New Emergency Management in a Resilience Era Facing Health, Climate and Energy Challenges

6th to 10th December 2021

December 6th, 11:45 to 12:10

Eric Saylors

Sacramento City Fire Department

Introduction

- The Greatest Value of the Fire Service is the Event That Didn't Happen
  - How can we prove a negative?
  - How can we quantify a negative?
- Post Incident Assessment Model
- Urban Fire Suppression
- Expandable Model to all Domains of Emergency Management

Quantifying the Negative: How Homeland Security Adds Value

Posted on December 2015

Eric Saylors

HOMELAND SECURITY AFFAIRS

The Journal of the NPS Center for Homeland Defense and Security

Problem Statement

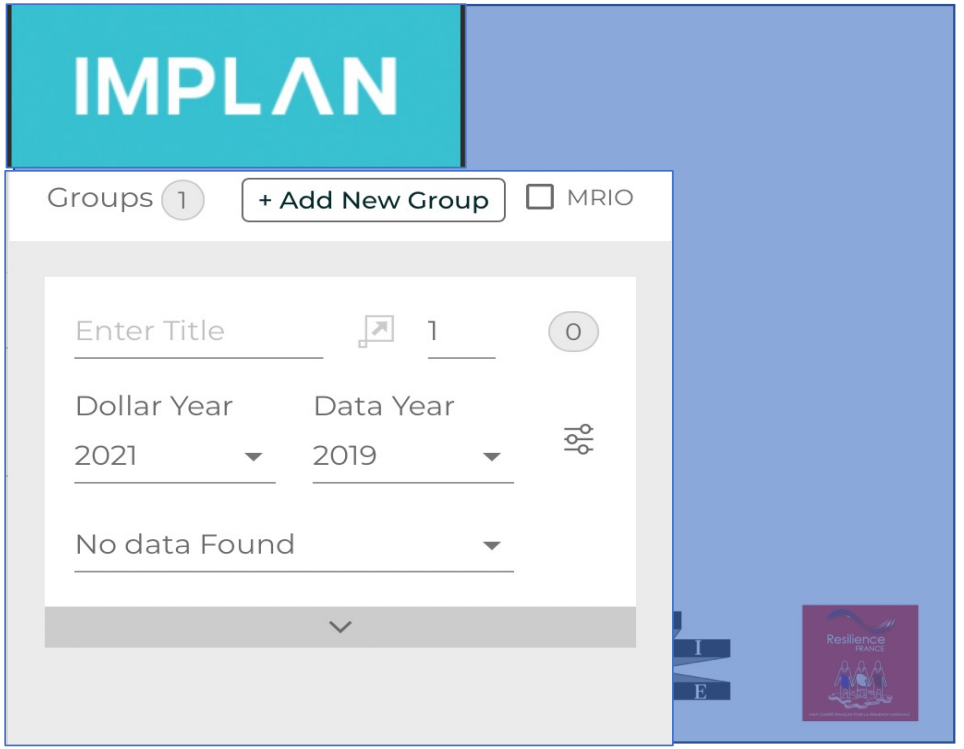
- What is the value of the fire service?
  - Can we calculate what is saved?
  - Can we calculate a Return on Investment?

Theoretical Framework

- Network Theory
  - Links
  - Nodes
  - Degree
  - Density

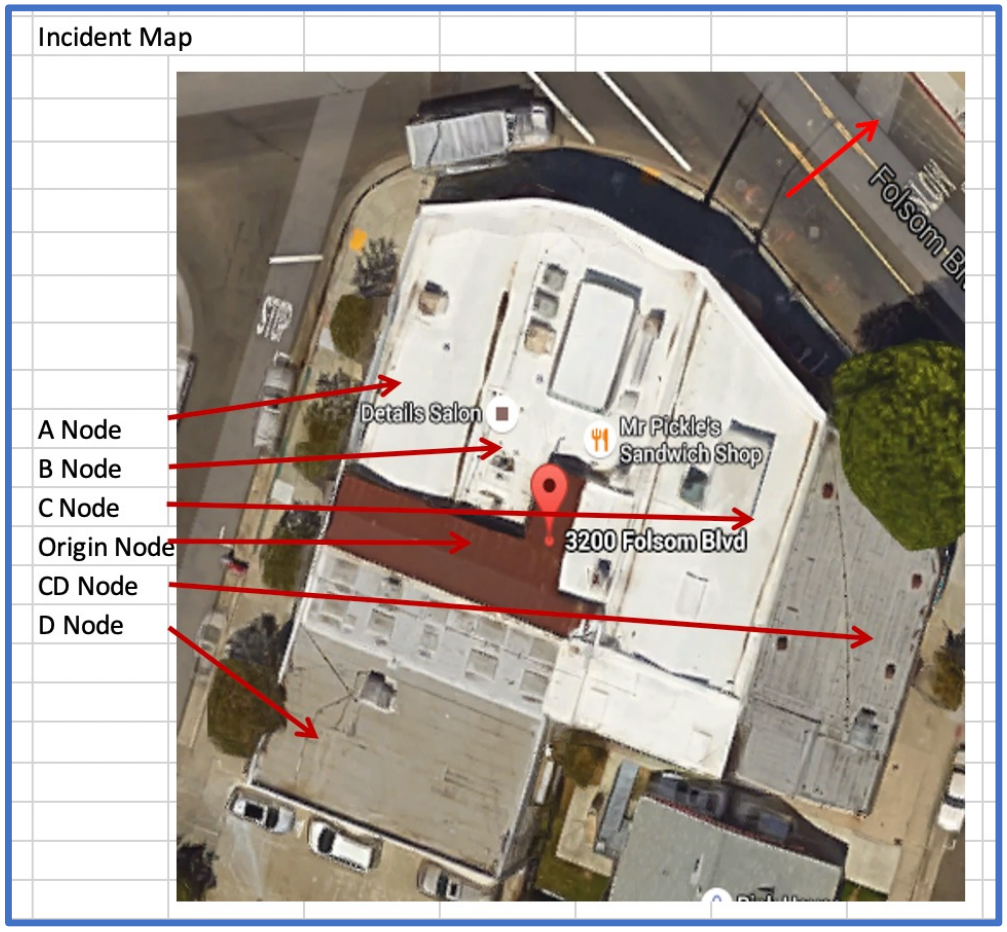
Conceptual Framework

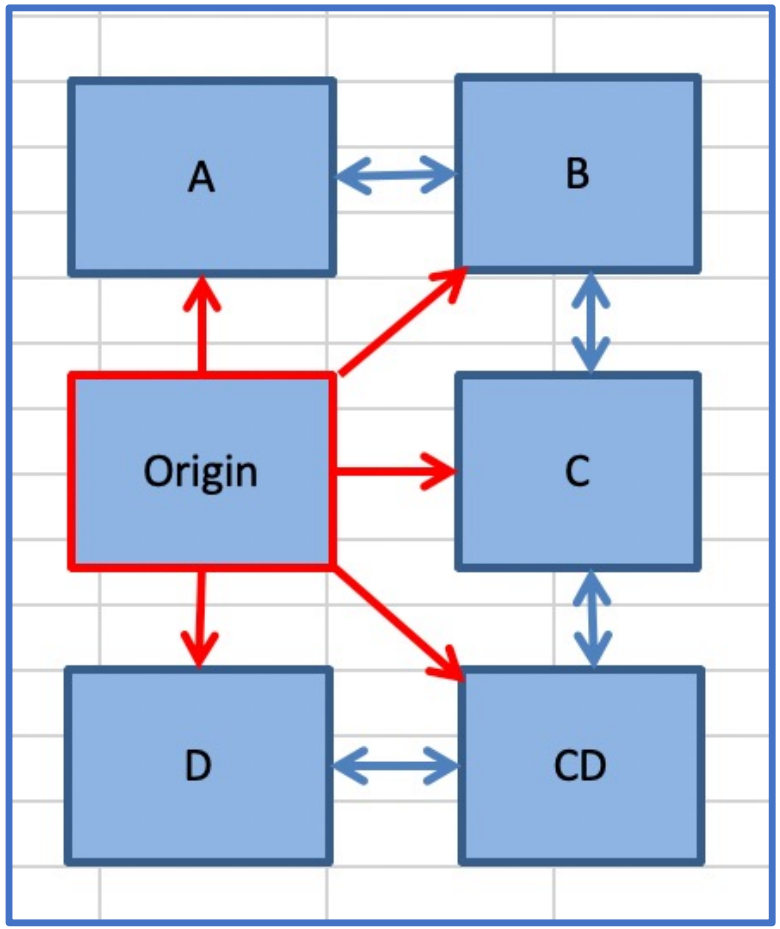
- Inductive Replacement Cost Approach (IRCA)
- Regional Economic Impact Modelling



Case Study

- Multi-unit Commercial





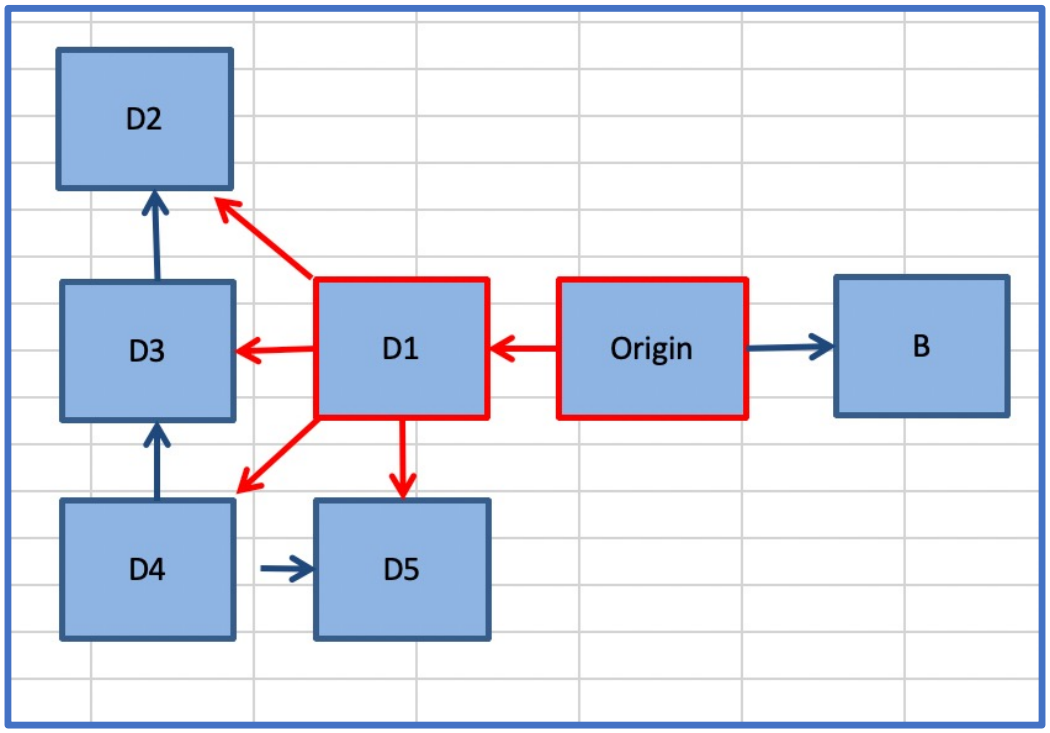
Case Study

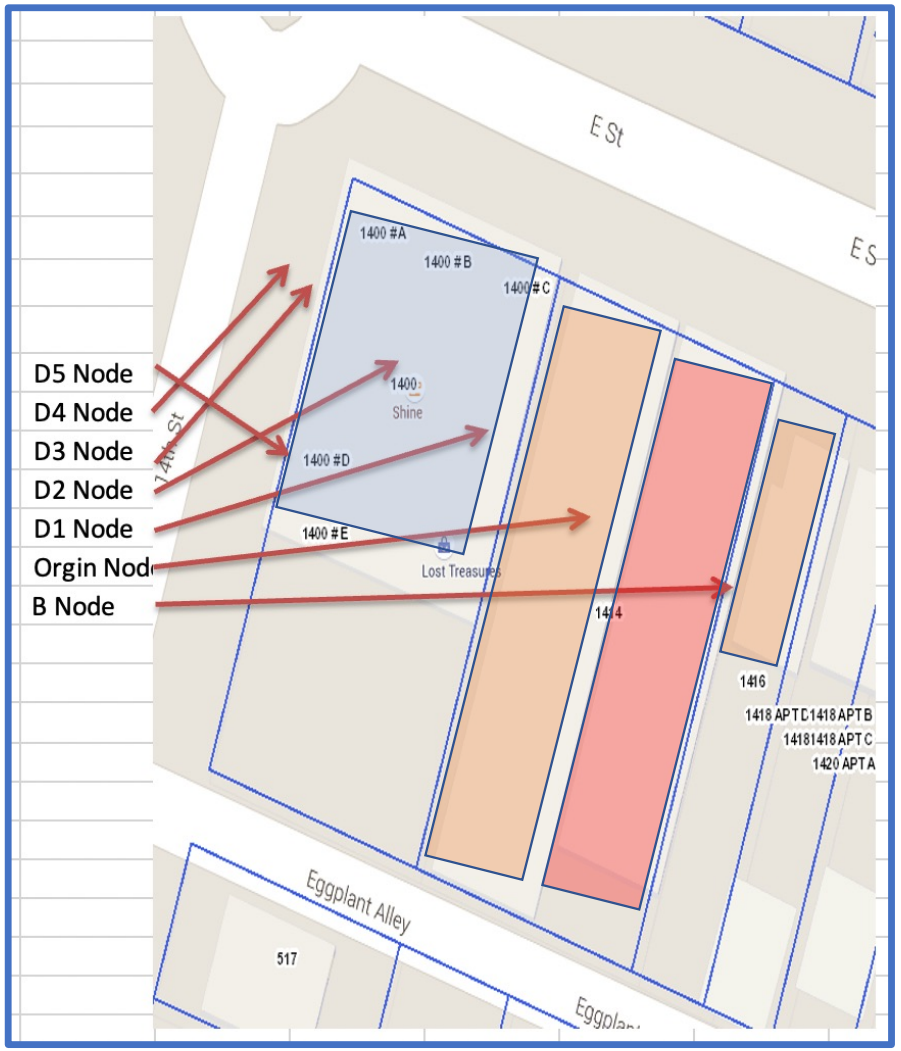
- Multi-unit Commercial

ΣT_V	Tangible value	$ 1,996,597.16
ΣIT_V	Intangible	$ 7,681,979.00
Σ_V	Total Value	$ 9,678,576.16
T_L	Tangible Loss from Fire	$ 70,000.00
IT_L	Intangible loss	$ -
Σ_L	Total loss	$ 70,000.00
Σ_S	Saved	$ 9,608,576.16
	S Ratio	99%

Case Study

- Multi-building





Case Study

- Multi-building

ΣT_V	Tangible value	$ 3,036,788.29
ΣIT_V	Intangible	$ 3,255,483.00
Σ_V	Total Value	$ 6,292,271.29
T_L	Tangible Loss from Fire	$ 996,410.57
IT_L	Intangible loss	$ -
Σ_L	Total loss	$ 996,410.57
Σ_S	Saved	$ 5,295,860.72
	S Ratio	84%

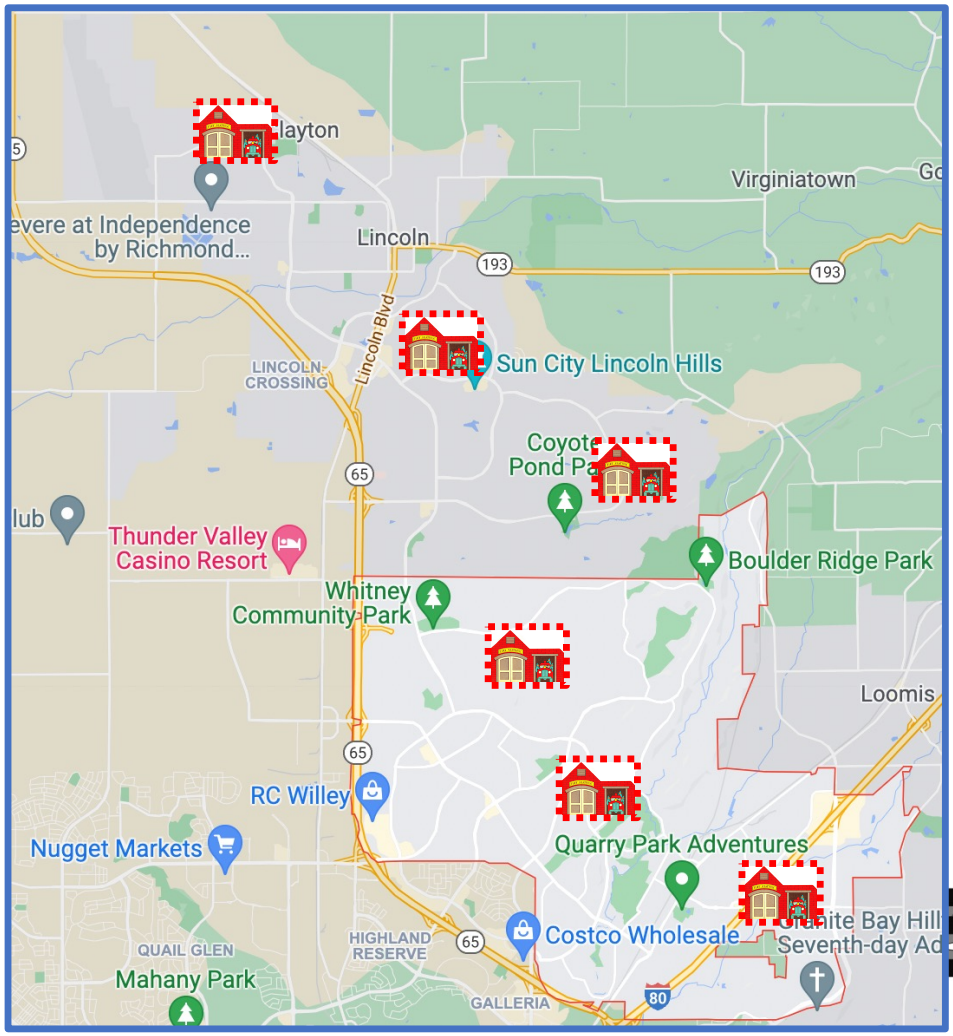
Conclusions

- Total for 1 year

RIO	
Total value saved	$ 19,149,420.40
Average value saved per building fire	$ 4,787,355.10
# of building fires in 2014	451
Annual saved	$ 2,159,097,150.21
Annual Budget	96,000,000
Annual ROI	2249%

Larger Applications City A/B Testing

- City A – City B
- Same Square Miles: about 26 miles
- Similar Population
- Same Population Density
- Same Number of Fire Stations



Larger Applications City A/B Testing

Fig. 5

2. Network Model

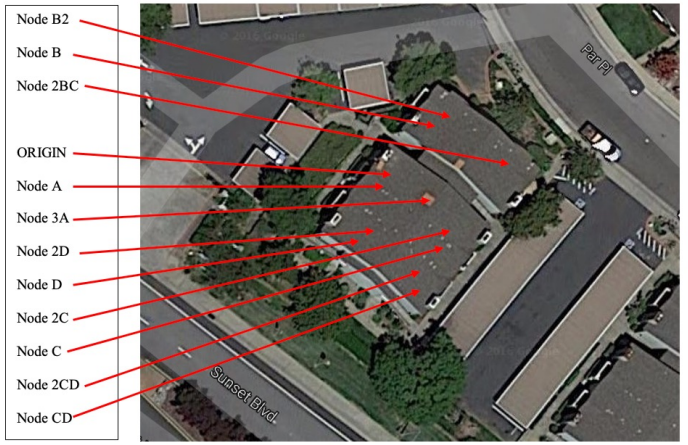
The network model in Figure 6 is modeled to a height of one from the contagious node, consisting of three nodes and two links.

Fig. 6

3. Quantification

Table 3 shows tangible and intangible values of each at risk node on the network model. The table also shows the tangible and intangible loss for the fire along with the total value saved and a calculated 'S' ratio. The number of nodes and links were calculated to obtain the network density and mean degree of the network.

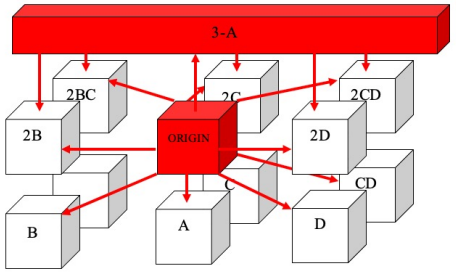
Fig. 7



2. Network Model

The network model in Figure 8 modeled to a height of one from the contagious node, consisting of twelve total nodes and sixteen links leading out from the contagious node.

Fig. 8



Larger Applications City A/B Testing

City A			City B	
Total Tangible Value at Risk	$ 6,861,548.03		Total Tangible Value at Risk	$ 16,541,366.90
Total Intangible Value at Risk	$ 84,225.54		Total Intangible Value at Risk	$ 7,945,343.27
Total Value at Risk	$ 6,945,773.57		Total Value at Risk	$ 24,486,710.18
Total Tangible Fire Loss	$ 1,289,721.08		Total Tangible Fire Loss	$ 196,500.00
Total Intangible Fire Loss	$ 84,225.53		Total Intangible Fire Loss	$ 70,362.02
Total Fire Loss	$ 1,373,946.61		Total Fire Loss	$ 266,862.02
Total Value Saved	$ 5,571,826.96		Total Value Saved	$ 16,039,722.97
Average 'S' Ratio	66%		Average 'S' Ratio	93%
Average Mean Degree	1.845004669		Average Mean Degree	1.184444444
Average Network Density	1.001068376		Average Network Density	0.592222222

Larger Applications City A/B Testing

Total Value Saved	$ 5,571,826.96		Total Value Saved	$ 16,039,722.97
Average Value Saved per Fire	$ 992,253.37		Average Value Saved/Structure	$ 1,458,156.63
Annual Budget	$ 4,422,826.00		Annual Budget 2016	$ 7,128,200.00
Annual ROI	126%		Annual ROI	225%

The Value of Additional Firefighters

- A/B testing - $600,000

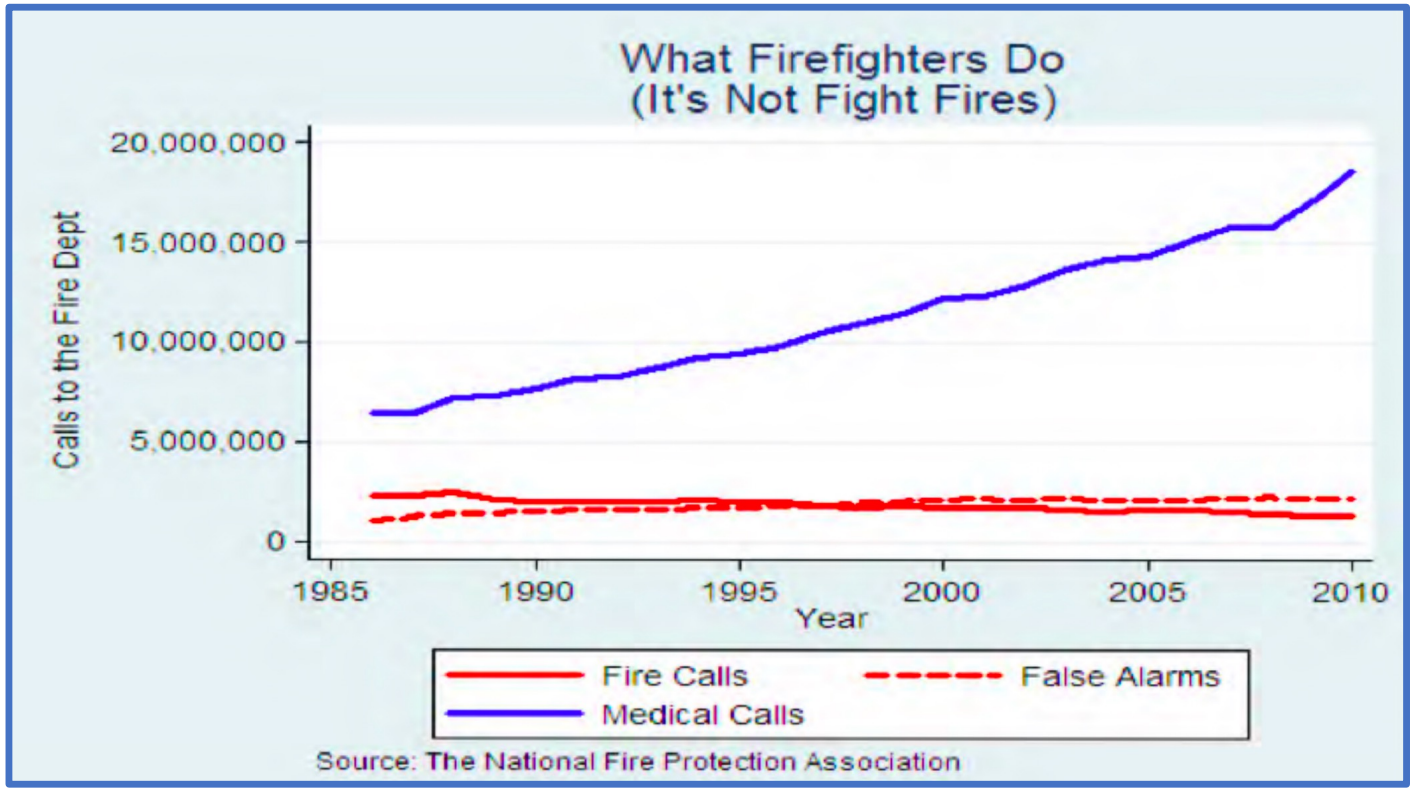
How much is each additional Firefighter on an Engine worth? About $600,000.

Eric Saylors May 19, 2017 · 4 min read

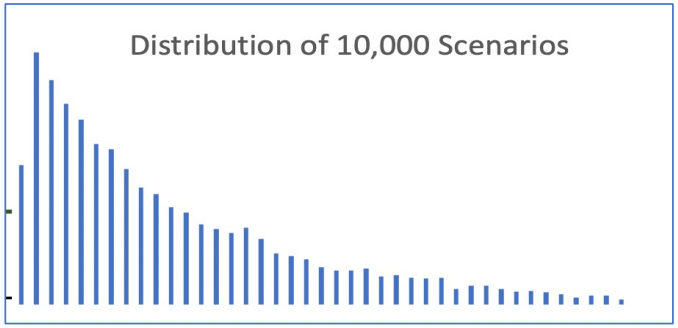
A single firefighter may cost $120,000 in total costs, but saves the

Recommendations

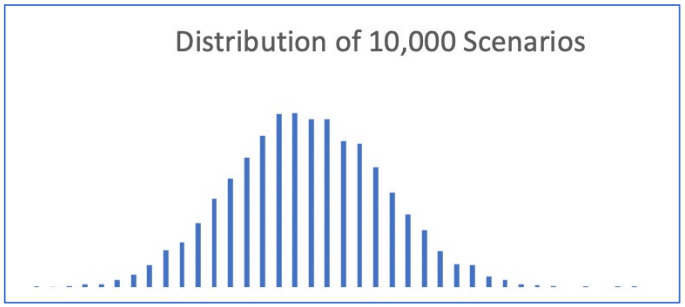
- Be Careful How We Frame Problems
  - Fires Follow a Power law
  - Most Events Follow a Normal Distribution



Power law



Bell Curve



Ontology

What can we known?

Potential to self replicate?

No

Yes

What do we know?

Simple

Complex

Epistemology

How do we know it?

Independent

Connected

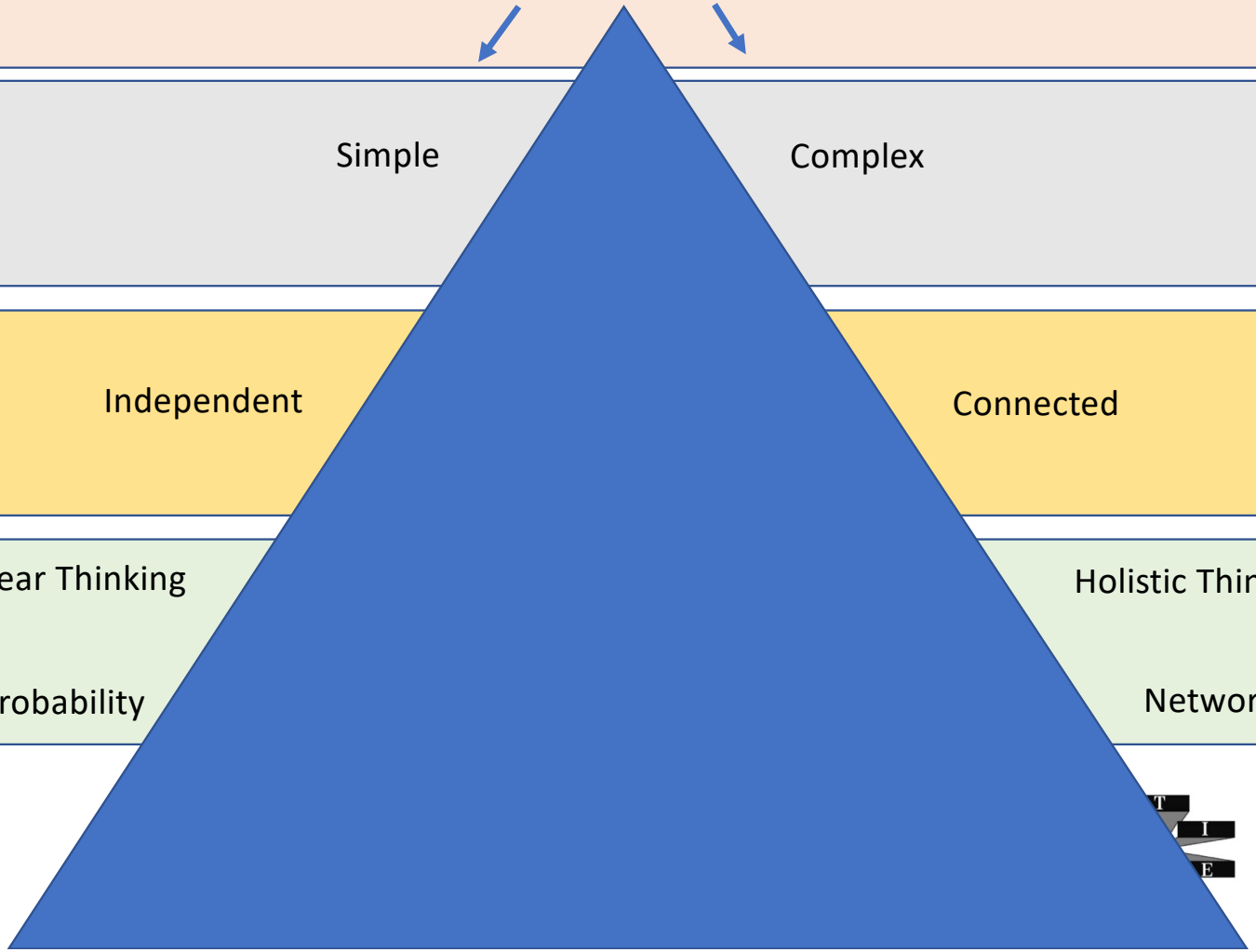
How do we work with it?

Linear Thinking

Holistic Thinking

Statistics and Probability

Network theory



Thank You

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