Hitchins' Five Layer Model as an Evaluation Framework for Regulations

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Science of Laws Conference

December 2, 2017

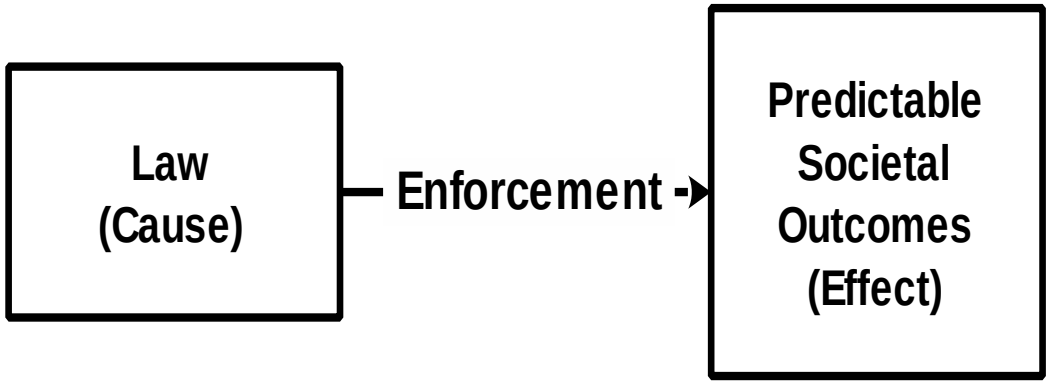
Abstract

- This paper proposes using a 5-layer model of systems engineering developed by Hitchins to examine the impact of laws and regulations on the various socio-economic structures of a society.
- The specific focus is a simple example of energy policy with an emphasis on developing causal relationships between laws and society using systems theory.

Layer	Generic Title	Sphere
5	Socio-Economic System Engineering	Legal and political influences. Government regulation and control
4	Industrial System Engineering	National wealth creation – the nation's engine – industries comprise the socio-economic system
3	Business System Engineering	Industrial wealth creation – many businesses make an industry
2	Project System Engineering	Corporate wealth creation
1	Product/Subsystem Engineering	artifacts

The Premise of Law Making

- Regulation: the rules that govern the provision of services to the public (society
- Examples are energy, water, and telecommunications

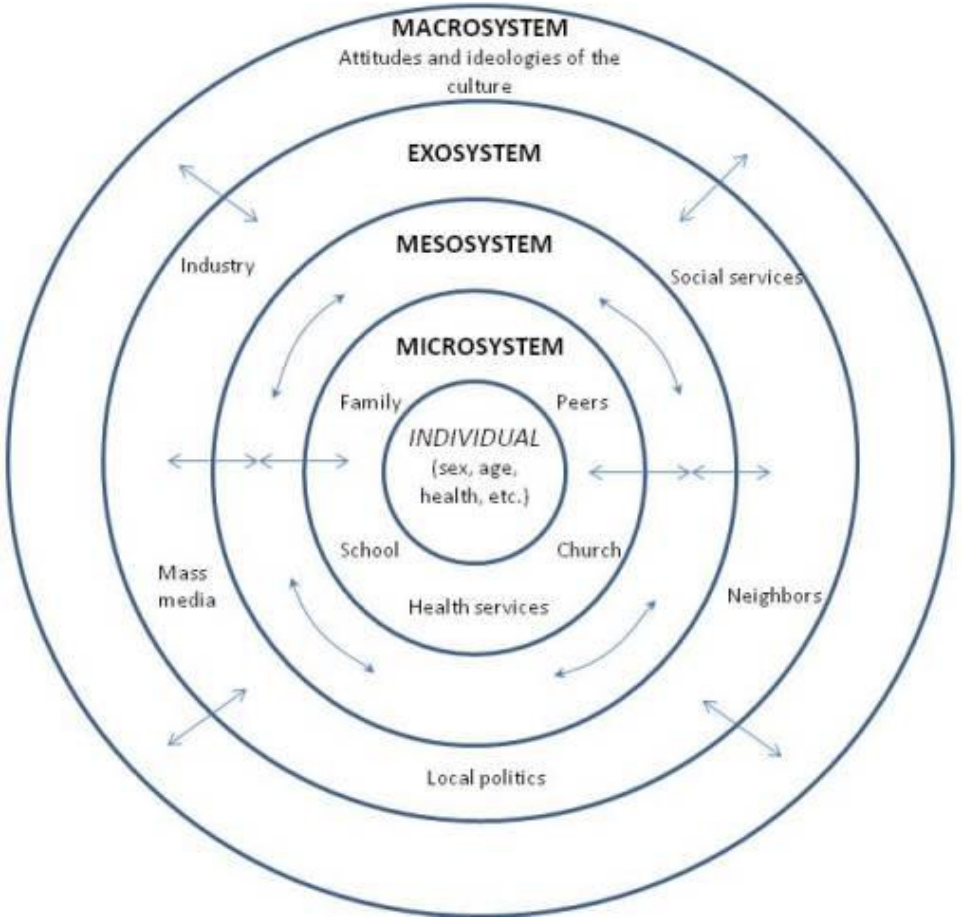


Given the mechanism for the development and implementation of regulations there is a potential for abuse; regulations that advance a political agenda. Hence the necessity for an analysis framework that can assess the societal impact of a regulation

Schrunk 2005

Society as a System

- Bronfenbrenner's Ecological Systems Theory Model
- Not shown is the Chronosystem



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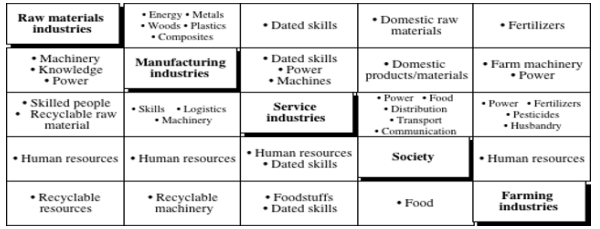
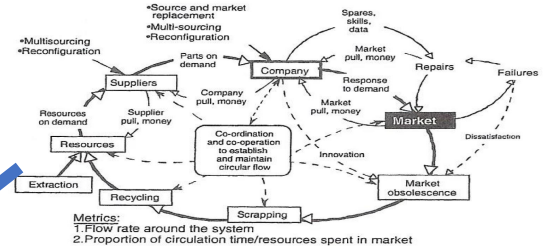
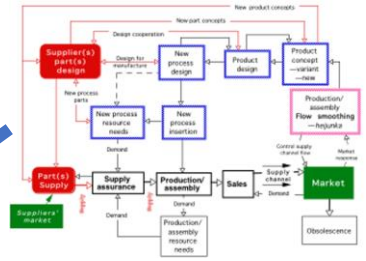
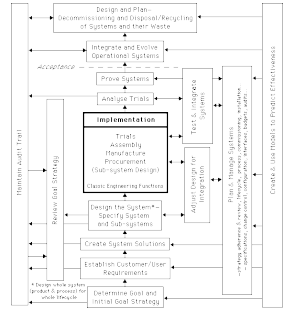
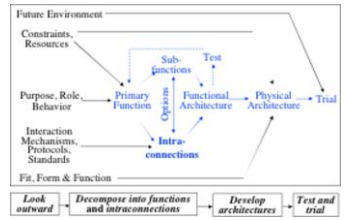






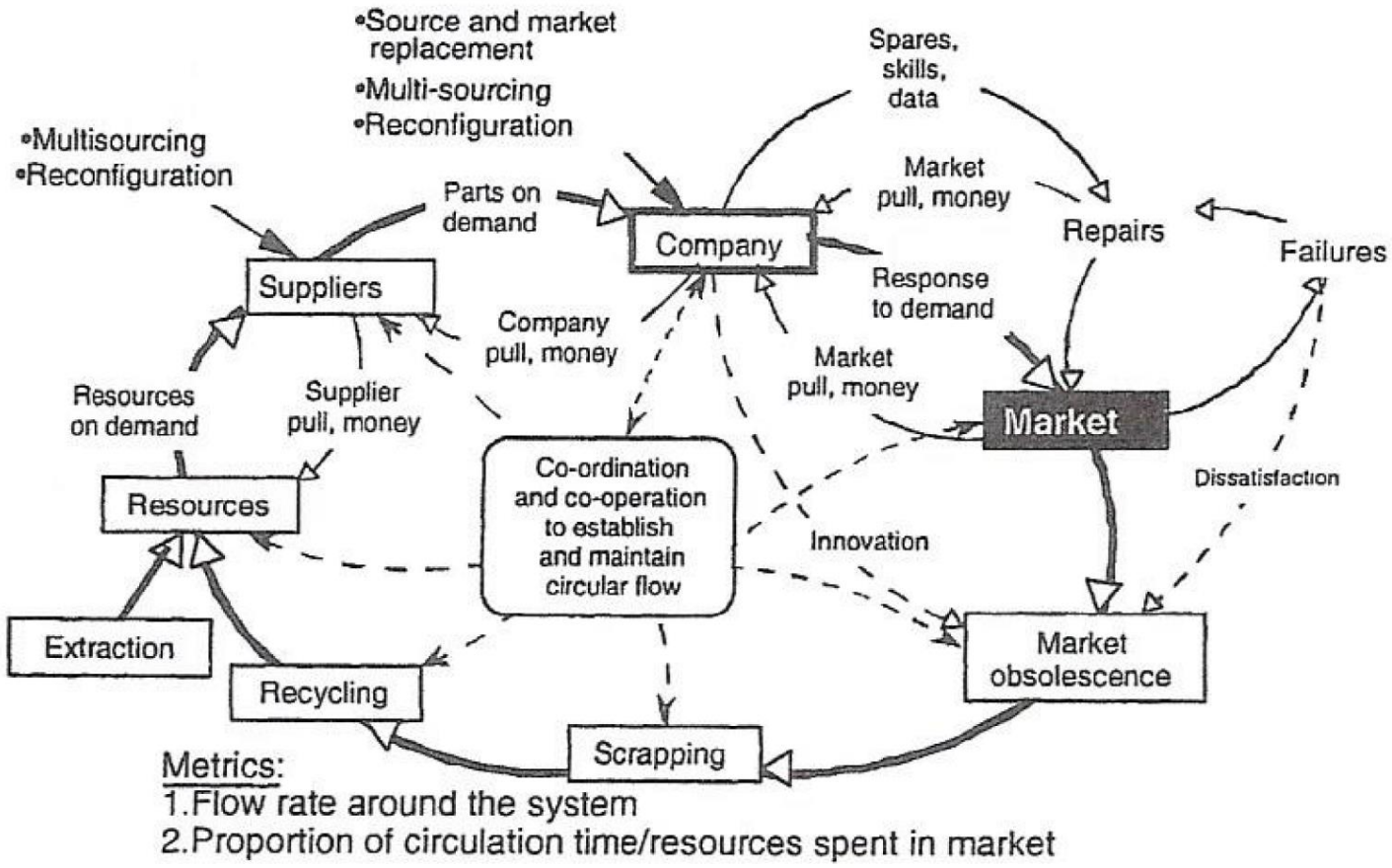




Hitchins' Layer 5 Socio-Economic Model

Raw materials industries	• Energy • Metals • Woods • Plastics • Composites	• Dated skills	• Domestic raw materials	• Fertilizers
• Machinery • Knowledge • Power	**Manufacturing industries**	• Dated skills • Power • Machines	• Domestic products/materials	• Farm machinery • Power
• Skilled people • Recyclable raw material	• Skills • Logistics • Machinery	**Service industries**	• Power • Food • Distribution • Transport • Communication	• Power • Fertilizers • Pesticides • Husbandry
• Human resources	• Human resources	• Human resources • Dated skills	**Society**	• Human resources
• Recyclable resources	• Recyclable machinery	• Foodstuffs • Dated skills	• Food	**Farming industries**

Hitchins Layer 4 Industry Model

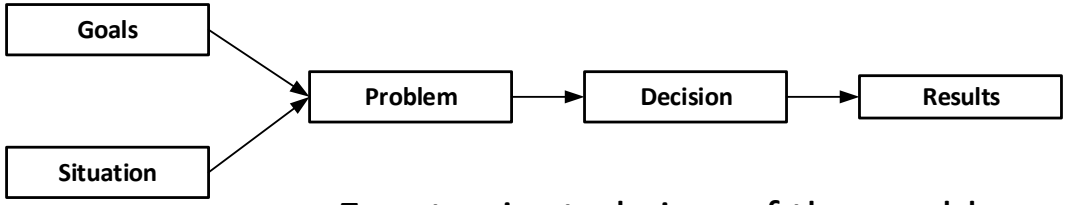


A Methodology to Assess the Impact of Laws and Regulation

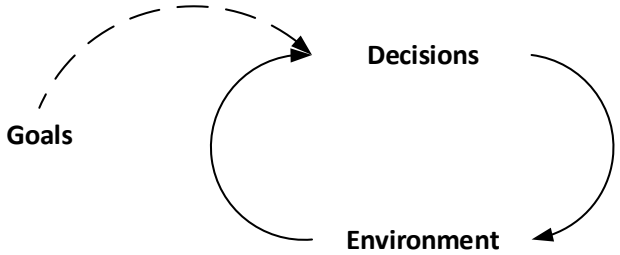
- Regulatory laws impact society at all five levels.
- The socio-economic layer is typically where the regulatory system resides though industries can self-regulate through standards committees.
- It is important to realize the socio-economic system is also a hierarchy with various levels from national to local. In practice, regulation trickles down through all layers.

- The basic methodology is straightforward:
  1. Identify the major entities of interest and capture them in a N-2 diagram
  2. Identify the relevant inputs and outputs
  3. Develop the causal loop models for each entity
  4. Create a stock and flow model from the causal loops
- Step 4 is required only if a quantitative analysis is desired.

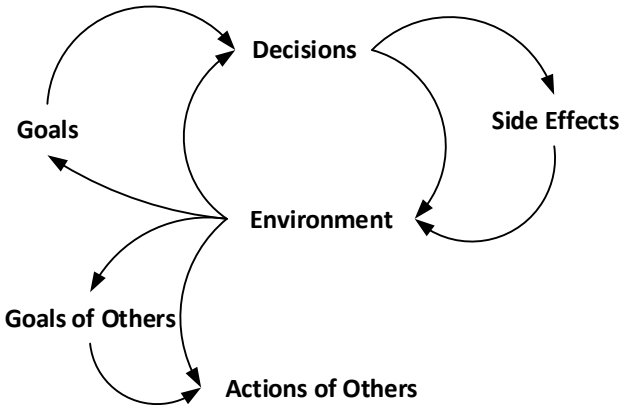
Regulation of Energy Example



Event-oriented view of the world

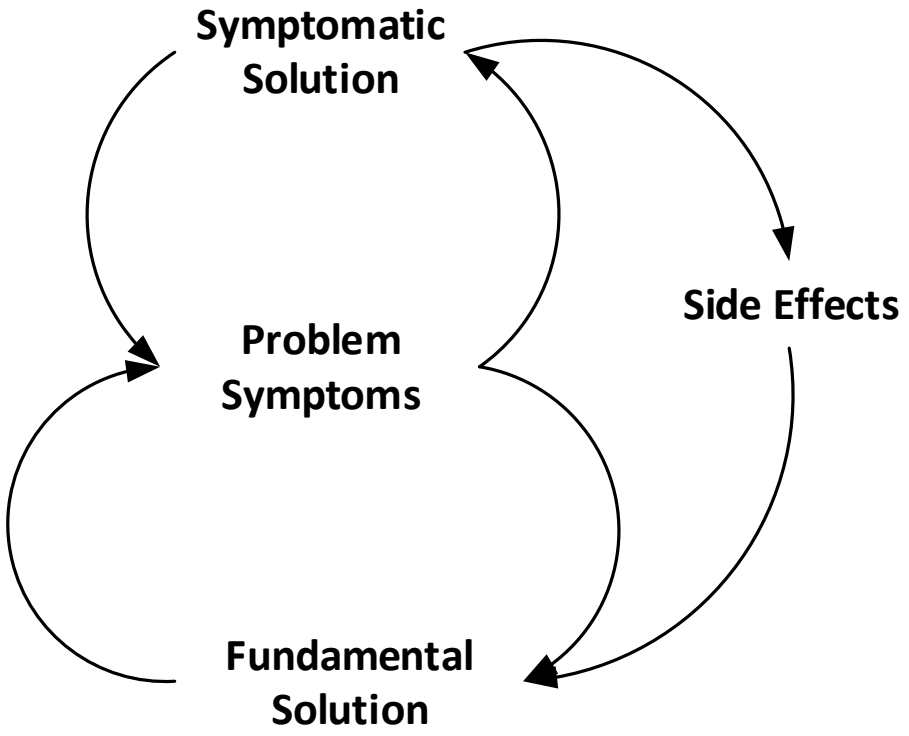


The Feedback View

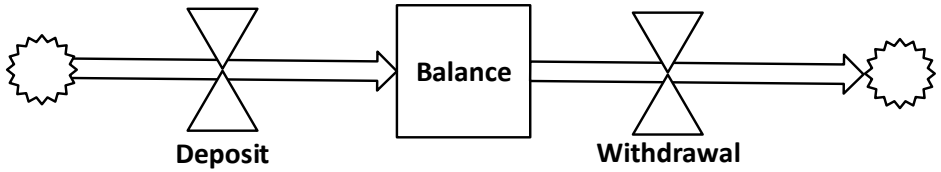


An Expanded View

What is the Real Solution?



A Stock and Flow Model



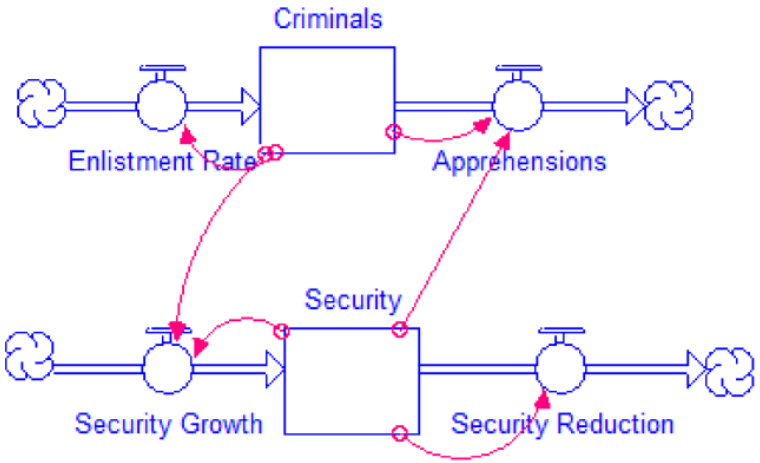


Figure 17. Example Oscillating Structure for Criminal and Security Populations

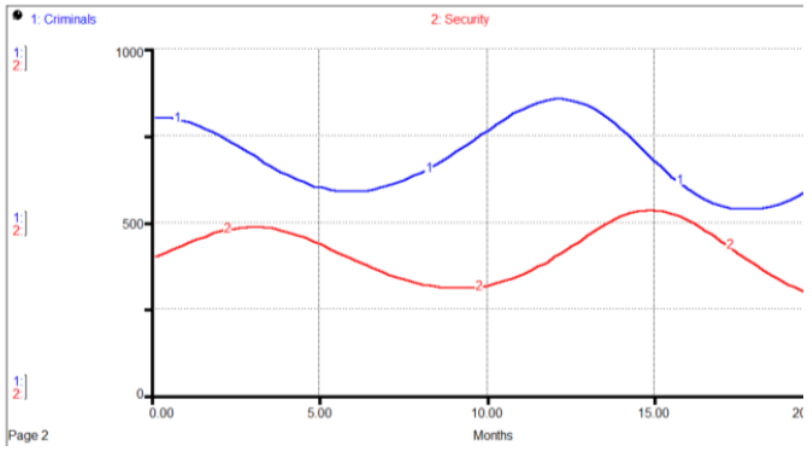


Figure 18. Example Oscillating Behavior

System Dynamics Structures for Modeling Lawmaking Processes

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THE SCIENCE OF LAWS JOURNAL
VOLUME 3, ISSUE 1

Application to the Science of Laws

- A science is predicated upon a theory.
- Theory provides the foundation for the practical through its axioms and its models and their ability to predict outcomes.
- For the Science of Laws to be viable it has to move from the normative form to a descriptive form where results can be assessed empirically.
- This paper has presented the overview of a modeling approach that contributes to that goal.

Summary

- This paper has presented a brief introduction into several systems engineering concepts that can be used to model the impact of regulations and by extension, laws in general.
  - ❖N-2 diagrams are useful diagrams by which to establish basic relationships within a system or system of systems.
  - ❖They can be easily extended to causal loop diagrams which facilitate an initial qualitative analysis of the problem space.
- While stock and flow models can be developed independently of causal loop models, the two are complementary and, when combined with N-2 diagrams, support the analysis of existing and future regulations.

Future Work

- What scientific advances are required to better understand the linked behavior of laws and complex socio-economic systems?
- How can this knowledge be applied to the design and implementation of analytic tools needed to advance the Science of Laws?