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## **Law System Use Case Modeling**

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Dr. Raymond Madachy  
Naval Postgraduate School  
Dept. of Systems Engineering

[rjmadach@nps.edu](mailto:rjmadach@nps.edu)



# Overview

- Use case modeling is predominant in systems and software engineering to help define system boundaries, external actors, stakeholder goals and the scenarios that achieve them.
- Use cases serve as structured requirements, a basis for system development and testing (often called “use case driven” development).
- Since law systems are also human-engineered systems, the same methods are applied to help gain insight into the law development process to help improve it. However, there are contrasts from traditional systems composed of software, hardware, people, facilities, etc.
- This research also investigates the degree to which use case modeling is applicable to specifying and analyzing law systems, and how to best adapt the modeling methods.



# Acknowledgments

- This work is performed with the INCOSE Systems Engineering and Lawmaking (SELAW) Working Group.



# Definitions

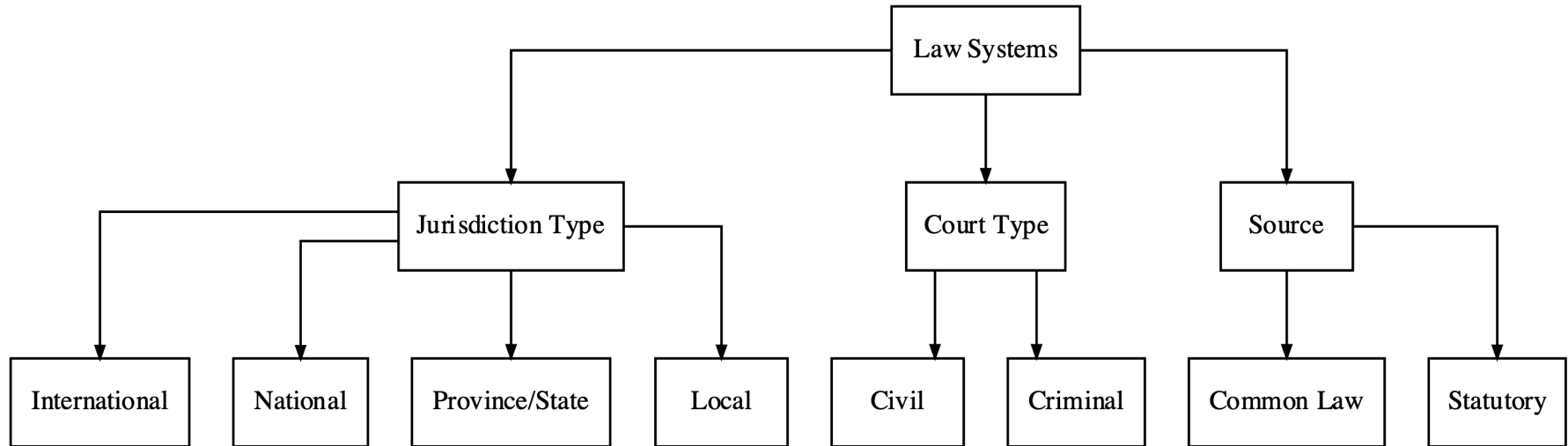
- System:
  - A combination of interacting elements organized to achieve one or more stated purposes (ISO/IEC/IEEE 2015)
  - An arrangement of parts or elements that together exhibit behavior or meaning that the individual constituents do not. (INCOSE Fellows, 2019)
- Elements may include hardware, software, firmware, people, information, techniques, facilities, services, related natural artifacts and other support elements.
  - This applies to engineered systems that are created with a purpose to provide value to one or more beneficiaries.
- The system's properties as a whole result from the parts or elements and their individual properties, and the relationships and interactions between and among the parts, the system and its environment.

Q. Do law systems qualify as human-engineered systems?

\* Source: [https://www.sebokwiki.org/wiki/System\\_\(glossary\)](https://www.sebokwiki.org/wiki/System_(glossary))



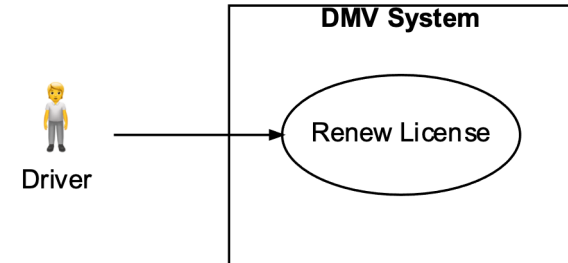
# Law System Types





# Use Cases

- A formal way of representing how a system interacts with its environment
  - A sequence of actions a system performs that yields a valuable result for a particular actor
- Communicates at a high level what the system needs to do
- Used to document or improve a current system, or develop a new system
- Illustrates the activities that are performed by the users and other actors of the system
- A scenario-based technique from UML incorporated into SysML
- Use cases are initiated by outside actors and not the system itself



## Goal

Driver receives renewed license

## Scenario

1. Driver makes appointment with DMV
2. DMV confirms appointment
3. Driver enters DMV
4. DMV processes paperwork and provides renewed license



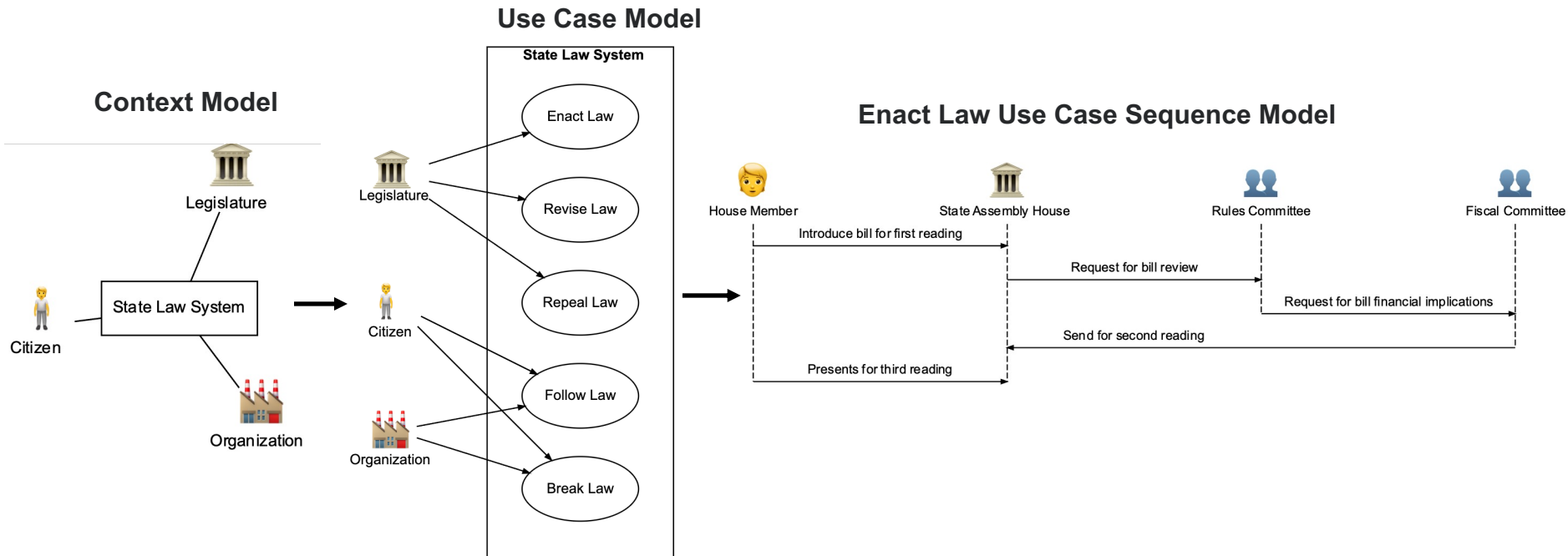
# System Modeling Thread with Use Cases

- Iterative system modeling begins with high-level context models identifying a system-of-interest and outside actors.
  - Succinct definition of the bounded system
  - Actors transfer data with the system
- Use case models decompose the system into functional use cases associated with the actors.
- Detailed use cases include scenarios between system and actors that can be transformed into sequence models and activity models of the processing.
- Sequence models may decompose the internal system elements elaborating a design and implementation.
- Decomposition leads to iteration and refinement of the top models.



# Example State Law System Decomposition

**State Law System:** A state's written laws, underlying lawmaking processes, organizations, subsystems\*, and people enacting them.



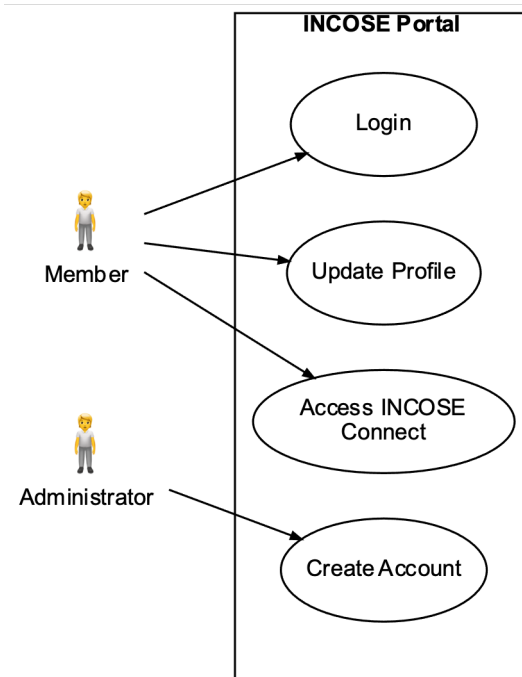
\* Note subsystems may include software and hardware





# Use Case Diagrams

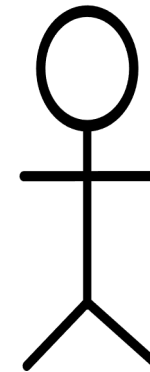
- Use case diagrams describe what a system does from the standpoint of an external observer. The emphasis is on *what* a system does rather than *how*.
- Show the bounded system with use cases contained within
- Identify outside actors and their interactions with the use cases
- Show relationships to represent communication between actors and use cases depicted by lines.
- Relationships also exist between use cases
  - Generalization
  - Include
  - Extend





# Actors

- Actors are users or outside systems that interact with the system to obtain some value
- They can be:
  - Human
  - Organizations
  - External system or subsystem
  - Peripheral device (hardware)
  - Time or time-based event
- Actors trigger use cases
- Actors are modeled as object classes
- Traditionally represented by stick figure





# Use Case

- Each use case describes a single function in which users interact with the system
  - May contain **several paths** that an actor can take
  - Each path is referred to as a **scenario**
- Labelled using a descriptive verb-noun phrase
- Represented by an oval

Update  
Profile

Renew  
License



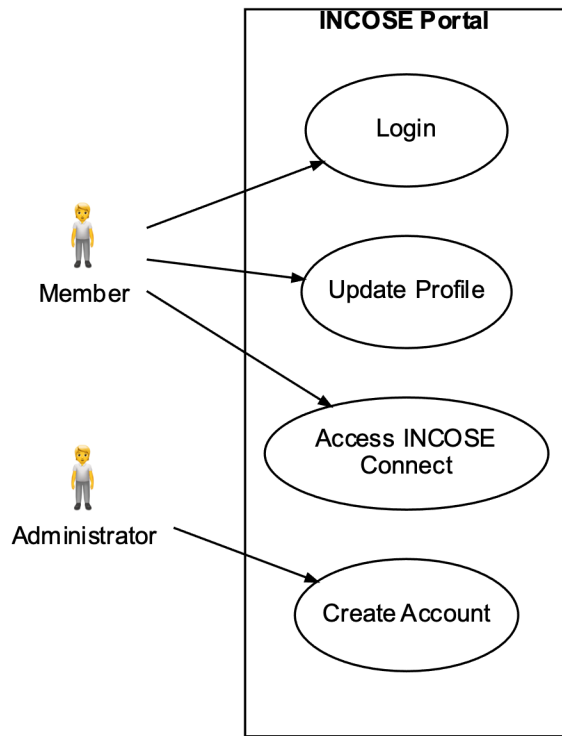
# Detailed Use Case Basic Template

- **Use Case:** Use Case Name
- **Actors**  
Actors are anything that interface with the system including people, devices, other software systems, etc.
- **Goal**  
A summary of the use case goal describing the interaction that occurs.
- **Preconditions**  
Tell what state the system must be in at the start of the use case.
- **Scenario**  
The scenario flow of events as a series of declarative statements listing the steps of a use case. Include user actions and system responses in the steps.
- **Exceptions**  
Exceptions describe anticipated allowable exceptions to the primary scenario.



# Iterative Levels of Detail

## High level use cases



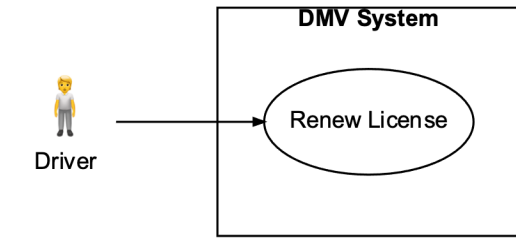
## Detailed use case

- **Use Case:** Login
- **Actors**  
Member
- **Goal**  
INCOSE user logs in to access portal
- **Preconditions**  
User has a valid INCOSE account, Internet access and a web browser open.
- **Scenario**
  1. User goes to the INCOSE portal login website.
  2. Portal displays login screen
  3. User enters username and password.
  4. Portal displays member resource space
- **Exceptions**  
Login fails due to incorrect/expired password, the system is unavailable or a browser related problem.



# Example Use Case Refinement

## Preview



### Goal

Driver receives renewed license

### Scenario

1. Driver makes appointment with DMV
2. DMV confirms appointment
3. Driver enters DMV
4. DMV processes paperwork and provides renewed license

## Refinement

- **Use Case:** Renew License
- **Actors**  
Driver
- **Goal**  
Driver receives renewed license
- **Preconditions**  
Driver is a state resident with a valid license.
- **Scenario**
  1. Driver makes appointment with DMV
  2. DMV confirms appointment
  3. Driver enters DMV
  4. DMV processes paperwork and provided renewed license
- **Alternate Path**
  1. Driver accesses DMV online
  2. DMV enables license renewal
  3. Driver enters renewal information
  4. DMV confirms renewal and mails renewed license
- **Exceptions**  
Driver cannot make payment or is ineligible due to conviction.



# Example CA State Law Process Improvement As-Is

**Use Case:** Enact Law

**Actors**

House Member, State Assembly House, State Senate House

**Goal**

A societal problem is addressed by creating a new law

**Preconditions**

A need is identified.

**Scenario**

1. Bill is introduced by a house member (author)
2. House performs first reading
3. Rules committee reviews bill
4. Fiscal committee reviews the bill if financial implications for the state
5. House performs second reading
6. House member presents the bill for final passage on third reading.
7. Steps 2-5 are repeated by the second house

**Postconditions**

Bill is written into law

**Exceptions**

Rules committee defeats the bill.  
Third reading defeat of the bill.

**Alternate Paths**

At any time during the legislative process the bill may be amended, either in committee or on the Floor.



# Example CA State Law Process Improvement To-Be \*

**Use Case:** Enact Law

**Actors**

House Member, State Assembly House, State Senate House

**Goal**

A societal problem is addressed by creating a new law

**Preconditions**

A need is identified.

**Scenario**

1. Bill is introduced by a house member (author)
2. **Legislative Counsel ensures in-depth problem definition of need and assignment of priority in draft bill**
3. House performs first reading
4. Rules committee reviews bill
5. Fiscal committee reviews the bill if financial implications for the state
6. **Committee reviews bill for statement of purpose, measures of success, sanctions models, cost analysis and risk analysis**
7. House performs second reading
8. House member presents the bill for final passage on third reading.
9. Steps 2-8 are repeated by the second house

**Postconditions**

**Enforced law has been objectively validated**

**Exceptions**

Rules committee defeats the bill.

Third reading defeat of the bill.

**Alternate Paths**

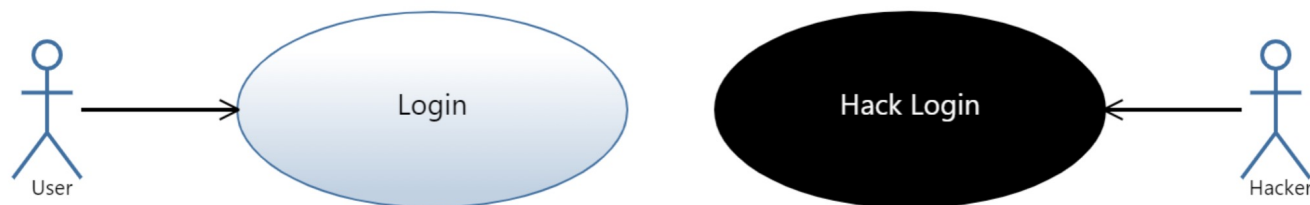
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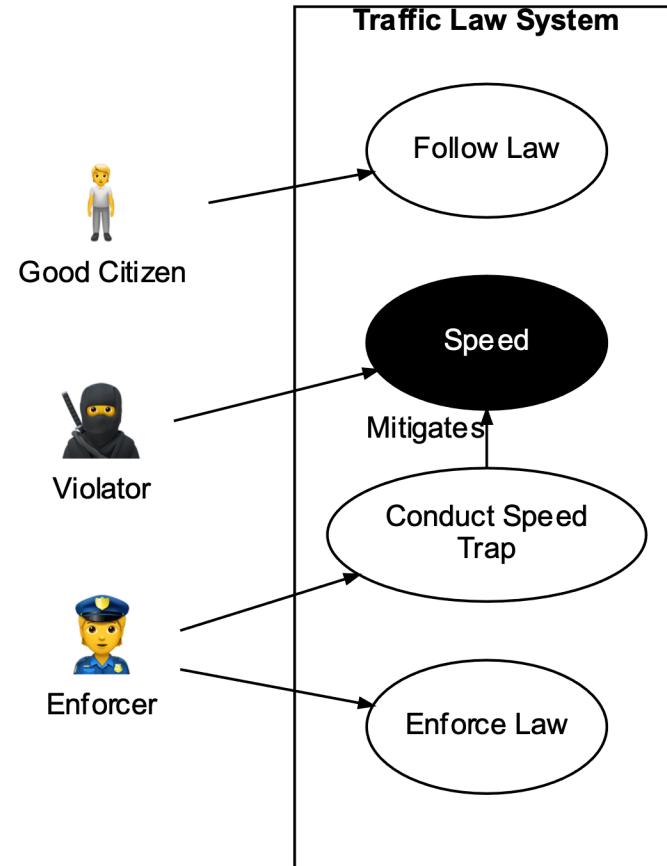
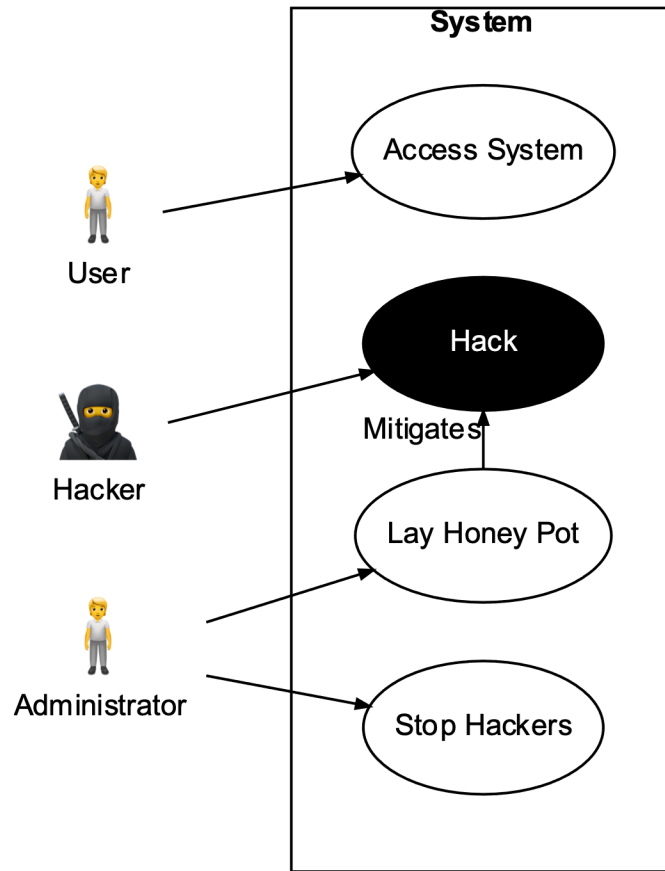
# Misuse Cases

- A misuse case describes a negative scenario
- The scenario goal is
  - a threat to the system, an actor or organization
  - desired by a hostile agent, not necessarily human
- Can be applied to elicit security or enforcement requirements, identify test cases, perform design tradeoffs to prevent or mitigate threats
- Oval is drawn in inverted colors





# Example Misuse Cases and Mitigations





# Conclusions and Future Work

- Law systems are a form of human-engineered systems
- They can benefit from proven modeling techniques already used on complex systems.
- We have barely scratched the surface of formal law system modeling
- Future work involves integrating SysML-based models with dynamic sanctions models
  - E.g., using executable activity models of the scenarios to help design laws and perform tradeoffs



# References

- SEBoK contributors, "System (glossary)", *SEBoK*, [https://www.sebokwiki.org/wiki/System\\_\(glossary\)](https://www.sebokwiki.org/wiki/System_(glossary)) (accessed December 2, 2022).