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Systems Security Engineering

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Security Systems Thinking

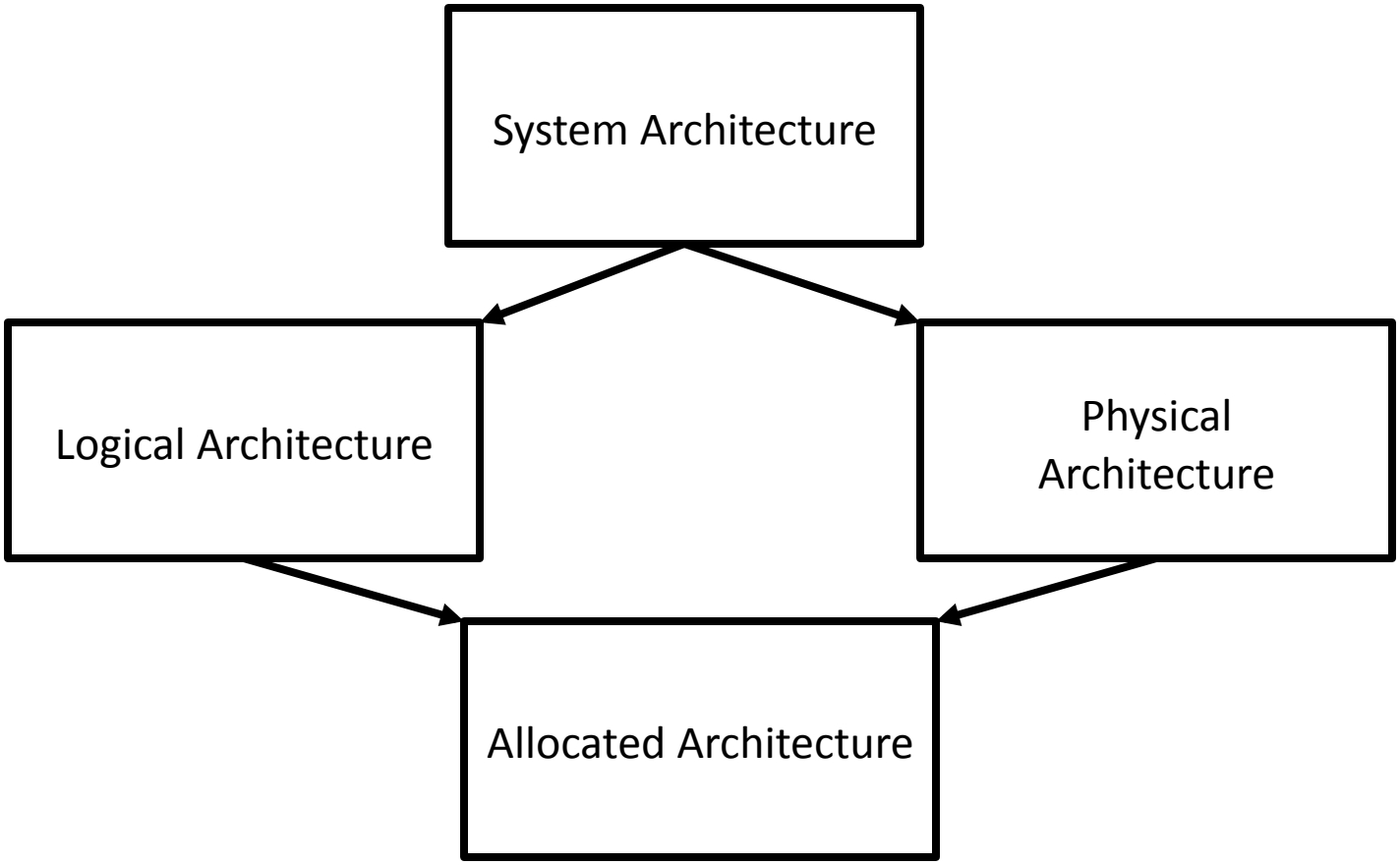
Source: J. Boardman and B. Sauser, *Systems thinking: Coping with 21st century problems, Taylor & Francis, 2008.*

Advantages of the Engineering Approach

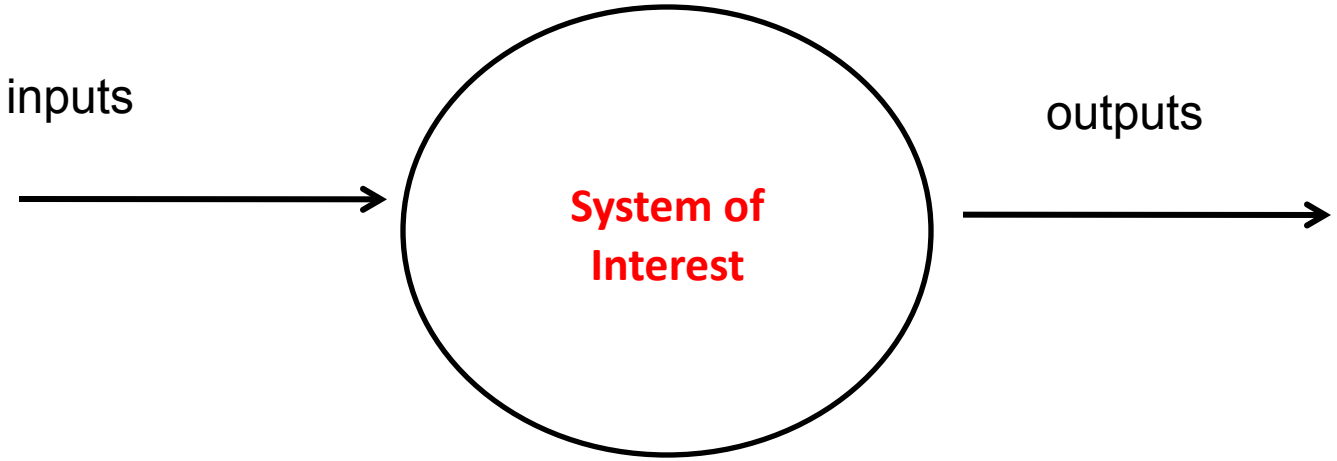
1. Manage Complexity
2. Top-down requirements tracing
3. Black box modeling
4. Logical flow analysis
5. Documentation
6. Peer Review
7. Detailed Communication

Adapted from: J. Sherwood, A. Clark and D. Lynas, Enterprise security architecture, CMP Books, 2005.

Systems Concepts



Systems Engineering



System Engineering Requirements Breakdown

1. **Functional**

2. **Interface**

3. **System-wide – "ilities"**

Systems security engineering required to know when it should be placed here.

Security vulnerabilities are frequently introduced here.

Systems engineering literature traditionally places security here.

Source: Buede, *The engineering design of systems, models and methods, Wiley, 2009*

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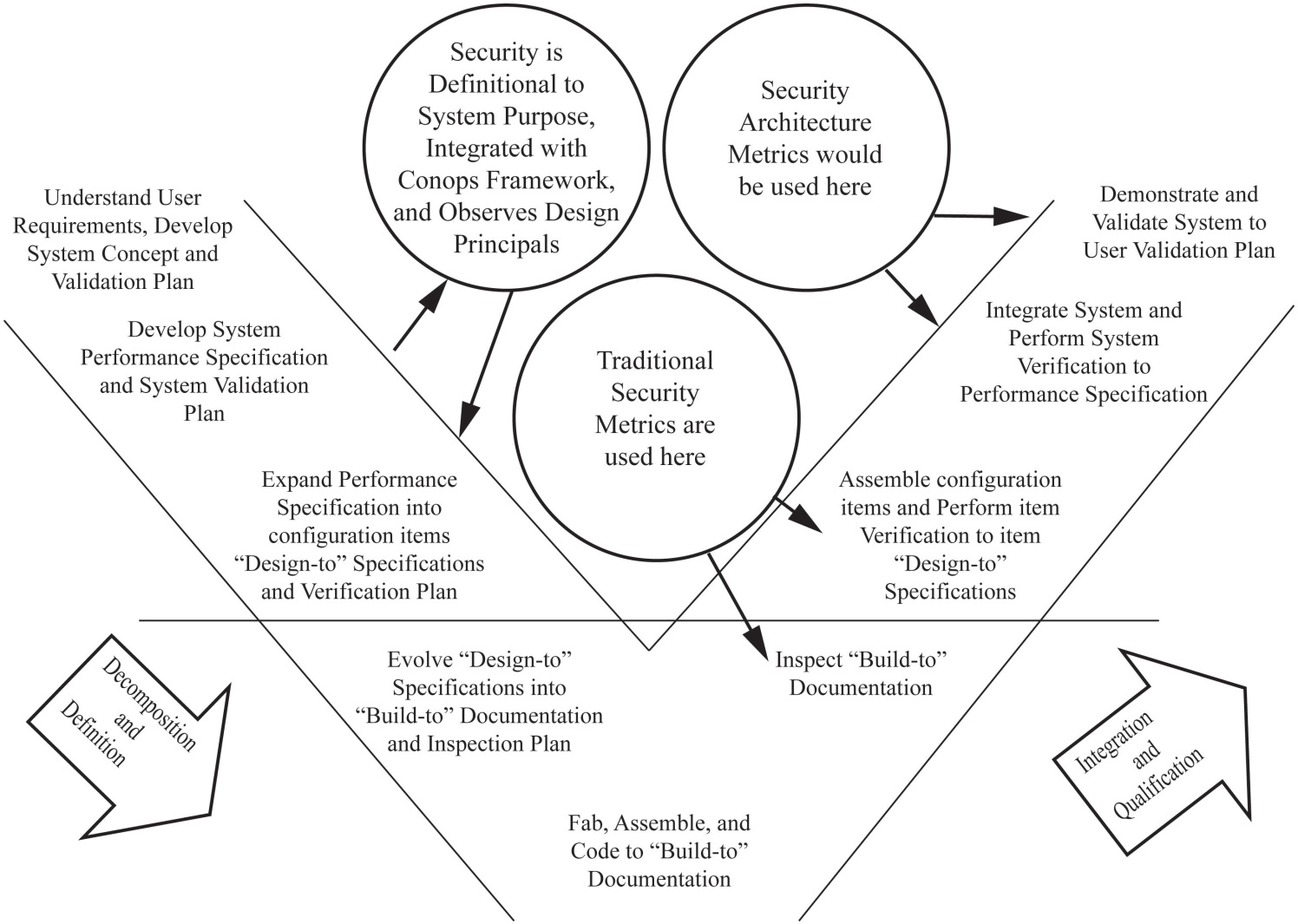
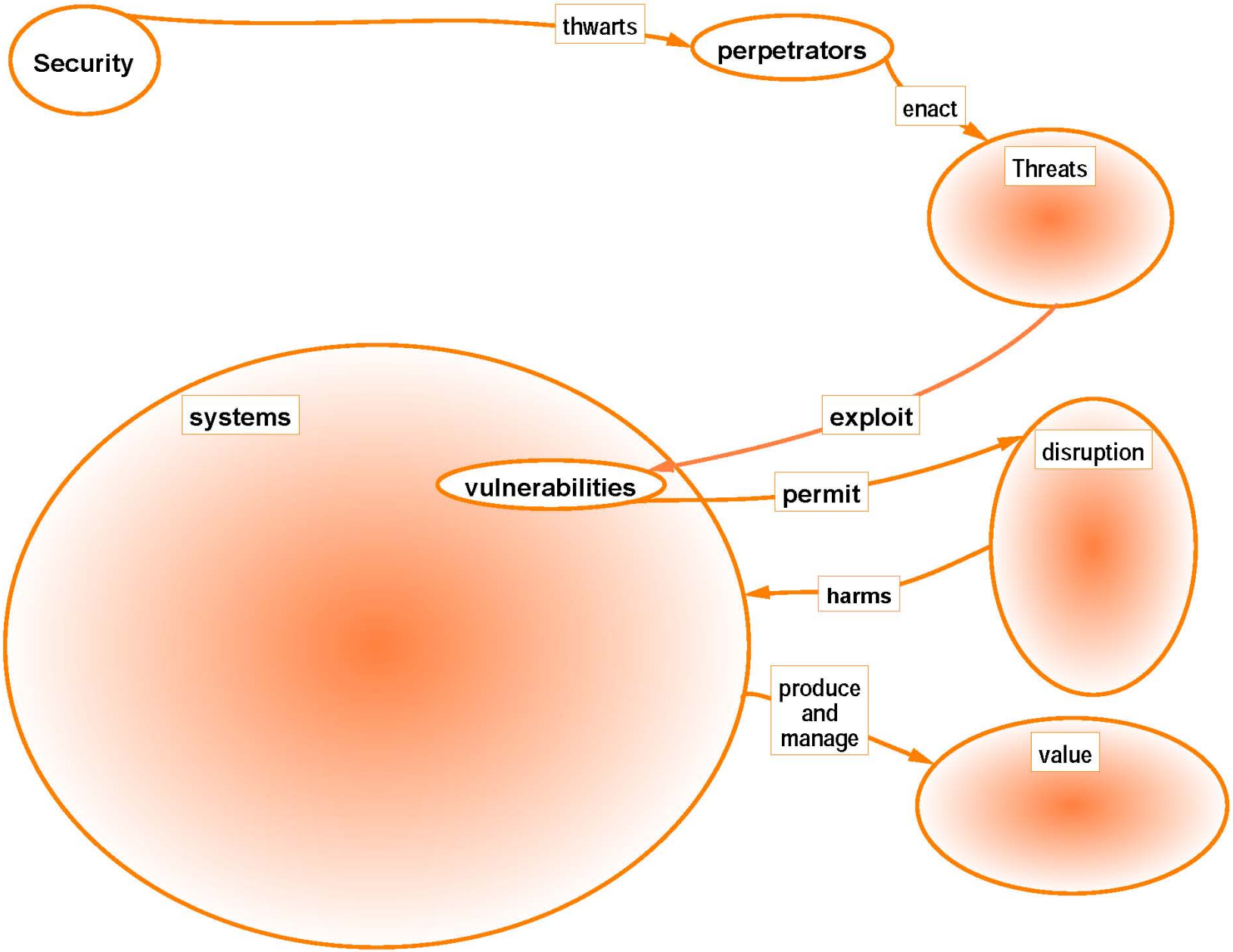
The Vee Model



Source: Based on Buede and, Bayuk and Horowitz, An Architectural Systems Engineering Methodology for Addressing Cyber Security, Systems Engineering, 2011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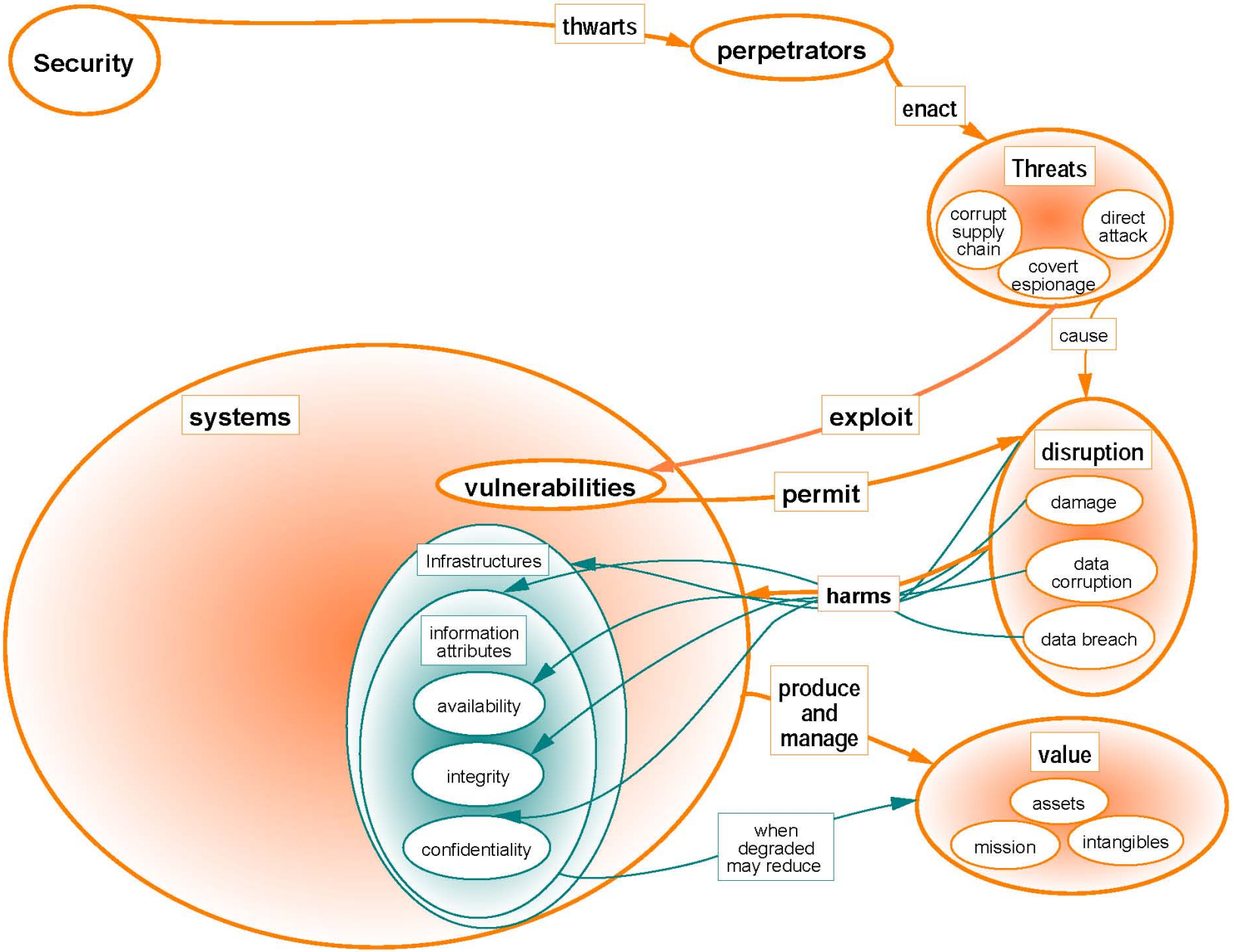
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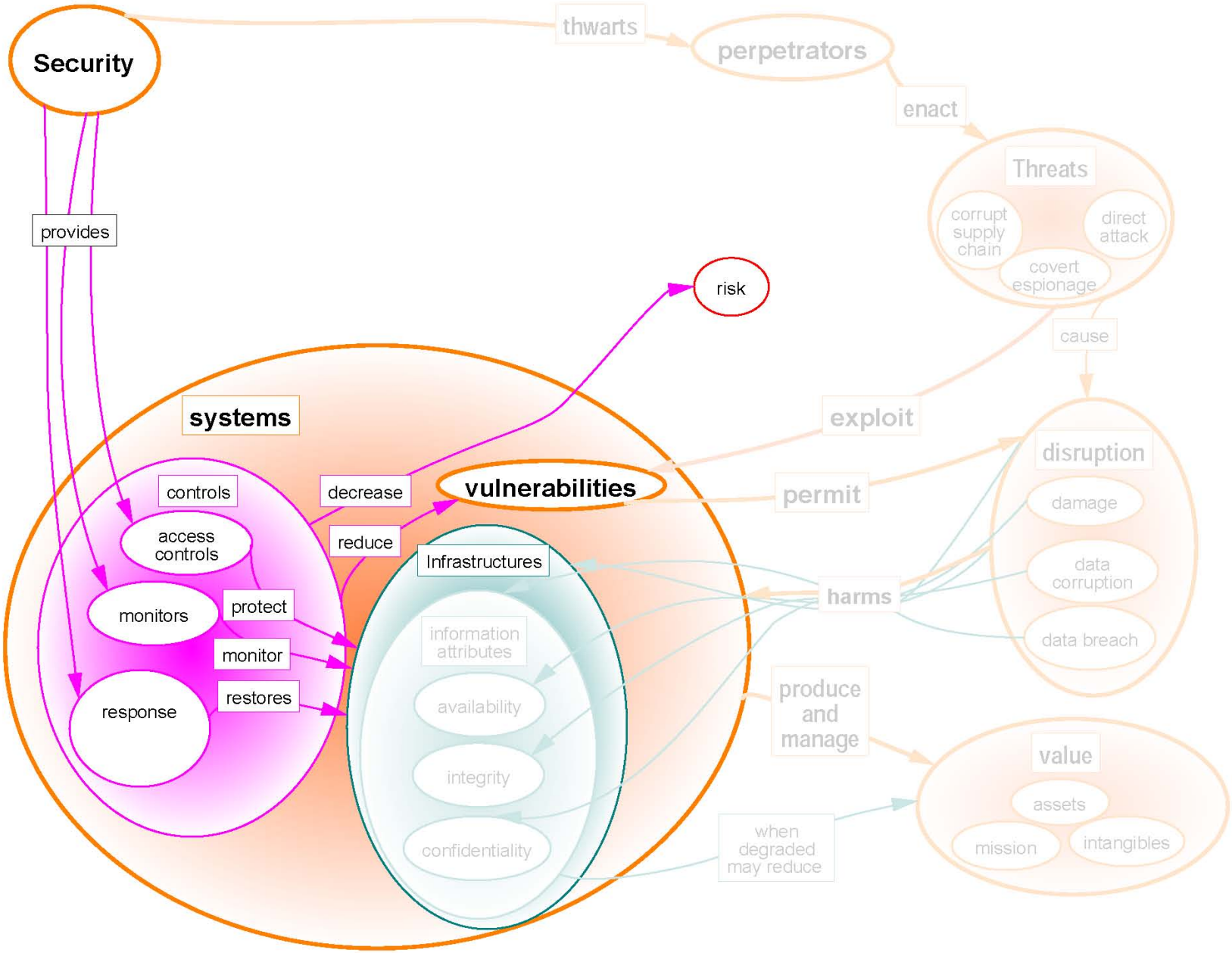
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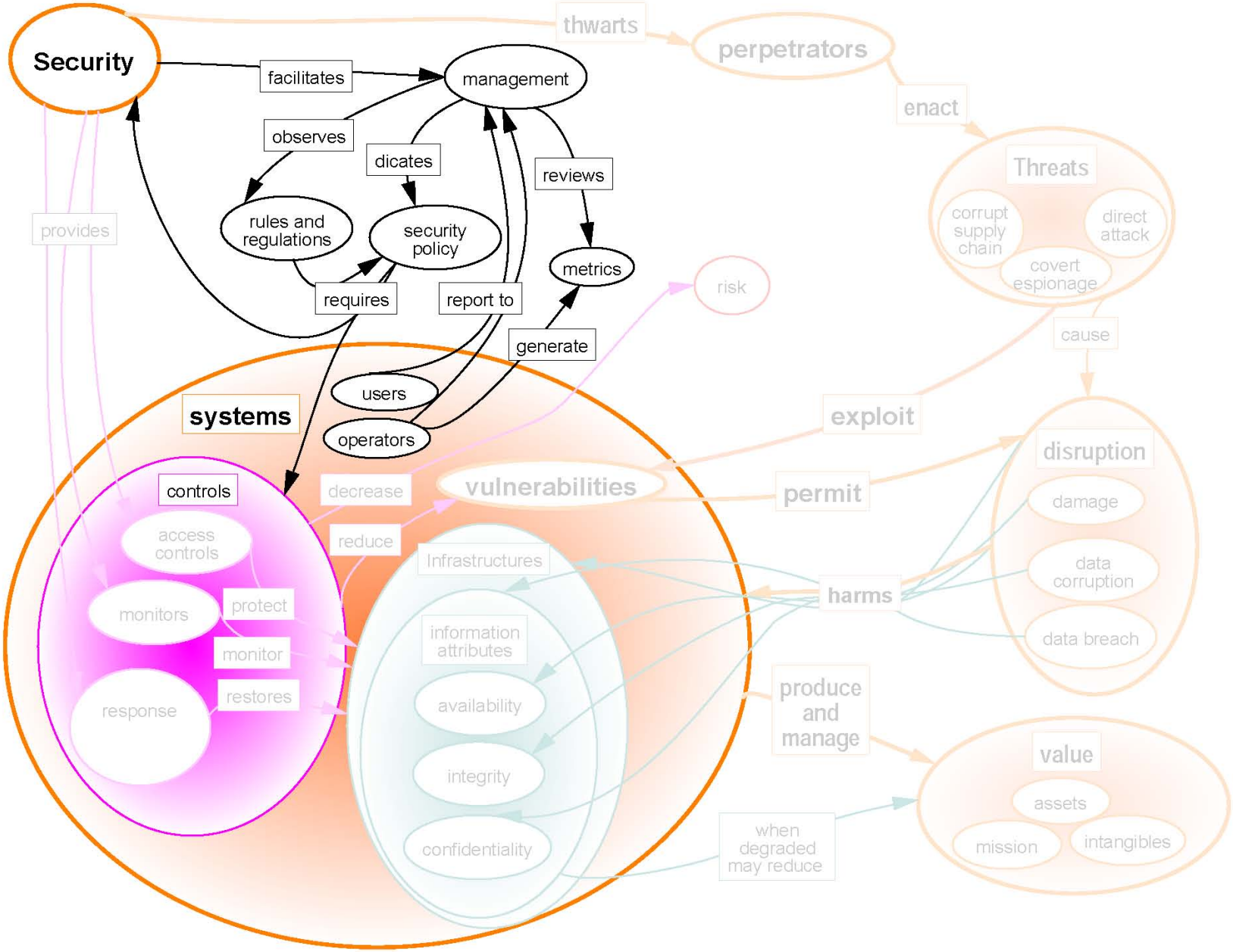
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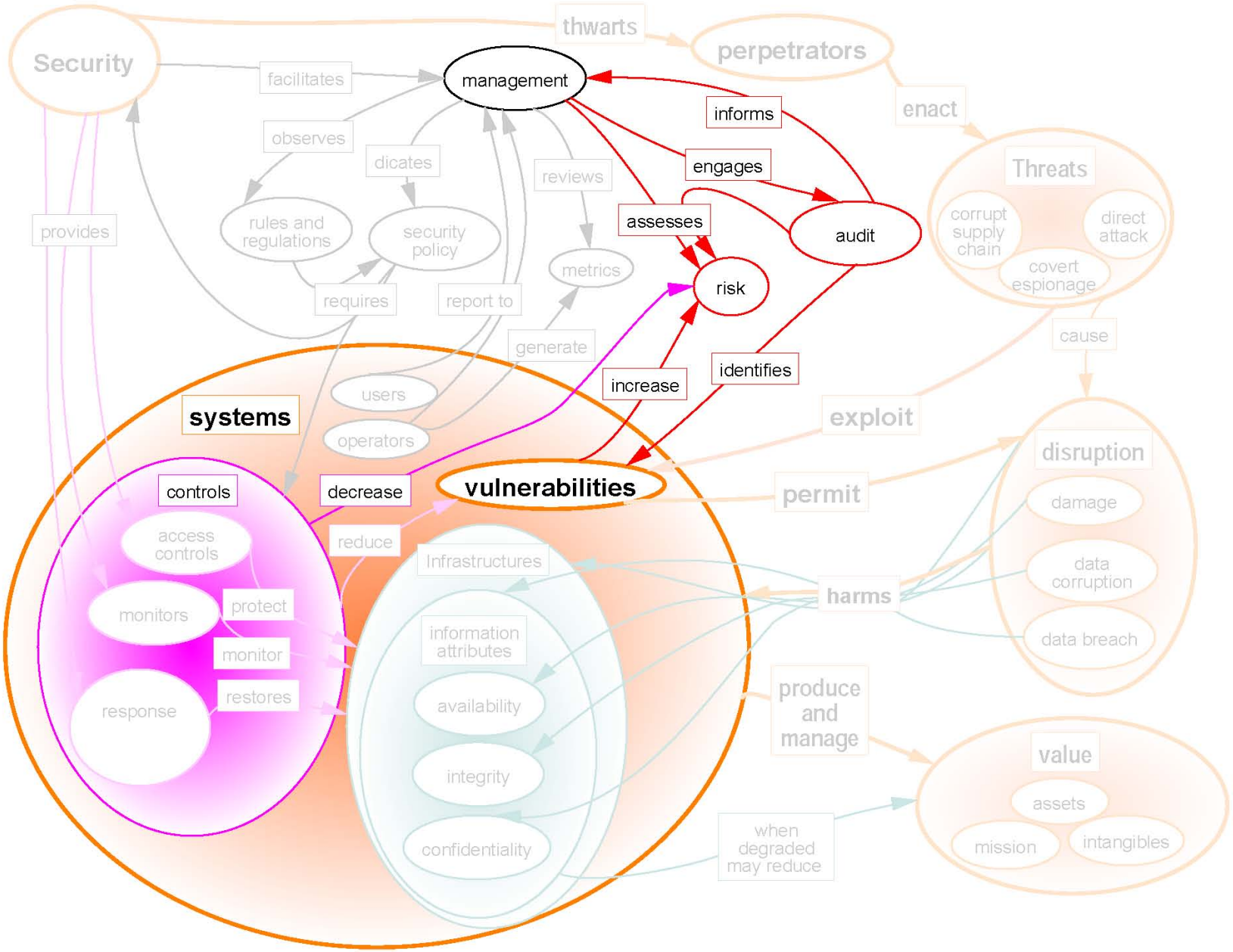
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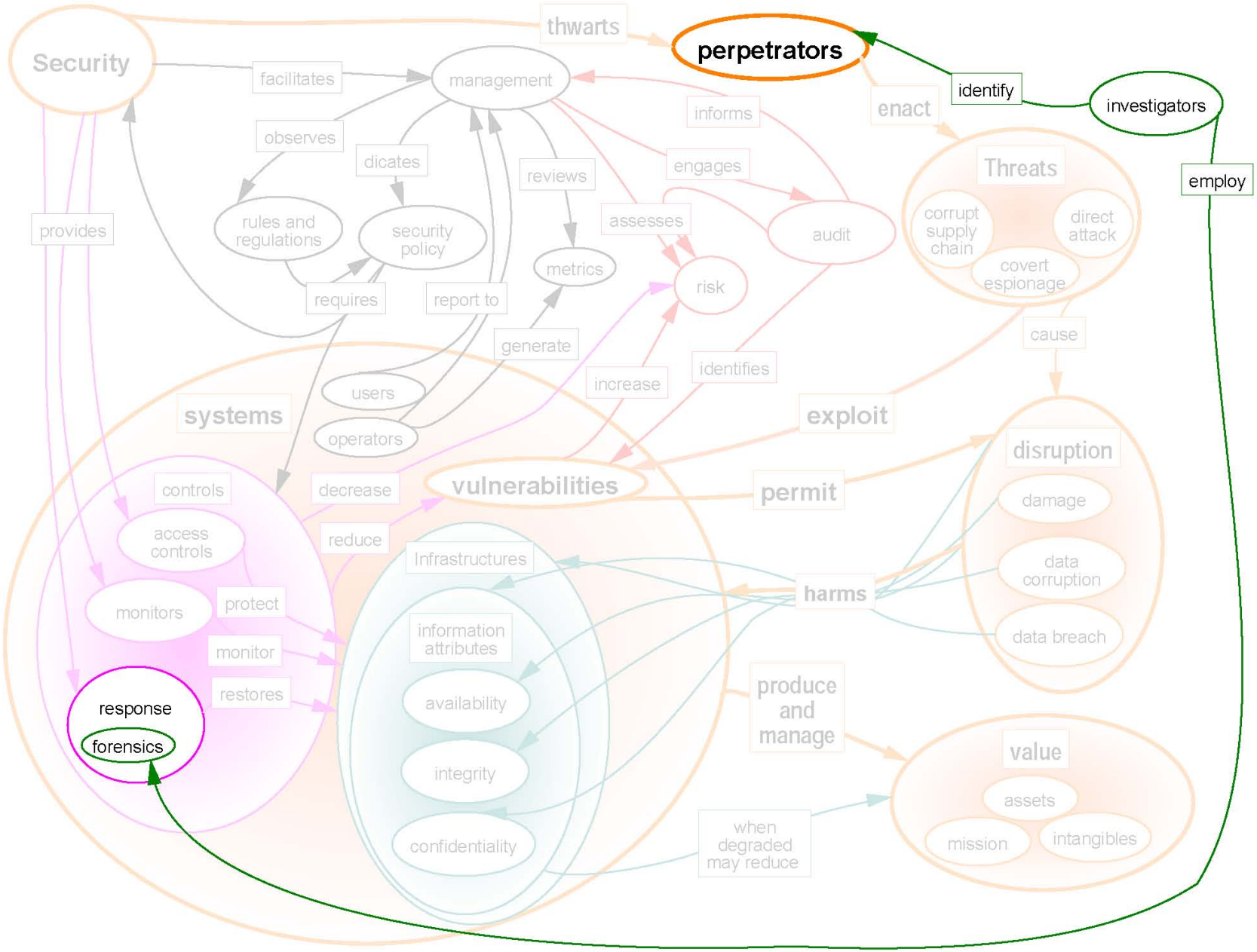
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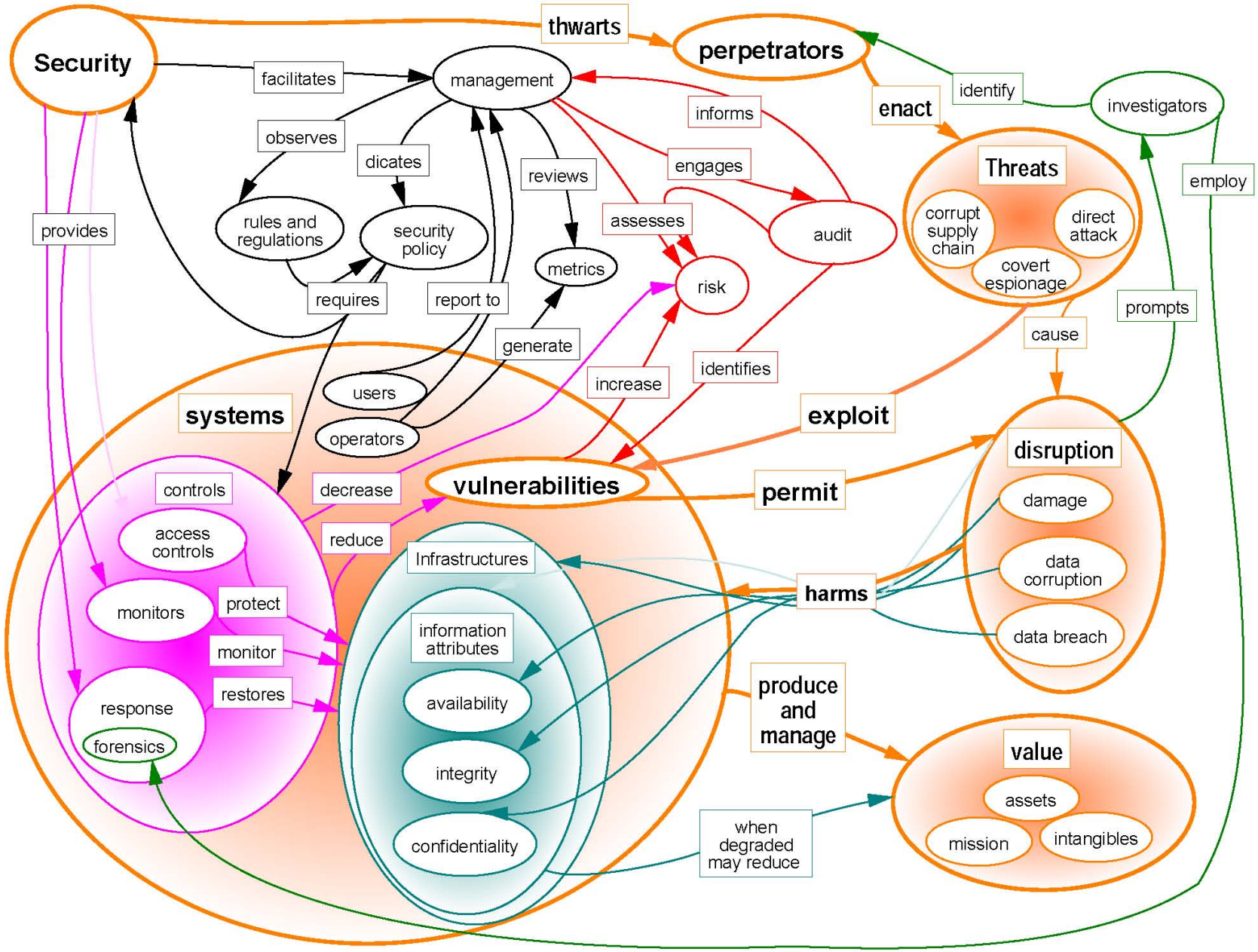
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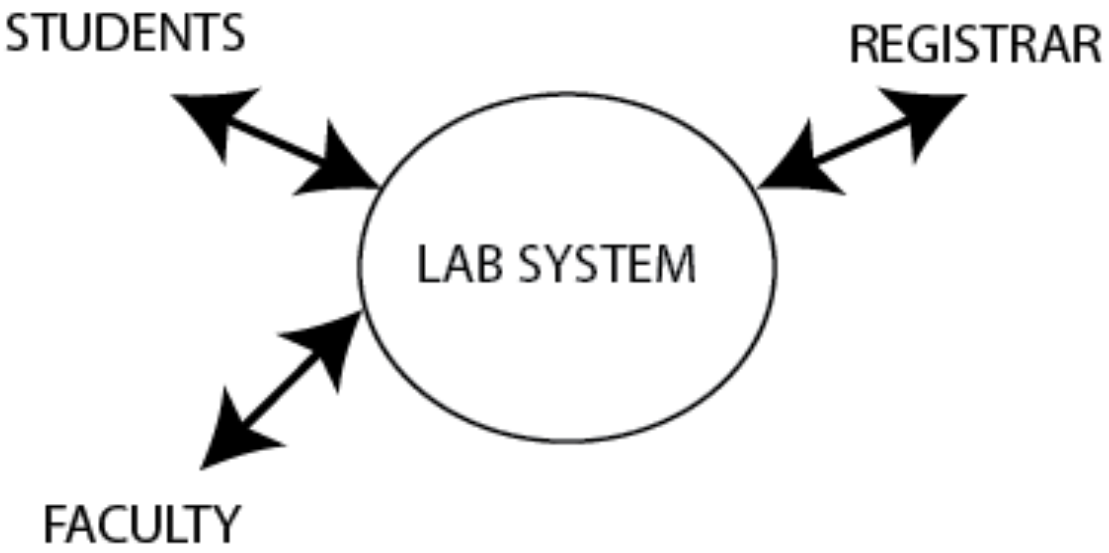
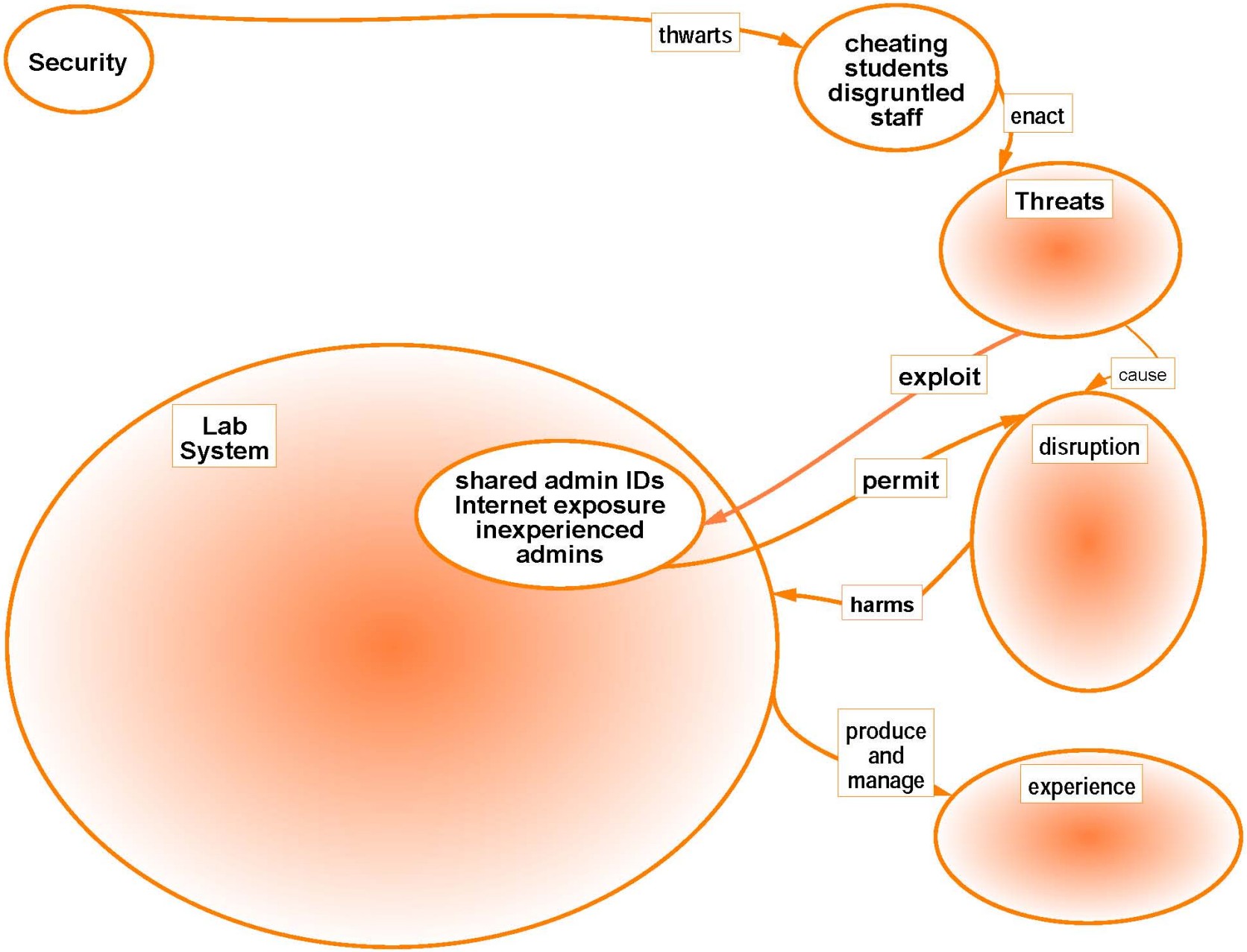
Example



Source: Bayuk, SSE Lab Architecture Definition, 2010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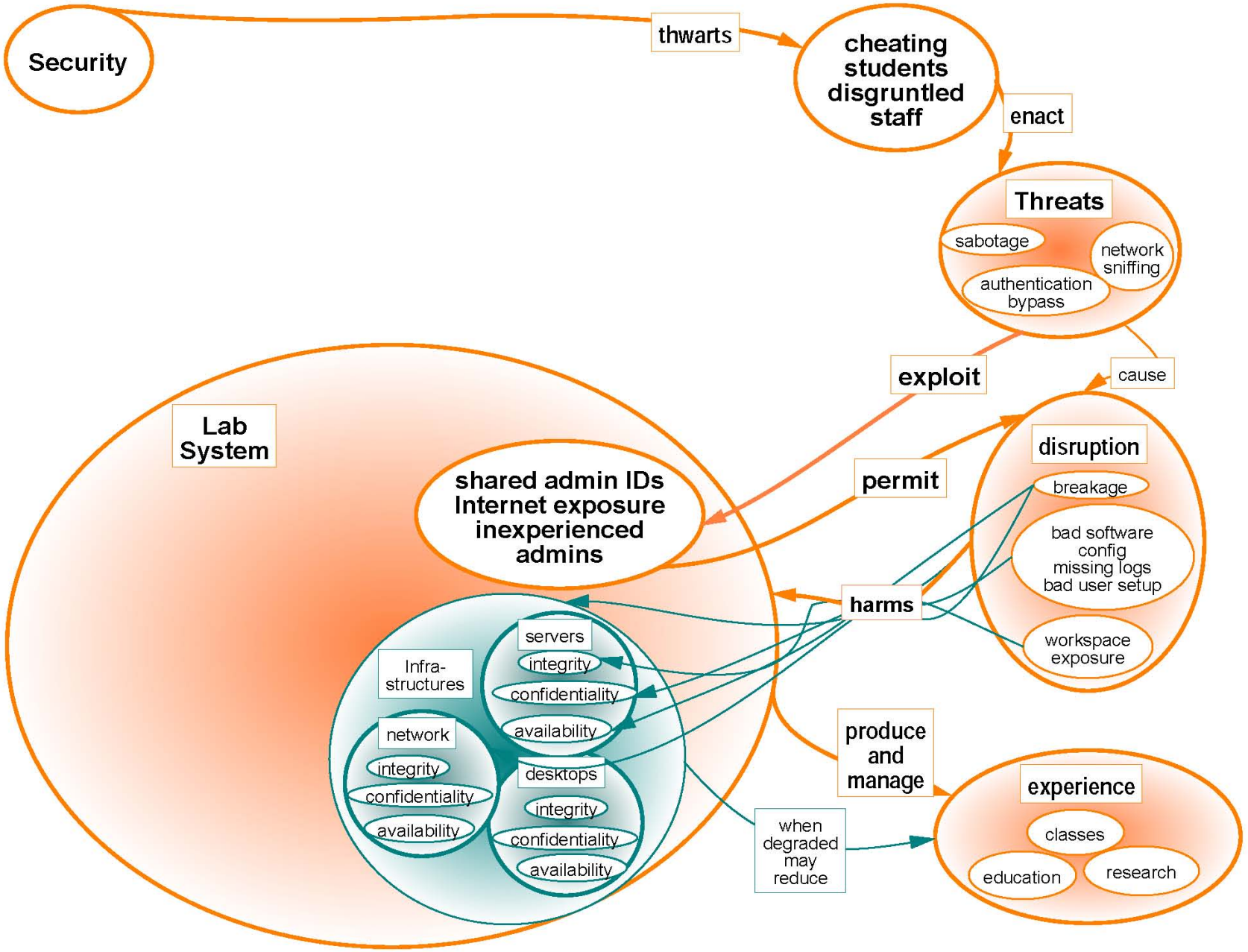
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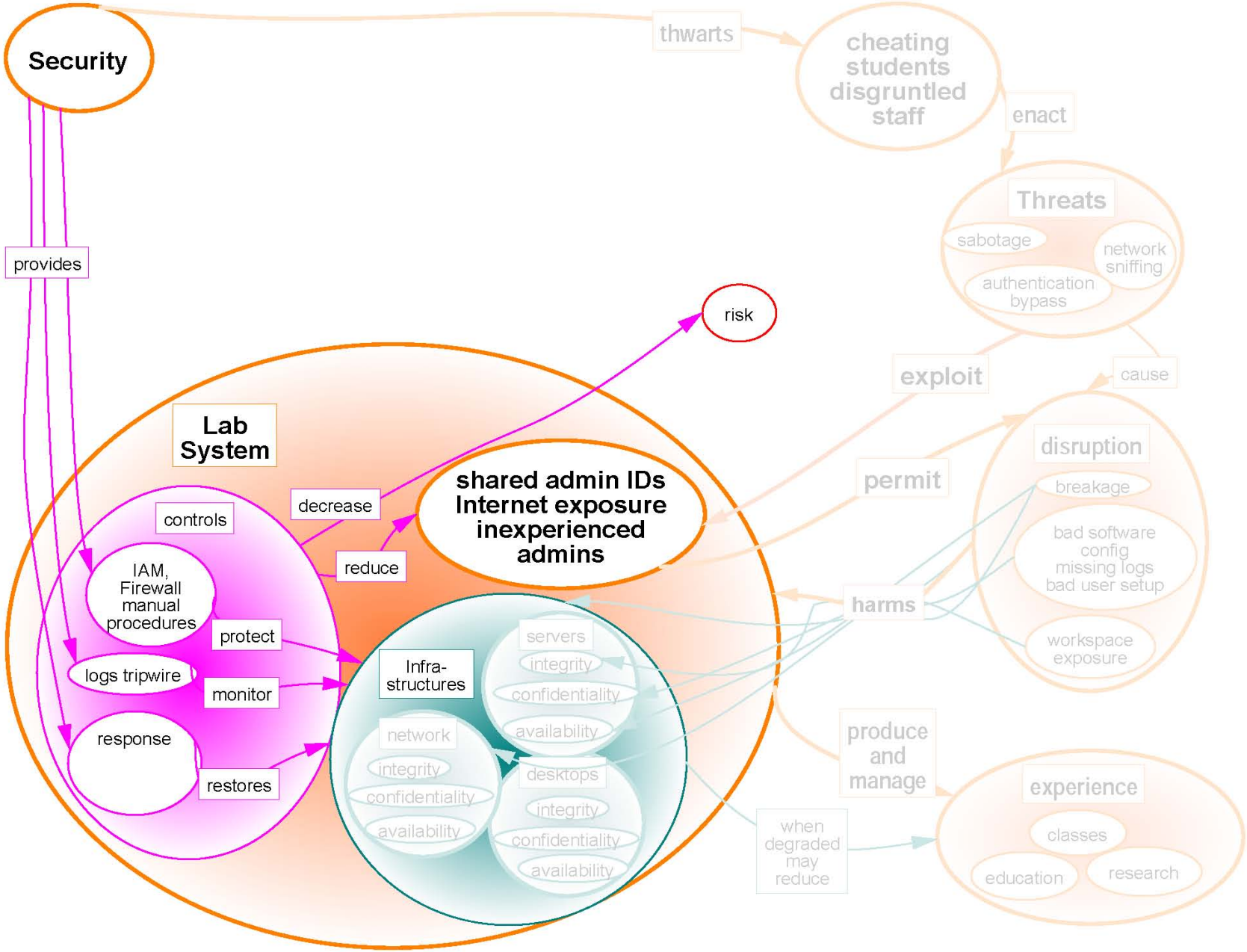
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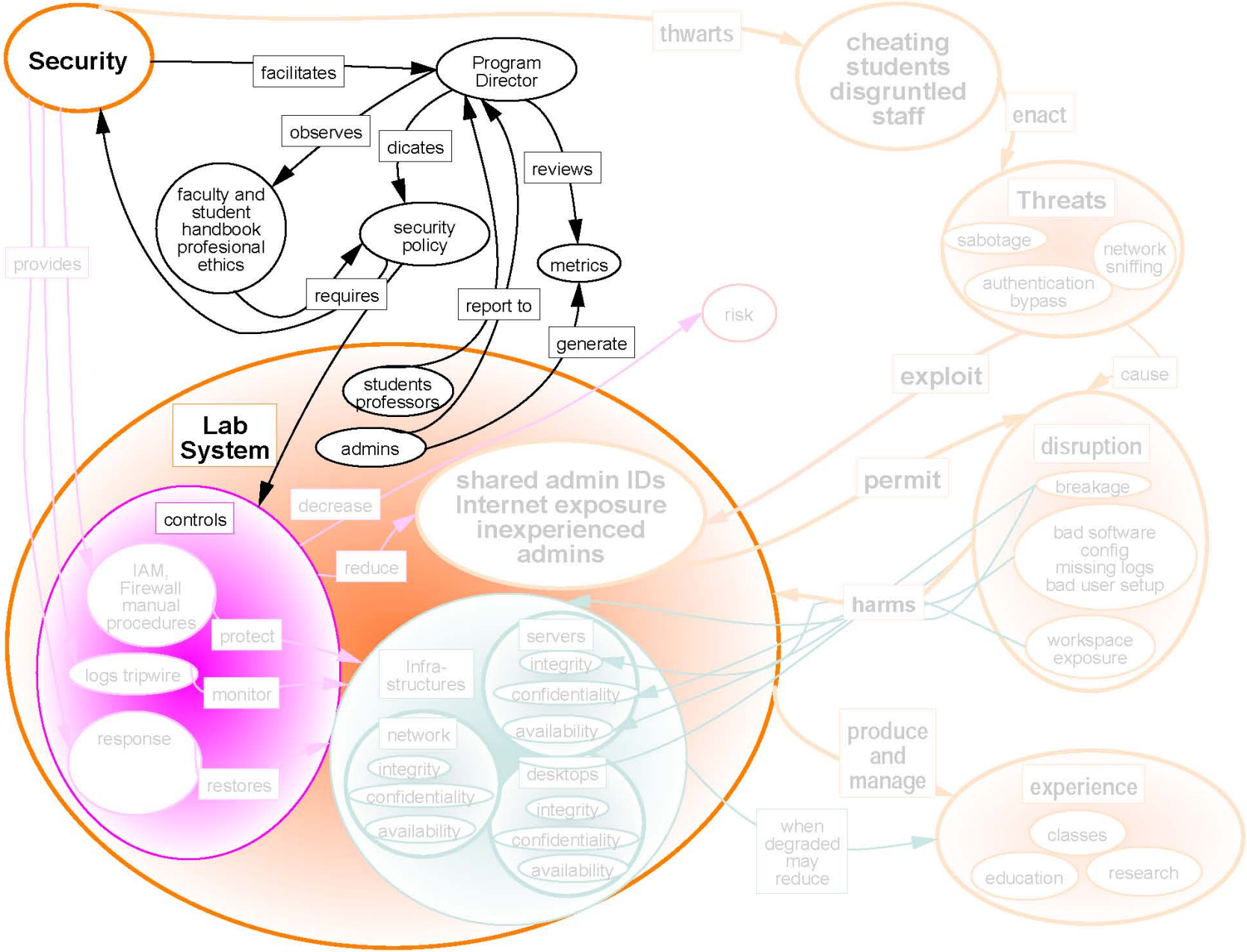
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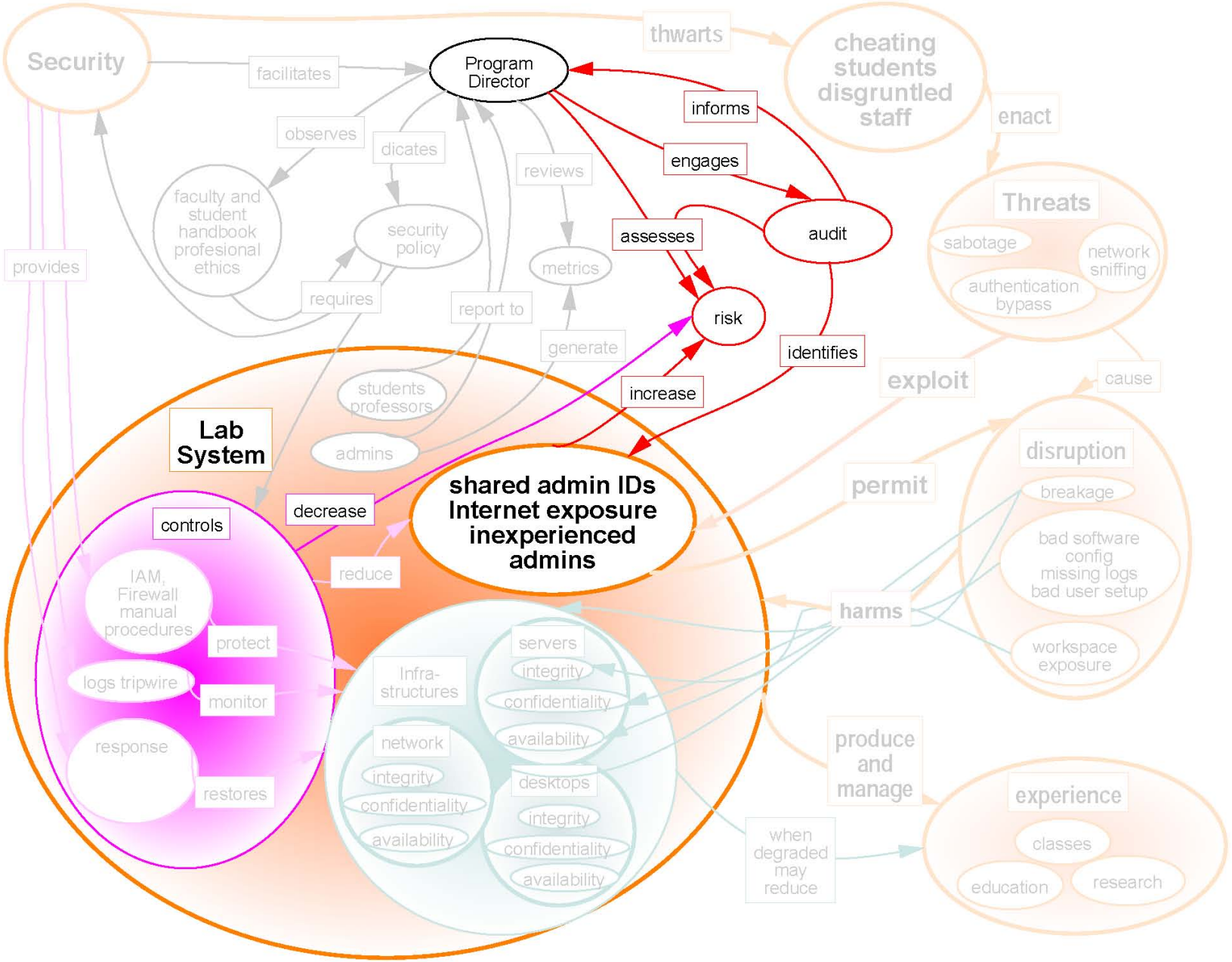
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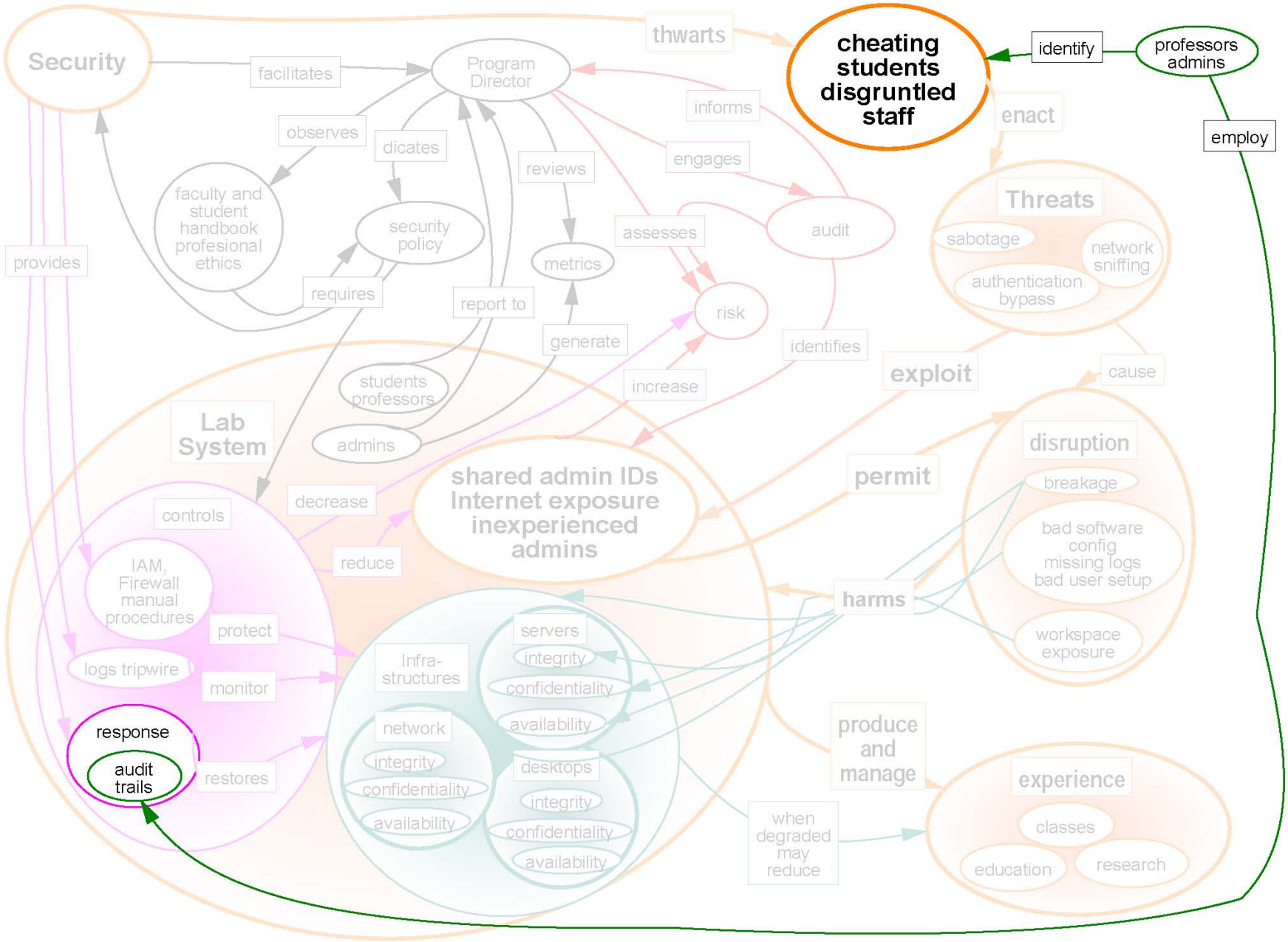
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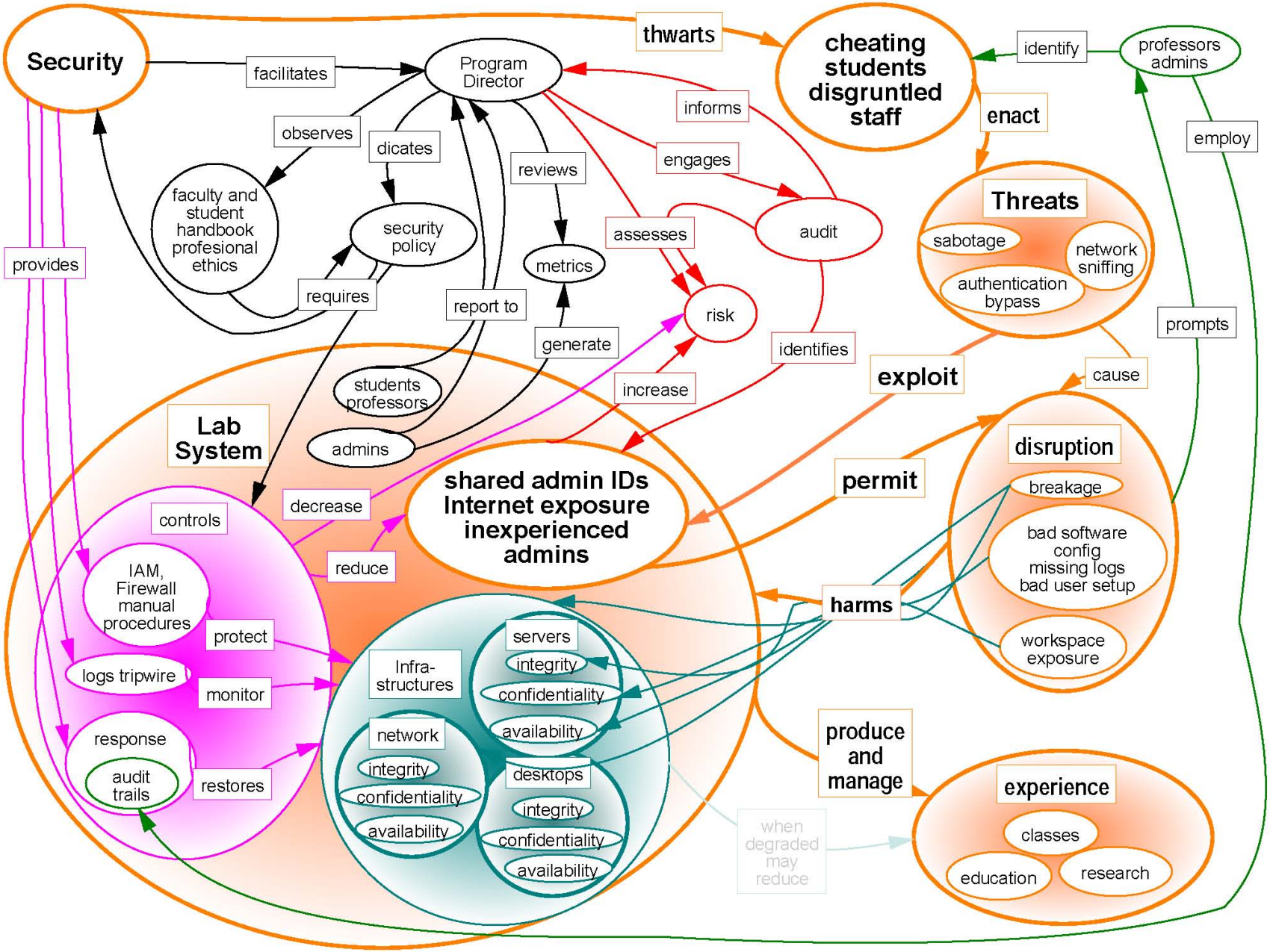
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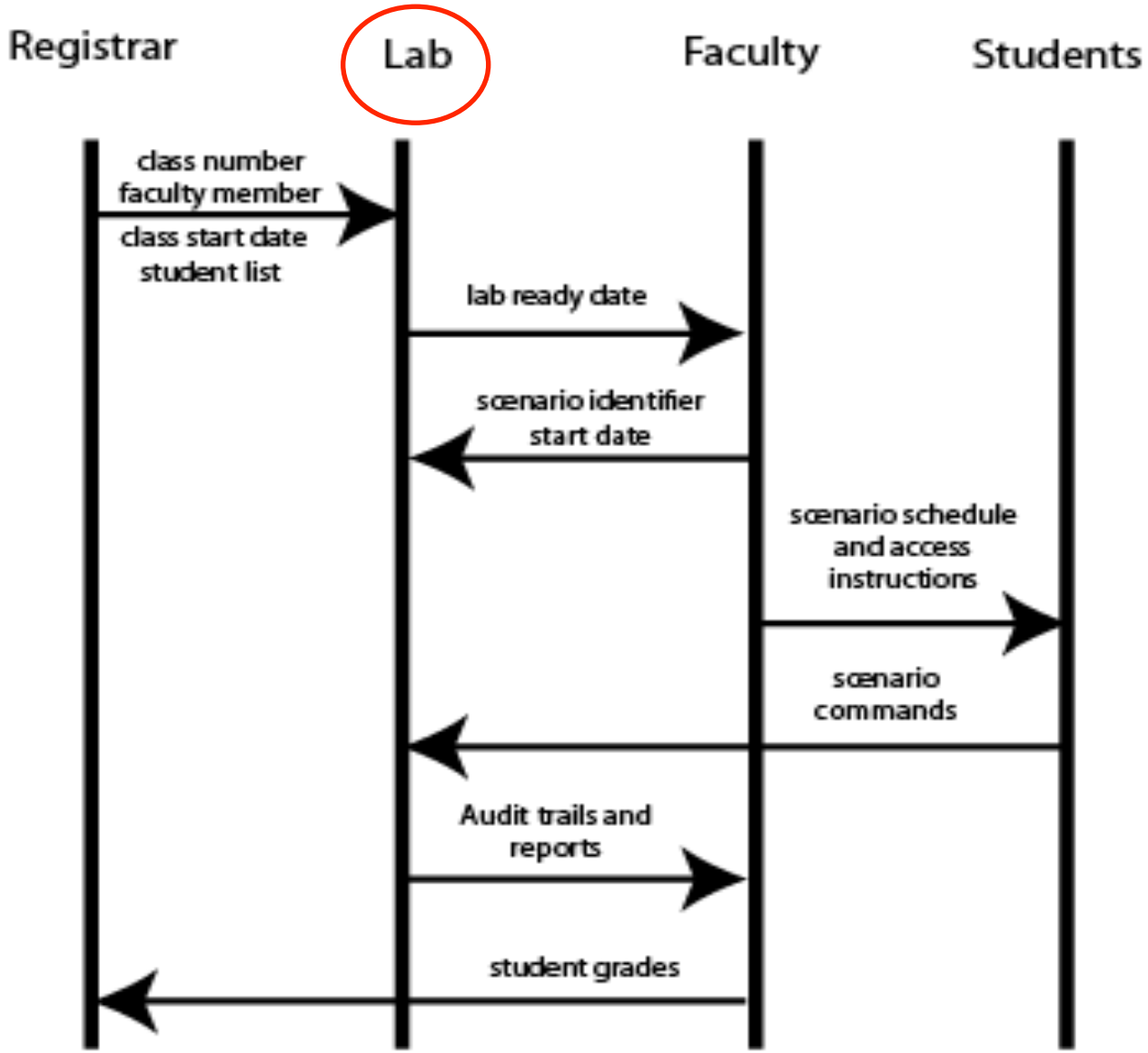
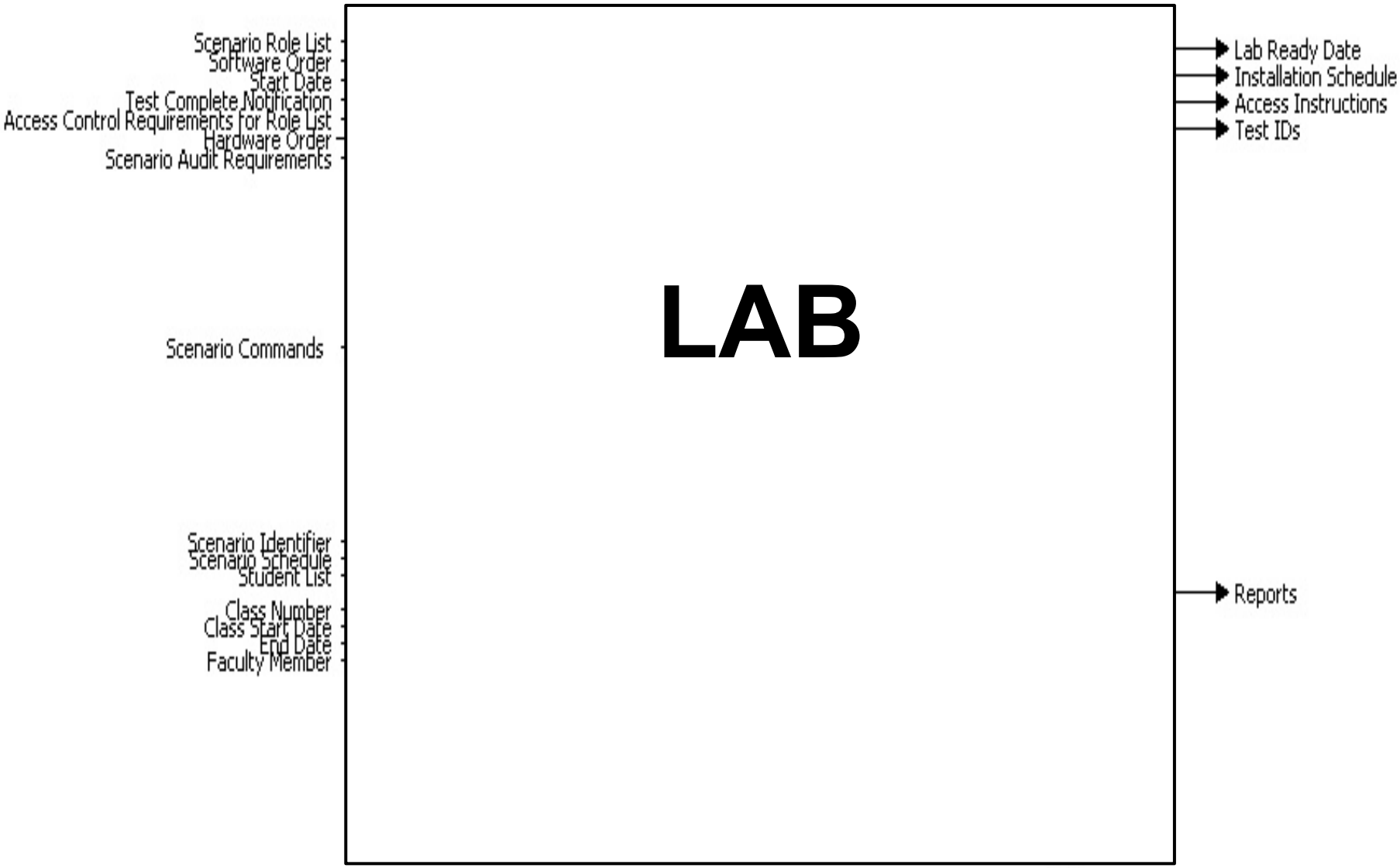
Requirements Gathering Example



Source: Bayuk, SSE Lab Architecture Definition, 2010

Input and Output Requirements



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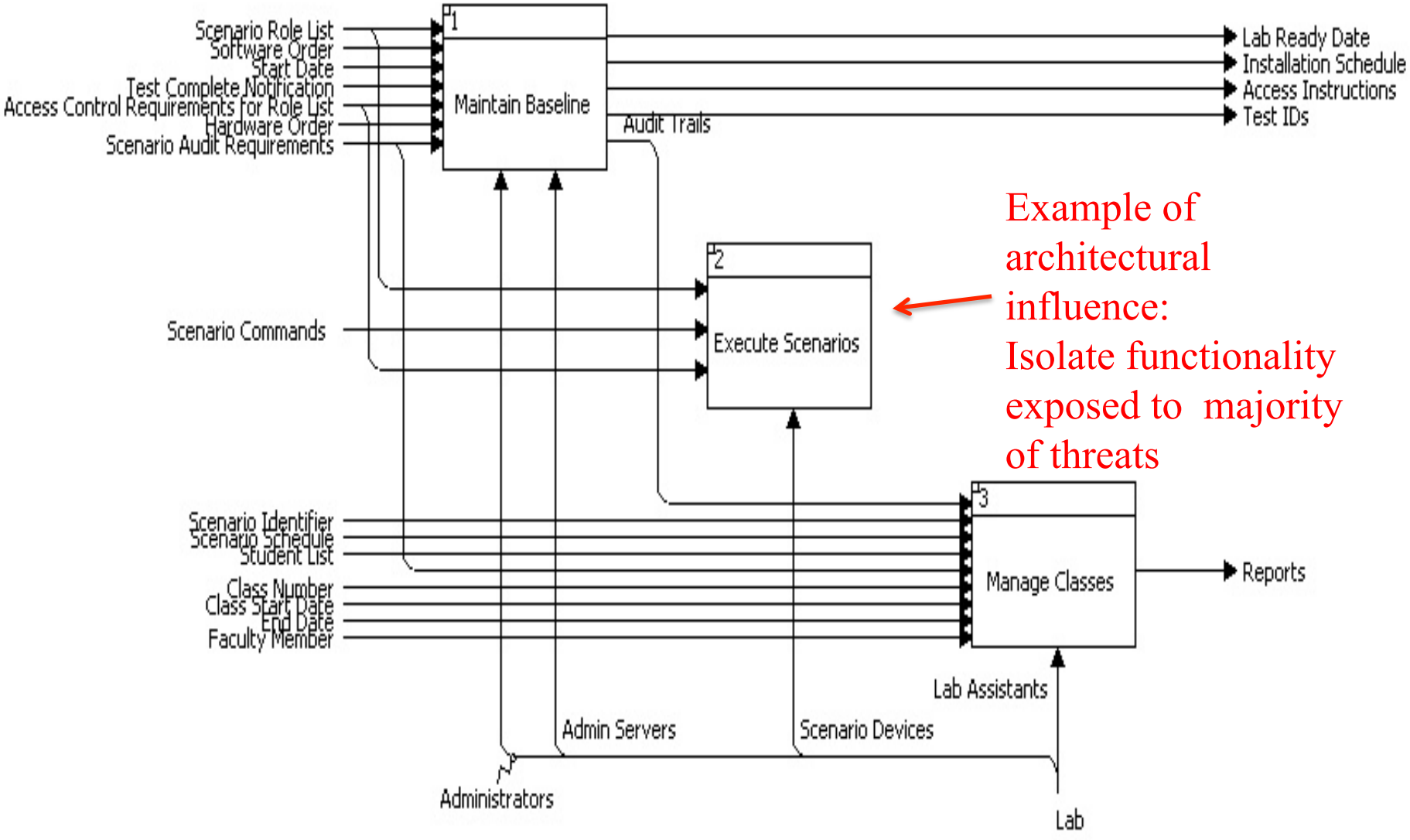
Functional Decomposition



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Security Metrics

V and V

- Verification – Did we build the system right?
- Validation – Was the right system built?

Also known as:

- Correctness – Do the security features work?
- Effectiveness – Is the system adequately secure?

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SERC Security Roadmap

Security:	**Something that thwarts perpetrators who enact threats that exploit system vulnerabilities to cause damage that adversely impacts system value.**
Security Feature:	**A system capability that contributes to its security.**
Security Metric:	**Measurement that characterizes an attribute of the system of interest that is proposed to have both face and construct validity in the context of a hypothesis that the system is secure.**
Security Framework:	**The concept of operations, mission, and environment under which a system operates.**

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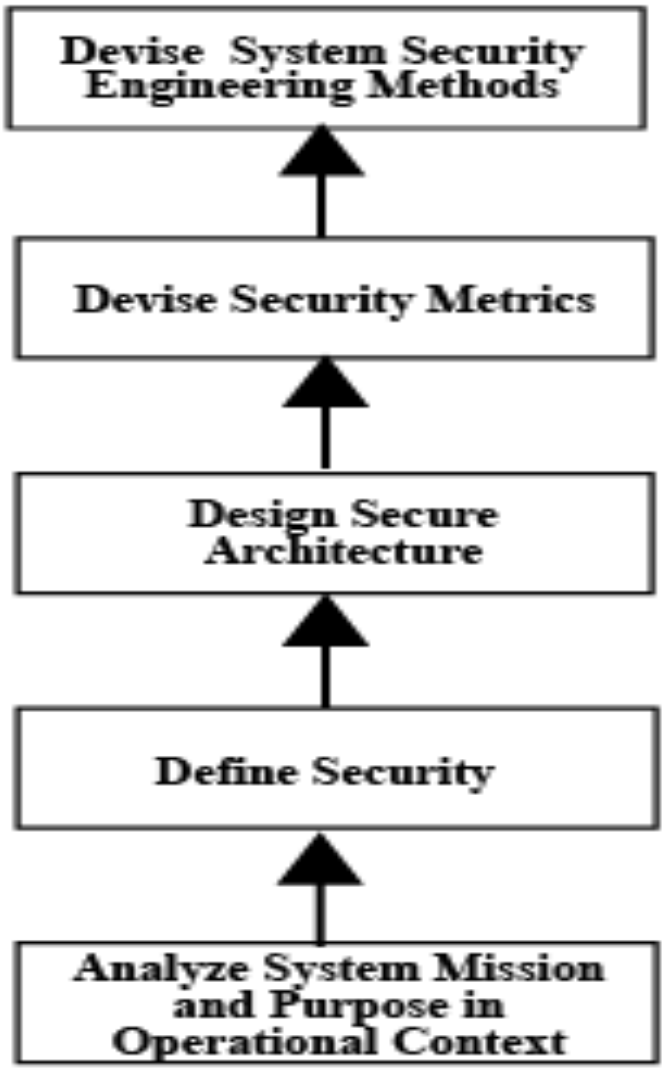
SERC Security Approach



Security Systems Engineering Community

- If each SERC member concentrated on one system of interest and could prove something provided more or less security in that context, then we could, in combination, demonstrate the utility of the systems engineering methodology.
- Though such an engineering approach may seem like practical application rather than research to some in our community, they may be overlooking the fact that security is not at all well understood, and so any serious investigation of its properties constitutes a research endeavor.