ISO TRL Definitions and Assessment Criteria - Status

James Bilbro[1], Cornelius Dennehy[2], Prasun Desai[3], Jenny Holzer[4], Corinne Kramer[4], William Nolte[5], Richard Widman[6], Richard Weinstein[7]

JB Consulting International
Goddard Space Flight Center
Langley Research Center
Institute for Defense Analysis
Air Force Research Laboratory
Boeing
Independent Consultant

Status of Proposed ISO TRL Definitions and Assessment Criteria

- What is ISO?
- What is TRL?
- Current Status
- What documents are being considered as inputs for the Handbook?
- The Way ahead

Status of Proposed ISO TRL Definitions and Assessment Criteria

- "ISO (International Organization for Standardization)

is a global network that identifies what International Standards are required by business, government and society, develops them in partnership with the sectors that will put them to use, adopts them by transparent procedures based on national input and delivers them to be implemented worldwide."
  - ISO is not a Government or treaty Organization; like IEC, ITU
  - **Members: 157** national standards bodies (e.g. ANSI)
  - **208** technical committees, **531** subcommittees
- ISO TC20/SC14 Space Systems and Operations– Estab. 1992
  - 12 Participating countries ; 7 Observers ; 7 Liaison Orgs.
  - May 18-22, 2009, Berlin, Germany : 19th Plenary, 31st WG1 meeting,
  - ~100 attendees, 11 countries represented

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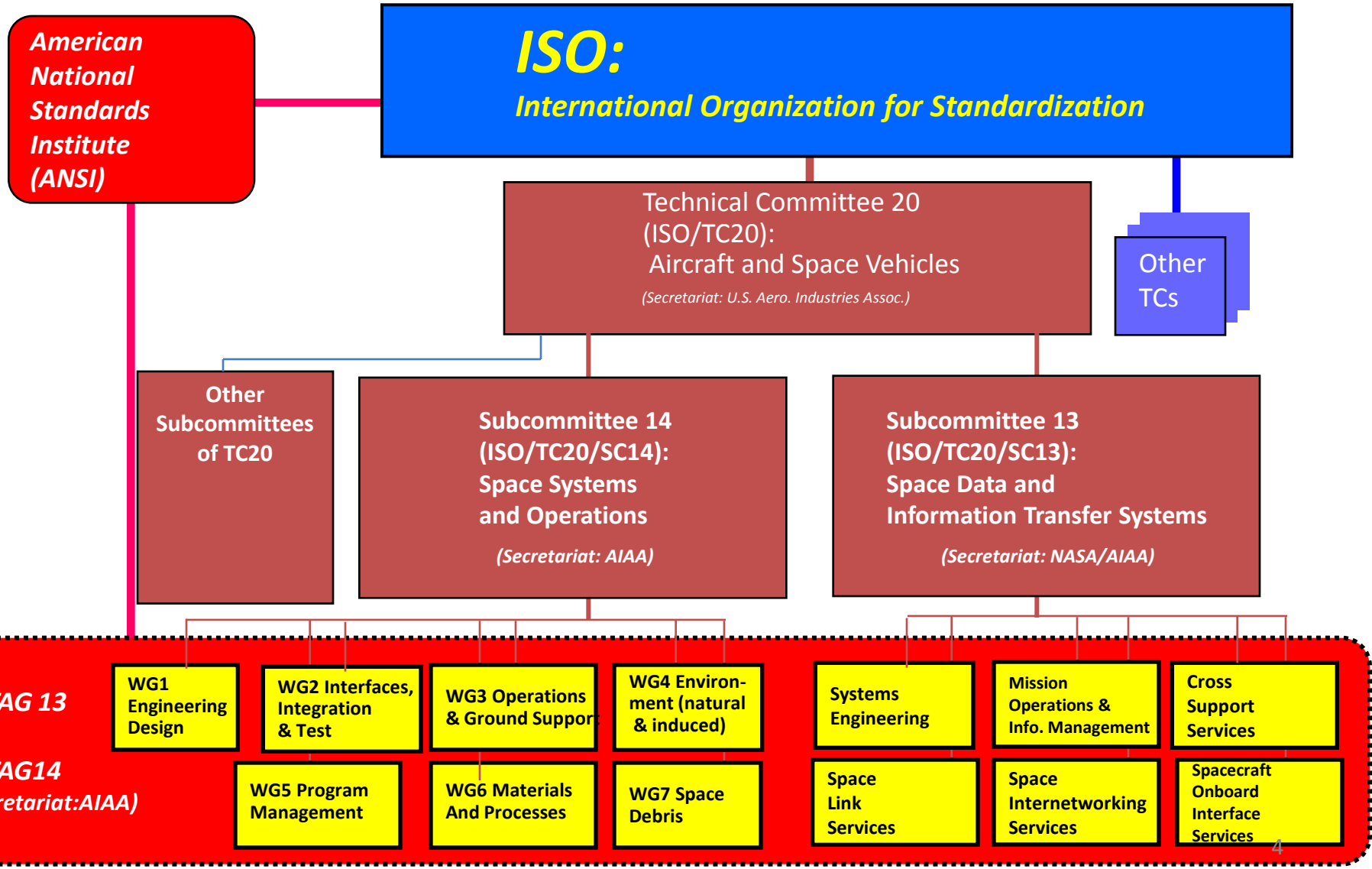

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International harmonized stage codes

STAGE	SUB-STAGE						
	00	20	60	90 Decision			
	Registration	Start of main action	Completion of main action	92 Repeat an earlier phase	93 Repeat current phase	98 Abandon	99 Proceed
00 Preliminary stage	00.00 Proposal for new project received	00.20 Proposal for new project under review	00.60 Close of review			00.98 Proposal for new project abandoned	00.99 Approval to ballot proposal for new project
10 Proposal stage	10.00 Proposal for new project registered	10.20 New project ballot initiated	10.60 Close of voting	10.92 Proposal returned to submitter for further definition		10.98 New project rejected	10.99 New project approved
20 Preparatory stage	20.00 New project registered in TC/SC work programme	20.20 Working draft (WD) study initiated	20.60 Close of comment period			20.98 Project deleted	20.99 WD approved for registration as CD
30 Committee stage	30.00 Committee draft (CD) registered	30.20 CD study/ballot initiated	30.60 Close of voting/comment period	30.92 CD referred back to Working Group		30.98 Project deleted	30.99 CD approved for registration as DIS
40 Enquiry stage	40.00 DIS registered	40.20 DIS ballot initiated: *5 months*	40.60 Close of voting	40.92 Full report circulated: DIS referred back to TC or SC	40.93 Full report circulated: decision for new DIS ballot	40.98 Project deleted	40.99 Full report circulated: DIS approved for registration as FDIS
50 Approval stage	50.00 FDIS registered for formal approval	50.20 FDIS ballot initiated: *2 months.* Proof sent to secretariat	50.60 Close of voting. Proof returned by Secretariat	50.92 FDIS referred back to TC or SC		50.98 Project deleted	50.99 FDIS approved for publication
60 Publication stage	60.00 International Standard under publication		60.60 International Standard published				
90 Review stage		90.20 International Standard under periodical review	90.60 Close of review	90.92 International Standard to be revised	90.93 International Standard confirmed		90.99 Withdrawal of International Standard proposed by TC or SC
95 Withdrawal stage		95.20 Withdrawal ballot initiated	95.60 Close of voting	95.92 Decision not to withdraw International Standard			95.99 Withdrawal of International Standard

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ISO TRL WG objectives

14N665 *Definition of the Technology Readiness Levels (TRL) and their criteria of assessment*

The scope of this project is to standardize the definition of the Technology Readiness Levels (TRL) and of their criteria of assessment.

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ISO TRL Working Group meetings

- British Standards Institute, London, UK, May 11, 2010.
- Centre National d'Etudes Spatiales(CNES), Paris, France, October 26-27, 2010.
- European Space Agency (ESA), Paris, France, March 24-25, 2011.
- Berlin, Germany, May 23-24, 2011.

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Project Leader: Frédéric Safa (ESA/ESTEC)

WG members – Country Leads

US: Jim Bilbro

FR; Franck Durand-Carrier

Japan: Satoshi Kikuchi

UK: Nicolas Chesher

DE: Andreas Jain (represents also WG5)

Brazil: Paulo Roberto Sakai

Ukrainian: Yuriy Stryzhak

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US Team Members

Jim Bilbro	JB Consulting International
Tim Barth	NASA Kennedy Space Center
Neil Dennehy	NASA Goddard Space Flight Center
Prasun Desai	NASA HQ, Office of Chief Technologist
Mike Ellis	DMD Group Inc.
Oscar Gonzalez	NASA, Goddard Space Flight Center
Jenny Holzer	Institute for Defense Analysis
Hoyt Johnson	DOE, Office of Waste Processing
John Kelly	NASA HQ, Office of Chief Engineer
Corinne Kramer	Institute for Defense Analysis
Steve Kapurch	NASA HQ, Office of Chief Engineer
David McGowan	NASA HQ, Office of Chief Technologist
Bill Nolte	Air Force Research Laboratory
Bob Rassa	Raytheon
James Reuther	NASA HQ, Office Chief Techonologist
Brian Sauser	Stevens Institute
Sandra Smalley	NASA HQ, Office Chief Engineer
Ellen Stigberg	NASA HQ
Dick Weinstein	NASA Consultant
Rich Widmann	Boeing

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- CNES TRL Handbook is the basis of the ISO proposal
- Additional Documents recommended by participants to date
  - DLR TRL Handbook
  - DOD TRA Deskbook
  - NASA SE TRA Process
  - NASA TRL Description & Definitions
- ISO document will draw on all sources to develop a consensus Handbook
- Participation of interested organizations/companies is welcome & encouraged

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Definitions and Criteria

Technology Readiness Level	Milestone achieved for the element	Work achievement (documented)
TRL 1 - Basic principles observed and reported	Potential applications are identified following basic observations but element concept not yet formulated	Expression of the basic principles intended for use. Identification of potential applications.
TRL 2 - Technology concept and/or application formulated	Formulation of potential applications and preliminary element concept. No proof of concept yet.	Formulation of potential applications Preliminary conceptual design of the element, providing understanding of how the basic principles would be used.
TRL 3 - Analytical and experimental critical function and/or characteristic proof-of-concept	Element concept is elaborated and expected performance is demonstrated through analytical models supported by experimental data/characteristics	Preliminary performance requirements (can target several missions) including definition of functional performance requirements Conceptual design of the element Experimental data inputs, laboratory-based experiment definition and results Element analytical models for the proof-of-concept
TRL 4 - Component and/or Breadboard Functional Validation in Laboratory Environment	Element functional performance is demonstrated by breadboard testing in laboratory environment	Preliminary performance requirements (can target several missions) with definition of functional performance requirements Conceptual design of the element Functional performance test plan Breadboard definition for the functional performance validation Breadboard test reports

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Definitions and Criteria

TRL 5 - Component and/or Breadboard Critical Function Validation in a Relevant Environment	Critical functions of the element are identified and the associated relevant environment is defined. Breadboards not full-scale are built for validating the performance through testing in the relevant environment, subject to scaling effects.	Definition of performance requirements Identification and analysis of the element critical functions Preliminary design of the element, supported by appropriate models for the critical functions validation Definition of the relevant environment Critical function test plan. Analysis of scaling effects. Breadboard definition for the critical function validation Breadboard test reports.
TRL 6 - Model Demonstrating Critical Functions in a Relevant Environment	Critical functions of the element are validated, performance is demonstrated in the relevant environment and representative model(s) in form, fit and function	Definition of performance requirements Identification and analysis of the element critical functions Preliminary design of the element, supported by appropriate models for the critical functions validation Definition of the relevant environment Critical function test plan. Model definition for the critical function validations Model test reports.
TRL 7 - Model Demonstration for the Operational Environment	Performance is demonstrated for the operational environment, on the ground or if necessary in space. A representative model, fully reflecting all aspects of the flight model design, is build and tested with adequate margins for demonstrating the performance in the operational environment.	Performance requirements are established and agreed upon. Model definition and realisation Model test plan Model test results
TRL 8 - Actual system completed and “flight qualified” through test and demonstration	Flight model is qualified and integrated in the final system ready for flight	Flight model is built and integrated into the final system Flight acceptance of the final system
TRL 9 - Actual system “flight proven” through successful mission operations	Technology is mature. The element is successfully in service for the assigned mission in the actual operational environment.	Commissioning in early operation phase In-orbit operation report

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The Way Forward

- The TRL report has been submitted as Committee Draft for comments (DC/C).
- Comments are expected by 5 December, 2011.
- A meeting will be held December 15-16, 2011 at ESTEC in Noordwijk NL to discuss and incorporate comments into a final document.
- The modified document will then be circulated to a formal vote (CD/V) before mid-January with a deadline of April with ballot results and comments if any by end April 2012
- The revised draft for Draft International Standard (DIS) stage would be submitted end of May/early June, with a deadline of early November, 2012.

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Contact Information:

James W. Bilbro

JB Consulting International

E-mail: jbci@knology.net

Telephone: 256-534-6245

Cell: 256-655-6273