25th anniversary
annual INCOSE
international symposium
Seattle, WA
July 13 - 16, 2015

On the Definition of Terms in a Requirements Expression

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History

- The RWG produced the “Guide for Writing Requirements” in 2012.
  - The paper was a good start, but several key things were missing:
    1. The overall context within which requirements exist
    2. Definitions of key terms
- These missing items were addressed at the RWG meetings during INCOSE IW2014
- This paper is based on a paper “*An Improved Taxonomy for Definitions Associated with a Requirement Expression*” written by the authors to document the outcomes of the RWG activities during IW2014.

History (cont.)

- At INCOSE IW2015, the RWG integrated the contents of the paper into the INCOSE RWG "Guide to Writing Requirements"
  - A framework diagram showing context and levels of requirements was added
  - Definitions of terms associated with a requirement expression were added
  - Existing information on characteristics and rules was updated
  - The section on attributes was greatly expanded
  - The resulting document was reviewed by RWG members who attended IW2015
  - The result was sent to TechOps for their review
  - The Guide to Writing Requirements is now ready to be released at IS2015!!!

Background

- Definitions of a requirement are contained in many sources
  - Most of the sources provide definitions of the term associated with a requirement statement
    - few contain any guidance as to the process of developing a requirement
    - there are only occasional agreements on common definitions
    - often defined terms are too narrowly focused to be useful across the full requirements engineering domain

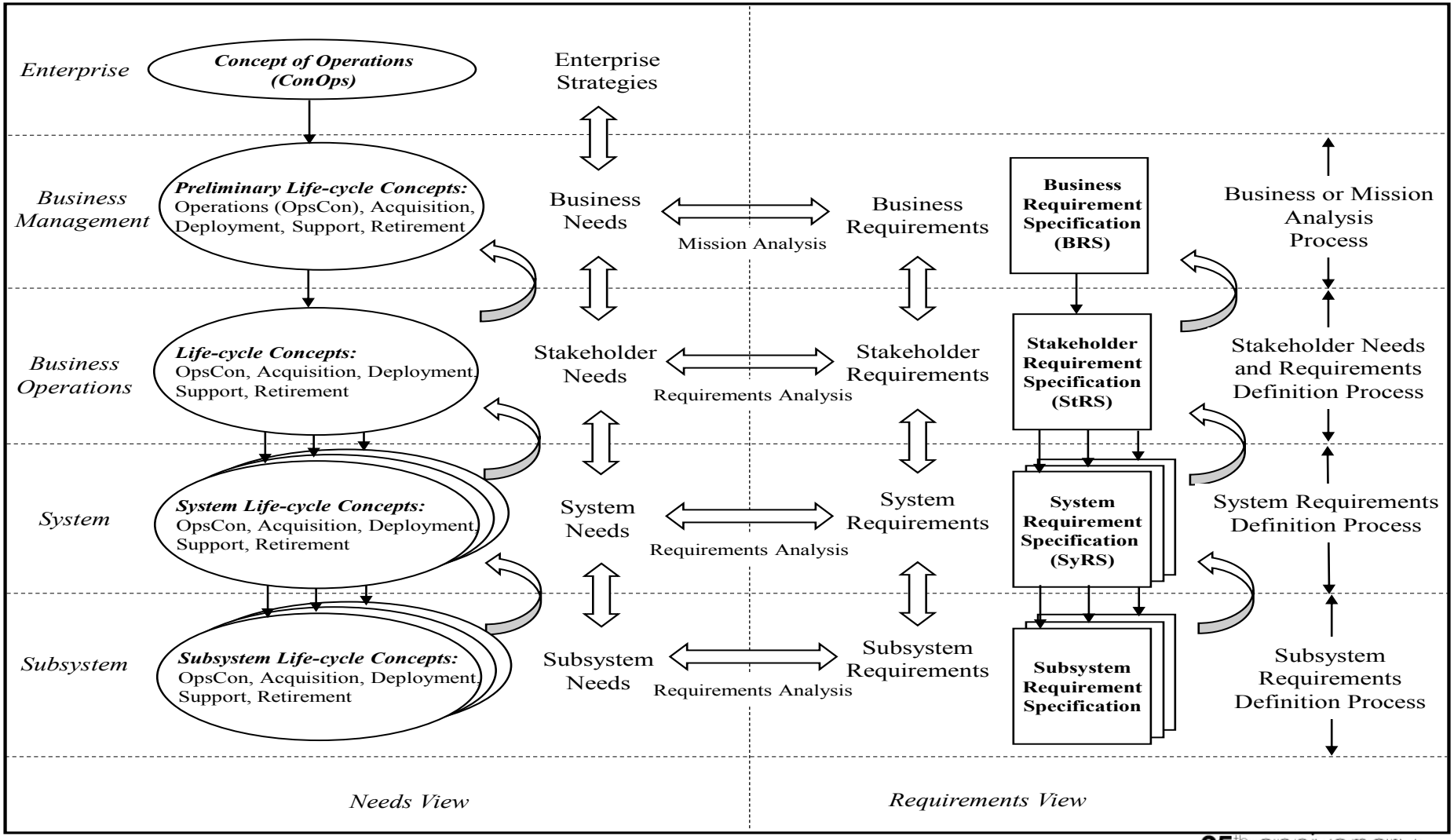
Background (cont.)

- Requirements do not just appear—a framework is essential
  - For the formal transformation of needs into requirements
  - For the development of well-formed requirement expressions and well-formed sets of requirements
- Unfortunately, however, there was no such agreed-to framework, nor was there consensus on the definitions or usage of the terms associated with the expression of a requirement

Contents

- This paper:
  - Describes a framework within which requirements are developed
  - Proposes a cohesive set of definitions of the terms associated with a requirement expression

Framework for the transformation of needs into requirements



Ryan MJ (2013) An improved taxonomy for major needs and requirements artifacts. INCOSE International Symposium IS2013

Layers of Requirements

- *Enterprise view*: enterprise leadership sets the enterprise strategies
- *Business Management* view: business management derives business needs and constraints as well as formalize the business requirements
- *Business Operations* view: stakeholders define their needs and requirements for implementing the enterprise strategies within the context of the business requirements
- *Systems* view: the system(s) needed by Business Operations are defined in logical and physical views
  - system may comprise a number of elements including products, people, and processes
- *System element* view: the system elements that make up the system

Flow down of requirements

- At each level, needs are documented and transformed through analysis into requirements.
- The resulting requirements will be documented, agreed-to, baselined, and will be put under configuration management.
- Once a set of requirements has been documented, agreed-to, and baselined at one layer; they will flow down to the next layer as shown in the figure.
- In all cases, for each layer shown, the set of requirements can be traced back to the requirements at the previous layer from which they were either decomposed or derived.
- This process continues for the next layer of system elements.

Requirement Purpose

- The purpose of a *requirement expression* is to communicate clearly the needs of various entities into a formal language such that the intent is clearly understood by all involved:
  - those whose job it is to implement the requirement
  - those responsible for proving the built system meets the requirement
  - those responsible for proving the resulting system meets the needs of the relevant entity

Definition of an “needs”

Needs are the result of a formal transformation of one or more concepts for an entity into agreed-to expectations for that entity to perform some function (or possess some quality (within specified constraints).

- Focus is on stakeholder expectations
- Structured processes used by the RE or BA to elicit specific needs include user stories, use cases, scenarios, system concepts or operations concepts

Definition of an “Entity”

An *entity* is a single thing to which a need or requirement refers: an enterprise, business unit, system, system element (which could be a product, process, human, or organization).

– Can exist at any level

Definition of an "Requirement"

- A *requirement statement* is the result of a formal transformation of one or more needs into an agreed-to obligation for an entity to perform some function or possess some quality (within specified constraints).

- A *requirement expression* includes a requirement statement with a set of associated attributes.

Definition of an "Attribute"

- An *attribute* is additional information included with a requirement statement, which is used to aid in the management of that requirement.
- Attributes can be organized within four broad categories
  - *Attributes to help define the requirement and its intent. (e.g.,* rationale, parent requirement, source, etc.)
  - *Attributes associated with verification. (e.g.,* verification method, verification level, verification phase, verification results, verification status, etc.)
  - *Attributes to help maintain the requirements.* (e.g., identifier, name, originator/author, date, owner, stakeholders, priority, criticality, risk, etc.)
  - *Attributes to show applicability and allow reuse.* (e.g., applicability, region, country; state/province, application, market segment, business unit, business line, etc.).

Definition of a “Set of Requirements”

A *set of requirements* is a structured set of agreed-to requirement expressions for the entity and its external interfaces.

Close

- The framework and these definitions are included in the RWG “Guide for Writing Requirements”
- Characteristics of well-formed requirements are included in the Guide addressing both the concept of “formal transformation” as well as “agreed-to obligation”
- To help write requirements with these characteristics, a set of 44 rules are provided
- The guide also introduces 44 attributes that can be defined as part of the requirement expression

Biography

Lou Wheatcraft is a senior instructor/consultant for Requirements Experts (RE) who educates organizations on the importance of writing good requirements and helps them implement Requirement Development and Management (RD&M) processes based on industry best practices. Lou has taught over 185 requirement seminars over the last 15 years.

Lou works with both government and industry clients to tailor training for their organizations and provides just in time team training for specific projects. Lou has spoken at Project Management Institute (PMI) Chapter meetings, International Council of System Engineering (INCOSE) conferences and NASA's PM Challenge and delivered tutorials to PMI and INCOSE chapters at multiple locations.

Lou has had published and presented a multitude of papers on requirement RD&M topics for NASA's PM Challenge, INCOSE, INCOSE INSIGHT Magazine, and Crosstalk Magazine.

Lou is a member of INCOSE, co-chair of the INCOSE Requirements Working Group, a member of PMI, the Software Engineering Institute (SEI), the World Futures Society, and the National Honor Society of Pi Alpha Alpha.

Lou is co-author of the INCOSE RWG "Guide for Writing Requirements"

Lou has a BS degree in Electrical Engineering from Oklahoma State University, an MA degree in Computer Information Systems from the University of Houston – Clear Lake, an MS degree in Environmental Management from the University of Houston – Clear Lake, and has completed the course work for an MS degree in Studies of the Future from the University of Houston – Clear Lake.

Lou is the primary contributor to RE's blog on requirements best practices.
The blog can be assessed at: http://www.reqexperts.com/blog .

Biography

Dr. Mike Ryan is a Senior Lecturer with the School of Information Technology and Electrical Engineering, University of New South Wales, Canberra, at the Australian Defense Force Academy.

Mike holds Bachelor, Masters, and Doctor of Philosophy degrees in electrical engineering as well as a Graduate Diploma in Management Studies.

Mike lectures and regularly consults in a range of subjects including communications and information systems, systems engineering, requirements engineering, and project management.

Mike is the conference chair of two annual international conferences, he is the editor-in-chief of the Journal of Battlefield Technology, and is chair of the Requirements Working Group in the International Council on Systems Engineering (INCOSE).

Mike is the author or co-author of ten books, three book chapters, and over one hundred technical papers and reports.

Mike is co-author of the INCOSE RWG “Guide for Writing Requirements”

Biography

Dr. Jeremy Dick received BSc and DPhil degrees in Computing Science from Imperial College, London.

With a background in formal methods, Jeremy has worked as a consultant in the requirements engineering domain for nearly 20 years, first with QSS and Telelogic, now with Integrate Systems Engineering Ltd. His roles have afforded him a broad exposure to requirements management practices and issues across many industry sectors.

Recent work has included 3 years as part of the requirements team in a major UK defense program applying Evidence-base Development, and currently working in the rail sector with HS2 and the civil nuclear sector with Sellafield.

Jeremy is co-author of a Springer book entitled “Requirements Engineering”, Jeremy has been an advocate of tool-supported requirements processes for many years. Known for his work on traceability, he coined the term “rich traceability” for the concept of traceability rationale. These principles have evolved into the concept of “Evidence-based Development”, which is one of his current interests. He is also a past chair of the INCOSE Requirements Working Group.

Jeremy is co-author of the INCOSE RWG “Guide for Writing Requirements”

Biography

Richard Zinni is a Principal Systems Engineer for Harris Corporation; RF Communications Division in Rochester, NY.

Richard is Program Director of the Finger Lakes Chapter of INCOSE, and Co-chair of the INCOSE Requirements Working Group for several years.

Richard is co-author of the INCOSE RWG “Guide for Writing Requirements”

Richard holds a Master of Science degree in System Engineering (MSSE) from Florida Institute of Technology (FIT), and a Bachelor of Science degree in Electrical Engineering from Rochester Institute of Technology (RIT).

Richard has been working on small, medium and large domestic and international government programs for 10 years, and has been a very active member of INCOSE the last four years, specializing in Requirements.