SAND2020-5931C

A Proposed Model-Based Approach To Qualification (Formal V&V)

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2020 INCOSE Western States Regional Conference – Seattle, WA

MBSE – Not Just For Design

- Qualification = V&V!
  - Government systems, formal process
- Many companies have moved to model based design and development
- Some operations – qualification – still document based

Using MBSE tool to track, organize, and finally grant "Qualified" status to a product can save time and money

Document Based Qualification

- My role: Qualification Engineer for multiple components
- Qualification Plan in MS Word
  - Wide range of parts: tire valve to complex Electro/mech parts
  - Requirements, design, production, Reliability
  - Plan is for Verification; approach works for Validation also
- Required for Government / High Consequence Items

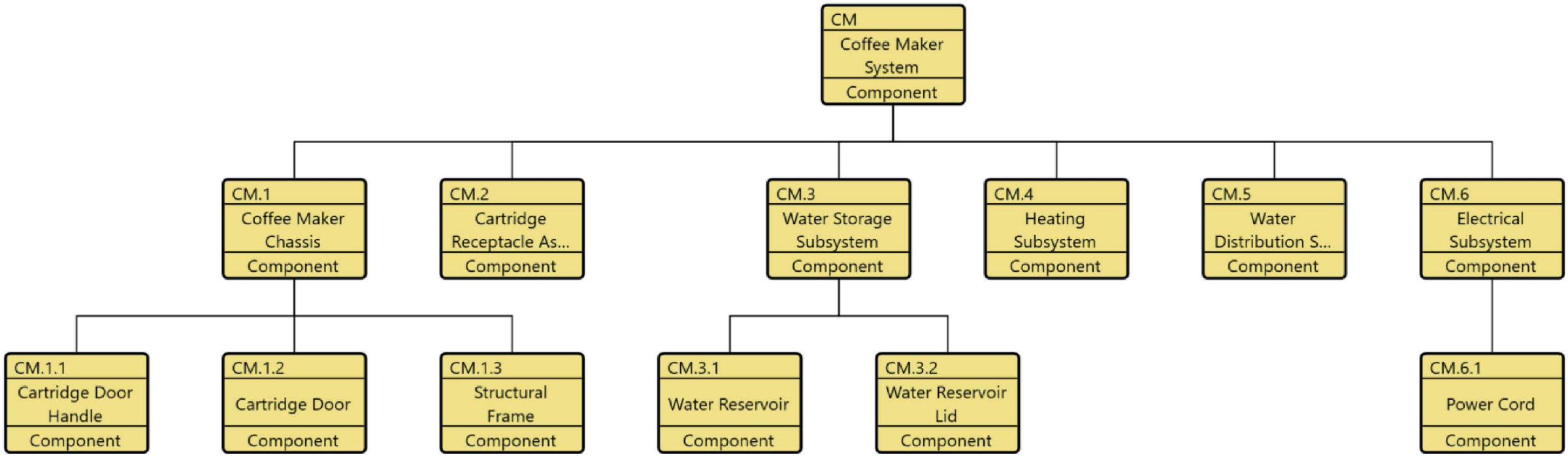
Tracking the work is not doing the work; any reductions through use of a MBSE tool are most welcome

Example: Coffee Pot

Data Elements: Requirements & Design

- Integrated Data as a Foundation of Systems Engr.
- Define data elements!
  - Requirements
    - Functional, Interface, Transport, Environmental, …
  - Solid drawings / CREO
  - Handling specification
  - Production specifications
  - Programmatic: status reports, SEMP, REMP, V&V plan, …

Top Level Physical Architecture



Move to V&V Plan: MS-Word

- Introduction
- Product Information
- Drawing Set
- Qualification Strategy
  - Prototype Builds
  - Status Reports
  - Test Equipment
  - Customer Experience tests
- Requirements Validation
  - Chassis, Cartridge seat, … Electrical
- Design Qualification
  - Prototype Build 1, 2, 3
  - Chassis, Cartridge seat, … Electrical
- Readiness Level
  - TRL / MRL
  - Chassis, Cartridge seat, … Electrical
- Production Development
  - Tooling, gauges
  - Vendor data and qualification
  - Production, Handling, Packaging specs
- Test Strategy
  - Acceptance Equipment
  - Customer trials
- Verification
  - Data repository
- Final Acceptance

Hard to access specific data quickly

Very Linear! Read Top-to-Bottom

- Introduction
- Product Information
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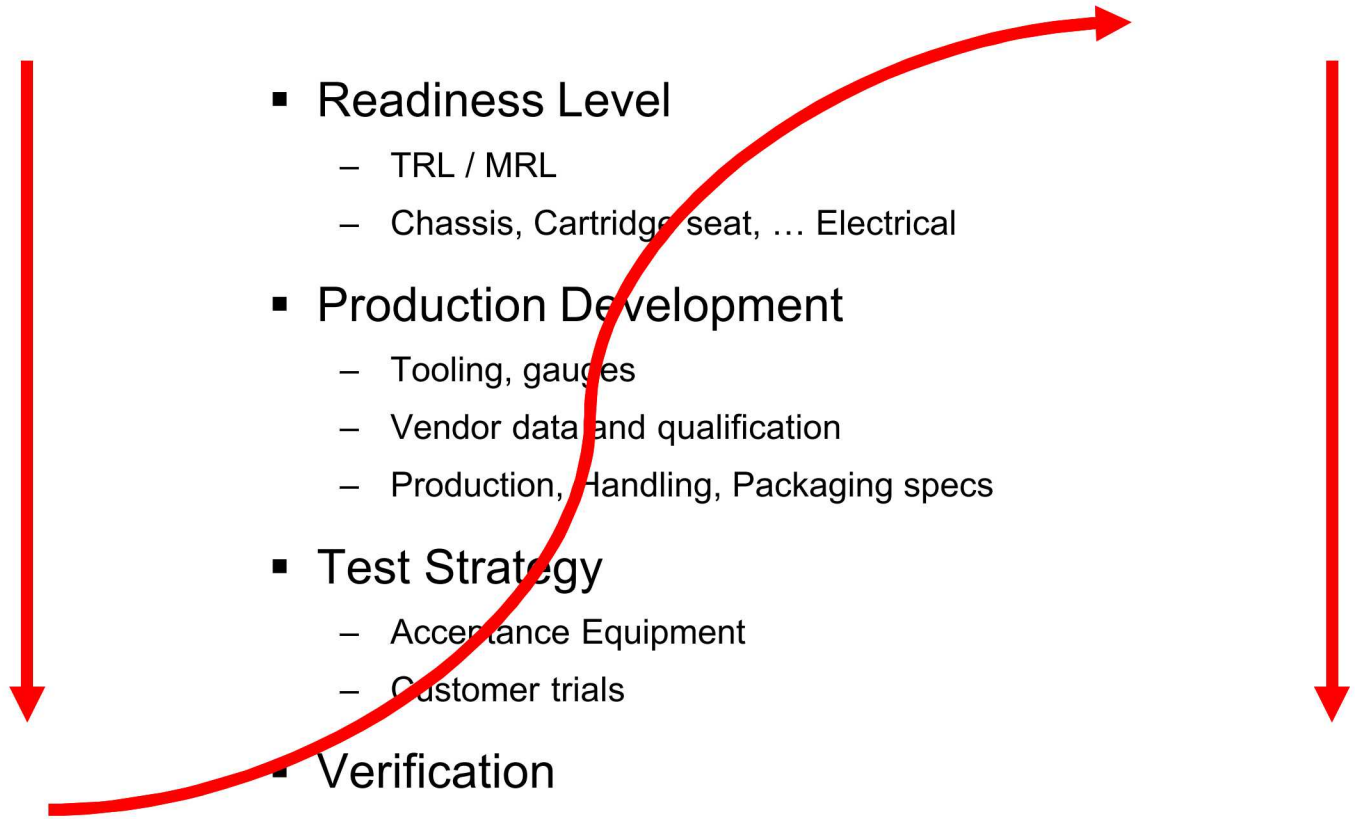

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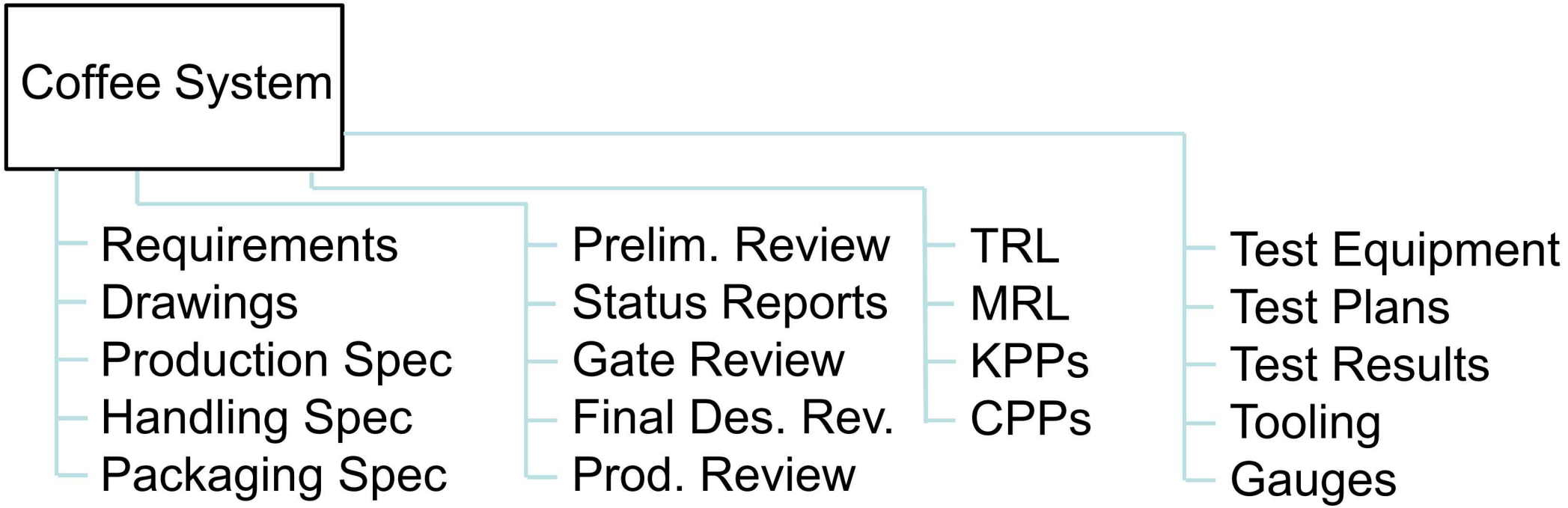
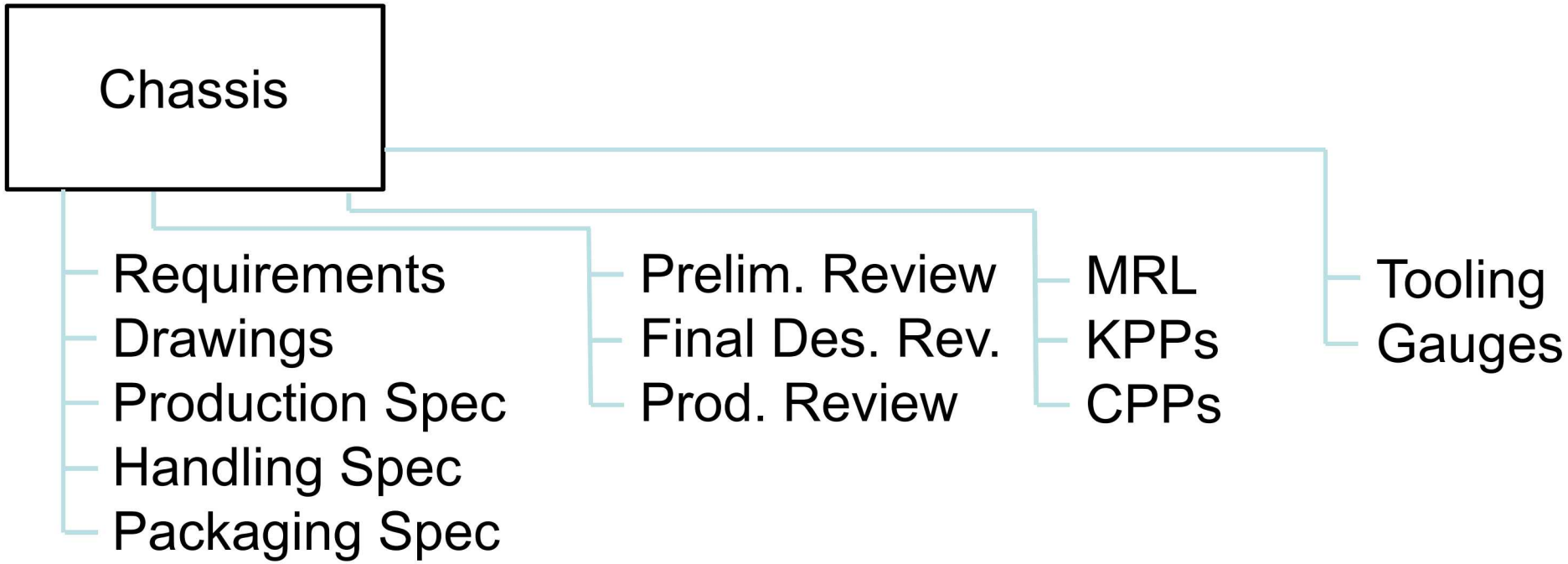
The MS-Word approach is “One-dimensional”: up and down the page. It’s all there, but hard to access specific data quickly

New Approach: Model Based



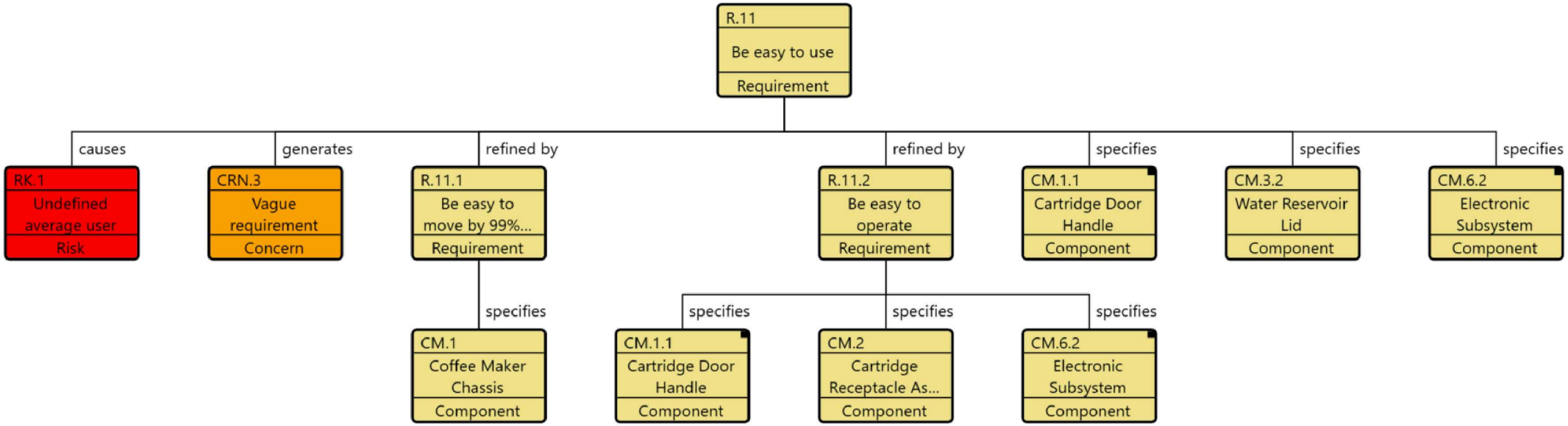
Each physical item's data is more accessible than buried in a MS Word document

Recursive



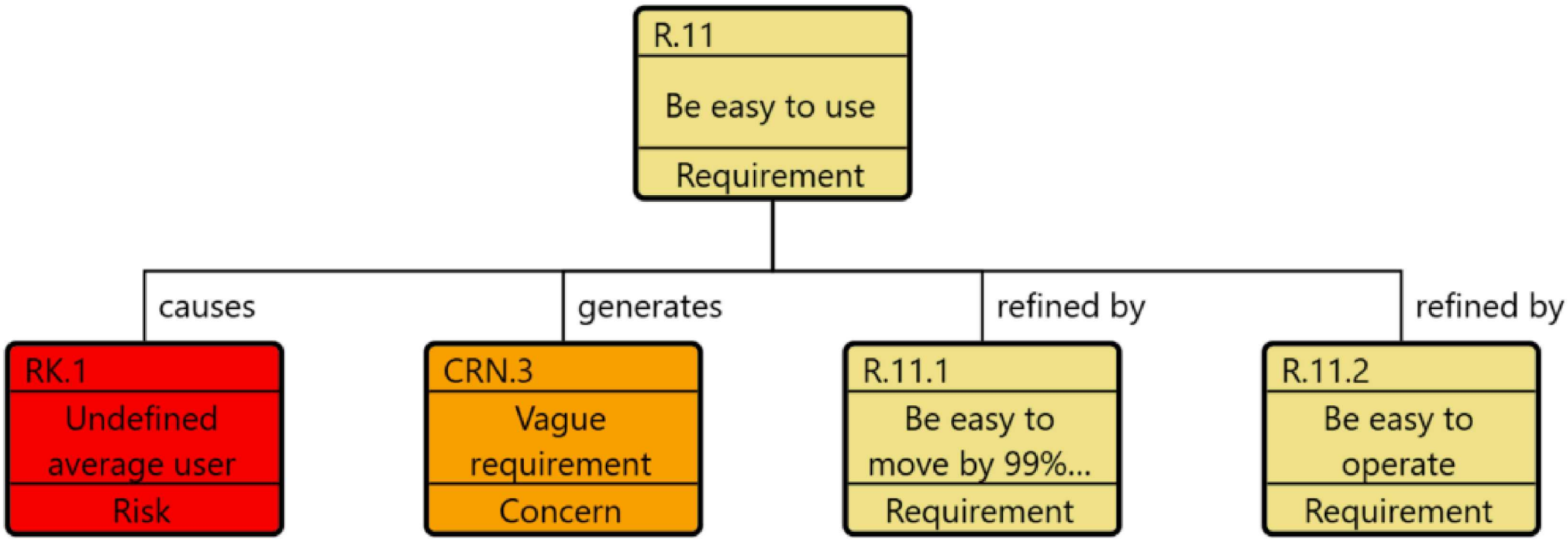
Model allows flexible and recursive approach

MB Qualification – What Information Ties to a Requirement?

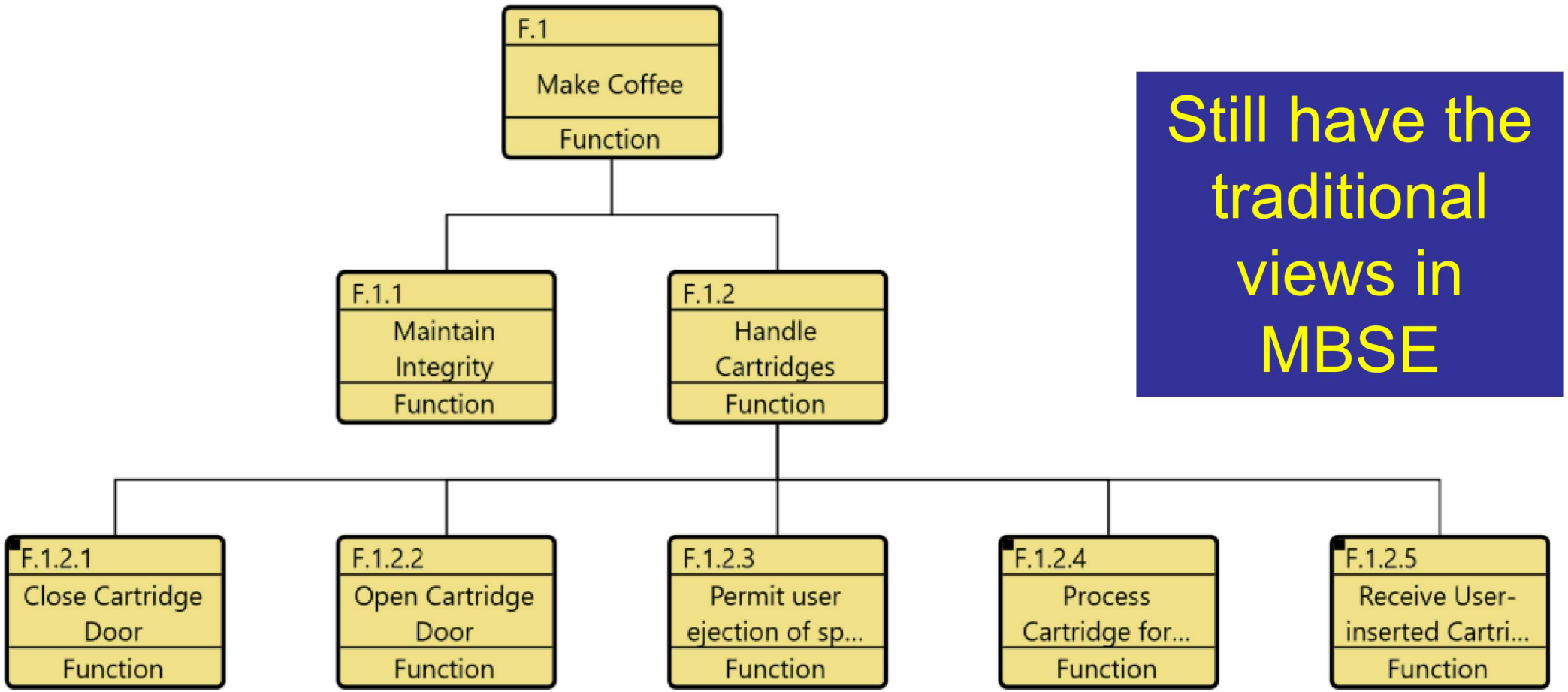


This view very helpful for formal V&V

Risks and Concerns – Side by Side with Child Requirements

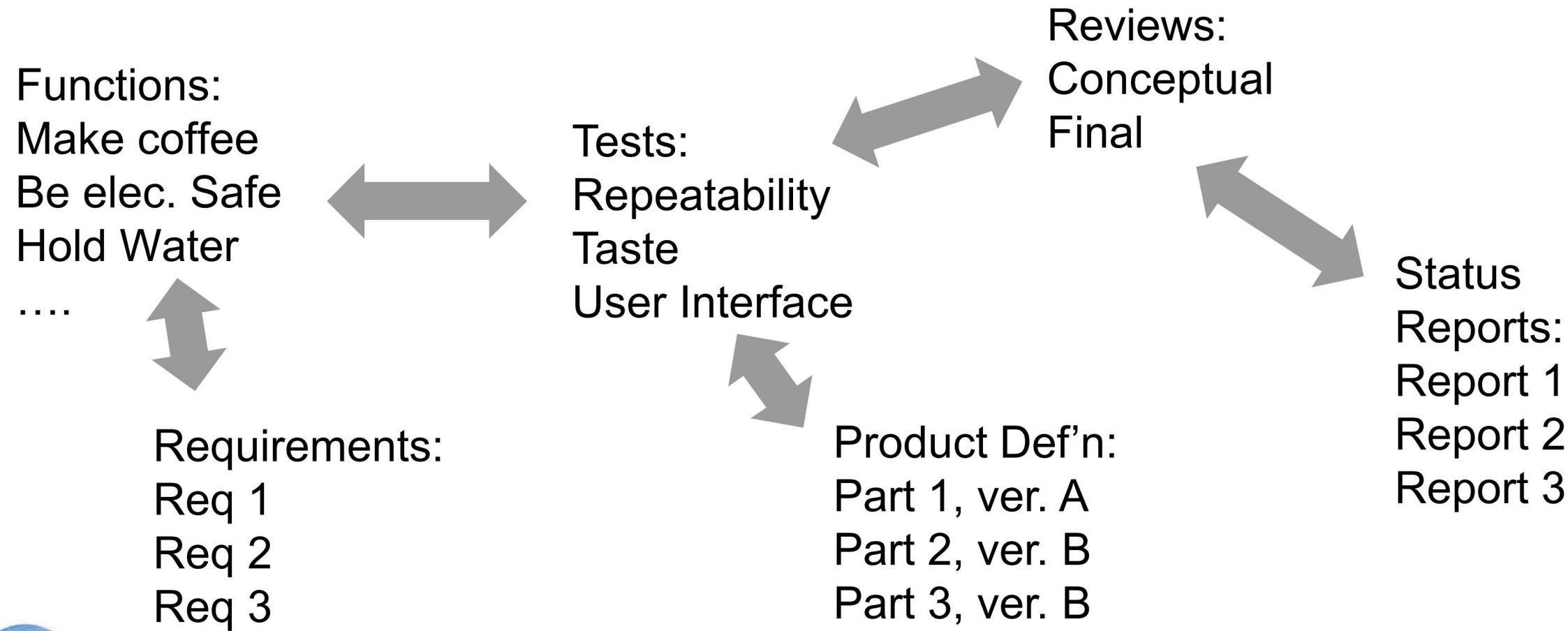


Functional Architecture - Excerpt

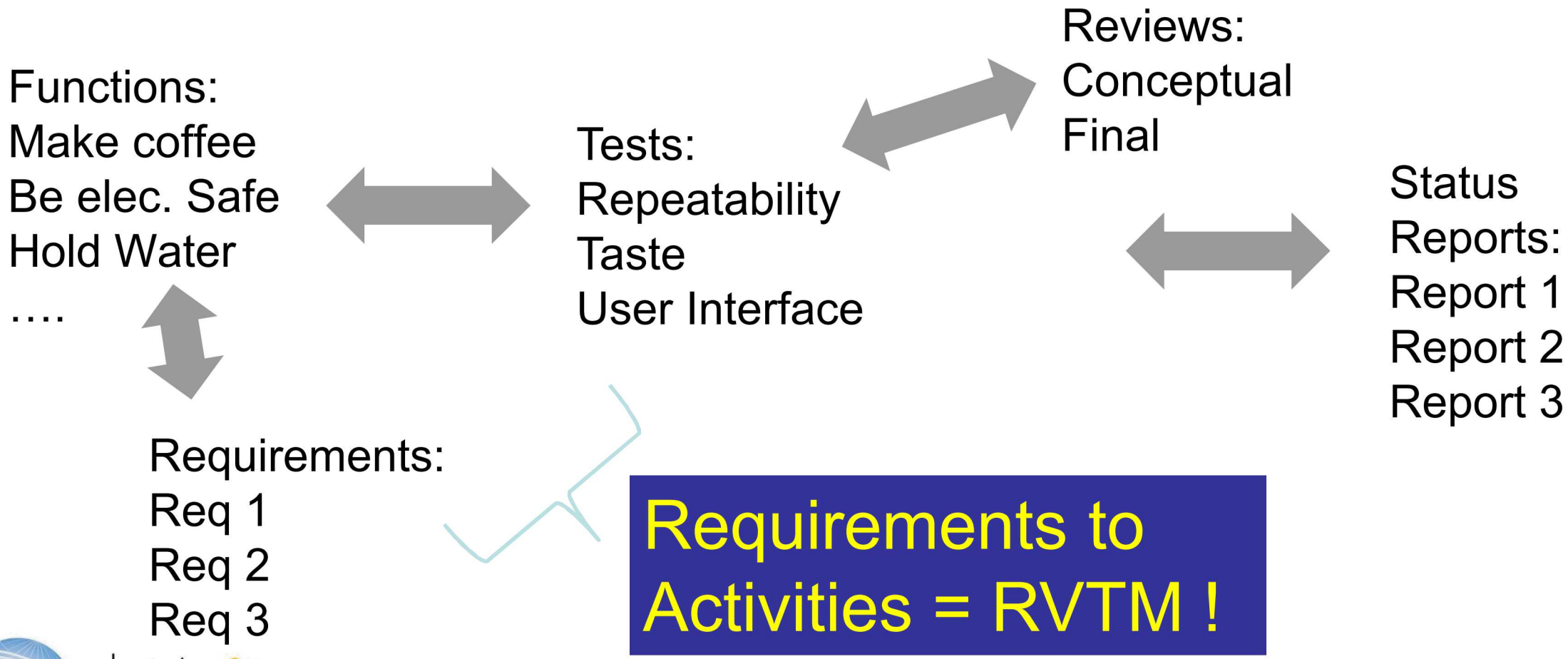


Still have the traditional views in MBSE

Can Link other Data Elements …



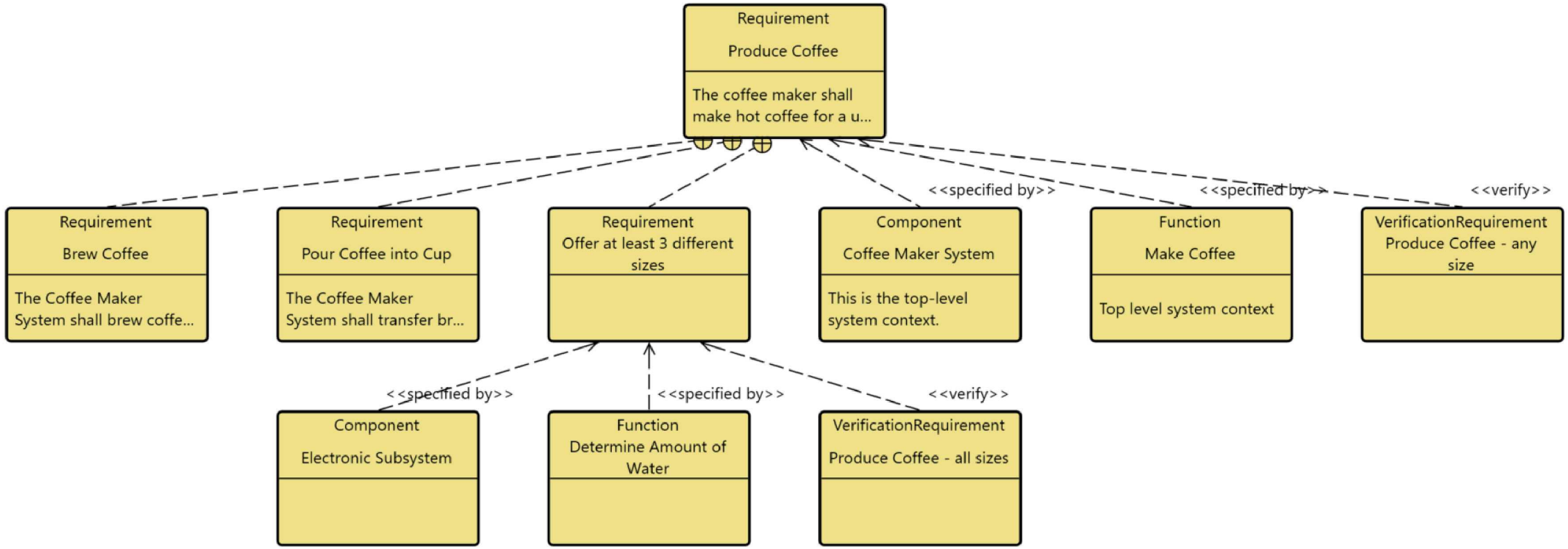
… to Produce the Traceability Matrix



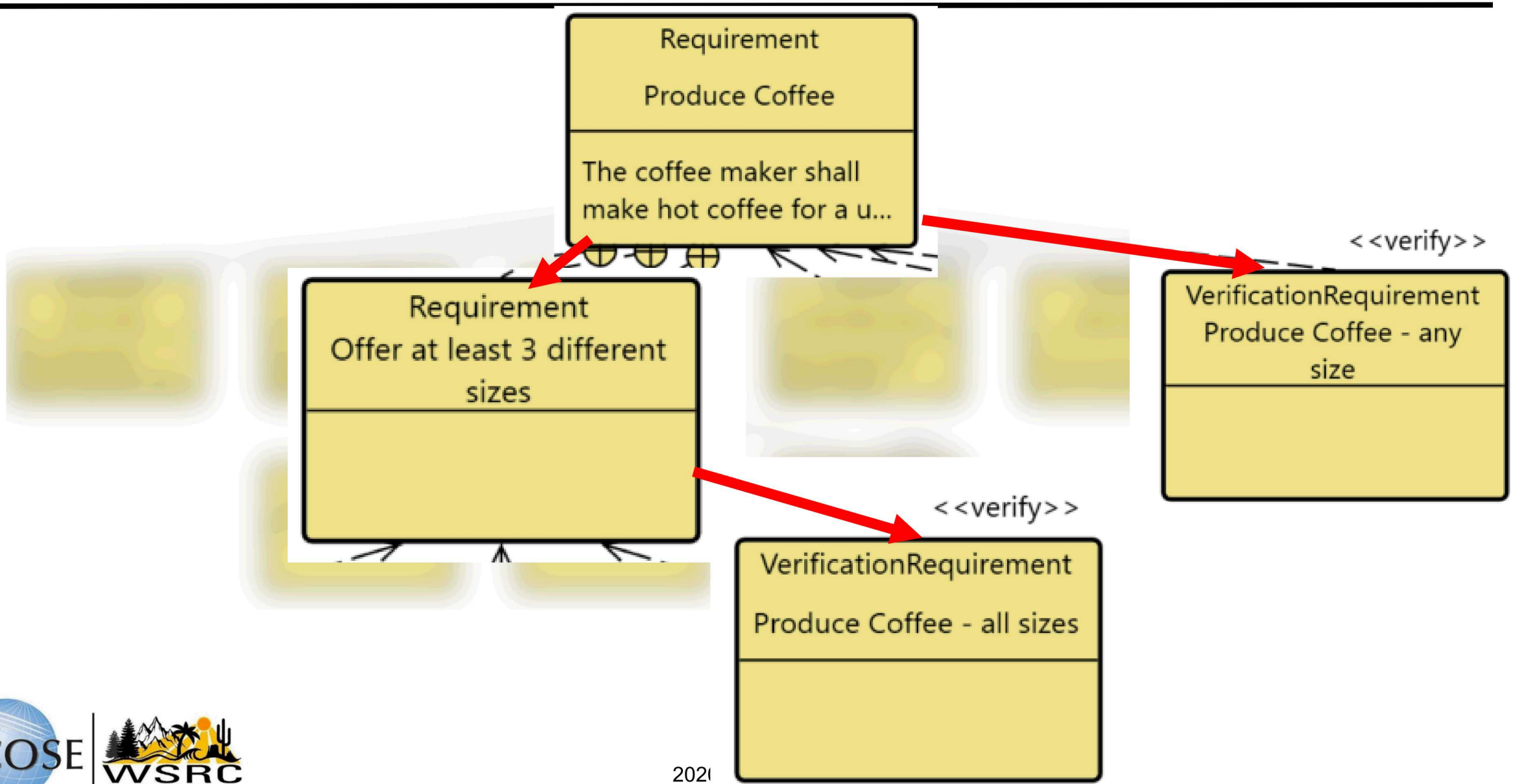
Example RVTM Matrix – Combined with Up/Down Traceability

Require-ment	specifies (components, functions)	refines (parent)	refined by (child)	verified by (verif. Reqmt)
R.1 Produce Coffee	*Component* CM Coffee Maker System *Function* F.1 Make Coffee		R.1.1 Brew Coffee R.1.2 Pour Coffee R.1.3 Offer => 3 sizes	Verif. Reqmt Produce Coffee - any size
R.1.1 Brew Coffee		R.1 Make Coffee		
R.1.2 Pour Coffee		R.1 Make Coffee		
R.1.3 Offer => 3 sizes		R.1 Make Coffee		

Can Show Same Info, and More, in the MBSE Tool



Has Graphical Trace to Verification!



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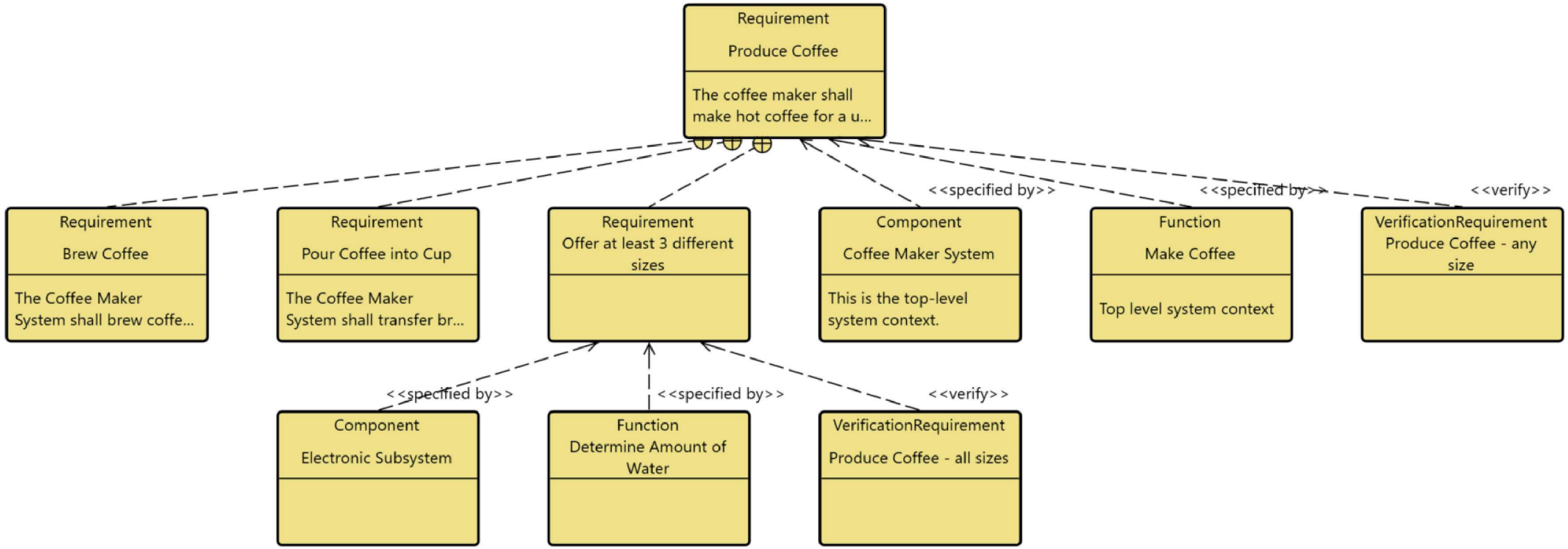
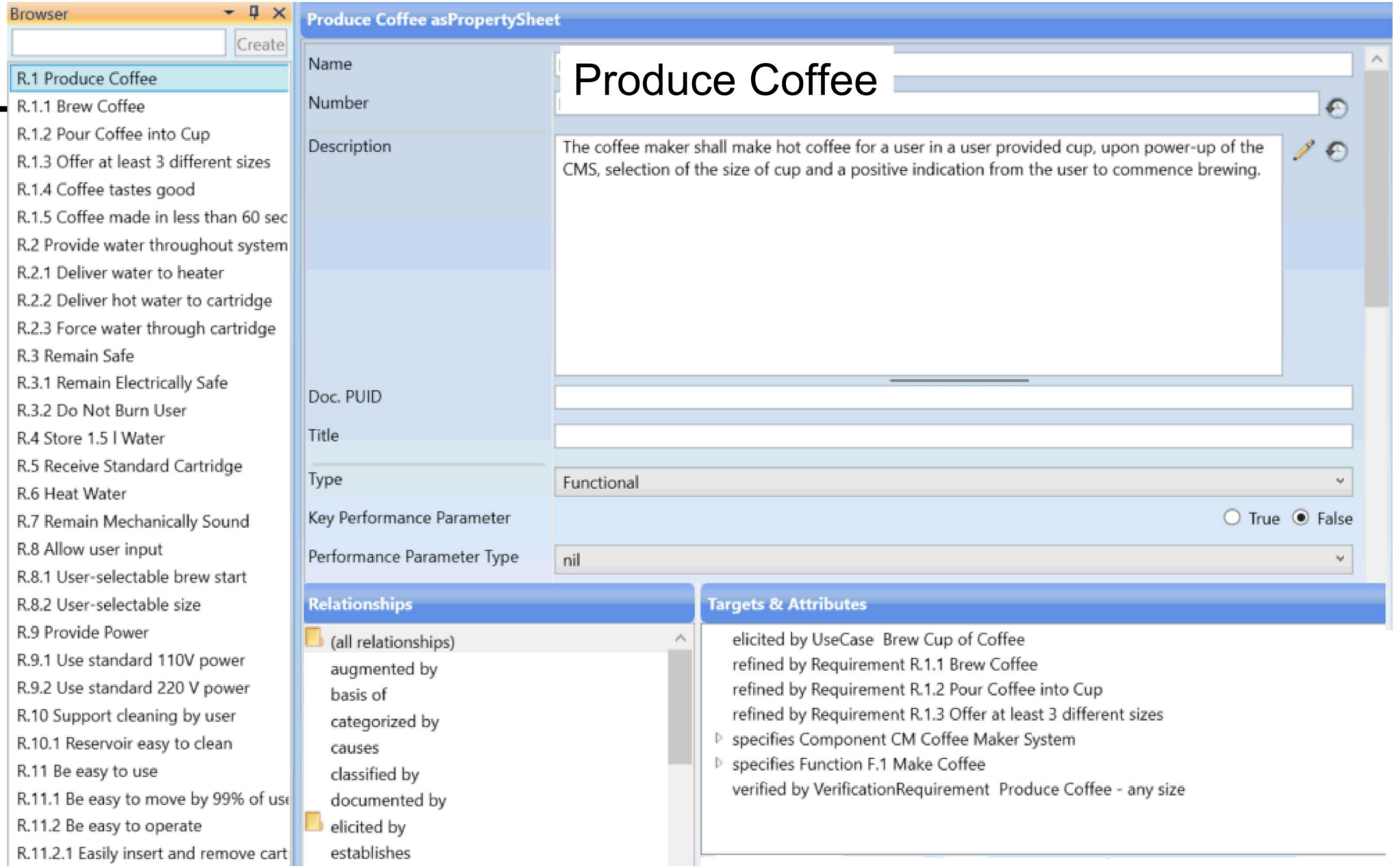


Each Block is "Clickable" – to Reveal Specifics

"Details" for each block, one double-click away



V&V Data Much More Accessible

- Requirements, mapped to:
  - Functions, Physical architecture, Testing, equipment, tooling
- Adaptable to changes
  - Edit a MS Word doc –> now we edit the Model.
- Verification & Validation now far smoother
  - Test activities, pointers to artifacts (plans, reports) linked.
  - RVTM can be produced automatically
    - May still want to enter linking into a RM database such as DOORS

Can still produce typical Sys Engr. artifacts

Clarifications

- Not a replacement for a RM system such as DOORS
- Not performing engineering design
  - May find interfaces
  - Could hang off of a design MBSE system
- Requires maintenance, tool support
- Not for change control, or workflow management

All of these are workable! MB approach still recommended

Proposed: Worth the Front End Effort

- Easier for Qualification Engineer to perform job
  - Built-in Context Diagram
  - Scalable: can drill-down to part (or function) in question
- Can easily pass on work to successor, mid-project
- Government acceptance can be Model-Based
  - Reviews can walk through the model, vs. a Word doc.
- Can spot gaps, hidden interfaces more easily
  - Early on is best, but can see gaps at any time

Higher Quality Product, Lower Cost

- Time (hours, salary) spent on qualification effort reduced
- Visual approach, easier to spot interface V&V gaps
- Increase customer confidence, satisfaction
  - Some government customers, very concerned about transparency
  - Some like to ‘drill down’.

Up-front investment in MBSE V&V infrastructure is worth it

Questions

Q/A Session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