

# Quality Attributes and Requirement Traceability

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*"A few lines of code can wreak more havoc than a bomb." "*

*—Tom Ridge*

*(Former) Secretary of U.S. Department of Homeland Security*

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# Quality Attributes and CDpro<sup>2</sup>



*"They always say that time changes things, but you  
actually have to change them yourself"*

*- Andy Warhol*

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## Abstract

Quality Attributes are requirement which directly affect the building of application and software systems. Quality Attributes in fact act as "super" requirements. It might be better to call them meta-requirements. A single Quality Attributes might impact hundreds of other client requirements. It would be desirable to be able to capture Quality Attributes in a requirements database and provide "traceability" between the QA, the requirements, the features of a solution and the components of the eventual proposed architecture.

Unisys has developed a proprietary requirements driven methodology called CDPro<sup>2</sup> (Customer Driven Proposal Process). CDPro<sup>2</sup> is both a process and a tool set to achieve traceability between the information components of requirements driven proposals and projects. This methodology allows Unisys to capture and documents requirements of an architecture, features of an architecture (including its Quality Attributes), components of an architecture and the associated costs to build those architecture components.

This process/methodology is accompanied by a tool set built as on "overlay" on top of IBM's Rational Tools Suite, including the requirements management tool, Requisite Pro. Requisite Pro has been considerably extended from its basic requirements mission to become a generalized information manager. The customization allows for the capture of all types of information related to requirements (including Quality Attributes) and provides for generalized traceability between all information data types.

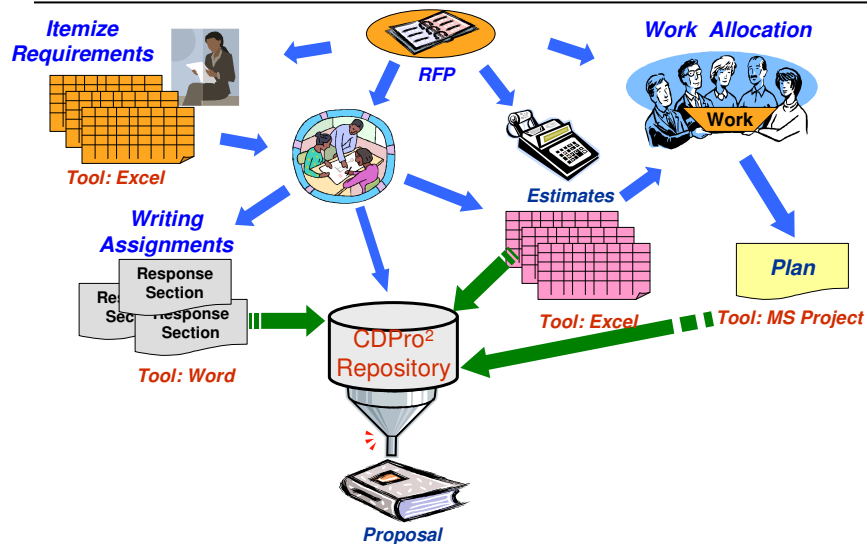
As a result, it allows a development team to capture all architecture components. This information can then be traced from the requirements to the Quality Attributes to the architecture components and finally to their development costs. Thus extensive information traceability is provided, which improves requirements development and management.

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3D Blueprint  
CDPro<sup>2</sup>

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## Proposal Process



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## Multiple Dimensions (\*) of a Proposal

Customer / Stakeholder need, Profitability, ROI, Time to Market, etc.

>>> *(RFP Requirements)*

Why?

Programme, Product, Service, Reference architecture, etc...

>>> *(Features or Product Structure FBS or PBS)*

What?

Deliverables, Methods, Techniques, etc...

>>> *(Work Breakdown Structure or WBS)*

How?

Financial Information (Cost, Should Cost, Margins, etc...)

>>> *(Basis of Estimate (BOE), Bill of Material (BOM) )*

How Much?

Organization, Team, Customer, etc...

>>> *(Organization Breakdown Structure or OBS)*

Who?

Phase, milestones, schedule, project plan, etc.

>>> *(Part of BOE)*

When?

Region, Country, etc.

>>> *(Part of OBS)*

Where?

\* Adapted from the Zachman framework

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## Customer Driven Proposal Process: CDPro<sup>2</sup>

CDPro<sup>2</sup> is a **core proposal process**  
made up of activities (based on standards), deliverables,  
best practices, tools and templates to support Unisys sales.

This provides Unisys with the ability to deliver quality proposals  
with solution and cost **traceability** and  
also allows investment **recovery**.

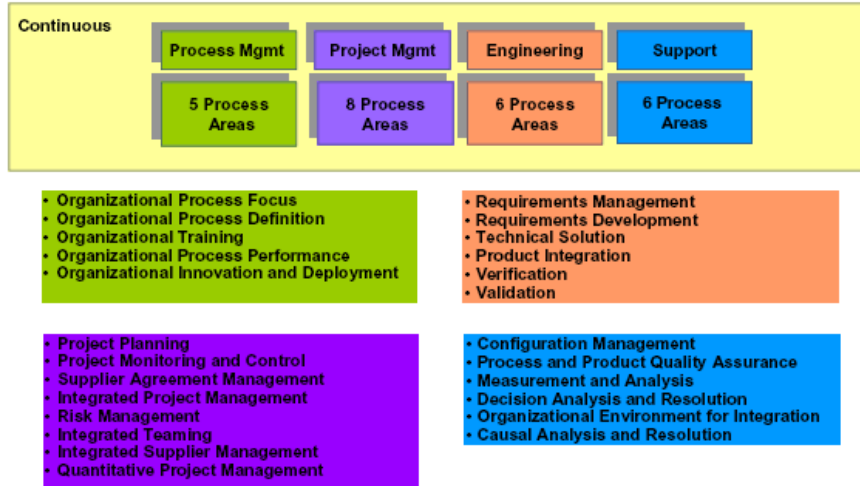
The proposal deliverables will be used during  
proposal preparation, contract negotiations,  
project initiation and project governance.

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## Continuous View of CMMI



## CMMI v1.2 Integration with CDPro<sup>2</sup>

- Major Process Areas Addressed
  - RD Requirements Development)
  - REQM (Requirements Management)
  - SAM (Supplier Agreement Management)
  - PP (Project Plan)
  - TS (Technical Solution)

## CMMI v1.2 Integration with CDPro<sup>2</sup>

### RD (Requirements Development)

#### SG 1 Develop Customer Requirements

- SP 1.1 Elicit Needs
- SP 1.2 Develop the Customer Requirements

#### SG 2 Develop Product Requirements

- SP 2.1 Establish Product & Product Requirements
- SP 2.2 Allocate Product Component Requirements
- SP 2.3 Identify Interface Requirements

#### SG 3 Analyze and Validate Requirements

- SP 3.1 Establish Operational Concepts & Scenarios
- SP 3.2 Establish a Definition of Required Functionality
- SP 3.3 Analyze Requirements
- SP 3.4 Analyze Requirements to Achieve Balance (Risk Assessment)
- SP 3.5 Validate Requirements

## CMMI v1.2 Integrated with CDPro<sup>2</sup>

### REQM (Requirements Management)

#### SG 1 Manage Requirements

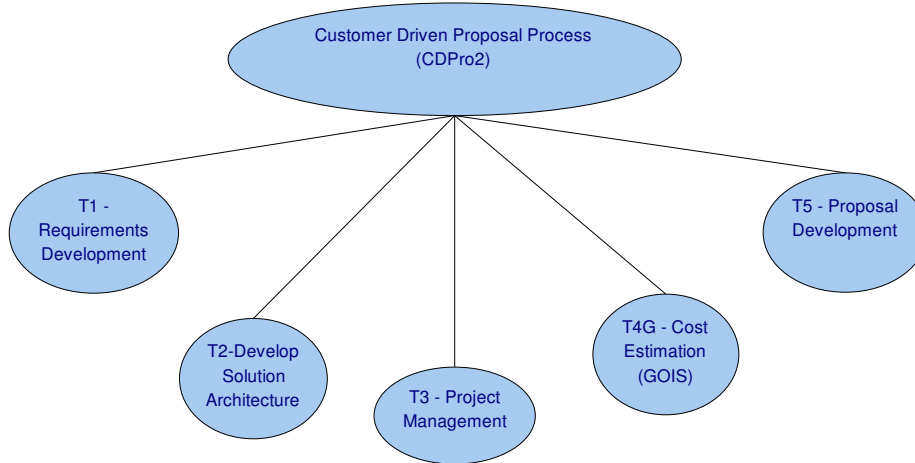
- SP 1.1 Obtain an Understanding of Requirements
- SP 1.2 Obtain a Commitment to Requirements
- SP 1.3 Manage Requirements Changes (amendments/revisions to RFP)
- SP 1.4 Maintain Bidirectional Traceability of Requirements
- SP 1.5 Identify Inconsistencies Between Project Work & Requirements

### SAM (Supplier Agreement Management)

#### SG 1 Establish Supplier Agreements

- SP 1.1 Determine Acquisition Type
- SP 1.2 Select Suppliers
- SP 1.3 Establish Supplier Agreements

## 3D Blueprint: CDPro<sup>2</sup> Proposal Process

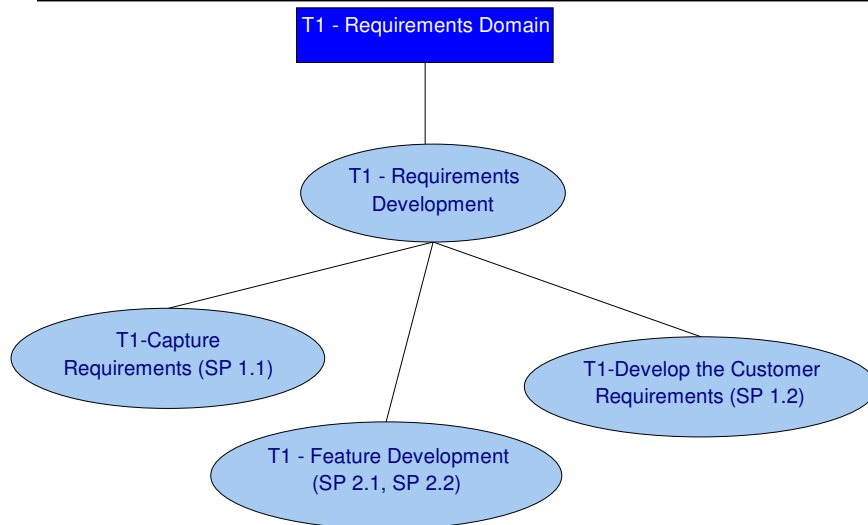


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## 3D Blueprint: Requirements Domain

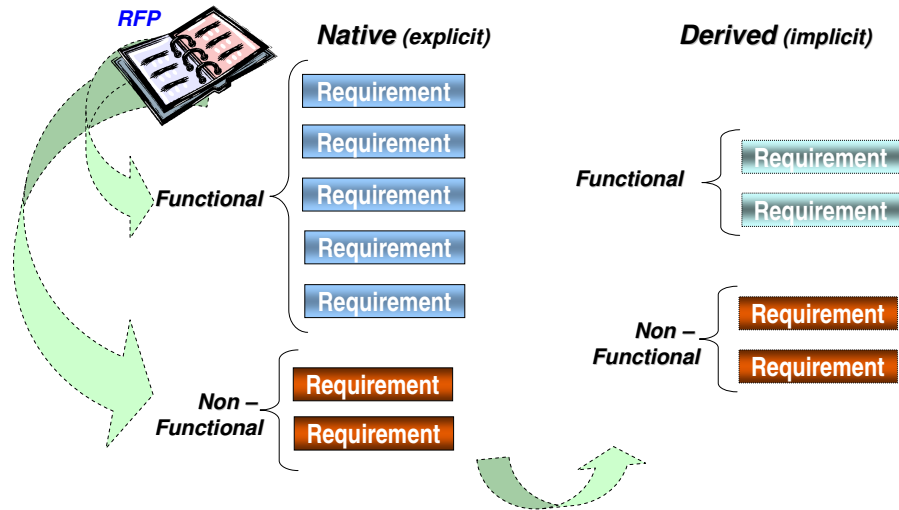


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## Requirements Types

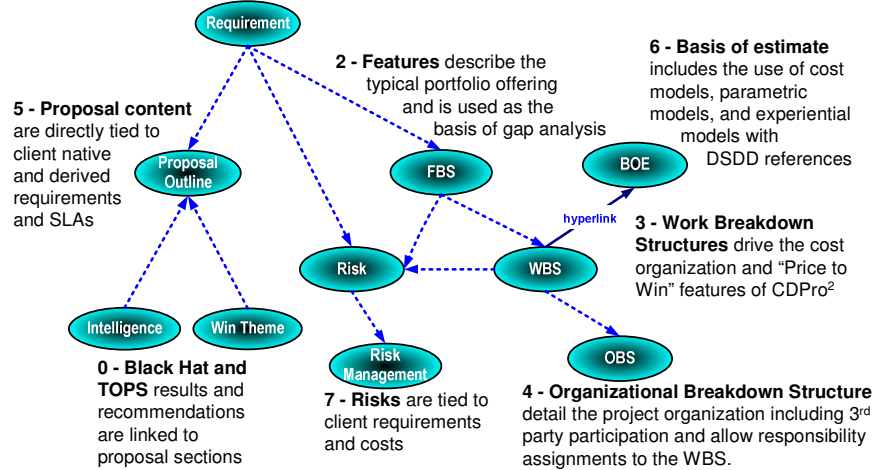


## Requirements Attributes

- *Native vs. Derived*
- *Architecturally Significant*
- *Constraint*
- *Assumption*
- *Quality Attribute*
- *Others*
  - *Methodological (e.g.: TPI)*
  - *Legal (e.g.: provide a Bond)*
  - *Human Resource (e.g.: match the pension plan)*
  - *Resource (e.g.: must use the existing security contractor)*

## CDPro<sup>2</sup> Information Types and Work Products

**1 - Requirements** development captured from JRM, client RFP or Tender, questions and includes derived requirements

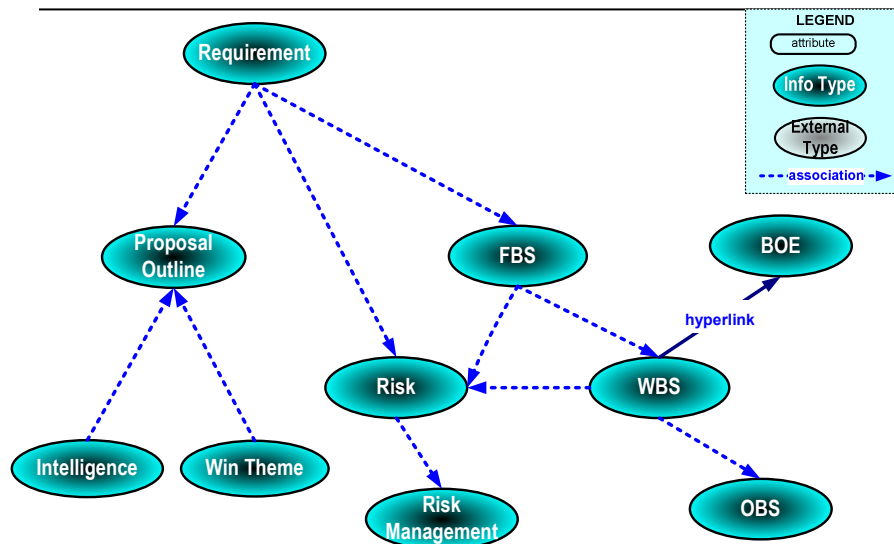


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## CDPro<sup>2</sup> Information Schema



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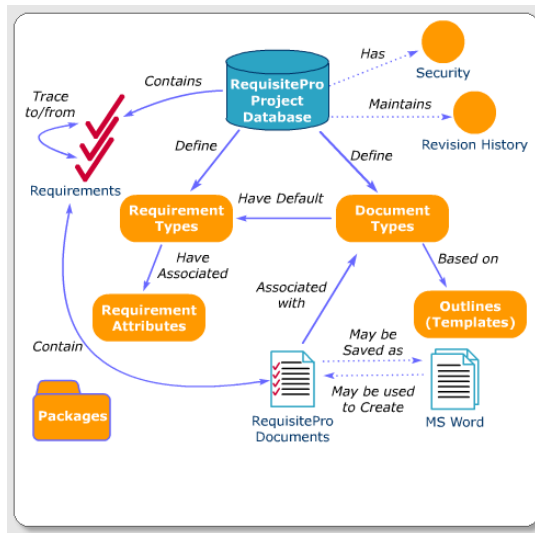
## Traceability



- Traceability is needed to connect the information in the data base, i.e:
  - Trace a Requirement to a Feature
  - Trace the a WBS element to the Organization
  - Trace a Risk to a WBS Element
- The dependency between data types can be implemented as traceability in ReqPro in one of two ways:
  - “trace-to” association between two data types
  - “trace-from” association between two data types
- CDPro<sup>2</sup> uses the “trace-to” association exclusively; this is done to guarantee the results of the packaged reports provided with the template
- Traceability is required for producing meaningful reports

## RequisitePro

- A flexible, multi-user environment
- Allows for defining Information Types
- **Traceability between types**
- Requirement Version Control
- Repository Baseline
- Linkage with other Rational and Microsoft tools



## Short Live Demo of CDPPro<sup>2</sup>

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## Augmenting CDPPro<sup>2</sup> with Quality Attributes

*"Approximately 60-70% of project failures result from poor requirements gathering, analysis, and management."*

*-- Meta Group, March 2003*

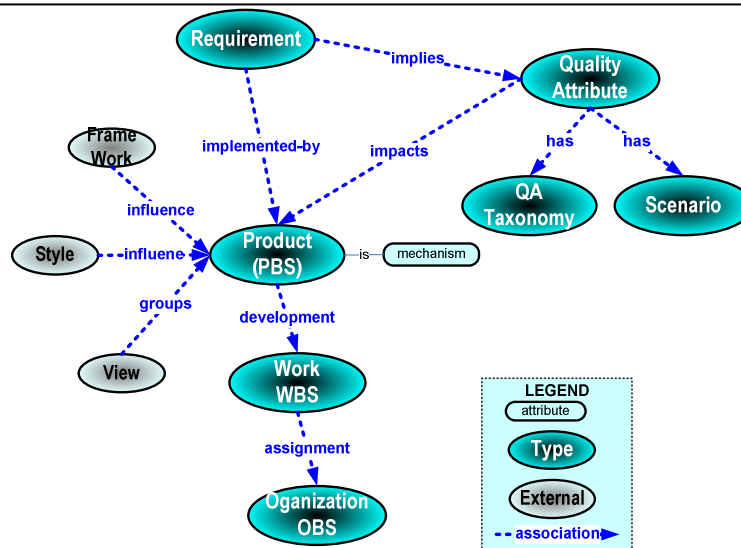
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## Review of SEI Terminology

- Quality Attribute:
  - Quality Attribute Taxonomy
  - Quality Attribute Scenario
- Architecture:
  - Architecture Mechanism
  - Architecture Style
  - Architecture Framework
  - Architecture View
- We use the CDPro<sup>2</sup> information model and extend it for Quality Attributes

## Information Schema Extended for QA



## New Information Type Definition

- **Requirement:**  
can be kept as-is (chose not to model quality as a requirement "attribute")
- **Quality Attribute**  
a type of information which is a sub-type of requirement, however Requisite Pro does not have the concept of sub-typing, so creating a new type is a better solution
- **Quality Attribute Taxonomy**  
a QA taxonomy can be simply created using the native mechanisms of Requisite Pro; any depth and breadth of taxonomy can be created
- **Scenario**  
a QA scenario can be created using the Requisite Pro native type of Use Case (a similar concept)
- **Product Breakdown Structure**  
the hierarchical breakdown of the solution or product; this can have any depth and breadth where each element is either a "Component" or a group of components; the grouping of the PBS can be dictated by a view, a framework, or a style  
"mechanism" is a an attribute of PBS
- **Framework**  
a pre-packaged set of components which provides a reference architecture for a product; the framework is external to Requisite Pro but acts as an organizing concept
- **Style**  
a pattern for grouping components or elements of a product;  
styles are defined externally to the architecture
- **View**  
a grouping of components  
views represent cohesive groups of components grouped for a logical reason  
views are external to Requisite Pro but can be created and maintained by modeling tools

## Traceability

Source	Target	Relationship
Requirement	Quality Attribute	implies: a requirement may imply one or more quality attributes, this will allow for impact analysis; quality attributes can be "derived" from the set of requirements
Requirement	Product PBS	implemented by: a requirement is assigned to an element of the product or service being developed; that element will implement the requirement partially or completely
Quality Attribute	Product PBS	impacts: quality attribute is mapped to each product or service design element
Quality Attribute	Taxonomy	has: this models a hierarchy of quality attributes; thus quality attribute "trees" can be kept and association can be made at the leaf level; the taxonomy itself is not a new type, but just the assembly of the tree
Quality Attribute	Scenario	has: each quality attribute can have many scenarios; those are used in making decision about product components

## External Types and Schema Attributes

Name	Purpose	Comment
Framework	Reference	Guide the Product architecture
Style	Reference	Guide the Product architecture
View	Grouping	Group elements of the architecture
mechanism	Attribute	Describes an aspect of a product element
importance	Attribute	A value assessed against the scenario
difficulty	Attribute	A value assessed against the scenario
sum	Attribute	A value assessed against the scenario

## Value Proposition

- Quality Attributes:
  - Identify and store in data base
  - Quality trees can be reused
  - Capture Scenario information
  - Track metrics of scenario evaluation
- Traceability:
  - Requirements to Quality Attribute
  - Quality Attribute to Product design element
  - Quality Attribute to Scenario
  - to/from Architecture Framework, Styles and Views
- CDPro<sup>2</sup> allows for the capture, management and reporting on all aspects of Quality Attribute Workshops and the up-stream information and down-stream reusability

## Short Live Demo of CDPro<sup>2</sup> extended for Quality Attributes

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# Thank You!

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