



Visual Analytics for Requirements-driven Risk Assessment

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The Problem

- Certification and Accreditation (C&A)
 - **Certification:** Assess level of compliance with baseline security requirements (specified in regulatory documents)
 - **Accreditation:** Agree upon an “**acceptable level of risk**” for authorizing system operation

- Large information space exists for understanding “**RISK**”
 - Complex interdependencies of systems of systems
 - Diverse socio-technical environment
 - Numerous natural language C&A requirements

Why Visual Analytics will help?

- Visual Analytics in the intelligence community
 - Combine human intuition and mathematically derived metaphors to highlight the obvious and discover the obscure
- Visual Analytics for Requirements:
 - Creation of abstract *visual metaphors* that help to systematically reason about the related software behavior in a large information space
 - Quantitative metrics
 - Compliance levels, Properties of analysis artifacts
 - Qualitative metrics
 - Criticality, Impact, Risk levels, Uncertainty, etc,...

Users and their Uses?

- The dilemma of a **Certification Analyst**:
 - Collective adequacy of diverse security constraints
 - Potential security risks due to non-compliance
- Some **really** helpful answers!
 - Necessity and sufficiency of C&A requirements
 - Prioritize C&A requirements
 - Cascading/propagative impact on other requirements
 - Coverage of risk components
 - Identify the influence of C&A requirements on the effective implementation of each other



The Visual Metaphors

■ The Cohesive Bar Graph

□ Color

- Presence
- Compliance level

□ Height

- Correlation index

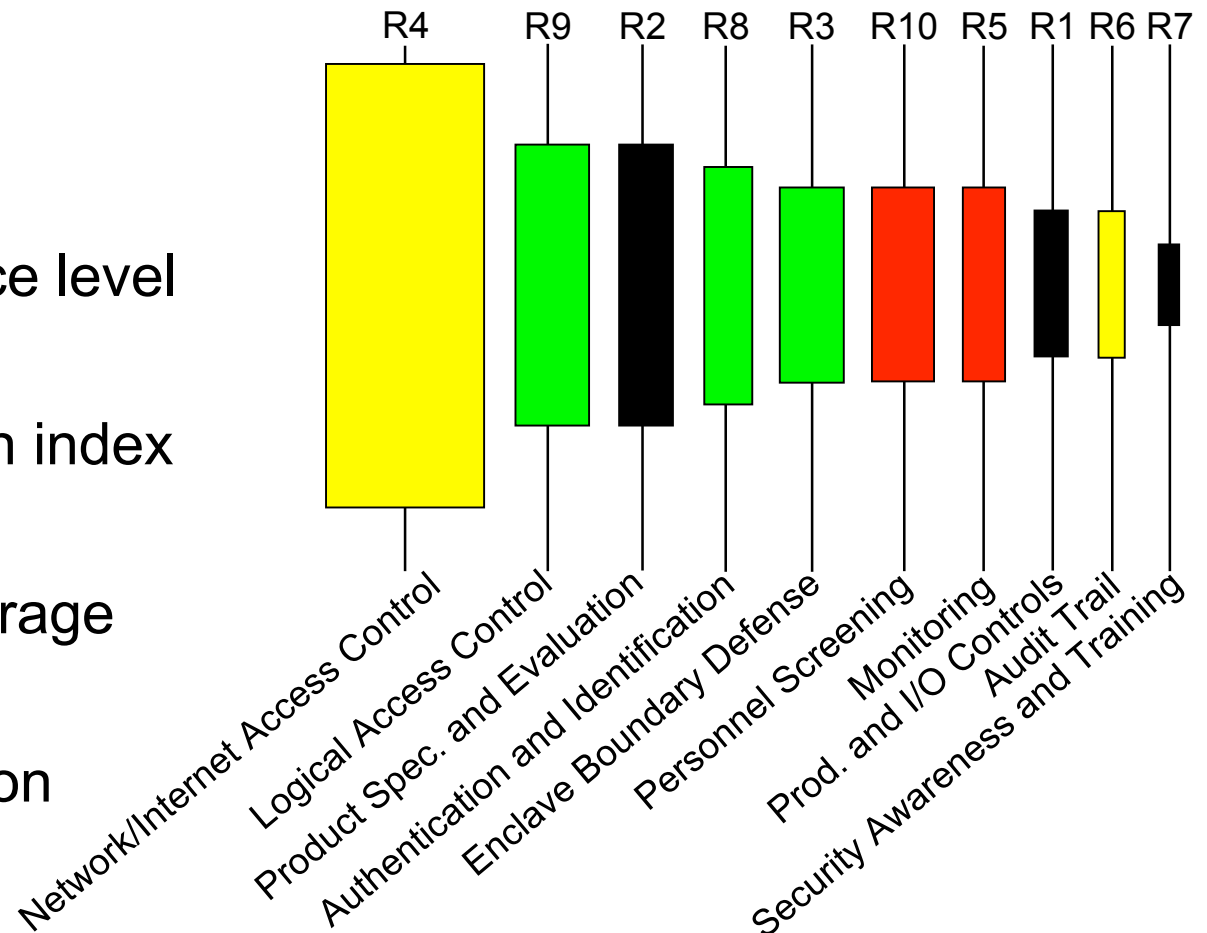
□ Width

- Risk Coverage

□ Order

- Prioritization

Risk: The **Threat** of *Unauthorized Activities* to the **Assets** of *Enclave* within *DoD/DoN Information System*



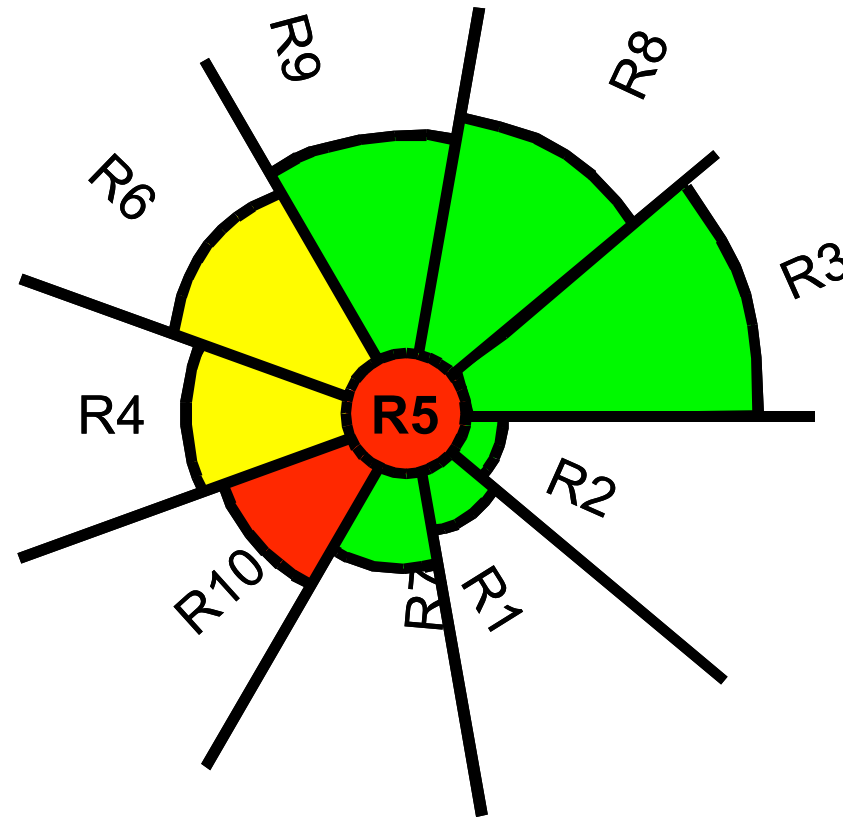
■ The Cohesive Arc Graph

Color

■ Compliance Level

□ Arc Radius

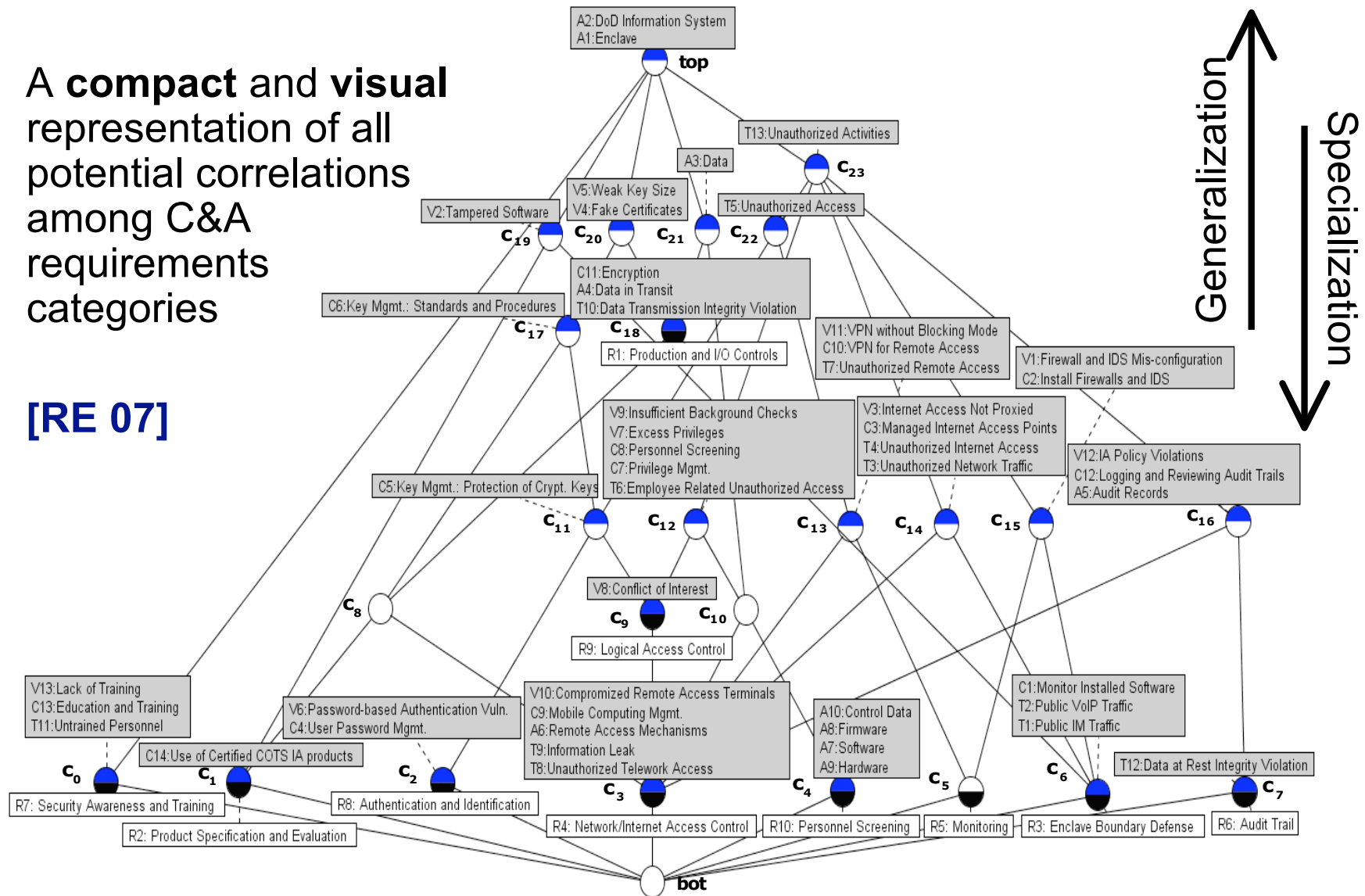
- Requirement Influence Factor



Computing the Visual Metaphors

A **compact** and **visual** representation of all potential correlations among C&A requirements categories

[RE 07]



Age Group	Percentage
18-24	10%
25-34	20%
35-44	30%
45-54	40%
55-64	50%
65-74	60%
75-84	70%
85+	80%



C5:1

✓ V6: Password-based
✓ C4: User Password M

S IA products

R8: Authent

and Evaluation



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Poster Explanation.....

Evaluations....

- The visual metaphors were evaluated as part of a larger case study with C&A experts

“The bar graph is great!”

“Easier for people to look at the visual representations rather than textual reports”

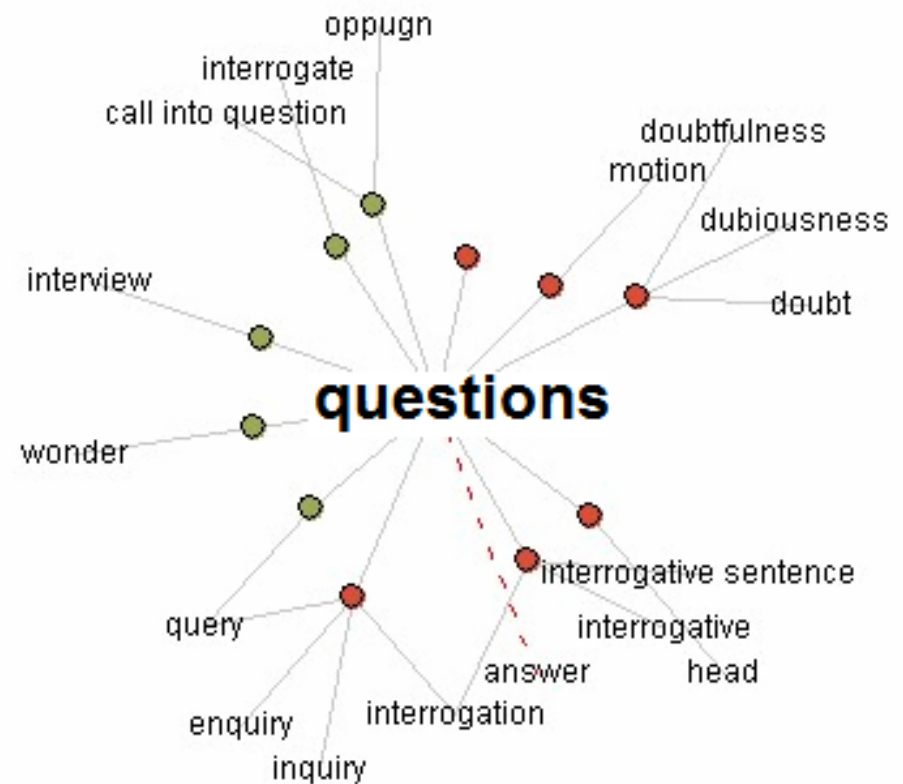
“Limit the chart [non-compliance impact analysis] to the node that is only 1 or 2 concepts above the requirement in question”

Critical Analysis

- In the presence of many requirements (at a high level of abstraction) the intuitiveness of the bar graph is reduced
 - Bite smaller chunks to eat the elephant
- Metaphors are computed based on the concept lattice, the domain ontology, and compliance levels
 - More interaction/input from the certification analyst
- Metaphors only use discrete levels for colors
 - Continuous scales carry rich information
 - Gradients, Overlaps, etc.,

Related, Ongoing and Future Work

- Requirements visualization for the C&A Process and corresponding risk assessment is ripe with opportunities
 - Understanding and analyzing C&A requirements
 - Compliance Management [\[Bellamy\]](#)
 - Understanding cost-effective solution spaces [\[Feather\]](#)
- Extending and Improving the usability of tool support [\[Research Demo/Poster RE 07\]](#)
 - Immersive and explorative requirements visualizations in a large information space
- Visualize static and dynamic aspects of system behavior



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