The Case for a Science of Law

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The Case for a Science of Law

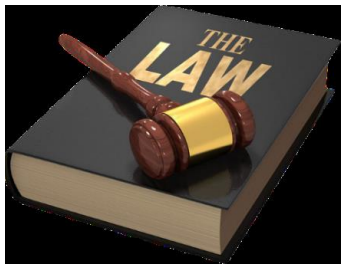
- TOPICS
  - The Systems Engineering and Lawmaking (SELAW) Working Group
  - A Systems View of Bodies of Law
  - Systems Thinking and the Systems View
  - Foundational Concepts for a Science of Governance and Law
  - Summary and Questions

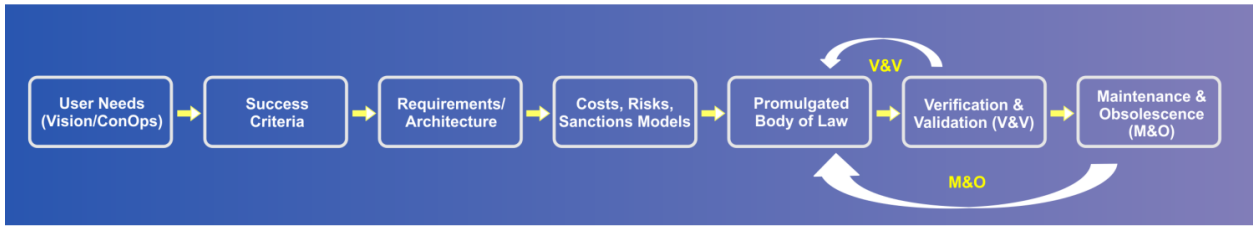
The Systems Engineering and Lawmaking (SELAW) Working Group

The Power of Systems Thinking

- SE has shown to be effective in improving quality and consistency in many sciences and engineering fields such as aviation, energy, and manufacturing

- Why then, do we not apply the same discipline to lawmaking?





https://www.incose.org/incose-member-resources/working-groups/process/selaw

About the SELAW Working Group

- Established in May 2022
- The SELAW WG is dedicated to the improvement of the lawmaking process through the application of systems engineering principles and processes
  - The 50 USA State Governments enact tens of thousands of Legislative Statutes annually, yet do not employ a standard process
- While there are many examples of successful laws, the lawmaking process itself remains inconsistent
  - This often leads to badly designed laws, which in turn leads to ineffectiveness, duplication, obsolescence, and waste
- The SELAW WG aims to evaluate
  - The structure and mechanics of laws of government
  - The applicability of SE standards and methodologies to law creation and validation

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Current SELAW Working Group Initiatives

- Flaws and omissions of traditional lawmaking
- Application of IEEE Std 15288 processes to law-creation
- Modeling of law sanctions (tariffs, fines, etc.)
- Law cost model(s)
- Law risk model(s)
- Law validation protocols
- Credentials for law designers
- Law-creation manual based on SE principles and practices

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A Systems View of Bodies of Law

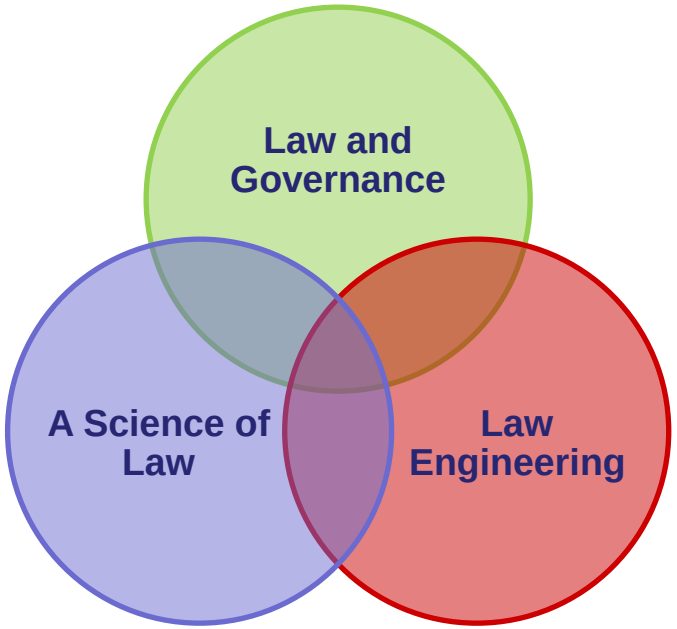
A Systems View – Bodies of Law (Law Codes)

Systems Thinking

- Law codes constitute a system or system of systems
- Law codes derive from a need for societal governance
- The primary purpose of laws is to provide social stability

A Science of Law

- Aims to provides rational and ethical justification for law codes
- Establishes practices and institutions



Law Engineering

- Publishes standardized processes for law development
- Establishes and maintains law codes
- Trains and certifies practitioners

Why Should We Apply Systems Thinking to Lawmaking?

- **The Need for a Science of Law**
  - Even a general understanding of the multitude and complexity of law codes and their application in modern society is not comprehensible to an interested citizen
  - Legal practice and law codes have developed organically across centuries without formalization of a science of law
  - Laws are often designed without preplanning for the ‘quality-in-application’ follow-through needed to demonstrate and validate effective outcomes
  - There are insufficient sunsetting provisions in law codes mandating consistent planning for
    - periodic review of laws for demonstrated effectiveness
    - currency of purpose
    - consistency with the larger body of law, and potential obsolescence

- **The case for the use of systems thinking processes and tools to establish a science and its applied application (engineering of law)**
  - A society’s legal codes in totality act as a system (or system of systems) of law
    - Therefore, a system-based science of law can be developed to address the challenges and limitations of existing law practice
  - Semiquantitative decision-making tools in common usage offer methodologies that can help manage the satisficing processes necessary for consensus to design and promulgate laws
    - Examples include analysis of alternatives, risk and opportunity analysis, cost-benefit analysis, and preplanned verification and validation
    - While not able to provide the mathematical certainty of the physical sciences, these tools can be used to bound the immediate and longer-term ‘less-than-desirable’ consequences of proposed laws

Addressing Complication in Current Law Practice

- A systems approach is required to transition from the historical ad-hoc complication of law practice to true complex systems solutions

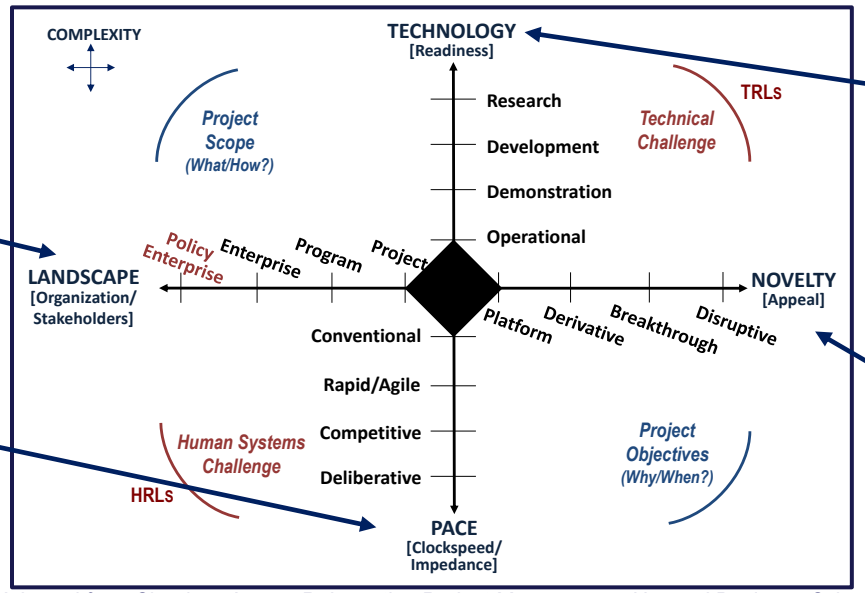
COMPLICATIONS RELATED TO THE LACK OF A SCIENCE OF LAW

LANDSCAPE COMPLEXITY

- **Policy Enterprise** – Numerous existing bodies of law at all levels of government without common or systemic approach to lawmaking

PACE COMPLEXITY

- **Deliberative (Low Reform Expectations)** – Clockspeed/impedance mismatch between stakeholders



Adapted from Shenhar, Aaron; *Reinventing Project Management*; Harvard Business School Press, 2007, pp.46-49

TECHNOLOGY COMPLEXITY

- **Research (Low-TRL Lawmaking)** – Lack of systems methodology and quality processes in current ad-hoc additions to bodies of law

NOVELTY COMPLEXITY

- **Disruptive** – A systems approach to lawmaking is controversial and revolutionary

Systems Thinking and the Systems View

Systems Thinking and the Systems View

- "Systems thinking" is not new to the 20th century
  - Modern practitioners have only coined the term – viewing the world as a system was a development of the scientific revolution
- Isaac Newton's Principia (1687) included his book "*The System of the World*"
  - Newton's rules of reasoning (axioms):
    - **Rule 1 [Simplicity]**: We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances
    - **Rule 2 [Intelligibility]**: Therefore to the same natural effects we must, as far as possible, assign the same causes
    - **Rule 3 [Universality]**: The qualities of bodies, which admit neither intensification nor remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever
    - **Rule 4 [Inference to the Best Explanation]**: In experimental philosophy we are to look upon propositions inferred by general induction from phenomena as accurately or very nearly true, not withstanding any contrary hypothesis that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions

https://en.wikipedia.org/wiki/Philosophi%C3%A6_Naturalis_Principia_Mathematica#Preliminary_version

Systems thinking encompasses a vision to investigate real-world structures and behaviors and model them as intelligible physical and human systems

How Can We Categorize Systems?

- **NATURAL SYSTEMS**
  - Physical systems
  - Biological systems
- **TECHNOLOGICAL SYSTEMS**
  - Technology-based systems (e.g., traditional engineered systems)
  - Human-machine interface (HMI) systems
- **VOLITIONAL SYSTEMS** *
  - Sociotechnical systems
    - INCOSE Vision 2030 initiatives
  - Social systems
    - Human interaction/governance
    - Public policy/law

We use natural system models to establish axioms and scientific laws in order to predict system behaviors
- Traditional scientific method
- Quantitative/mathematical solutions

Verification and Validation
- Logical validity of hypotheses plus observable corroboration

We apply natural system knowledge to create solutions to technological challenges
- Model-based systems engineering
- Traditional engineering disciplines
- Project/program management

Verification and Validation
- Verification (to requirements) and user validation (operational fitness for use)

We must develop volitional system models to establish axioms and practices that bound the behaviors of human influenced volitional systems
- Novel approaches to provide qualitative/ predictive solutions that bound undesirable and cascading consequences

Verification and Validation
- Need predictive models with quality control and operational validation

* **For volitional systems,** in general, the effectiveness of system solutions might be described as more dependent on controlling the volitional interactions (i.e., will) of the key stakeholders than on the underlying technologies

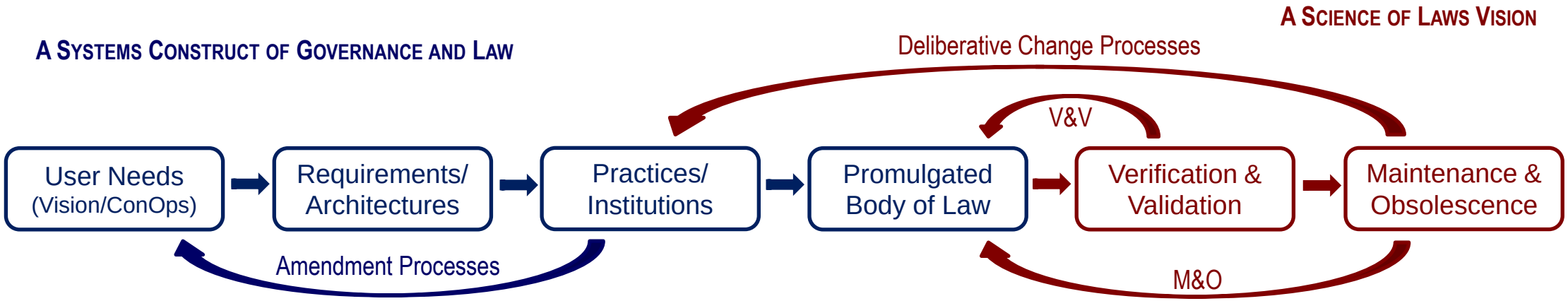
The Volitional Systems Challenge

- Volitional systems include social structures, governance, public policy, law, economics, and the management of technical and sociotechnical systems
  - As technologists we tend to focus on creating and applying knowledge gained from the reliable authority of research and experimentation (data/information/knowledge)
  - But factors such as human agency, preference, consensus, and ethics have confounded application of the traditional quantitative approaches of the scientific method from the physical sciences to these volitional systems
- Ethics and wisdom are confounding factors that challenge rational consensus and legitimate authority on the establishment of solutions to societal challenges
  - Ethics: *"A theory or system of moral values; the principles of conduct governing an individual or a group; a consciousness of moral importance"* (Merriam-Webster)
  - Wisdom: *"The ability to discern or judge what is true, right, or lasting; common sense; good judgment"* (The American Heritage Dictionary)

ACKNOWLEDGMENT OF A NEED FOR LEGITIMATE (ETHICAL/WISDOM BASED) AUTHORITY IS OFTEN VIEWED AS CONTROVERSIAL

A Systems Thinking Thought Experiment

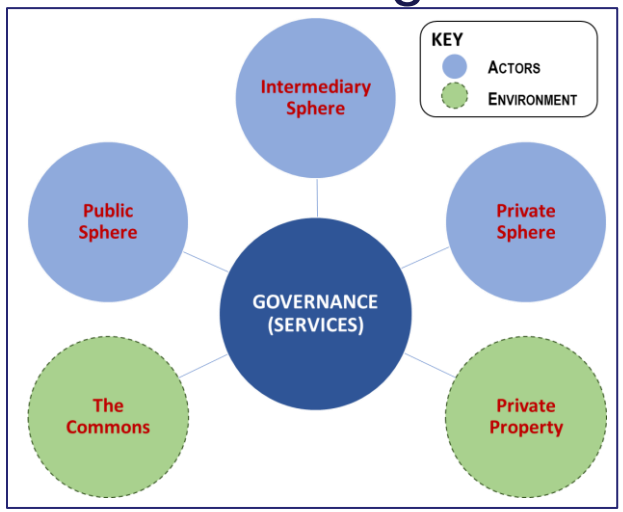
- How might you create a system of governance and laws starting from systems thinking principles?



Governments and codes of law are systems-based constructs – created through application of social technologies

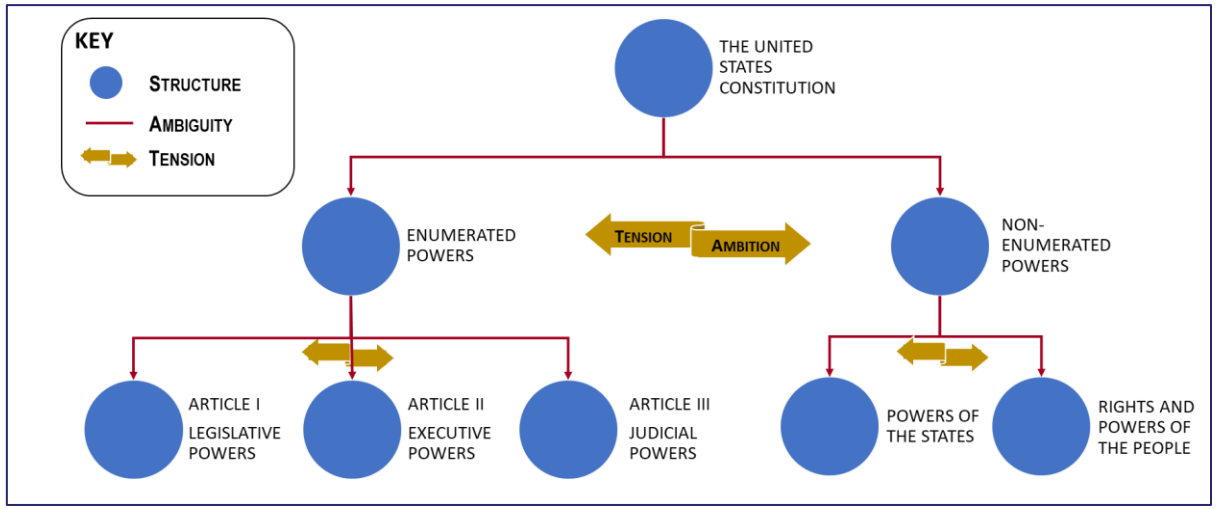
Governance Viewed as a System – The American Experience

Context Diagram



- System Boundary
- Actors/Environment
- Relationships/Association

The Constitution's Federalist Structure



- Structure/Hierarchy
- Limited Enumeration of Powers
- Openness/Ambiguities

The American Constitution balances structure with ambiguity to provide a deliberative means to long-term sustainable progress

Historical Misapplications of a Systems Science Approach to Volitional Systems

- The impact of 'scientism' *("the pretense of knowledge")*
  - Flawed 'scientific' approaches of the French Revolution and Marxism have led to envy, violence, authoritarianism, and totalitarianism
  - Centralized silos of 'expertise' based in 19th/20th century social theories lead to insularity, crowding out of the distributed/tacit knowledge within the larger populace, and a depreciation of generally recognized past wisdom
  - Severing of political-economy into silos of economics (individualist motivations of business and the general populace) and political science (idealized motivations of leaders for social progress)

    ❖ *Scientism: "A mechanical and uncritical application of habits of thought to fields different from those in which they have been formed"*

    – Friedrich Hayek; *"Scientism and the Study of Society,"* Economica, vol. IX, no. 35, August 1942; "The Pretence of Knowledge," Nobel Prize Lecture, 1974

- The challenge of quantification
  - Complex equities of utilitarianism to achieve greatest good for the greatest number cannot be quantifiably or ethically reconciled in practice (Bentham, Kant-Mill dilemmas, Pareto superiority, etc.)
  - Social science statistical methodologies – generally based in measurement of *"what-is"* as a presumed norm – do not address the *"what-ought-to-be"* aspects of ethical advancement

The early Enlightenment goal to establish a scientific foundation to the study and management of human activities has largely faltered in the arena of public policy, law, and governance

Foundational Concepts for a Science of Governance and Law

The Need to Establish Systems of Governance and Law

- The Challenge
  - Must political discourse and practices continue to be supported merely through opinion and tradition …
    - or, can we establish and apply a body of knowledge based in the natural law concepts of intelligibility, universality, and objectivity that underlie the physical sciences?
  - Currently, systems thinking, and it applications through systems engineering, focus on today's high technology applications …
    - including complex systems, systems of systems, high-tech products and services, big data, artificial intelligence, and software-intensive systems

A place for "systems" of governance and law within systems thinking and systems engineering has not been coherently addressed within current practice

Governance and Law – A System of Systems View

- Governance and law are human constructs created through mutual association (1)
  - Shared beliefs produce values and traditions
  - Traditions and values coalesce as practices
  - Practices underlie institutions
- Values, practices, and institutions evolve (2)
  - Acquisition/Inheritance: each new generation "acquires" a status quo based in the accumulated accomplishments and wisdom of previous generations
    - Deliberative and durable change leads to societal progress
    - Hasty and unreflective change, while satisfying the short-term passions of the populace, more often leads to faction and instability

Values, practices, and institutions are the foundations of the system of systems we call governance and law

1. Based on the work of Alisdair MacIntyre
2. Based on the work of Robert Nozick

Creating Systems of Governance and Law

- The Power of Systems Thinking
  - The purpose of government and law is to address the legitimate user needs of the populace for the larger goal of creating a stable and durable society (a system of systems)
    - Complication occurs in the absence of systems thinking to address any complex problem situation
  - New processes and tools are needed to address volitional systems
    - The developing science of chaos and complexity theory now offers the potential to address the limitations of quantitative deterministic tools that have challenged traditional application of the scientific method to human social systems
    - Concepts such as a bounded solution space, a horizon of predictability, and identification of cascading failure modes might substitute for traditional deterministic and probabilistic solutions

A Path Forward – What is Needed to Address Volitional Systems

- We must develop volitional system models to establish axioms and practices that bound the behaviors of human influenced volitional systems
  - Novel approaches to provide qualitative/predictive solutions that bound undesirable and cascading consequences
  - Predictive models with quality control and operational validation are needed for validation and verification
- The author believes a path to reignite interest in a scientific approach to applied volitional systems lies in the new science of chaos and complexity
  - The axioms of chaos and complexity theory can be applied to semiquantitatively or qualitatively bound rational and durable systems of human behavior (such as law and governance) and to help identify and avoid extremes that lead to societal failure
  - Applications of chaos and complexity theory to physical and biological systems have
    - Characterized behavioral dependencies on qualifying factors such as diversity, connectedness, interdependency, and adaptation; and,
    - Demonstrated predictable examples of instability and contagion as divergent 'tail' behaviors of qualifying factors take precedence

Three fundamental axioms of complexity/chaos

1. For certain behaviors, sensitivity to initial conditions limits the precision of predictability over time
2. Qualifying factors – such as diversity, connection, interdependency, and adaptation – tend to optimize outcomes within a mean range (a consequence of the central limit theorem)
3. Large divergence from mean behaviors (tails) can lead to system instability and cascading systemic failure

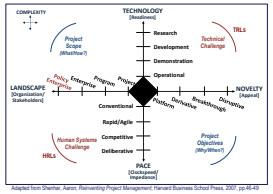
Volitional Systems Applications and Tools (Examples from previous Governance & Laws presentations)

Analysis of Complexity Factors – INCOSE Vision Initiatives

Management of Sociotechnical Systems
Tools: Analysis of Complexity Factors

- Solutions must be viewed as sociotechnical enterprises harnessing technology
  - The harder challenge is in the policy/enterprise domain (landscape), not the technology domain
  - Interdependencies between technology solutions and human social systems must be addressed

INCOSE SE Vision 2025 Initiatives
- **Factors Influencing System Complexity**
  - **Technology (readiness)**
  - **Landscape (organization/stakeholders)**
  - **Pace (clockspeed/impedance)**
  - **Novelty (appeal)**



Analysis of Complexity Factors – Science of Law

Addressing Complication in Current Law Practice

- For volitional systems such as law codes, a systems approach is required to transition from historical ad-hoc complication to true complex systems solutions

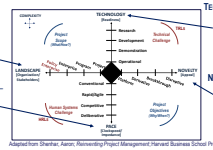
COMPLICATIONS RELATED TO THE LACK OF A SCIENCE OF LAW

Landscape Complexity
- **Policy Enterprise** – Numerous existing bodies of law at all levels of government without common or systemic approach to lawmaking

Pace Complexity
- **Deliberative (Low Reform Expectations)** – Clockspeed/impedance mismatch between stakeholders

Technology Complexity
- **Research (Low-TRL Lawmaking)** – Lack of systems methodology and quality processes in current ad-hoc additions to bodies of law

Novelty Complexity
- **Disruptive** – A systems approach to lawmaking is controversial and revolutionary



Adapted from Shenhar, Aaron; Reinventing Project Management; Harvard Business School Press, 2007, pp 46-49

Public Policy Consensus – Use of Rules of Thumb

The Challenge of Public Policy Consensus
Tools: Statistical Rules of Thumb

- Recognizing that ethical advancement in society (the moral arc) is evolutionary and asymptotic, how might we determine "settled" law and policy?
  - How is precedence established?
  - How is precedence broken?
- Possible milestones to establish social acceptance and ultimate precedence
  - Deliberation (50+/50-): criteria for potential adoption of law and policy
  - 1σ (68%): early populace acceptance point
  - Pareto rule (80/20): generally established populace acceptance
  - 2σ/3σ (95/99+%): "settled" (established as precedence)
- Reassessing precedence
  - Breaking established precedence generally requires a 'paradigm shift' in public perceptions and new milestones to achieve acceptance and settling of a new precedence

"Temporal Republicanism" (pacing is constrained by varying "clockspeeds" of numerous stakeholders)

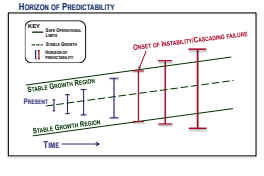
[*] Weiner, Greg; Madison's Metronome; University Press of Kansas, 2012, p.ix

Stable Growth in Societies – Predictability and Failure Analysis Methods

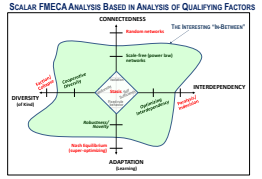
Maintaining Stable and Durable Growth in Societies
Tools: Predictability and Failure Analysis Methods

- Durable progress and social stability depends upon stable growth
  - Understand the horizon of predictability and avoid instabilities
  - Establish relevant qualifying factors and work in the interesting "in-between" (i.e., recognize and avoid destabilizing failure modes)

Horizon of Predictability



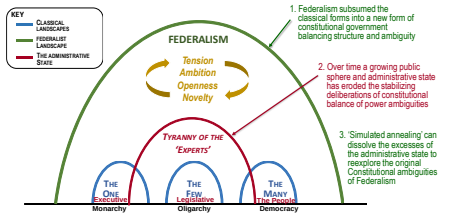
Scalar FMECA Analysis Based in Analysis of Qualifying Factors



Managing Governance & Law – Addressing Societal Gridlock

Managing Governance & Law – Addressing Societal Gridlock
Tools: 'Simulated Annealing' Analogy

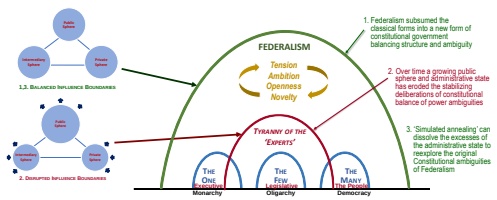
- 'Simulated annealing' derives from the materials science annealing process
  - It is used in complexity theory as an algorithm for rebalancing exploration and exploitation



Managing Governance & Law – Spheres of Influence

Managing Governance & Law – Spheres of Influence
Tools: Context Diagram Actors and 'Simulated Annealing' Analogy

- The ambiguities of Federalism provide a balancing of influences between the private, public, and intermediary spheres
  - This balance is disrupted by the growing of public sphere powers in the Administrative State



Societal Stability and Instability – Reliability Analogy

Societal Stability and Instability
Tools: Reliability Analogy

Technical Reliability
- *Stages*
  - Infant mortality – early burnout
  - Useful life – reliable performance
  - Obsolescence – deterioration
- *Satisfaction Criteria*
  - Minimum performance levels
  - Optimum performance levels
- *Failure to Satisfy*
  - Lack of fitness for use
  - Defects
- *Causes of Obsolescence*
  - Component decay
  - Environmental exceedances
  - Misuse

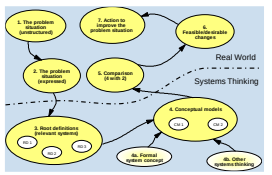
Social Systems Reliability
- *Stages*
  - Infant mortality – unrealizable utopian schemes
  - Useful life – tolerable 'functionality' of social power structures
  - Obsolescence – dissatisfaction leading to uprising of populace
- *Satisfaction Criteria (post rise of modern market economy)*
  - Economic – GDP/resident
  - Perceived equity – relative size of (and quality-of-life provided to) the middle classes; social mobility; concern for disadvantaged
- *Failure to Satisfy*
  - Caste structure – lack of social mobility
  - Loss of freedom – authoritarian/totalitarian rule
  - Curtailed opportunity – elitism, nepotism, 'siloing' of expertise
- *Causes of Obsolescence*
  - Consolidation of power – loss of openness in power structure
  - Gridlock – excessive/inconsistent laws and regulations
  - Rule-of-men over rule-of-law – lack of impartiality in enforcement

The strength and mobility of the middle classes have been the strongest indicators of social stability since the Industrial Revolution

Stakeholder Complexity – Checkland's Soft Systems Methodology

Managing Stakeholder Complexity
Tools: Checkland's Soft Systems Methodology

Checkland's Seven-Stage Soft System Methodology (SSM)



- Visualizing systems in a 'soft' sense* through a process of systemic inquiry as they interact in a complex organization/stakeholder landscape
  - I. Identifying and structuring the problem situation (Stages 1 & 2)
  - II. Defining the landscape within which the system-of-interest must be modeled (Stage 3)
  - III. Analyzing/validating the system-of-interest and its process interactions with a conceptual model (Stages 4 & 5)
  - IV. Identifying and selecting feasible and desirable strategies/solutions (Stage 6)
  - V. Implementing action that improves the problem situation and meets project objectives (Stage 7)

A 'soft' systems approach facilitates early recognition of aspects of complexity often missed with traditional hard/reductive systems engineering application

The Path Forward – A Science of Governance & Law Supported by Novel Tools and Techniques for Application and Validation

Summary and Questions

Summary – The SELAW Working Group Is Growing

- Monthly Virtual WG Meetings
  - Contact Greg Bulla, Leadership Chair, at gregory.bulla@incose.net
- We are seeking those interested in supporting any of the current WG Initiatives
  - Flaws and omissions of traditional lawmaking
  - Application of IEEE Std 15288 processes to law-creation
  - Modeling of law sanctions (tariffs, fines, etc.)
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Questions & Contacts

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LINK TO SELAW WORKING GROUP
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The Case for a Science of Laws

PRELIMINARY ABSTRACT
Legal practice and law codes have developed organically across centuries without formalization as a science of law. A general understanding of the multitude and complexity of law codes and their application in modern society is not comprehensible to an interested citizen subject to these laws. Since a society's legal codes in totality act as a system (or system of systems) of law, a system-based science of law should be developed to address the challenges and limitations of existing practices. The establishment of a science of law, and an applied specialization of law engineering, is recommended to promote excellence in law design and practice through the establishment of systems-based processes and tools that better address societal needs for an effective and sustainable system of governance and law.

BIO
Mr. Michael Martin, PE, PMP, is nearing the end of his career as a technical project manager, systems engineer, and adjunct instructor. He is currently a member of the team at the San Diego Chapter working to establish the Science of Laws working group. As he approaches retirement, he has found new interests in the application of systems principles to human social systems based in public policy, law, and governance. He plans to continue to highlight application of the tools of systems thinking and the sciences to these topics in future publications.