KCSE Principles:
Enhancing SE activities with a Global KM approach

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The REUSE Company – TRC Worldwide

Tools and solutions for knowledge Traceability, Reuse and Quality management

- Local partners: France, Germany, Italy, Spain and Japan
- Customers in different countries along United States, Europe and Asia
- TRC Headquarters is based on Madrid (Spain)
- United Kingdom TRC office
- Scandinavian TRC office (Sweden)
For example, it doesn’t matter in what order the letters in a word appear; the only important thing is that the first and last letter are in the right place. The rest can be a total mess and you can still read it without problem.
How does Requirements Understanding enhance SE activities?

40% Cost Saving

(Average Value)
Knowledge Centric Systems Engineering

- Business or Mission Analysis
- Stakeholder needs and requirements
- System requirements
- Architecture
- Design
- System Analysis

- Operation
- Maintenance
- Disposal

- Validation
- Transition
- Verification
- Integration

Knowledge Base - Ontology

Figure 1. Vehicle model structure
Knowledge Centric Systems Engineering
Knowledge Management
Capture, creation, representation, and exchange of knowledge across targeted groups of stakeholders

Traceability
Support the integration among assets through semantic interoperability to ensure the traces between similar elements

Requirements
Enhance Requirements writing engineering skills and ensure CCC based on the organizational know-how

Quality Management
Define, implement and perform measures to meet the quality priorities that satisfy the verification of any engineering element

CCC: Correctness, Completeness and Consistency
How does KCSE enhance SE activities?

40% Cost Saving
(Average Value)
COSYSMO computes effort (and cost) as a function of system functional size and adjusts it based on a number of environmental factors related to systems engineering.

http://csse.usc.edu/tools/COSYSMO.php
Constructive Systems Engineering Model - COSYSMO

Figure 14 Cost Driver EMRs in Order of Influence from Delphi Round 3

http://csse.usc.edu/tools/COSYSMO.php
Example of application – Cost Saving Percentages

**SE Cost for Nominal Values** = $9,454,288.00

**SE Cost for High Values** = $5,896,640.00

**SE Cost for Very High Values** = $3,687,172.00

**Percent Change Nominal to High** = 37.63%

**Percent Change Nominal to Very High** = 61.00%

Return on Investment with SES v18 - Pilot Project

- EFFORT Current State
- EFFORT Future State
- SE STUDIO (SES) COST
- NET SAVING WITH SE STUDIO

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Application of the KCSE Principles
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**Knowledge Management**
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Define, implement, and perform measures to meet the quality priorities that satisfy the verification of any engineering element.

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KCSE Framework

Tailoring

- Ontology
- Quality Set
- Process

CCC: Correctness, Completeness and Consistency
The Ontology for KCSE

01 Vocabulary
Controlled Organizational and Project Vocabulary for a common understanding among stakeholders

02 Architectures
Recreate and capture the system architectures represented in views and models. Establish relationships among system and system elements

03 Patterns
Represent requirements similarities and enable formal representation, automatic recognition and aid authors

04 Formalization
Representation of assets semantic through SRL – System Representation Language

05 Reasoning
A combination of rules, tasks and groups to infer information from valuable assets
Vocabulary

Controlled Organizational and Project Vocabulary for a common understanding among stakeholders
Architectures

Recreate and capture the system architectures represented in views and models. Establish relationships among system and system elements.
Patterns

Represent requirements similarities and enable formal representation, automatic recognition and aid authors.
Formalization

Representation of assets semantic through SRL – System Representation Language
05

Reasoning

A combination of rules, tasks and groups to infer information from valuable assets
The aircraft shall be able to operate at a minimum temperature of -70\(^\circ\) C. If the temperature is lower than -70\(^\circ\) C or higher than 65\(^\circ\) C, then the operation is not possible.
Application of the KCSE Principles

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KCSE Framework

Tailoring

Ontology
Quality Set
Process

CCC: Correctness, Completeness and Consistency
Quality in the context of KCSE

Completeness
Consistency

Correctness
Completeness
Consistency
Correctness Quality Check

Quality Analysis applied to single requirements

The Correctness Quality Set:

- Characteristics coverage
- Ontology dependency
- Effort needed to fix identified error
Completeness Quality Check

**Specification viewpoint**

**Ontology viewpoint**
Consistency Quality Check

**Specification Inconsistency**

**Ontology Inconsistency**

**Traces Inconsistency**
Project Performance

First Assessment

Second Assessment

Quality Evolution
Application of the KCSE Principles

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KCSE Framework

Tailoring

Ontology
Quality Set
Process
Operating between assets
Common Representation Language

Power Control System

Demand battery low level

Battery

Charge System

Charge System loading

Power Control System

Operational Amp

Resistor

<<Connection>>

Operational Amp

Resistor

<<Connection>>

Operational Amp

Ground

<<Connection>>

Operational Amp

Operational Amp

Capacitor
Efficient application of KCSE: Tailoring
Efforts to apply KCSE

Make it simple

KCSE application purpose

Process Automation
User’s Support
Both
Systems Engineering Studio v18.1

Verification Studio (V&V Studio)
Manages the preparation of verification actions
Manages the realization of verification actions
Manages and improves the quality of all types of work-products
Manages the results of the verification process

Authoring Tools (RAT)
Assists you in the activity of writing requirements and other natural language text
Performs Correctness and Consistency analysis on the fly
Suggests terminology changes based on a central knowledge base
Fully integrated in your Requirements Management Tool and Modelling Tool

Knowledge Manager (KM)
Manages terminology and knowledge of your system
Helps you in the creation of patterns
Provides methods for automatic generation of Ontologies
Manages knowledge evolution over time

Traceability Studio
Manages trace links between all sorts of information
Discovers user-tailored trace links
Monitors and reports trace links in a tailorable platform
Connects every tool involved in the systems engineering processes
1. Automatic requirements elicitation from documents

2. An application to check compliance with standards in the procurement projects

3. How are we performing?

4. Keep tracing all the information back to their source.
1. Automatic requirements elicitation from documents

Source Requirements Documents (Word, PDF)

Automatic Extraction based on patterns

Simple Index Process

Knowledge - Based Index Process

Requirements Documents (Excel, DOORS, Word, …)
2. An application to check compliance with standards

Statement of Work (SoW)
Defence Technical Specification
Support CLS / ILS
Work Breakdown SoW
Technical Specification SSS
3. An application to check compliance with standards

- Completeness
- Consistency

Correctness

Completeness

Consistency
3. Keep the performance under control

Key Performance Indicators from the beginning, up to today!

Automatic Evaluation of the different bidder’s documentation!
3. Do we specify our projects too much (or not enough)?

Overlapping analysis of documents
4. Keep tracing all the information back to their source

Smart Suggestion of Traces based on Ontology
Conclusions

KCSE approach as a mean to enhance projects

40% Cost Saving

Ontology Design and Architecture based on the goals and efforts

Tailoring activities to optimize tools, processes and assets

4 Person Month
Any Questions

THANK YOU!
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