Webinar guidelines

- You will be muted during the webinar
- Please, write your questions or comments in the Questions section
- The webinar will be recorded

A Systems Engineering Approach to Acquisition

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THE REUSE COMPANY

THE REUSE COMPANY IS
a solution provider specializing in the application of
SEMANTIC TECHNOLOGIES and
ARTIFICIAL INTELLIGENCE
to improve the digitalization of the
Systems Engineering Lifecycle.

THE REUSE

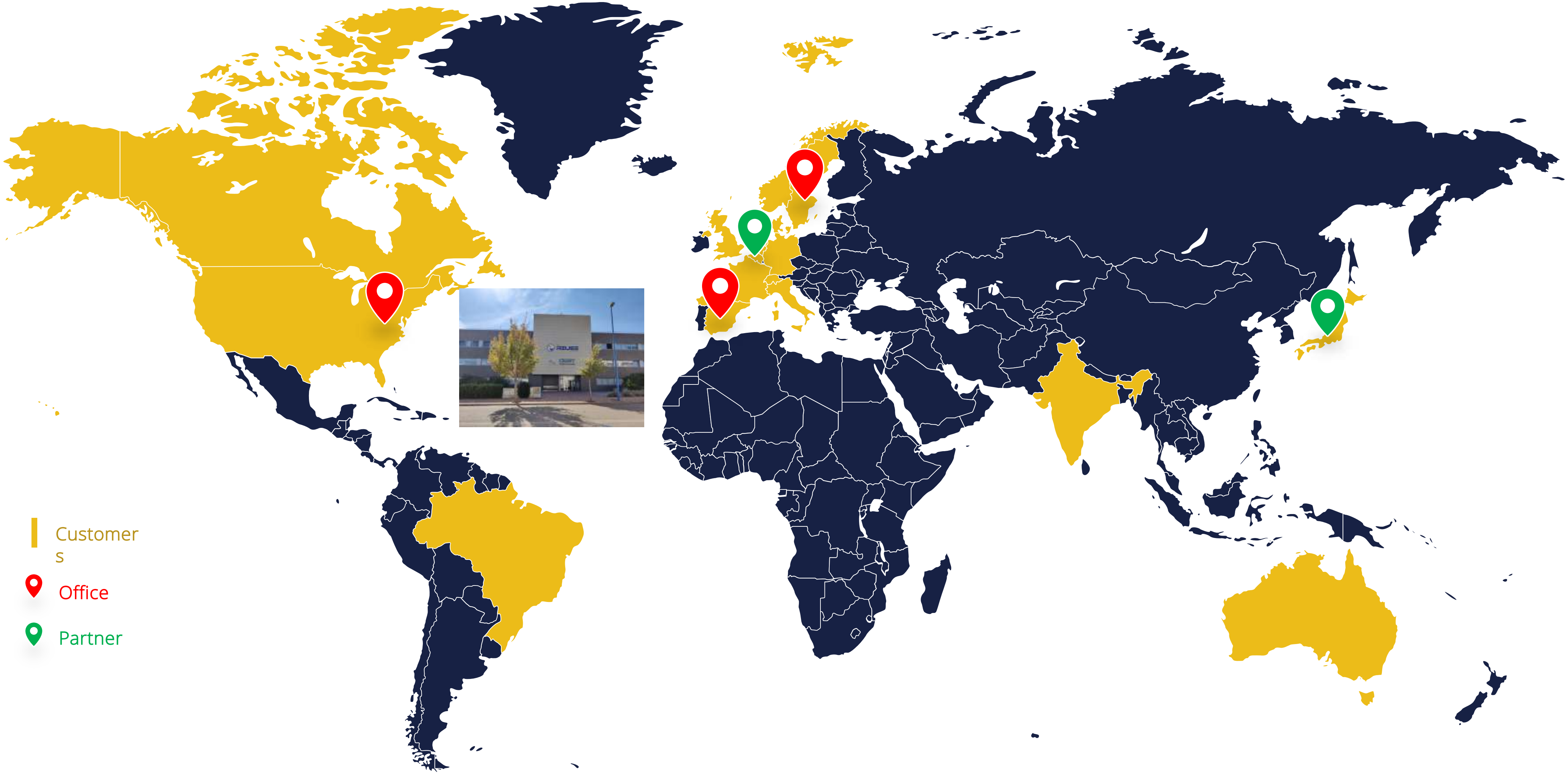

SES ENGINEERING
Studio

WHO IS USING OUR TECHNOLOGY?

Aerospace	Healthcare
Defense	Infrastructure
Automotive	Legal
Energy	Software

THE REUSE COMPANY

Our Presence Worldwide



Customers

Office

Partner

PRESENTER

Lars Anderberg

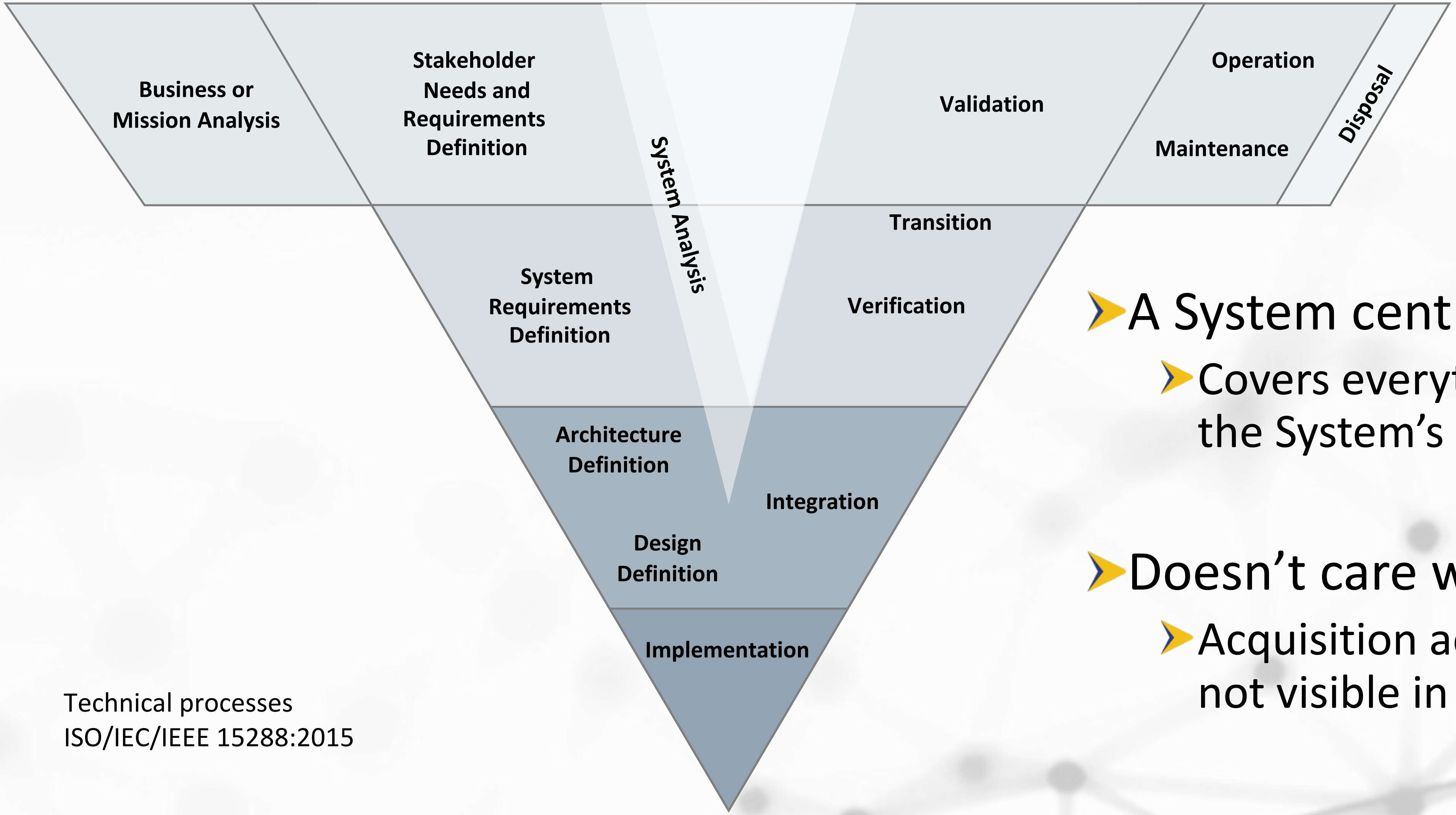
- Current position: Application consultant, The REUSE Company Scandinavia
- Requirements Engineering and Acquisition Support consultant for 20+ years
- INCOSE ESEP Certified
- IREB CPRE Certified

CONTENTS

- Acquisition as a part of the Systems Engineering lifecycle
- Co-ordinated Data Exchange over all project phases
- SES Tool support
- Demonstrations
  - Simple but powerful Data Exchange
  - Formal documents
- Continued work after Contract
- Future updates
- Summary, QnA

ACQUISITION AS A PART OF THE SYSTEMS ENGINEERING LIFECYCLE

SYSTEM DEVELOPMENT - V-MODEL



Technical processes
ISO/IEC/IEEE 15288:2015

- A System centric view
  - Covers everything needed from the System's point of view
- Doesn't care who is doing what!
  - Acquisition adds complexity that is not visible in the V-model

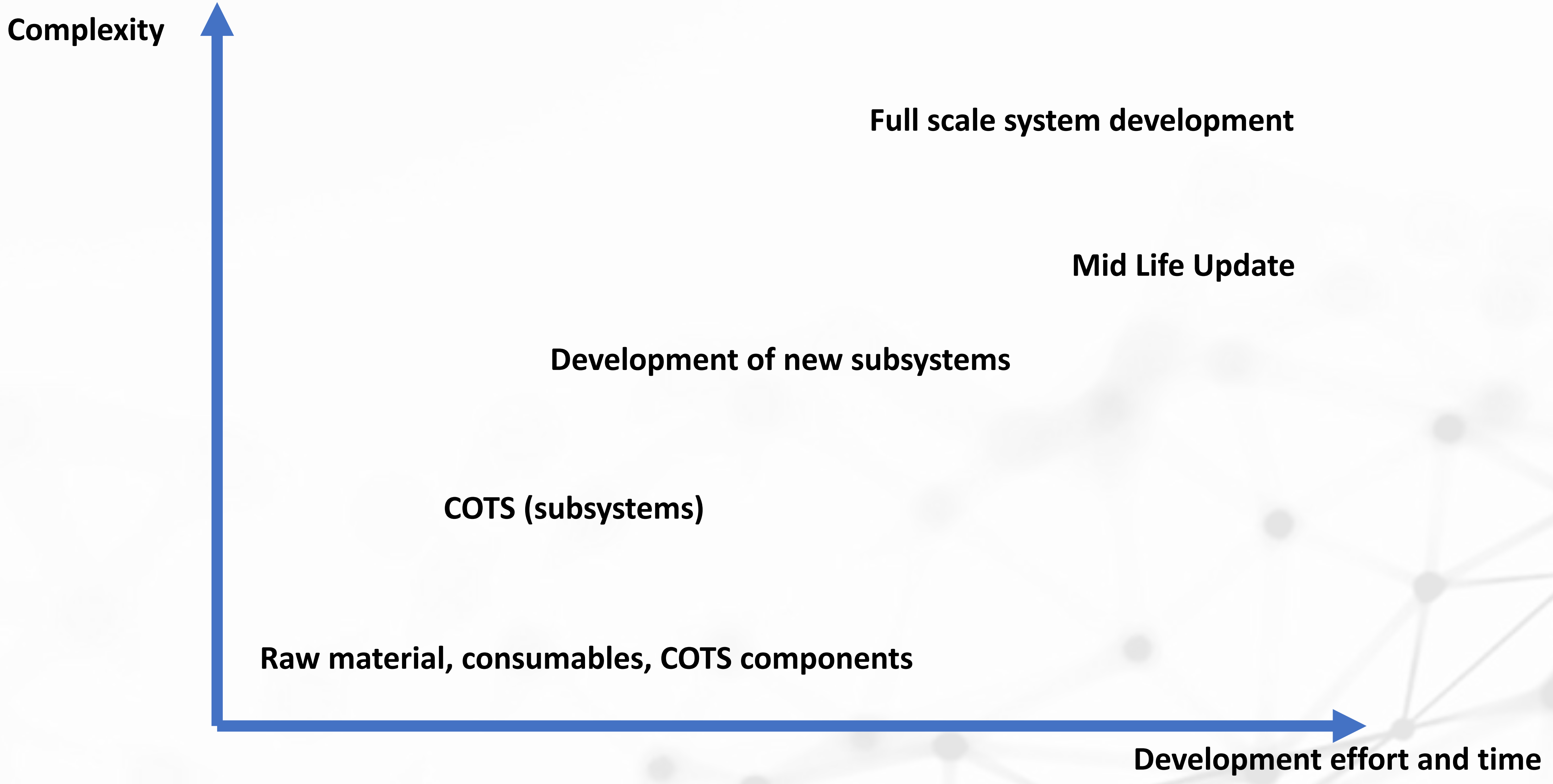
- Because you don't do everything from scratch within one single organisation

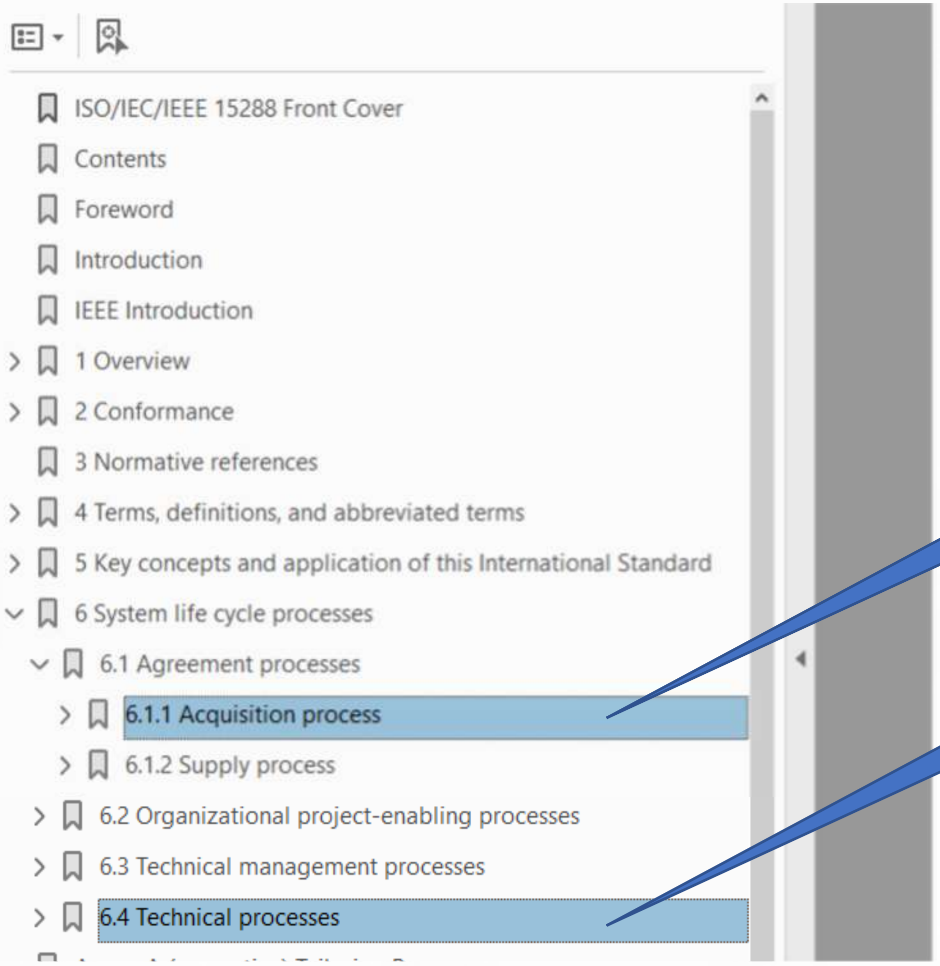
- Acquisition may be used to:
  - Acquire components or raw material
  - Acquire (more or less) Off-The-Shelf products or systems
  - Outsource production
  - Outsource complete development of a (sub) system
  - Outsource a Mid Life Update
  - … and so on

If your Organisation is a Procurement Agency then the whole idea is often to do this!

- In theory - It may also be: Leave it all up to the supplier
  - No Systems Development activities within the customer's organisation

SCOPE OF ACQUISITION, EXAMPLES





2 pages

39 pages

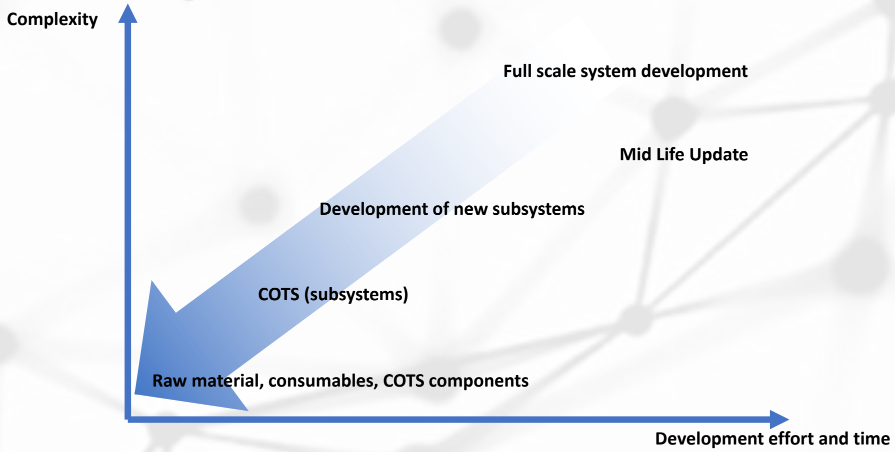

INTERNATIONAL STANDARD

ISO/IEC/IEEE 15288

First edition
2015-05-15

Systems and software engineering — System life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du système



- SE: System focus
  - V-model from the System's point of view

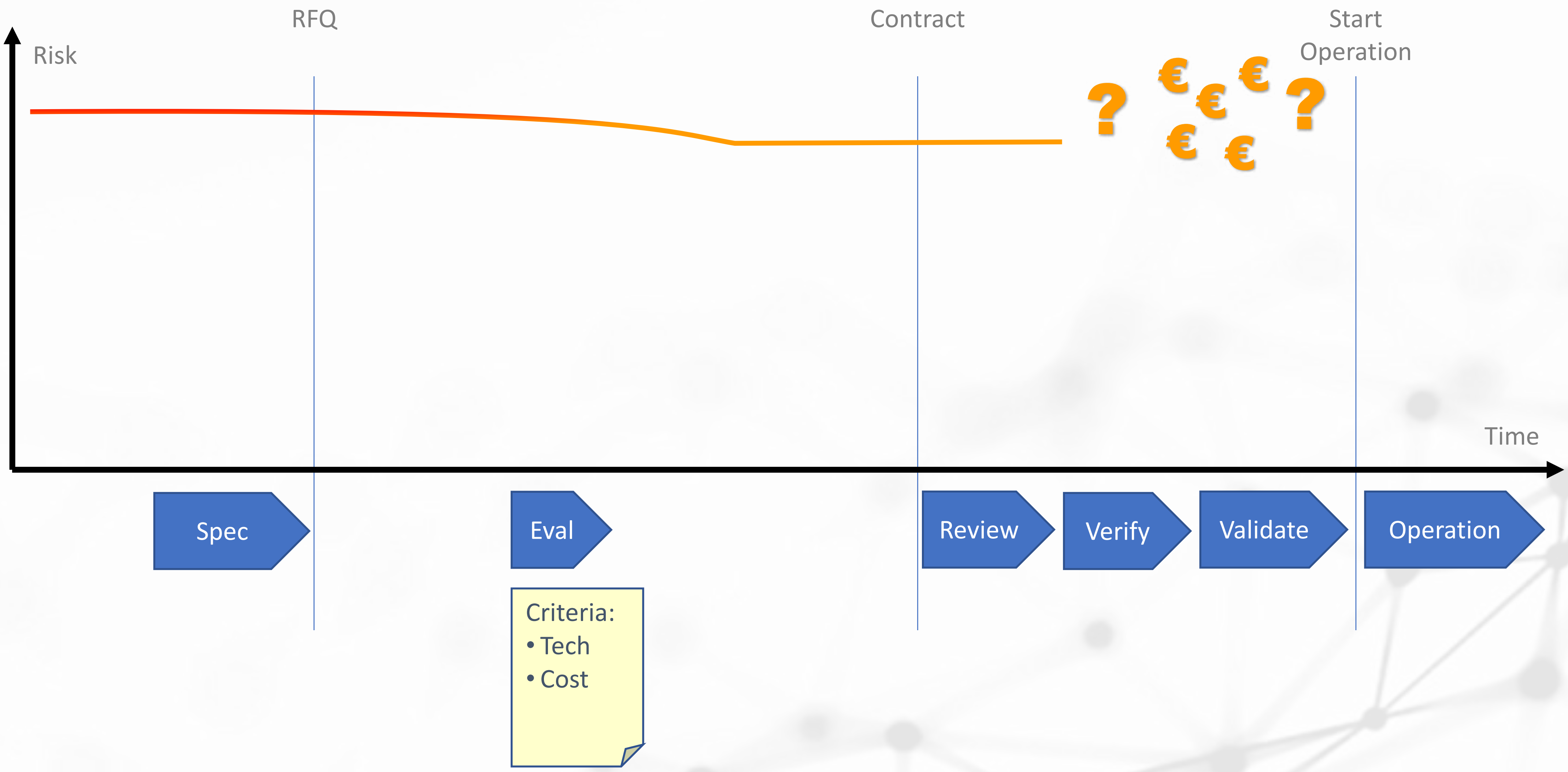
- Acquisition:
  - Perform Request for Quotation
  - Evaluate / select solution and supplier
  - Procurement regulations
    - Ensure equal treatment, traceability and transparency
  - Data exchange (initially: Multiple parties in parallel)
  - Contract documents

Typically not supported in Systems Engineering Tools

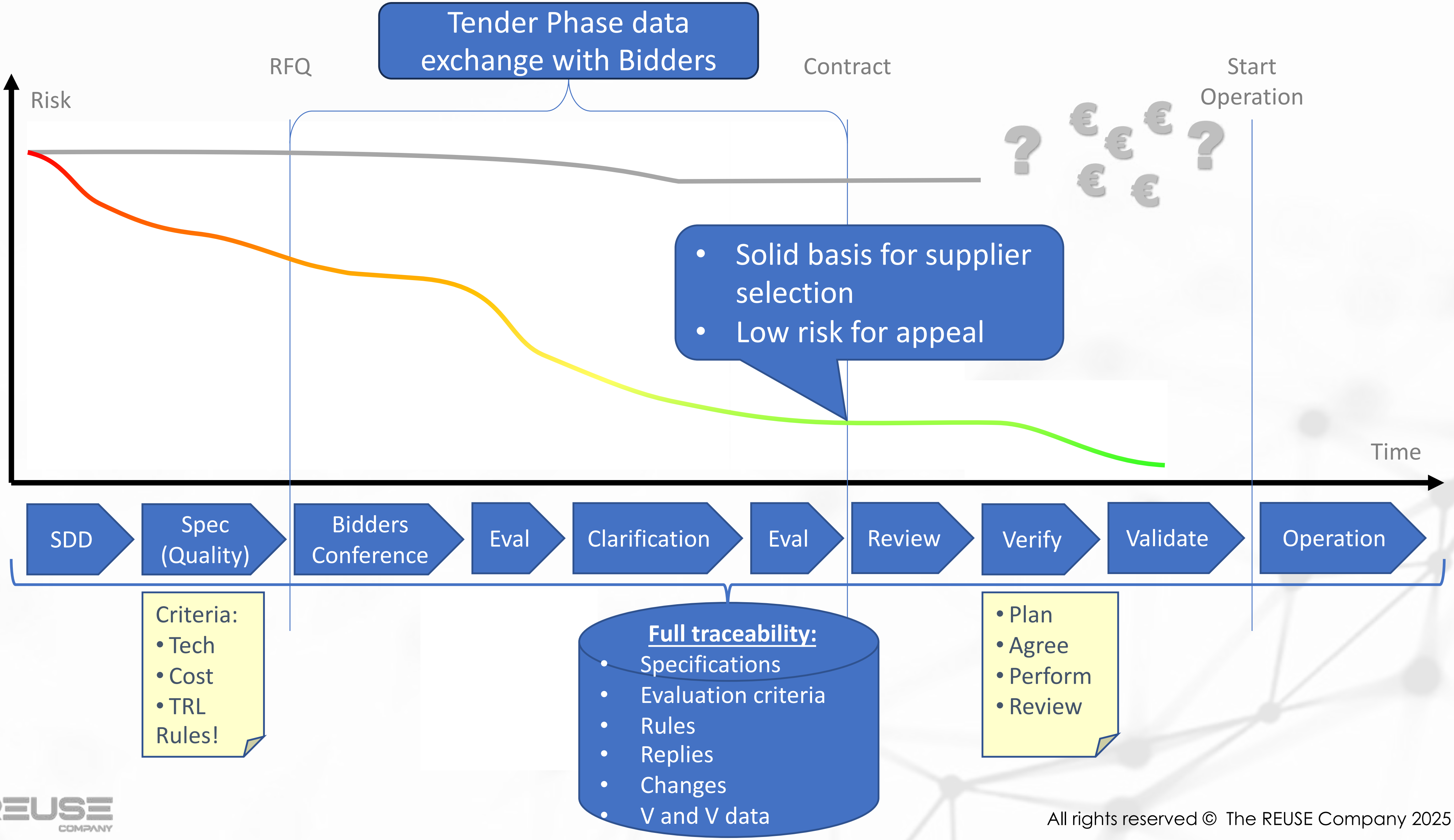
- After Contract signature
  - Back on track in the V-model
  - Monitor progress, Technical reviews, System Verification and Validation…
    … but with support for Data Exchange over the Contract Interface

CO-ORDINATED DATA EXCHANGE OVER ALL PROJECT PHASES

PROJECT PHASES – NON CO-ORDINATED DATA



MAKE IT RIGHT FROM START - PROJECT PHASES WITH MAINTAINED TRACEABILITY AND CONTROLLED DATA EXCHANGE STARTING IN TENDER PHASE



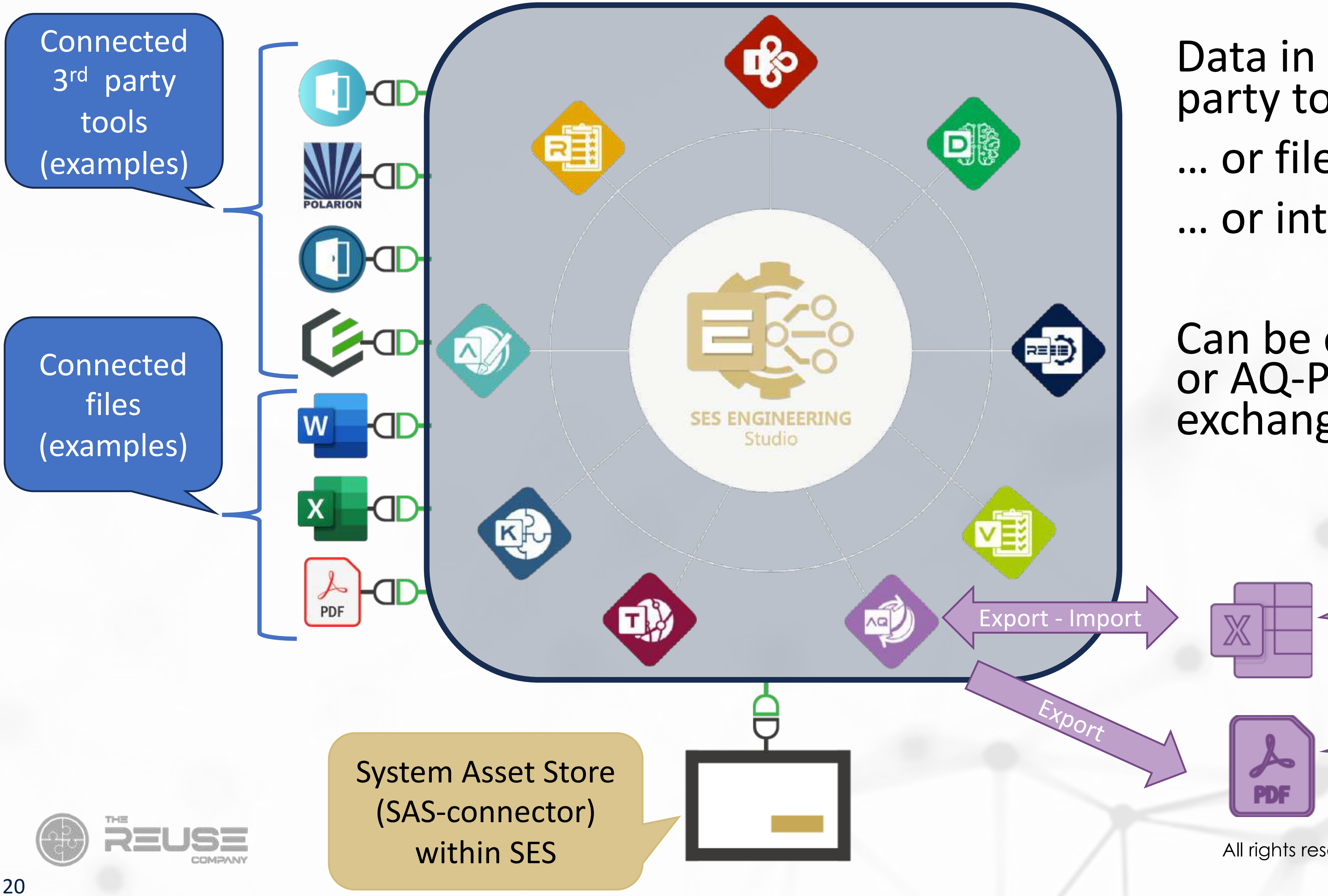
KEY FEATURES – TENDER PHASE DATA EXCHANGE WITH BIDDERS

- Generate Attribute set and Rules for Bid Response
- Generate dynamic Response Sheets with Input Validation
- Import Bids into the database for traceability and evaluation
- Generate (Draft) Contract Documents with traceability to the Database

- Commonality in Bid Response format simplifies Evaluation
- Tool supported Evaluation
  - Evaluate bids from all Bidders in parallel
  - Indicate changes in Bid Updates

SES TOOL SUPPORT

SES ENGINEERING STUDIO – A POWERFUL SE TOOL WITH ACQUISITION SUPPORT



Data in any connected 3rd party tool...

... or file...

... or internal SAS-connector

Can be exported to AQ-Excel or AQ-PDF for data exchange

Exported and re-importable Excel-file **AQ-Excel**

Exported PDF-file **AQ-PDF**

- General
  - Can be generated from data in any connection to SES
  - Can visually indicate changes relative to previous baselines
  - Has traceability back to source so that origin of the data can be determined

- Detached files – can be used in any environment

- AQ-Excel
  - Tailored Excel files for each export event with contents and features based on receiver and purpose
  - Editable in any remote party computer with standard Excel
  - Changes/updates importable to SES and Source for further handling
  - Protection of non-editable data (due to freeze or locks)
  - Dynamic user guidance and Input validation to enforce following of attribute rules
  - Dynamic change indication relative to selected baselines
  - Advanced presentation of linked data for link sufficiency evaluation

- Spin-off
  - AQ-Excel files can be very useful for internal use – non-frequent tool users can easily handle guided standard Excel files

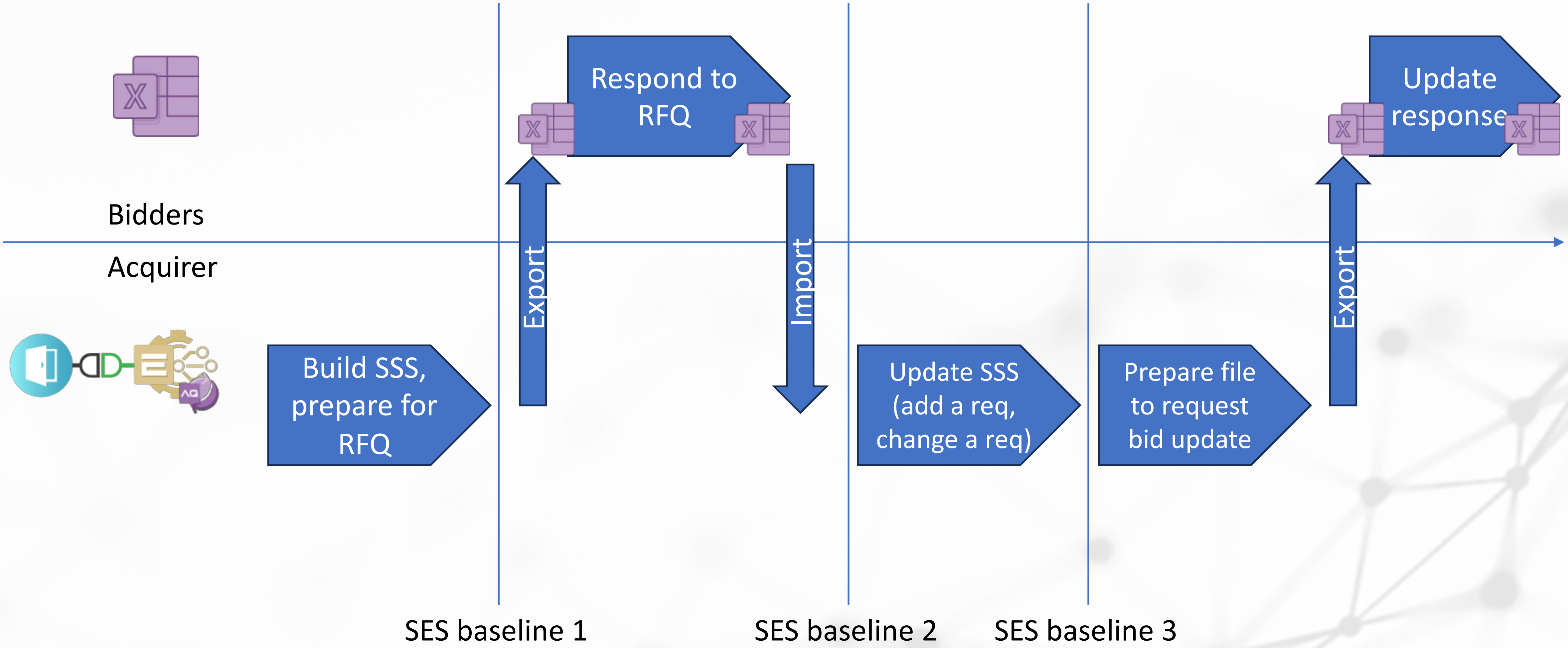
- AQ-PDF
  - Tailorable document templates with Company profile, layout, format and document metadata
  - Document Export Meta Data provides traceability to source
  - Revision history generated from baselines
  - Internal clickable cross-references

- Possible post processing (external sw): Certificates and digital signatures
  - If a file with traceability to the source is generated in a non-editable format, printed and signed then the source data is validated as agreed

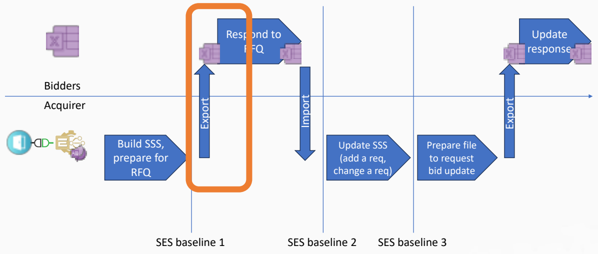
DEMONSTRATION

- Simple but powerful Data Exchange

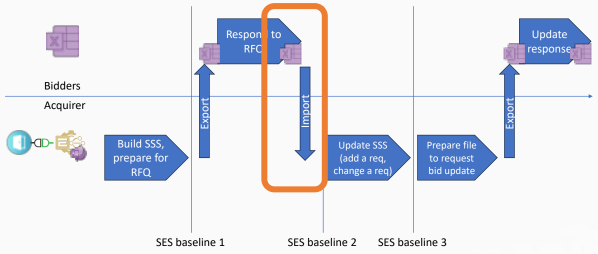
EXAMPLE SCENARIO



DEMONSTRATION STEP 1: BUILD A FILE FOR INITIAL REQUEST FOR QUOTATION



DEMONSTRATION STEP 2 – IMPORT REPLY AND BASELINE

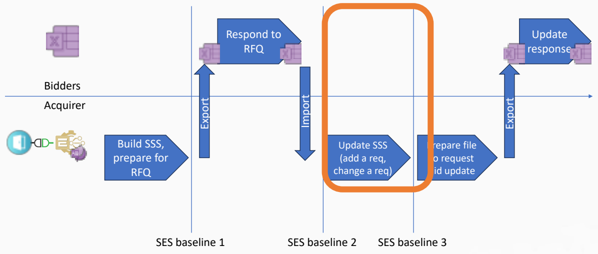


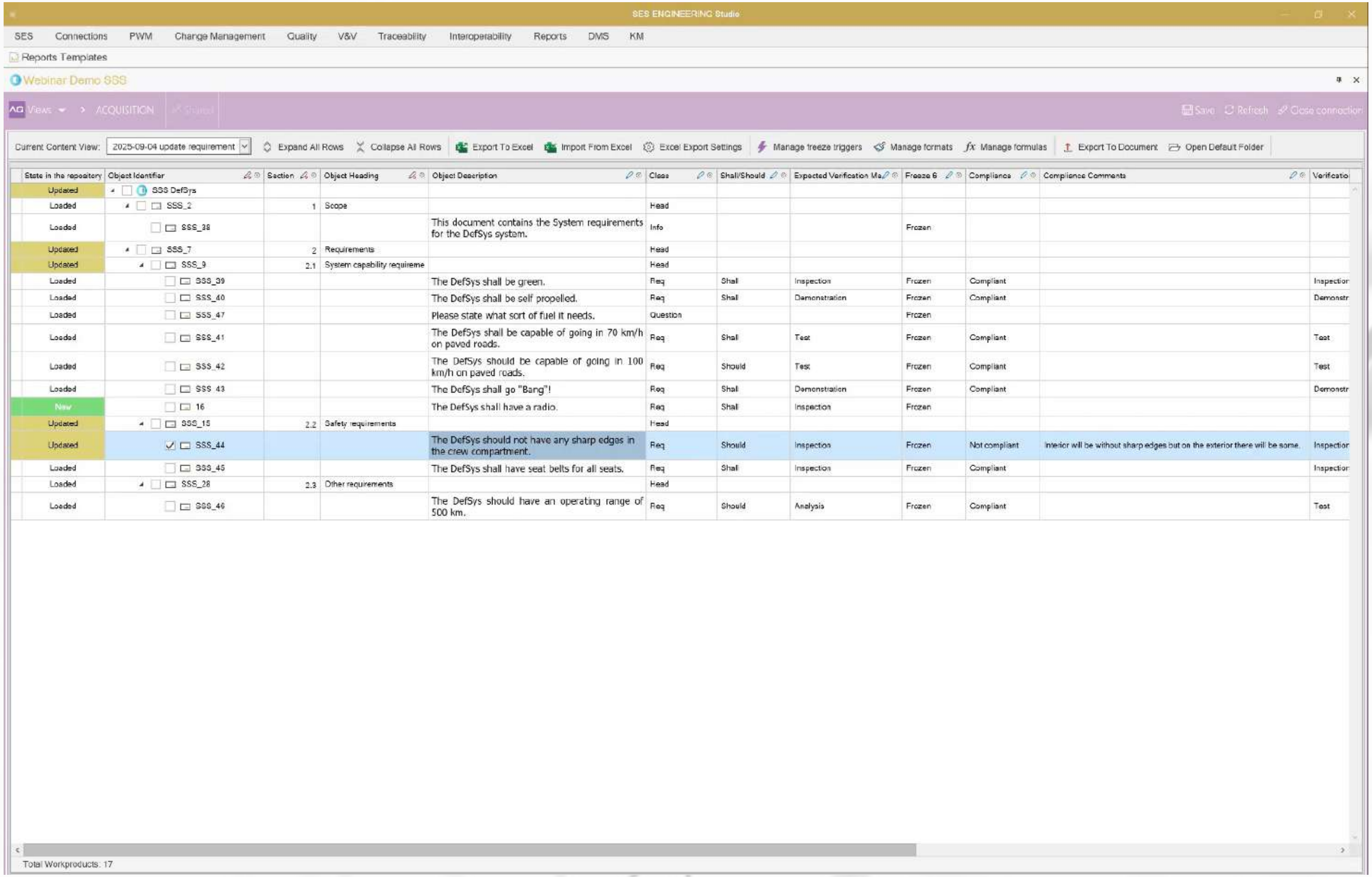
K13 — Interior will be without sharp edges but on the exterior there will be some.

Level	Object Identifier	Section	Object Heading	Object Description	Class	Shall/Should	Expected Verification Method	Frozen 6	Compliance	Compliance Comments	Verification Method	Verification Method Justification	Technology Readiness	TRL Supporting Document Reference	Bidder's reply	Input validation
1	SSS_2	1	Scope		Head											Completed
2	SSS_38			This document contains the System requirements for the DefSys system.	Info			Frozen								Completed
1	SSS_7	2	Requirements		Head											Completed
2	SSS_9	2.1	System capability requirements		Head											Completed
3	SSS_39			The DefSys shall be green.	Req	Shall	Inspection	Frozen	Compliant		Inspection		Concept 4-5		We have never made a green system before but we have a concept for how to achieve that.	Completed
3	SSS_40			The DefSys shall be self propelled.	Req	Shall	Demonstration	Frozen	Compliant		Demonstration		Existing solution 8-9	Mobility Verification Report 1.0.pdf		Completed
3	SSS_47			Please state what sort of fuel it needs.	Question			Frozen							Anything that burns	Completed
3	SSS_41			The DefSys shall be capable of going in 70 km/h on paved roads.	Req	Shall	Test	Frozen	Compliant		Test		Existing solution 8-9	Speed test Report v2.1.pdf		Completed
3	SSS_42			The DefSys should be capable of going in 100 km/h on paved roads.	Req	Should	Test	Frozen	Compliant		Test		Prototype 6-7	Propotype high speed mobility analysis report.pdf		Completed
3	SSS_43			The DefSys shall go "Bang"!	Req	Shall	Demonstration	Frozen	Compliant		Demonstration		Existing solution 8-9	Acoustic verification report 1.3.pdf		Completed
2	SSS_15	2.2	Safety requirements		Head											Completed
3	SSS_44			The DefSys should not have any sharp edges.	Req	Should	Inspection	Frozen	Not compliant	Interior will be without sharp edges but on the exterior there will be some.	Inspection		Concept 4-5			Completed
3	SSS_45			The DefSys shall have seat belts for all seats.	Req	Shall	Inspection	Frozen	Compliant		Inspection		Existing solution 8-9	Typbesiktningsprotokoll.pdf		Completed
2	SSS_28	2.3	Other requirements		Head											Completed
3	SSS_46			The DefSys should have an operating range of 500 km.	Req	Should	Analysis	Frozen	Compliant		Test	A test is more relevant for this configuration	Concept 4-5			Completed

Acquisition_Content | PURPOSE

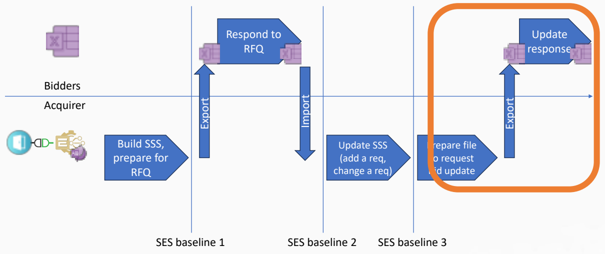
DEMONSTRATION STEP 3 – UPDATE REQUIREMENTS AND BASELINE

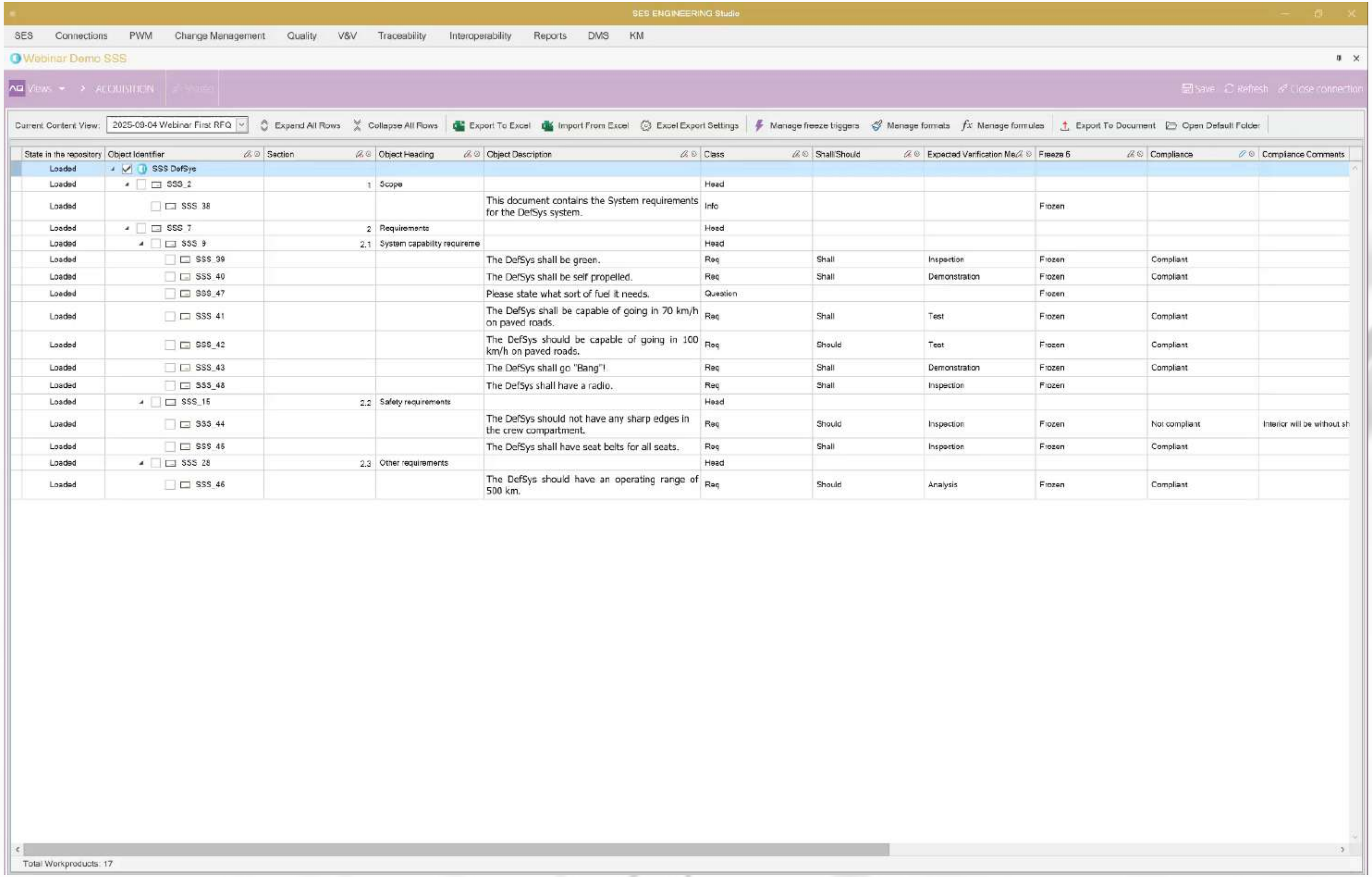




State in the repository	Object Identifier	Section	Object Heading	Object Description	Class	Shall/Should	Expected Verification Ma	Freeze 6	Compliance	Compliance Comments	Verificatio
Updated	SSS DefSys										
Loaded	SSS_2	1	Scope		Head						
Loaded	SSS_38			This document contains the System requirements for the DefSys system.	Info			Frozen			
Updated	SSS_7	2	Requirements		Head						
Updated	SSS_9	2.1	System capability requireme		Head						
Loaded	SSS_39			The DefSys shall be green.	Req	Shall	Inspection	Frozen	Compliant		Inspection
Loaded	SSS_40			The DefSys shall be self propelled.	Req	Shall	Demonstration	Frozen	Compliant		Demonstr
Loaded	SSS_47			Please state what sort of fuel it needs.	Question			Frozen			
Loaded	SSS_41			The DefSys shall be capable of going in 70 km/h on paved roads.	Req	Shall	Test	Frozen	Compliant		Test
Loaded	SSS_42			The DefSys should be capable of going in 100 km/h on paved roads.	Req	Should	Test	Frozen	Compliant		Test
Loaded	SSS_43			The DefSys shall go "Bang"!	Req	Shall	Demonstration	Frozen	Compliant		Demonstr
New	16			The DefSys shall have a radio.	Req	Shall	Inspection	Frozen			
Updated	SSS_15	2.2	Safety requirements		Head						
Updated	SSS_44			The DefSys should not have any sharp edges in the crew compartment.	Req	Should	Inspection	Frozen	Not compliant	Interior will be without sharp edges but on the exterior there will be some.	Inspection
Loaded	SSS_45			The DefSys shall have seat belts for all seats.	Req	Shall	Inspection	Frozen	Compliant		Inspection
Loaded	SSS_28	2.3	Other requirements		Head						
Loaded	SSS_46			The DefSys should have an operating range of 500 km.	Req	Should	Analysis	Frozen	Compliant		Test

DEMONSTRATION STEP 4 – BID UPDATE WITH CHANGE INDICATIONS





State in the repository	Object Identifier	Section	Object Heading	Object Description	Class	Shall/Should	Expected Verification Me	Freeze 6	Compliance	Compliance Comments
Loaded	SSS DefSys									
Loaded	SSS_2	1	Scope		Head					
Loaded	SSS_38			This document contains the System requirements for the DefSys system.	Info			Frozen		
Loaded	SSS_7	2	Requirements		Head					
Loaded	SSS_9	2.1	System capability requireme		Head					
Loaded	SSS_39			The DefSys shall be green.	Req	Shall	Inspection	Frozen	Compliant	
Loaded	SSS_40			The DefSys shall be self propelled.	Req	Shall	Demonstration	Frozen	Compliant	
Loaded	SSS_47			Please state what sort of fuel it needs.	Question			Frozen		
Loaded	SSS_41			The DefSys shall be capable of going in 70 km/h on paved roads.	Req	Shall	Test	Frozen	Compliant	
Loaded	SSS_42			The DefSys should be capable of going in 100 km/h on paved roads.	Req	Should	Test	Frozen	Compliant	
Loaded	SSS_43			The DefSys shall go "Bang"!	Req	Shall	Demonstration	Frozen	Compliant	
Loaded	SSS_48			The DefSys shall have a radio.	Req	Shall	Inspection	Frozen		
Loaded	SSS_15	2.2	Safety requirements		Head					
Loaded	SSS_44			The DefSys should not have any sharp edges in the crew compartment.	Req	Should	Inspection	Frozen	Not compliant	Interior will be without sh
Loaded	SSS_45			The DefSys shall have seat belts for all seats.	Req	Shall	Inspection	Frozen	Compliant	
Loaded	SSS_28	2.3	Other requirements		Head					
Loaded	SSS_46			The DefSys should have an operating range of 500 km.	Req	Should	Analysis	Frozen	Compliant	

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DEMONSTRATION

- Formal documents

- Generate data, validate data, review data, …
  - Work directly in source tool
  - Use AQ-Excel

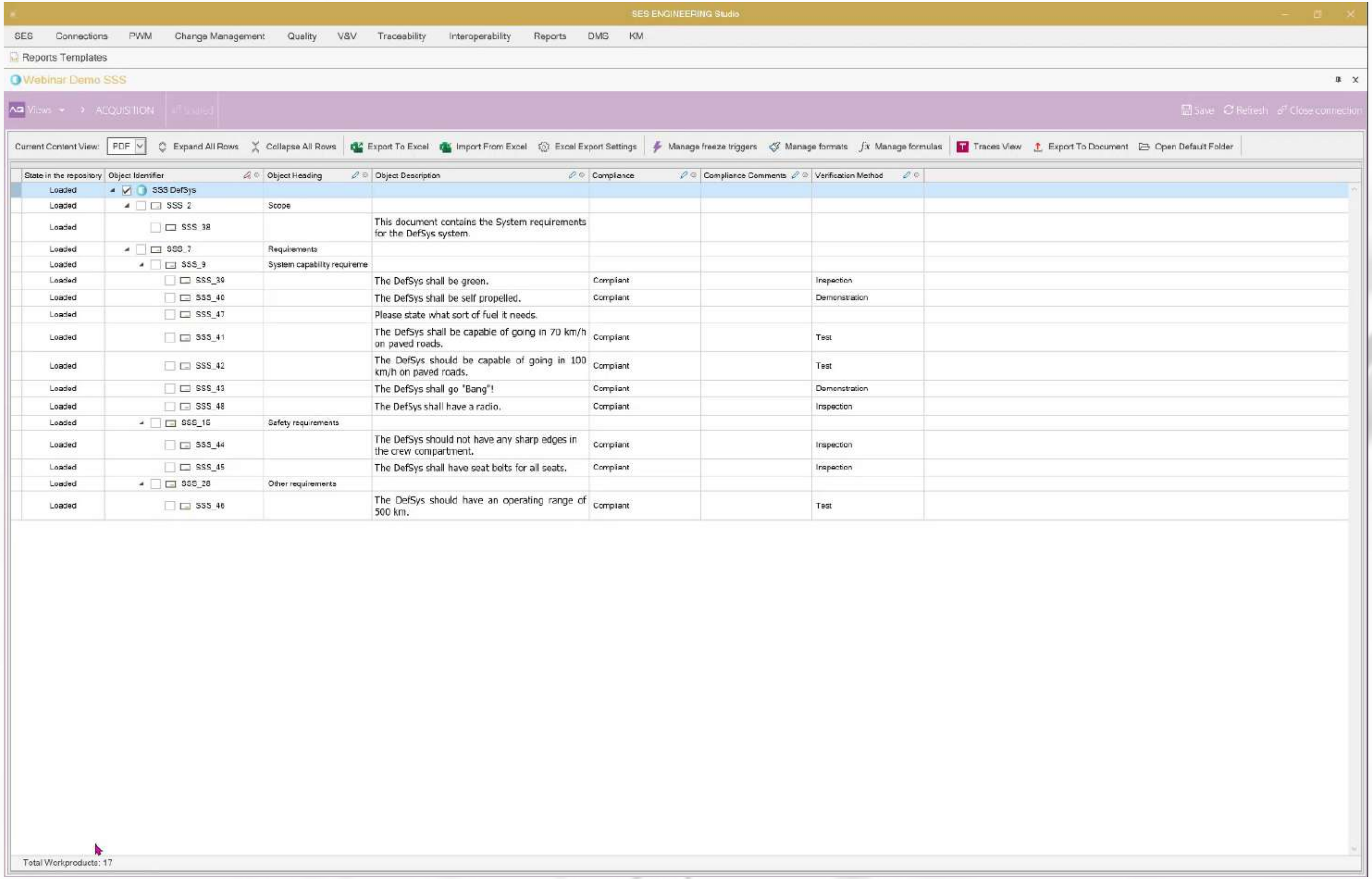
- Publish formal documents
  - Based on source contents regardless of source repository
  - Traceable back to source repository validates the source when signed

- Keep in mind:
  - Contracts are made of paper. The signed piece of paper rules.

- Publish documents for Contract – directly from the source

DEMONSTRATION – AQ-PDF FILES

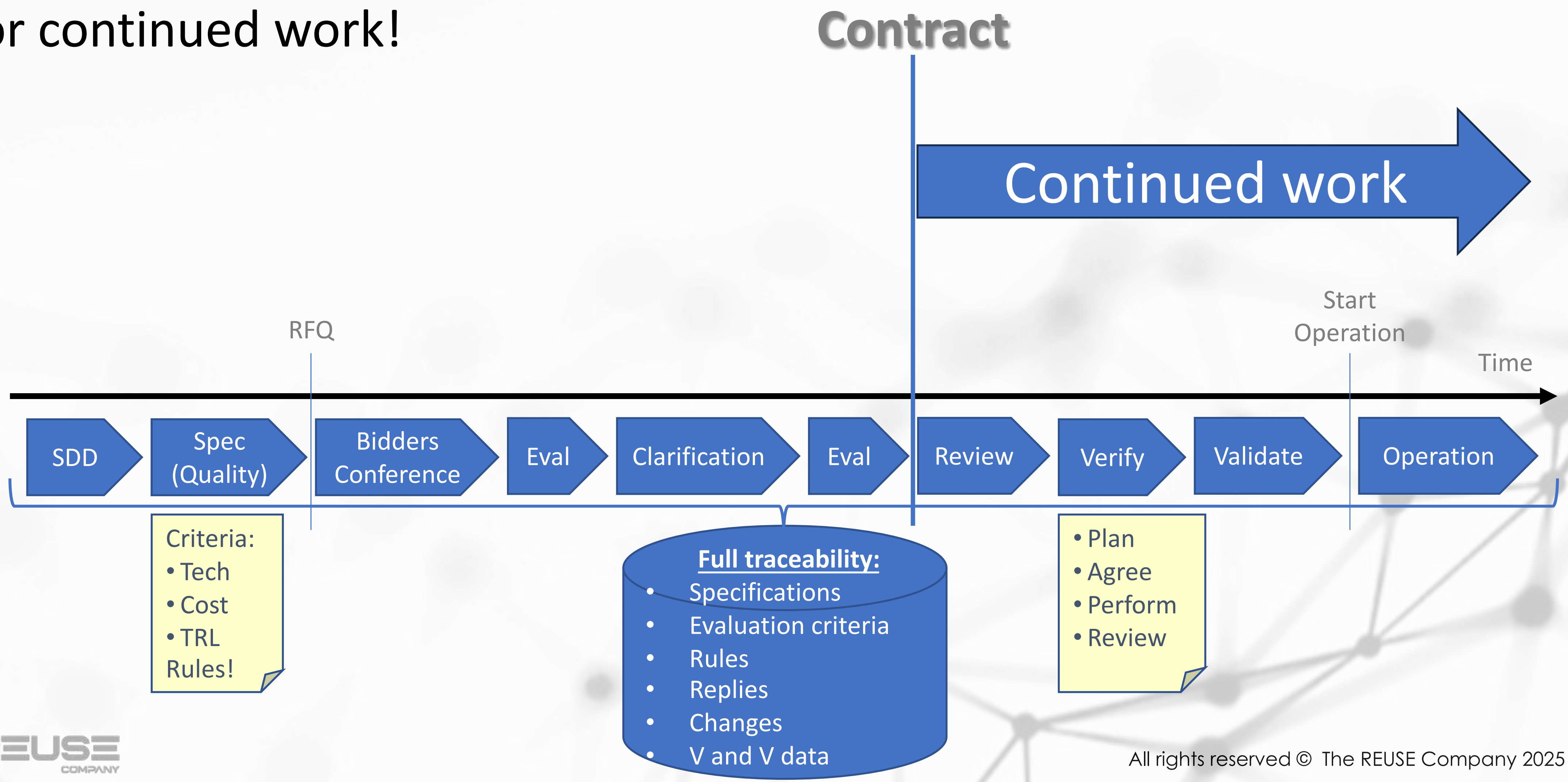
- Prepare template
- Prepare view
- Add metadata
- Export to Document

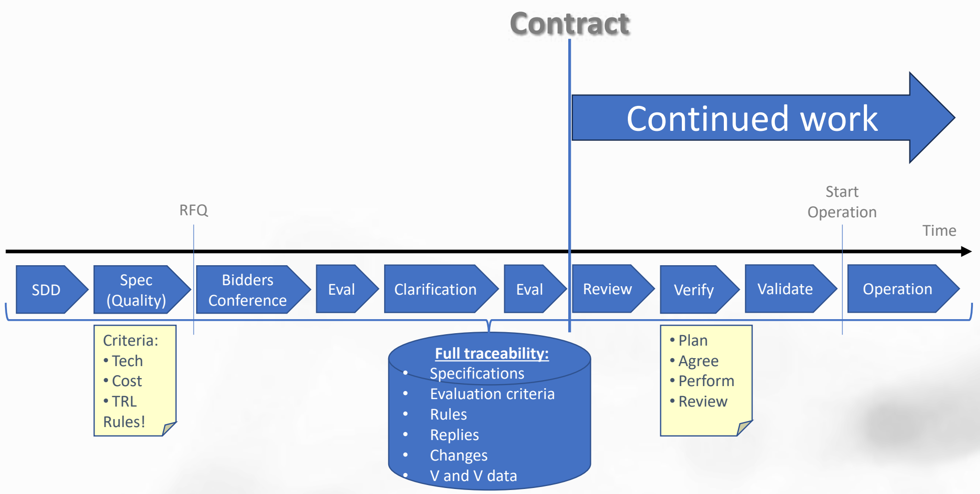


State in the repository	Object Identifier	Object Heading	Object Description	Compliance	Compliance Comments	Verification Method
Loaded	SSS DefSys					
Loaded	SSS 2	Scope				
Loaded	SSS 38		This document contains the System requirements for the DefSys system.			
Loaded	SSS_7	Requirements				
Loaded	SSS_9	System capability requireme				
Loaded	SSS_39		The DefSys shall be green.	Compliant		Inspection
Loaded	SSS_40		The DefSys shall be self propelled.	Compliant		Demonstration
Loaded	SSS_47		Please state what sort of fuel it needs.			
Loaded	SSS_41		The DefSys shall be capable of going in 70 km/h on paved roads.	Compliant		Test
Loaded	SSS_42		The DefSys should be capable of going in 100 km/h on paved roads.	Compliant		Test
Loaded	SSS_43		The DefSys shall go "Bang"!	Compliant		Demonstration
Loaded	SSS_48		The DefSys shall have a radio.	Compliant		Inspection
Loaded	SSS_16	Safety requirements				
Loaded	SSS_44		The DefSys should not have any sharp edges in the crew compartment.	Compliant		Inspection
Loaded	SSS_45		The DefSys shall have seat belts for all seats.	Compliant		Inspection
Loaded	SSS_28	Other requirements				
Loaded	SSS_46		The DefSys should have an operating range of 500 km.	Compliant		Test

CONTINUED WORK AFTER CONTRACT

- Good starting point for continued work!



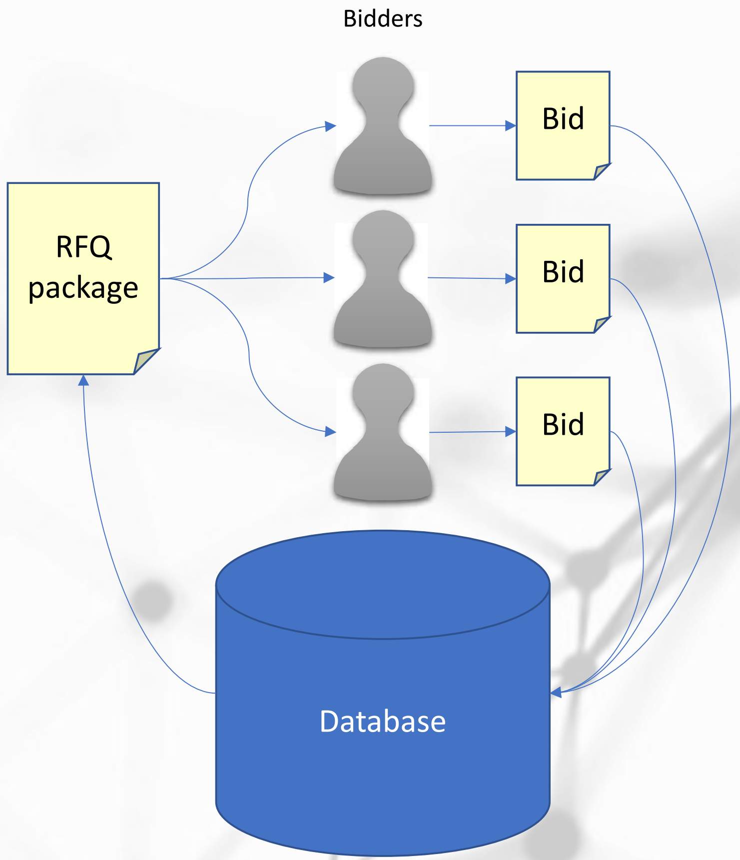


- Need for continued data exchange:
  - Techical reviews
  - System Verificaiton and Validation
  - Change management / Contract update
- Options:
  - Establish data exchange based on available tools on the remote side
    - Use SES Interworking capabilities, Remote SES capabilities etc…
  - Continue to use AQ-Excel and AQ-PDF
    - Internally for reviews
    - To prepare and review changes before CCB approval
    - To exchange data with external parties
    - In meetings off site
  - Any combination of the above

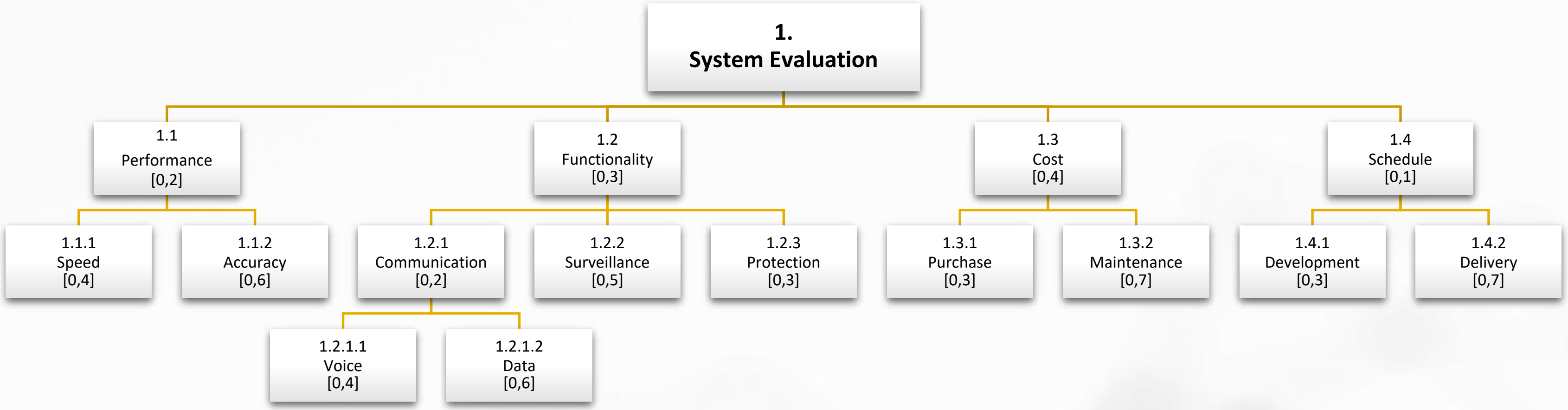
FUTURE UPDATE

- Enhanced Bid Evaluation support

- Existing:
  - Generate RFQ-files
  - Import replies
  - Link data to Evaluation Matrix for comparison
  - Support for updates of RFQ-packages
  - Support for Bid updates
- Near future:
  - Evaluation Matrix with Calculation of Weighted Grades based on imported bids
- Longer term evolution
  - Support for optimising Evaluation Matrix
  - Bid simulation to validate the Evaluation Matrix
  - Evaluation reports

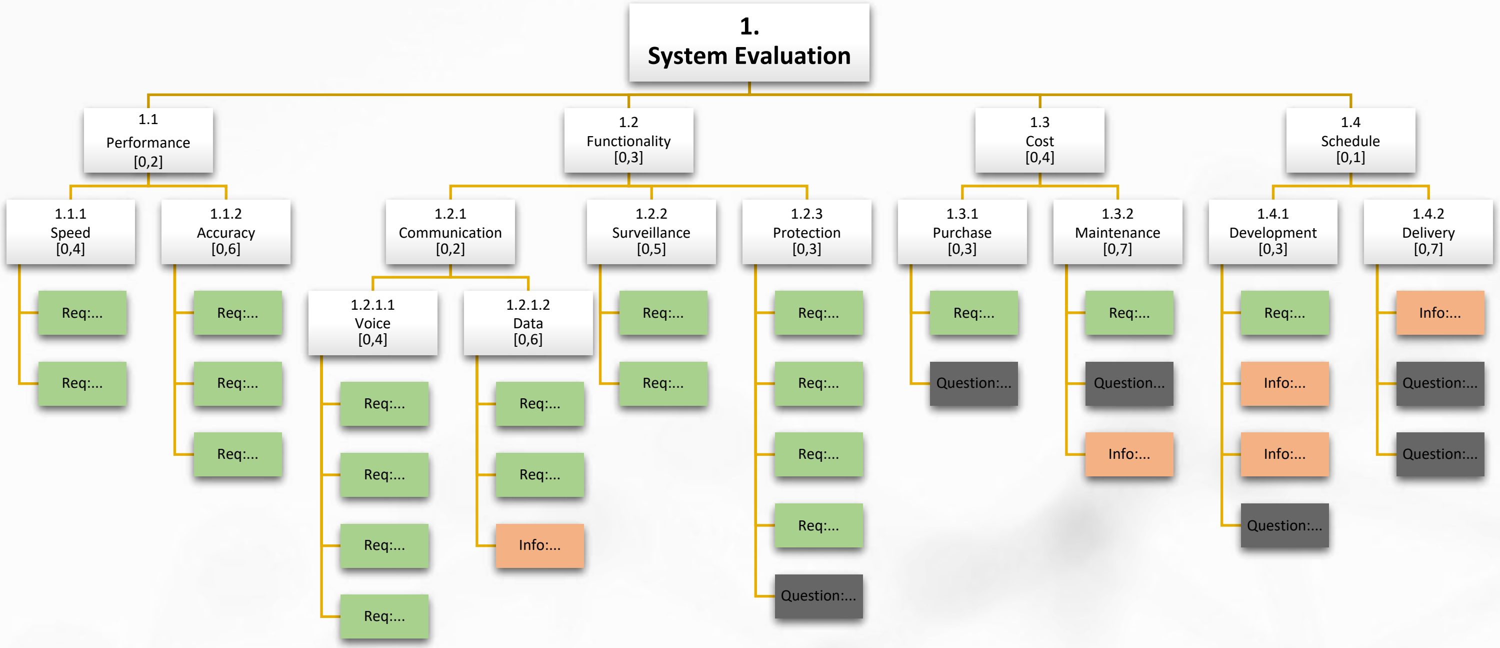


EVALUATION MATRIX WITH WEIGHTED GRADES



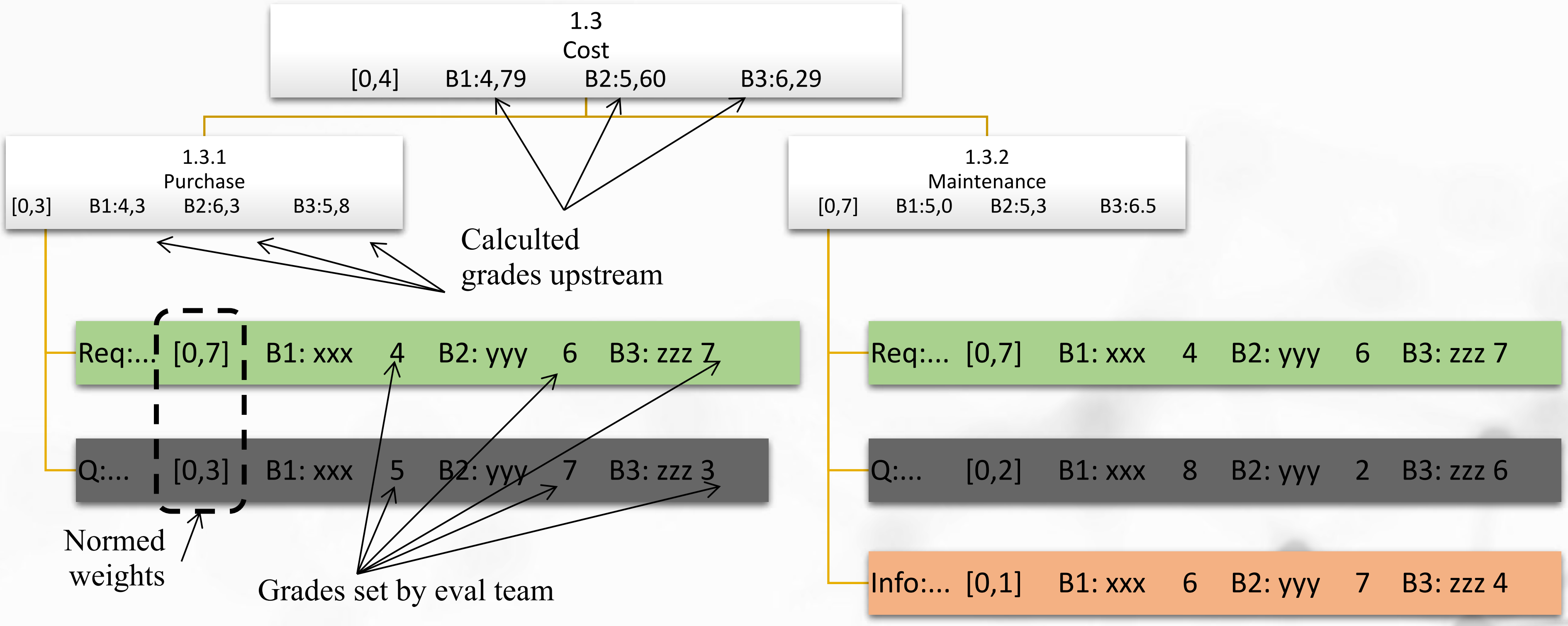
- Define an Evaluation Matrix in multiple levels
- Assign a Weight for each node

LINK EVALUATION OBJECTS TO EACH NODE



- Links from the Evaluation Module to each module where RFQ files have been used
- Bid replies are presented as leaves to each Evaluation node

SET GRADES ON NODES – CALCULATION UPSTREAM



- Task for the Eval team: Set grades (with justification) for each bidder's reply to each Evaluation Object
- Automatic calculation of grades upstream
- Evaluation result stored and baselined in SES

SUMMARY

SUMMARY

- Use your tool of choice for managing requirements and other data
- Improve Correctness/Completeness/Consistency with SES
- Prepare Request for Quotation packages with SES-AQ
- Collect Bids in generic, importable files with input validation and change indication
- Evaluate all Bids in parallel
- Produce traceable Contractual documents from source
- Continue Data Exchange after Contract Signature as before, or design bespoke formats and rules based on available tools on each side

- Use the capabilities of AQ-Excel and AQ-PDF for various additional purposes

- Full historic traceability including the Acquisition phase in your database


Q&A

This methodology enables contracting agencies to:

- Improve cost estimation accuracy
- Evaluate supplier maturity and technical readiness
- Assess lifecycle risks
- Classify and evaluate requirements quality
- Answer the question: Who is the best supplier from a technical, economic, and project perspective, and what risks are involved?

Dates:

- 30th and 31st of October

Lars Anderberg

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