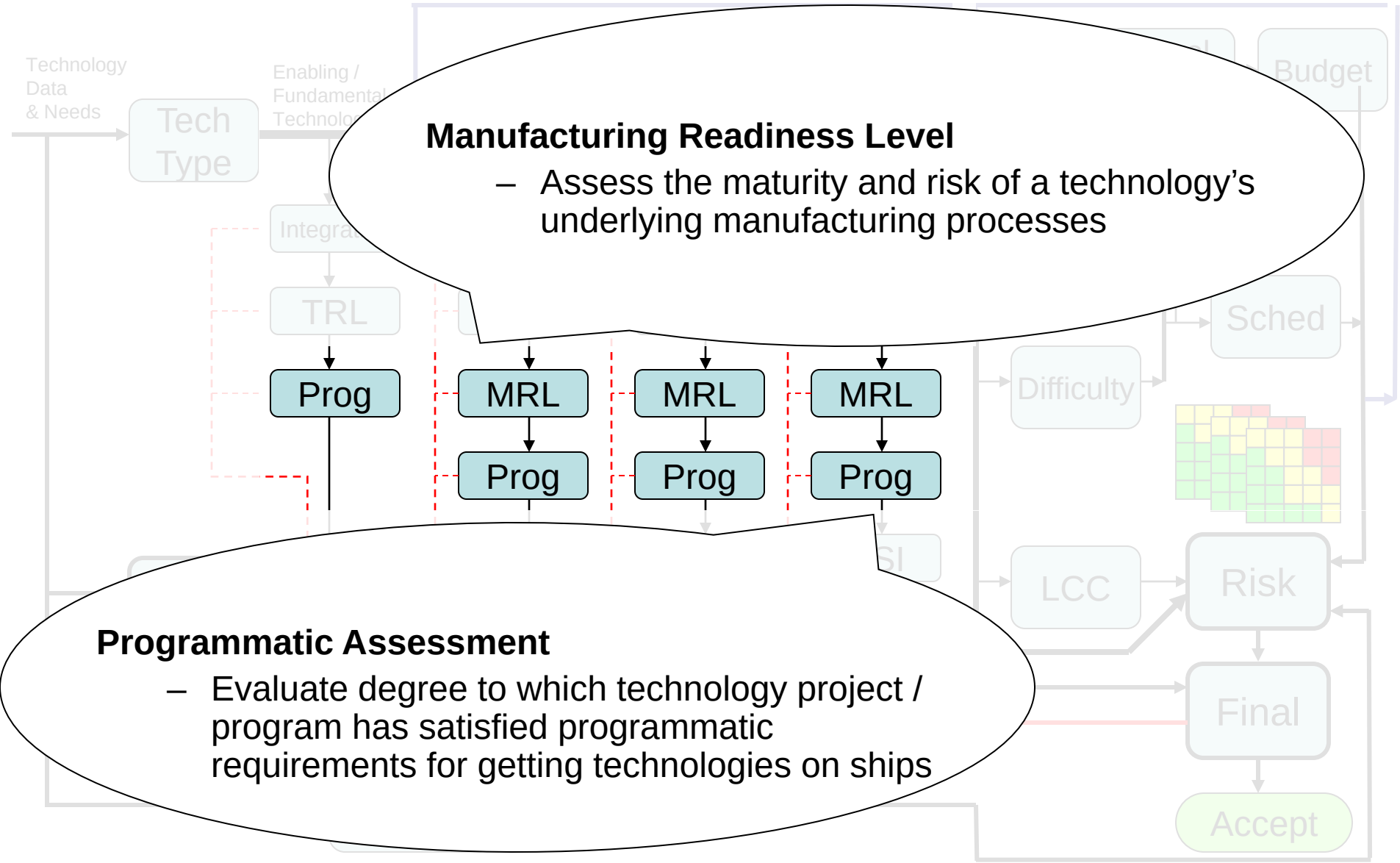
# Evaluation Processes




**Technology Readiness Level**

- The classic measure of technology maturity
- Focused on functional / developmental level
- Required by DoD policy. Recognized as not being the only important element of assessing a technology's maturity or readiness for acquisition

# Evaluation Processes



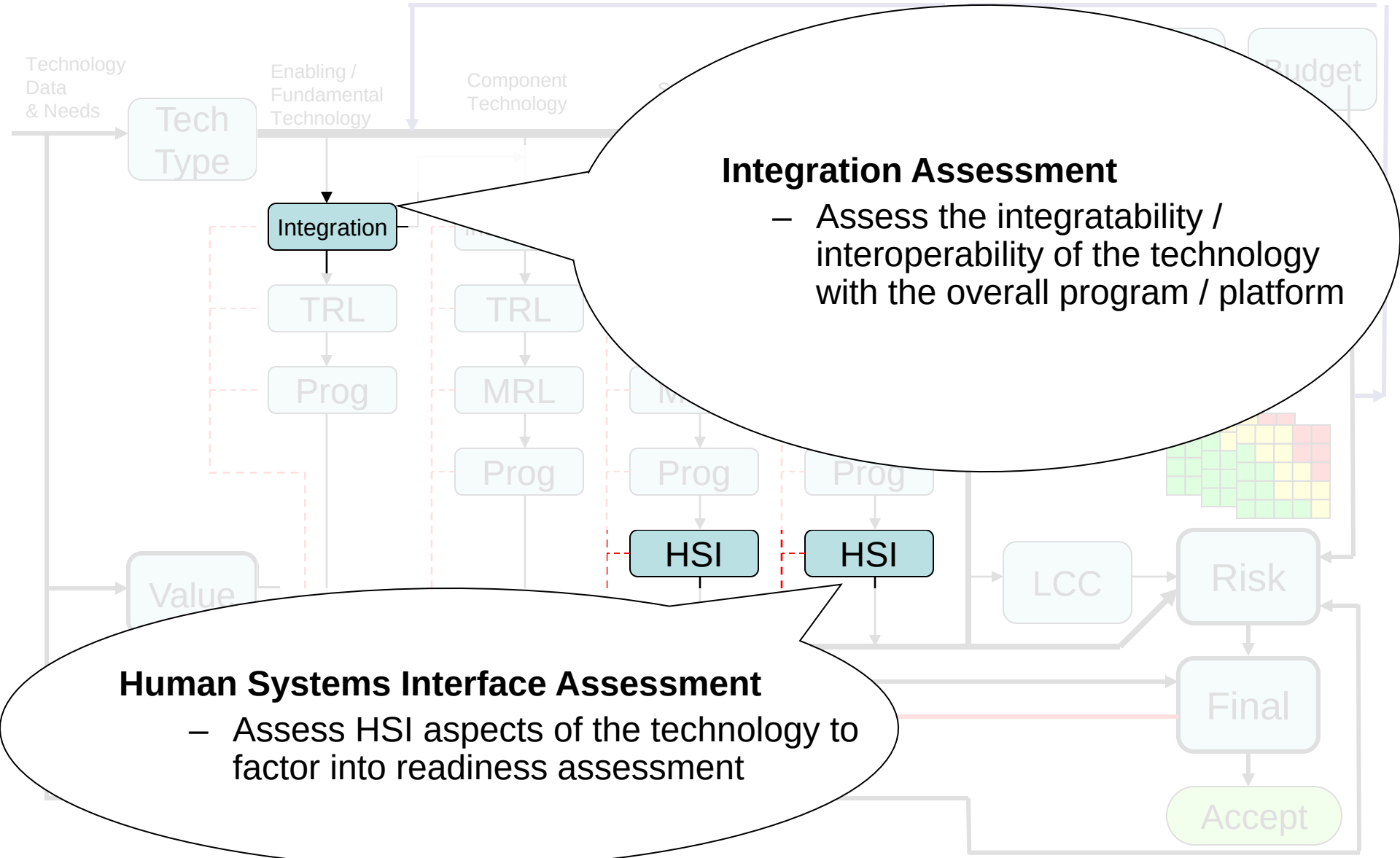

**Manufacturing Readiness Level**

- Assess the maturity and risk of a technology's underlying manufacturing processes

**Programmatic Assessment**

- Evaluate degree to which technology project / program has satisfied programmatic requirements for getting technologies on ships

# Evaluation Processes

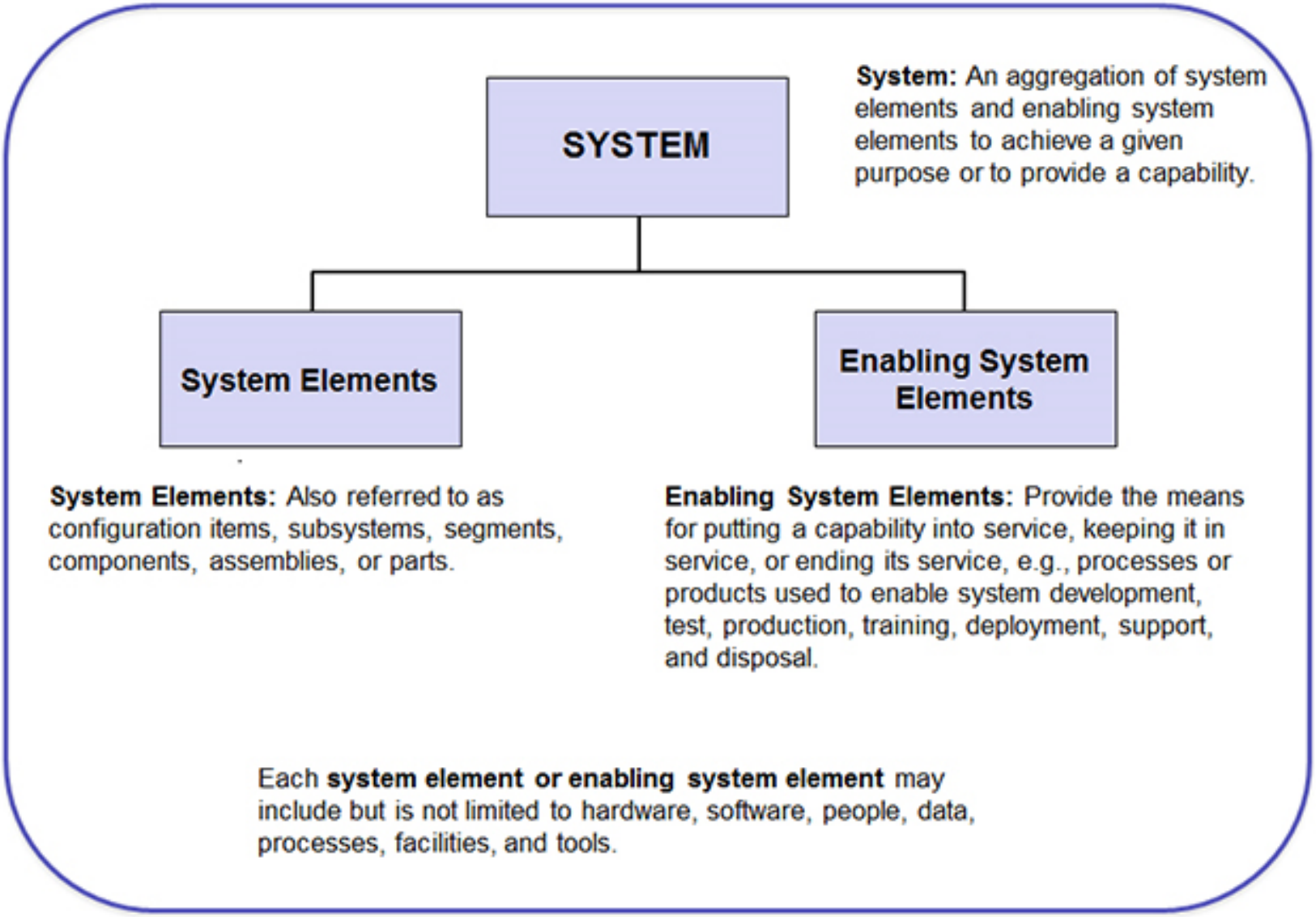



**Integration Assessment**

- Assess the integratability / interoperability of the technology with the overall program / platform

**Human Systems Interface Assessment**

- Assess HSI aspects of the technology to factor into readiness assessment


SYSTEM
System: An aggregation of system elements and enabling system elements to achieve a given purpose or to provide a capability.
System Elements
Enabling System Elements
System Elements: Also referred to as configuration items, subsystems, segments, components, assemblies, or parts.
Enabling System Elements: Provide the means for putting a capability into service, keeping it in service, or ending its service, e.g., processes or products used to enable system development, test, production, training, deployment, support, and disposal.
Each system element or enabling system element may include but is not limited to hardware, software, people, data, processes, facilities, and tools.