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The Value of Loss-Driven Systems Engineering (LDSE)

John S. Brtis & Kenneth Cureton

What we mean by LDSE

Loss-Driven Systems Engineering is the value adding unification of the systems engineering specialty areas that address the potential losses associated with systems. Examples of those specialty areas include: resilience, safety, security, operational risk, environmental protection quality, availability.

Where Does LDSE Fit in The SE Taxonomy?

- The LDSE specialty areas fall under the umbrella of Quality Characteristics
  - Quality characteristics are “inherent characteristics of a product, process, or system related to a requirement.” [ISO 15288:2022(E) draft]
  - Critical quality characteristics commonly include those related to health, safety, security, resilience, assurance, reliability, availability, and supportability. [ISO 15288:2022(E) draft]
  - “Quality characteristic,” as a category, doesn’t inform much about the characteristic other than it is inherently related to a requirement.
  - The LDSE category provides much more information on the characteristic: LDSE characteristics involve the use of coping strategies to manage potential loss of a value of interest due to an adversity, and there is potential commonalities and synergies among the LDSE quality characteristics.
  - The creation of this high value new category that offers a significantly improved framing for these specialty areas of SE.

A brief discussion on “Adversity”

- An “Adversity” is anything that might degrade the capability provided by a system-- requires consideration of all sources and types of adversity; e.g., from:
  - Environmental sources
  - System failure
  - As well as from adversarial, friendly, and neutral parties
- Characteristics:
  - Adversity from human sources may be malicious or accidental
  - Adversities may be expected or not
  - Adversities may be issues, risks and unknown-unknowns
  - Adversities may arise inside or outside the system

What is the Purpose of Loss-Driven Systems Engineering (LDSE)?

- Systems Engineering (SE) tends to be capability-driven
- Some quality characteristics are addressed to address potential losses associated with the SOI (e.g.; safety, security, resilience, risk, availability…) SOI.
- Work on the various loss-drive quality areas are often worked on separately from one another.
- We believe there is commonality and synergy among these specialty areas that should be leveraged:
  - Vocabulary
  - Taxonomy
  - Modeling and analysis
  - Adversities considered
  - Losses considered
  - Requirements
  - Architectural and design techniques
- We believe SE can harness this commonality to better manage possible system related loss.
- We call this unification Loss-Driven Systems Engineering

What are the Commonalities and Synergies Among Loss-Driven Specialty Areas?

- Commonality
  - Concerned with assets (objects of value)
  - Concerned with adversities
  - Concerned with types of loss
  - Concern with coping techniques
- Potential Synergies
  - Shared loss scenarios
  - Shared requirements
  - Shared analysis
  - Shared architecture and design solutions
  - Shared risk management

What are the Potential Benefits of the Unification of Loss-Driven Approach?

- Adds recognition and understanding of this important sub-set of quality characteristics
- Identification of commonalities and synergies among the loss-driven quality characteristics
- A more comprehensive consideration of loss
- A holistic loss-based viewpoint addressing the multiple perspectives
- Reduced engineering effort by eliminating overlapping SE processes and activities among the specialty areas (don’t re-invent the wheel!)
- Eliminating conflicts among the loss-driven solutions
- Effective solutions that address the interests of multiple loss-driven specialty areas
- Reducing the load of data generated by multiple specialty areas
- Mutual learning among the loss-driven specialty areas

Origins and Activities

- The concept and term LDSE were developed by employees of the MITRE Corporation, while working to improve the effectiveness of a customer's systems engineering processes in the areas of resilience, security and safety in 2017-2018
- An LDSE initiative was recommended and approved by TechOps Director, IW19
- Initial Exploratory Planning Meeting, IS19
- Call for Insight Papers, Jul 2019
- LDSE TTP workshop, IW20
- LDSE Initiative Info Sheet Distributed, Feb 2020
- Insight LDSE Issue Published, Dec 2020
- RSWG established as LDSE incubator, IW21
- SEBOK section on LDSE prepared, fall 2021.

Insight Call for Papers

INSIGHT Magazine

September 2020 Issue

Loss-Driven Systems Engineering

Call for Papers

While much of systems engineering focuses on delivery of desired capabilities, loss-driven systems engineering addresses potential losses associated with the system of interest. Loss-driven systems engineering is addressed by a number of specialty engineering areas such as safety, security, operational risk, resilience, critical infrastructure protection, recovery, and a number of ilities.
The objective of this special *INSIGHT* issue is to explore the belief that the loss-driven systems engineering specialty areas share a commonality and synergy when it comes to vocabulary, taxonomy, modeling and analysis, adversities considered, losses considered, requirements, and architectural and design techniques for achieving their objectives – and to identify means for exploiting such commonalities and synergies as part of the systems engineering process.

Example Categories of Papers Sought:

- The meaning of loss-driven systems engineering
- The effect of loss-driven systems engineering on the systems engineering life cycle
- Commonalities and synergies among loss-driven systems engineering specialty areas
- Where loss-driven specialty engineering areas should/must collaborate
- Synergies – and conflicts – among loss-driven systems engineering specialty areas
- Tools techniques and practices for achieving loss-driven systems engineering that apply to multiple practice areas
- Harmonizing the vocabularies of operational risk, resilience, safety and security
- Coordinating architecture and design decisions among loss-driven systems engineering specialty areas
- Loss-driven considerations for autonomous systems

Please submit abstracts (800 words or less) to jbrtis@mitre.org no later than August 16, 2019. Abstracts should be submitted as MS Word .doc files or plain .txt files. Use a simple file name like smith_abstract.doc. Acceptance of an abstract does not guarantee publication of an article. Final decision for publication will be made by the Editorial Board based on the final article.

Key Dates

Abstracts:	August 16, 2019
Final Draft Paper:	December 2019
Final Papers:	March 2020
Publication Date:	September 2020

LDSE Info Sheet
Feb 2020

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LOSS-DRIVEN SYSTEMS ENGINEERING (LDSE) INITIATIVE

DISCUSSION

While much of systems engineering focuses on delivery of desired capabilities by the system, loss-driven systems engineering specialty areas address potential losses associated with the development or use of systems. Loss-driven systems engineering is addressed by a number of specialty areas such as safety, security, operational risk, resilience, critical infrastructure protection and recovery, and a number of ilities.

The INCOSE LDSE Initiative is focused on achieving value through unification of the LDSE specialty areas and better integrating them into the mainstream of systems engineering lifecycle.

The October 2020 issue of the INCOSE Insight magazine will be dedicated to the topic of LDSE.

CONTACT

John S. Brtis – LDSE Initiative Lead

EMAIL:
jbrtis@mitre.org

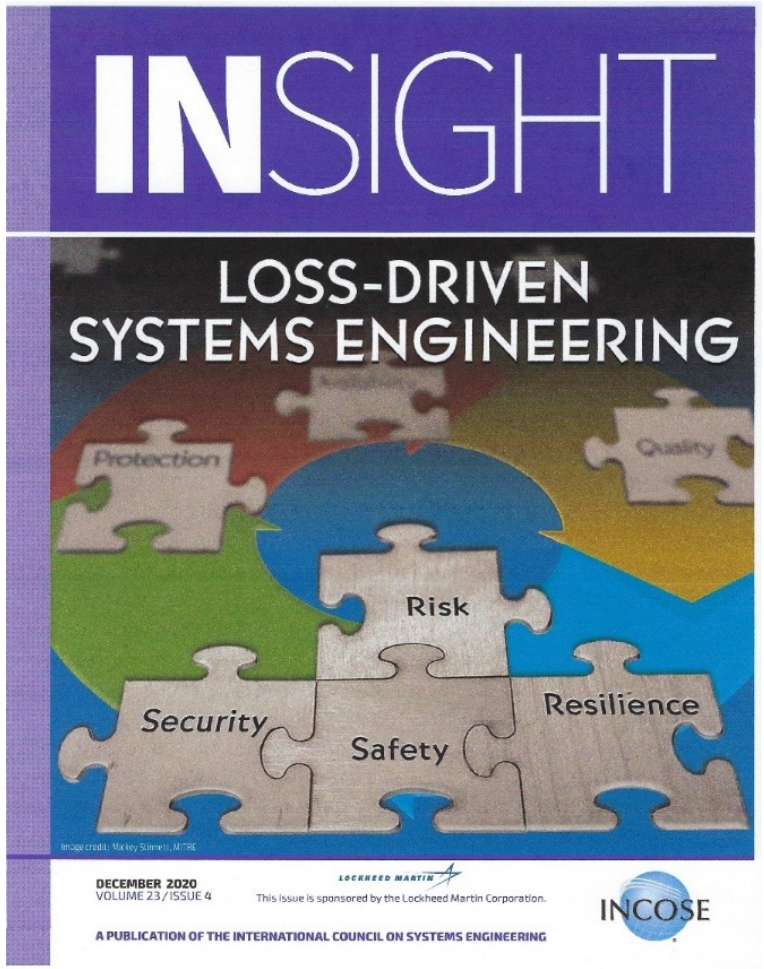
3 February 2020

LOSS-DRIVEN SYSTEMS ENGINEERING

Loss-Driven Systems Engineering is the value adding unification of the systems engineering specialty areas that address the potential losses associated with systems; e.g., resilience, safety, security, operational risk, environmental protection, quality, availability…

- **We believe there is commonality and synergy among these specialty areas, which needs to be addressed by systems engineering.**
- **They frequently share:**
  - Vocabulary
  - Taxonomy
  - Modeling and analysis
  - Assets of interest
  - Adversities considered
  - Losses considered
  - Resultant requirements
  - Architectural and design solutions
- **Potential Synergies**
  - Shared loss scenarios
  - Shared requirements
  - Shared analysis
  - Shared architecture and design solutions
  - Shared risk management
- **Expected Benefits of LDSE**
  - Reduced engineering effort by eliminating redundant efforts among the specialty areas
  - Comprehensive consideration of possible loss
  - Effective solutions that address the interests of multiple loss-driven specialty areas
  - Eliminating conflicts among the loss-driven solutions
  - Reducing load of data generated by multiple specialty areas to a minimal, non-redundant set
  - Mutual learning among the loss-driven specialty areas

LDSE Insight Issue, Dec 2020



What Working Groups Relate to LDSE

- Analytic Enablers
  - Resilience
  - Safety
  - Security
- Application Domains
  - Anti-Terror
  - CIPR
  - Defense
  - Health Care
- Process Enablers
  - Risk Management
  - Quality Management

Next Steps?

- RSWG is acting as advocate and incubator for LDSE, pursuing a bottom-up approach centered on LDSE deliverables and regular LDSE meetings with Resilience, Safety & Security and others as appropriate.
  - An LDSE article has been prepared for the SEBOK, get it published.
  - RSWG meetings dedicated to LDSE w/other WG participants
  - LDSE working meeting at IS23
  - LDSE session at IS23
  - Develop LDSE Definition, taxonomy and requirements structure
  - Continue LDSE TTP study
  - Expand on Winstead's LDSE principles
  - Implement Endler's LDSE process recommendations
  - An LDSE Primer?

Areas of Potential Commonality from LDSE Insight Issue, Dec 2020
"Unifying Loss-Driven Systems Engineering Activities"

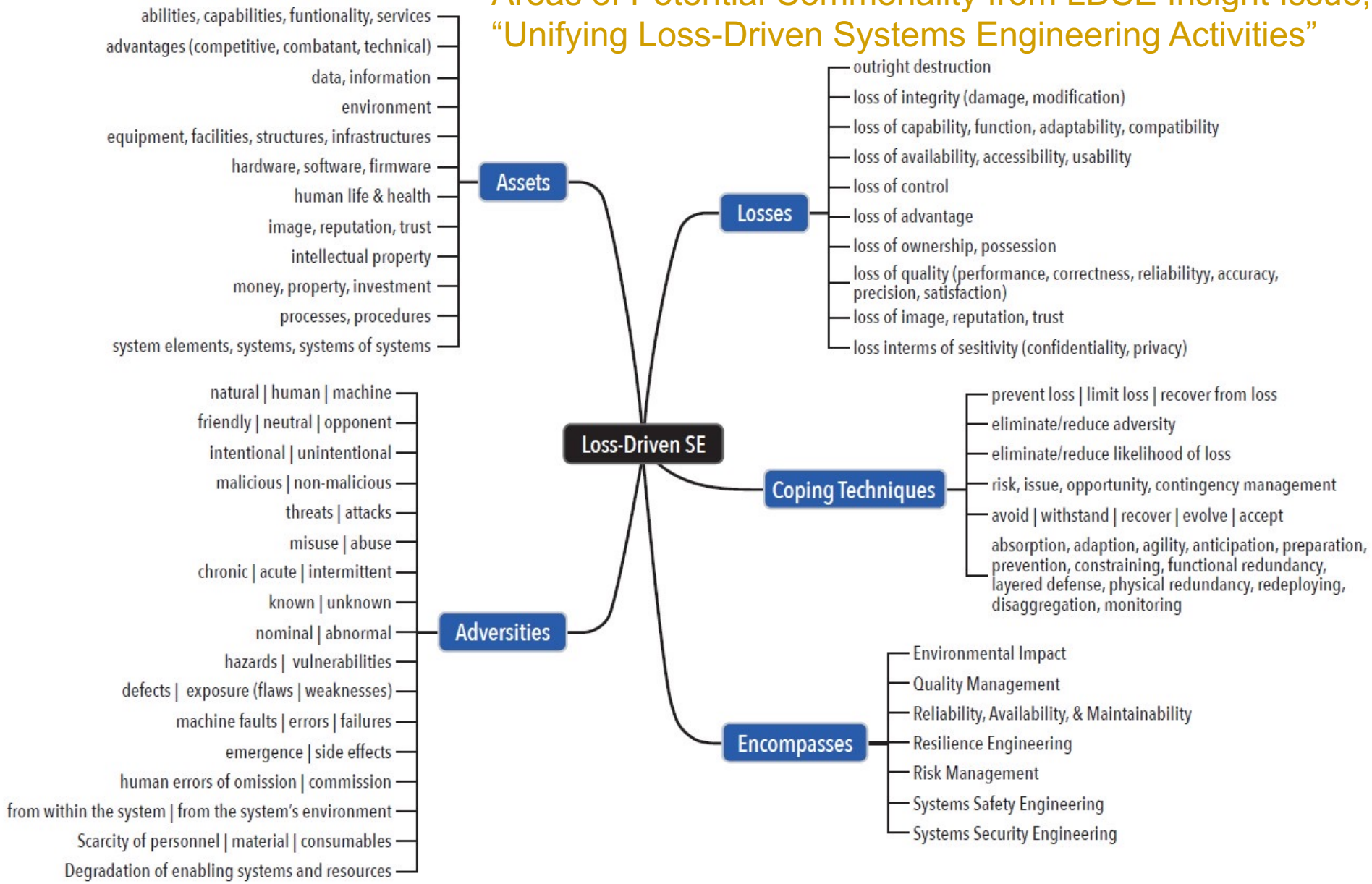


Figure 1. Attributes and Scope of the Integrated Loss-Driven Systems Engineering Problem Space