



33rd Annual **INCOSE**
international symposium
hybrid event

Honolulu HI USA
July 15 – 20, 2023

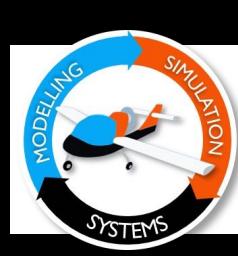
www.incose.org/symp2023



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iPhD Candidate (Uni of Adelaide) & Principal SE (Shoal Group)
<https://www.linkedin.com/in/JawaharBhalla/>



Tales of Tails, Cobras, Cats and Models



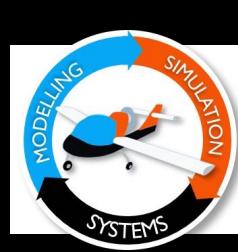
Its all about Models....



“Remember, always, that everything you know, and everything everyone knows, is only a model. Get your model out there where it can be viewed. Invite others to challenge your assumptions and add their own.”

Donella Meadows : Thinking in Systems

Disclaimer - the concepts expressed in this presentation are personal opinions and insights that continue to evolve based on theoretical and experiential learning and should not be associated with any organisation that I have been part of or that I am presently affiliated with, nor should they be taken as suggesting the truth.



The Island of Borneo – 1950...



A major outbreak of malaria amongst the Dayak people in Sarawak, Borneo

The WHO Responded – Sprayed DDT

Effect of DDT Use in Borneo

In the early 1950's the people in Borneo, suffered from Malaria the World Health Organization had a solution, kill the mosquitoes with DDT. This is what happened.

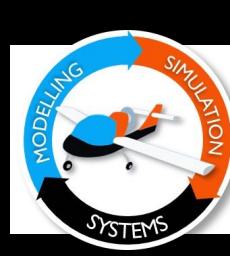


*Good
Intentions*

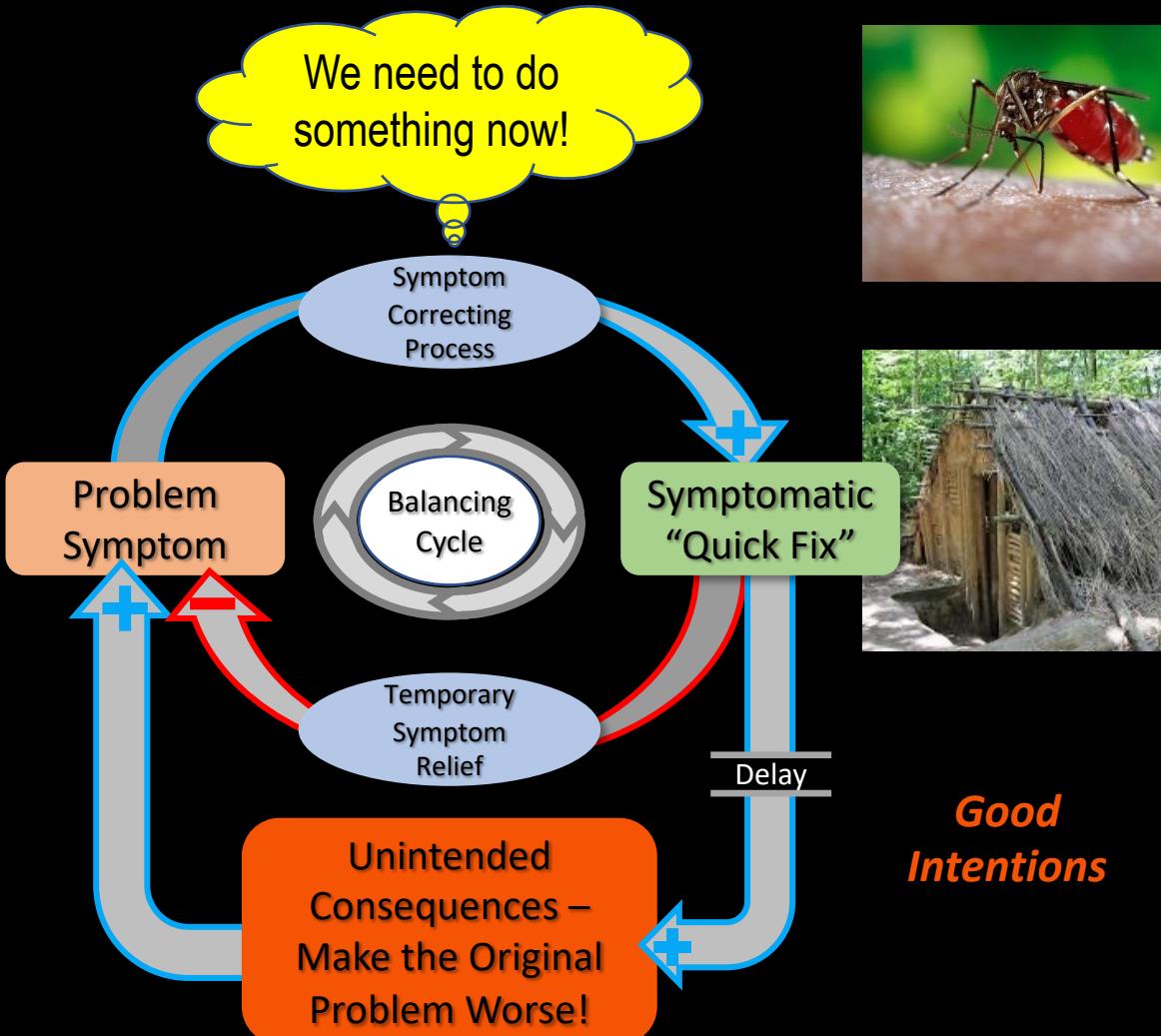


*Unintended
Consequences!*





Systems Archetypes - “Fixes that Backfire”

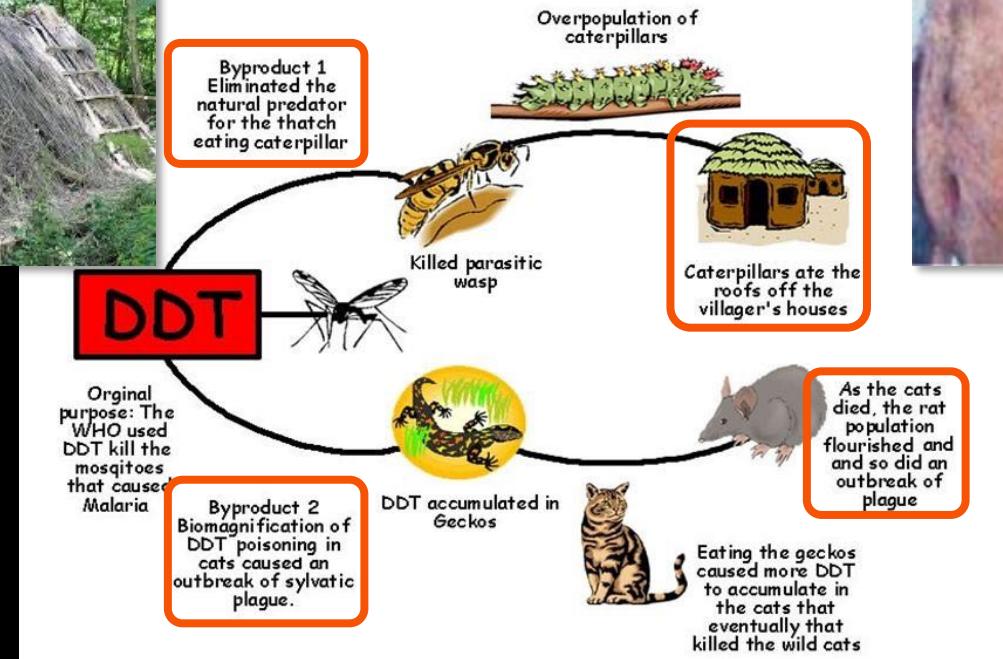


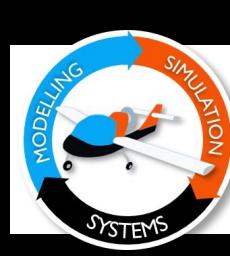
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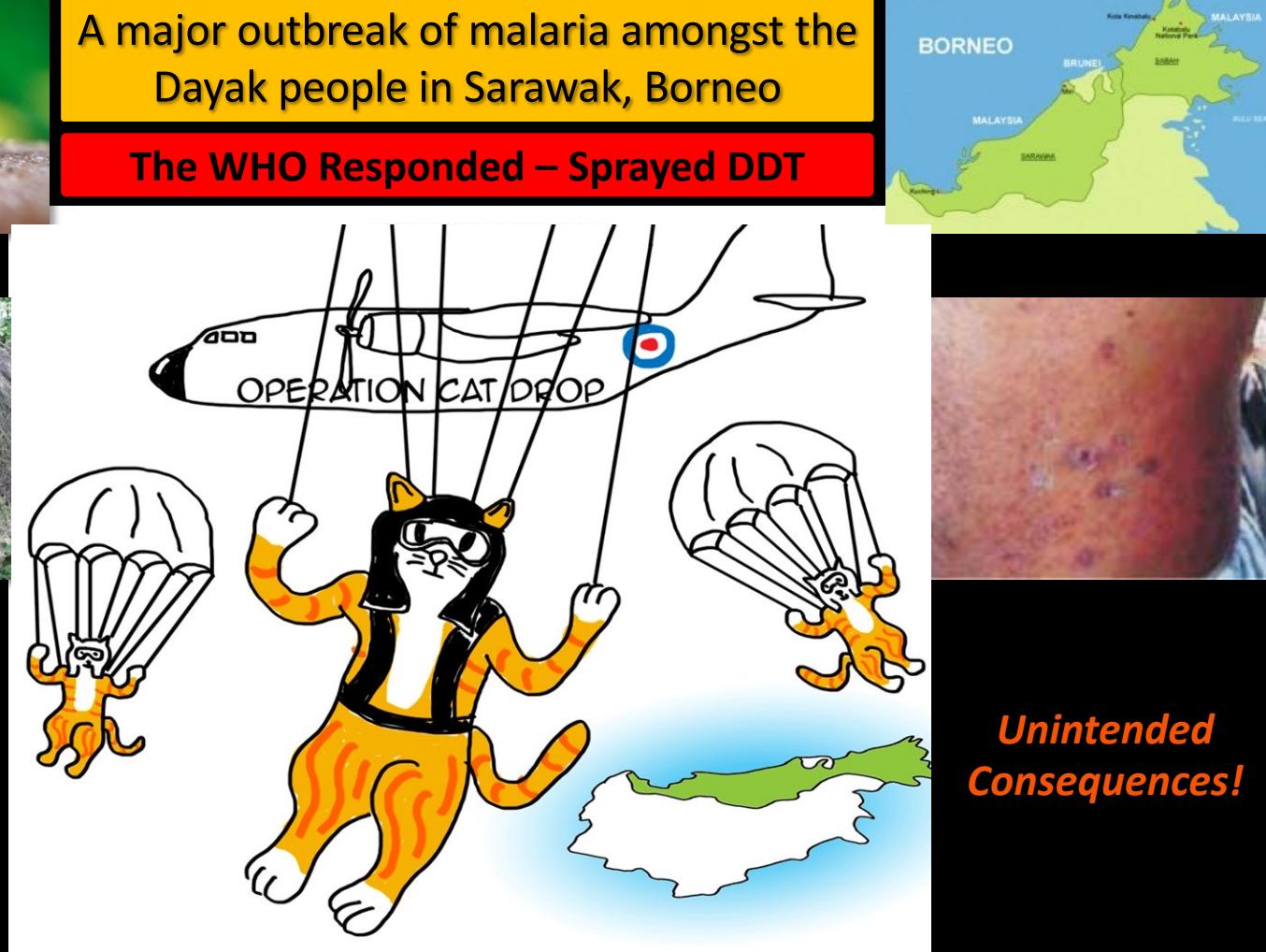
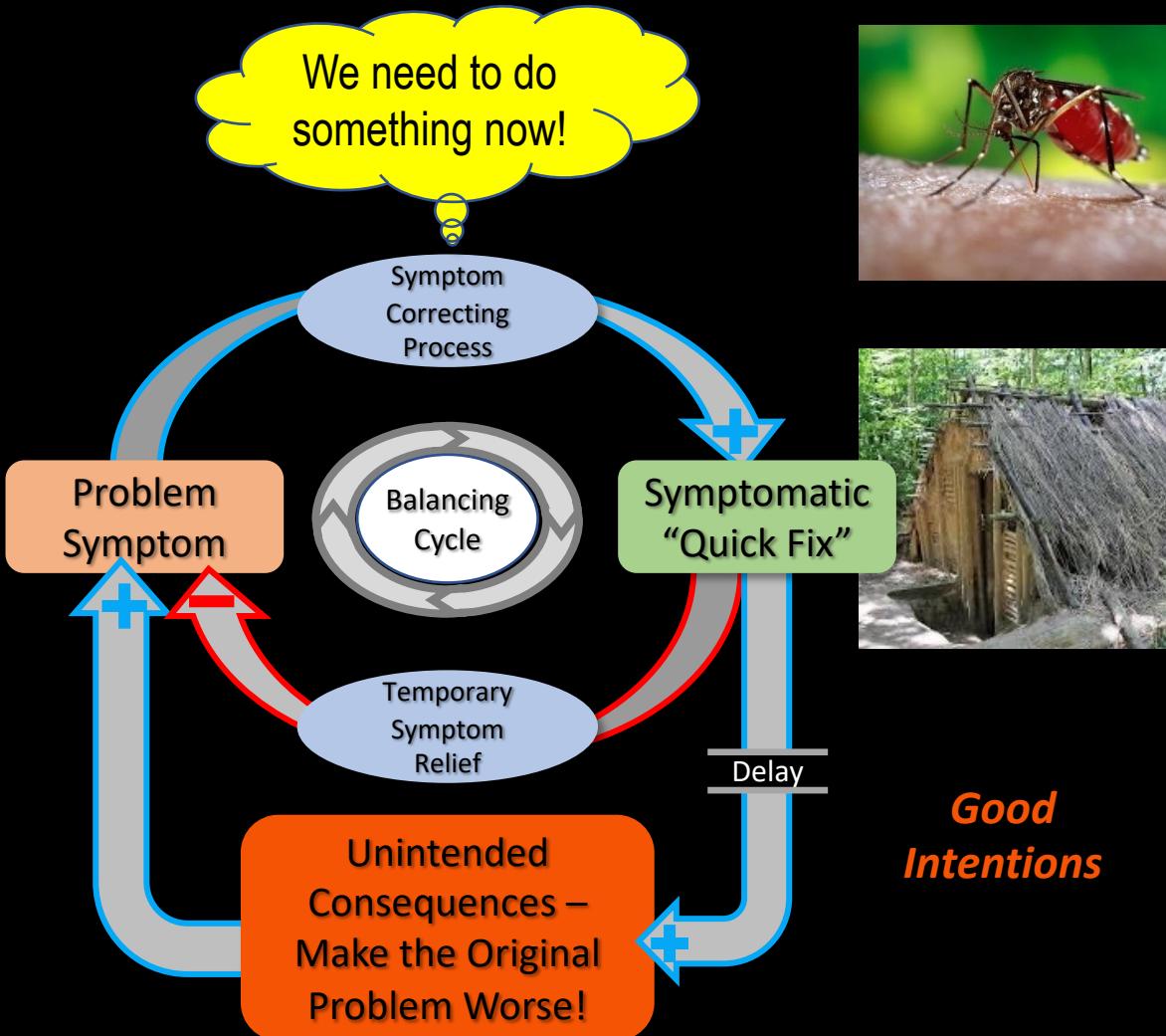


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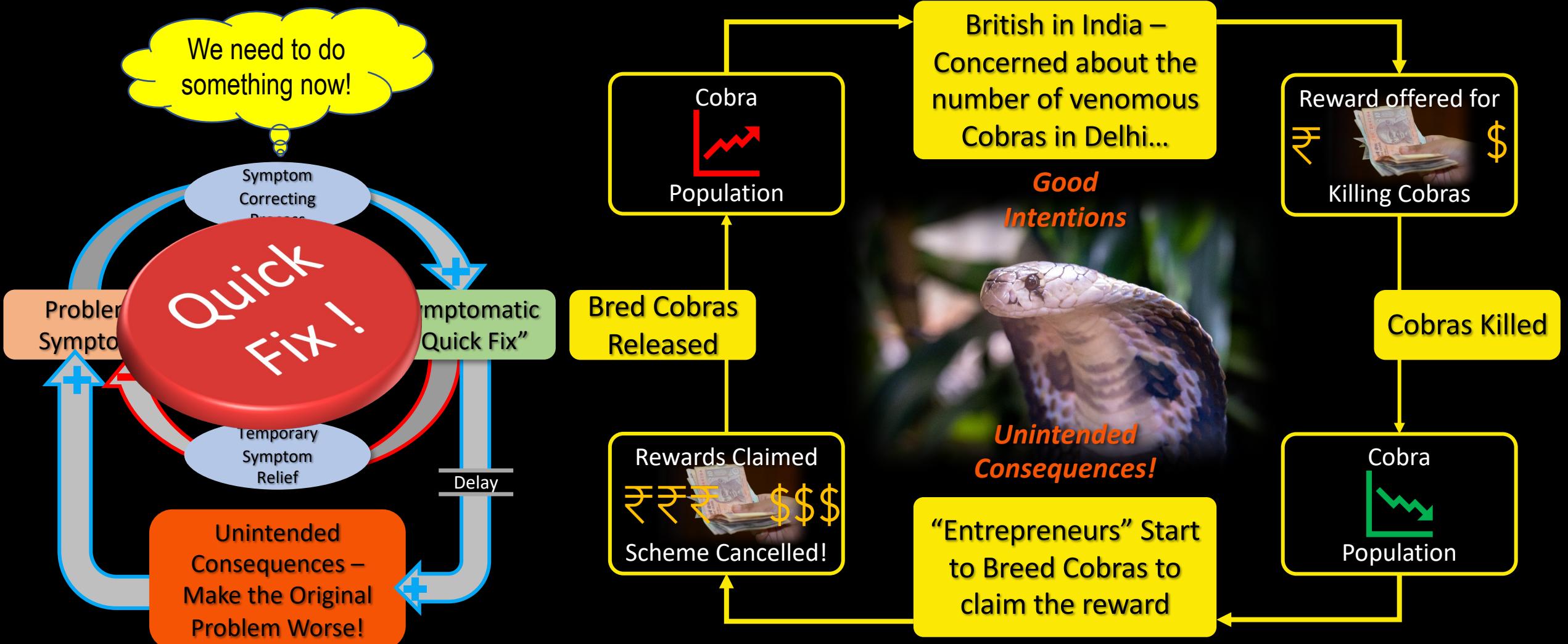


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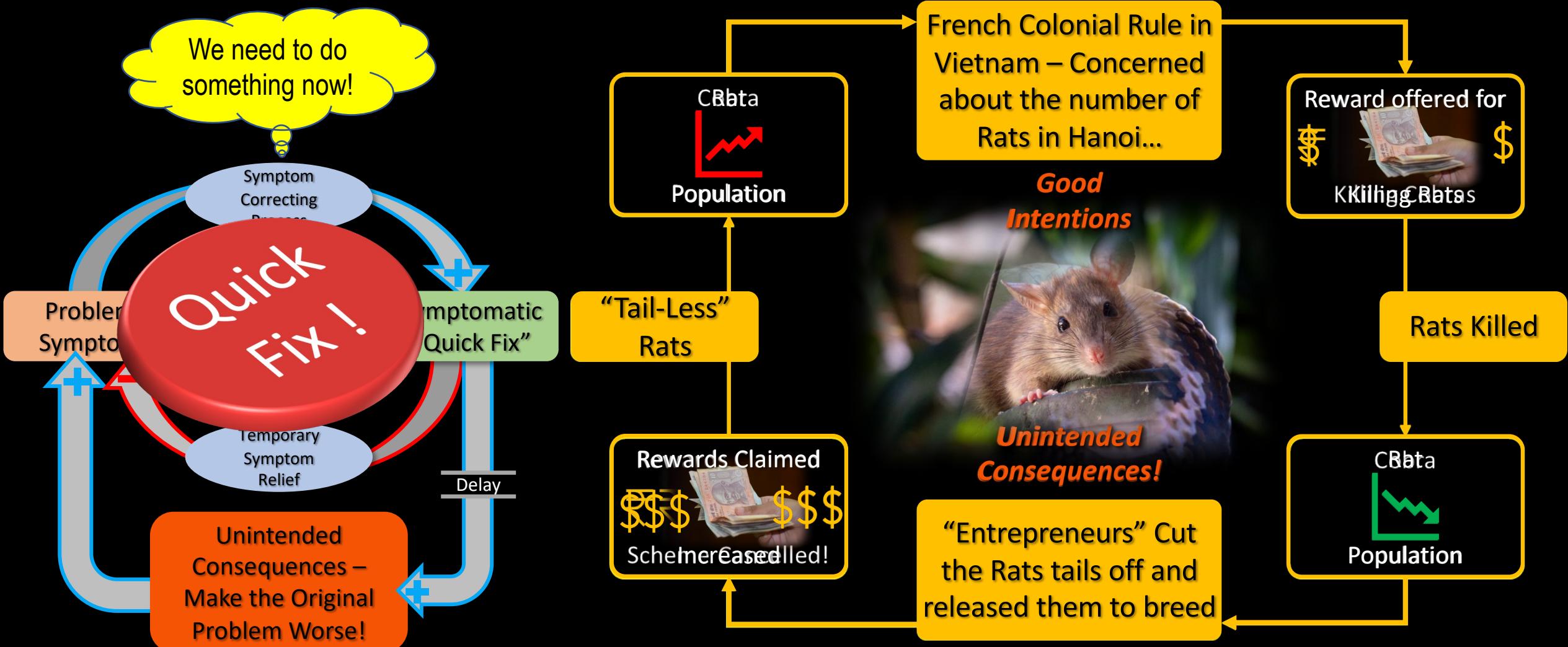


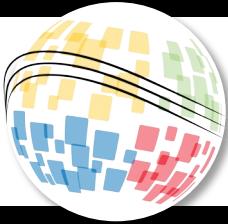
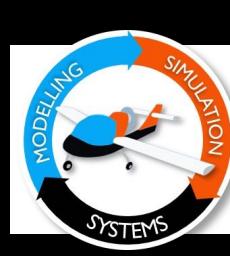
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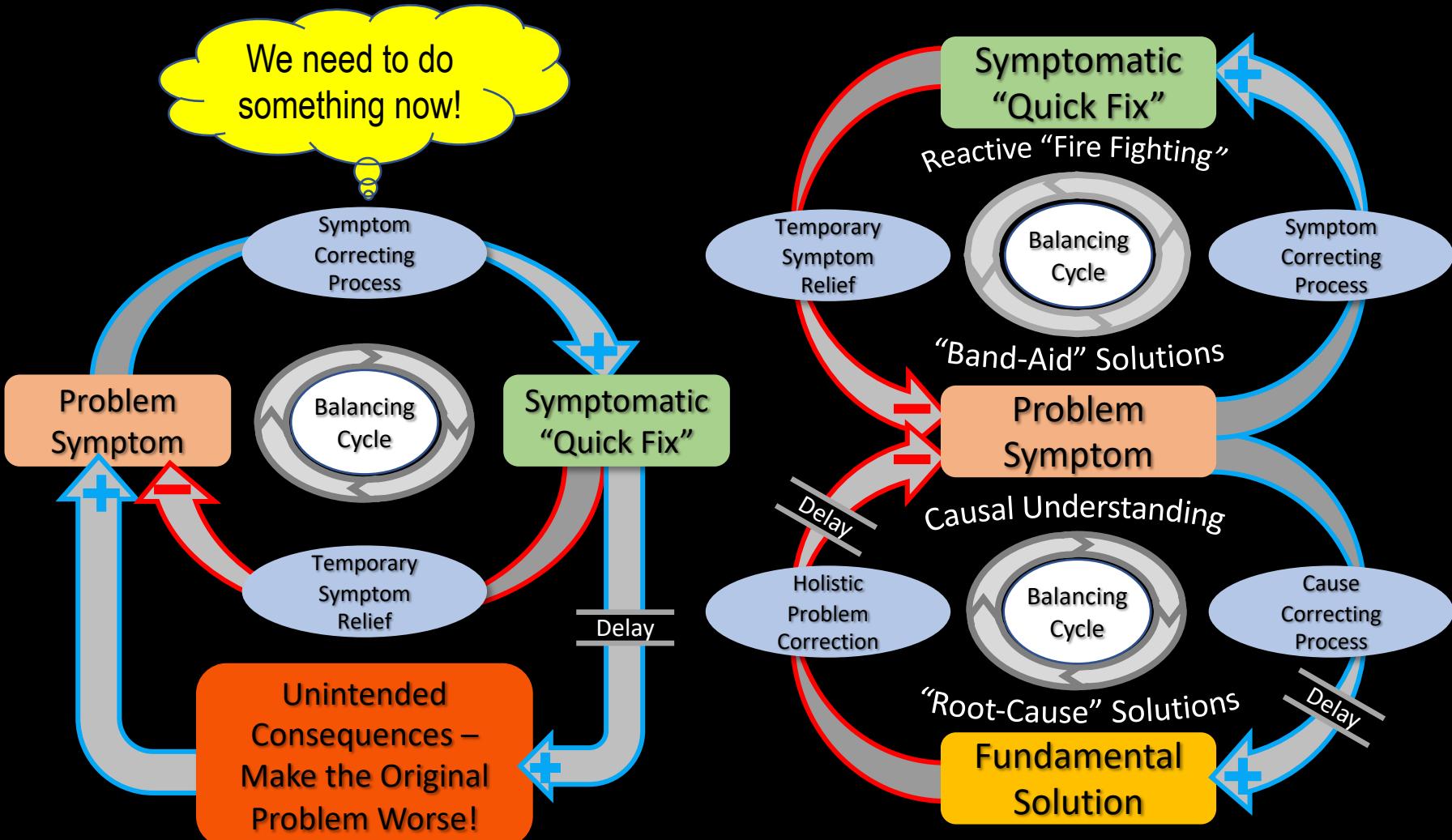


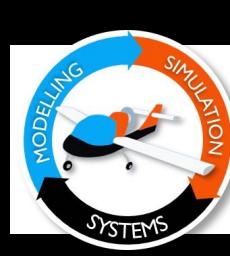
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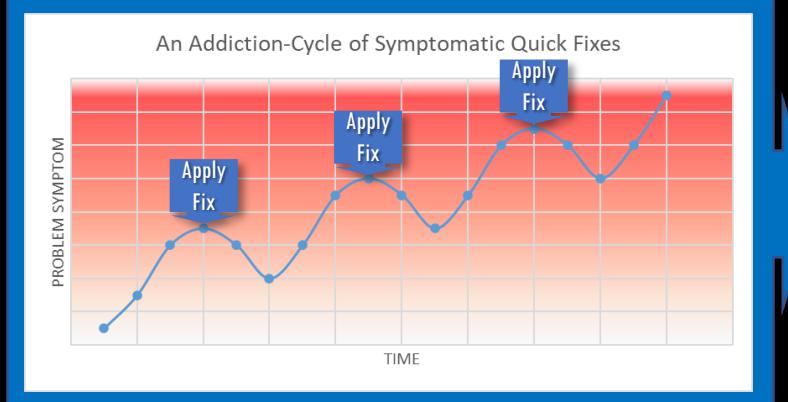


Systems Archetypes - “*Shifting the Burden*”

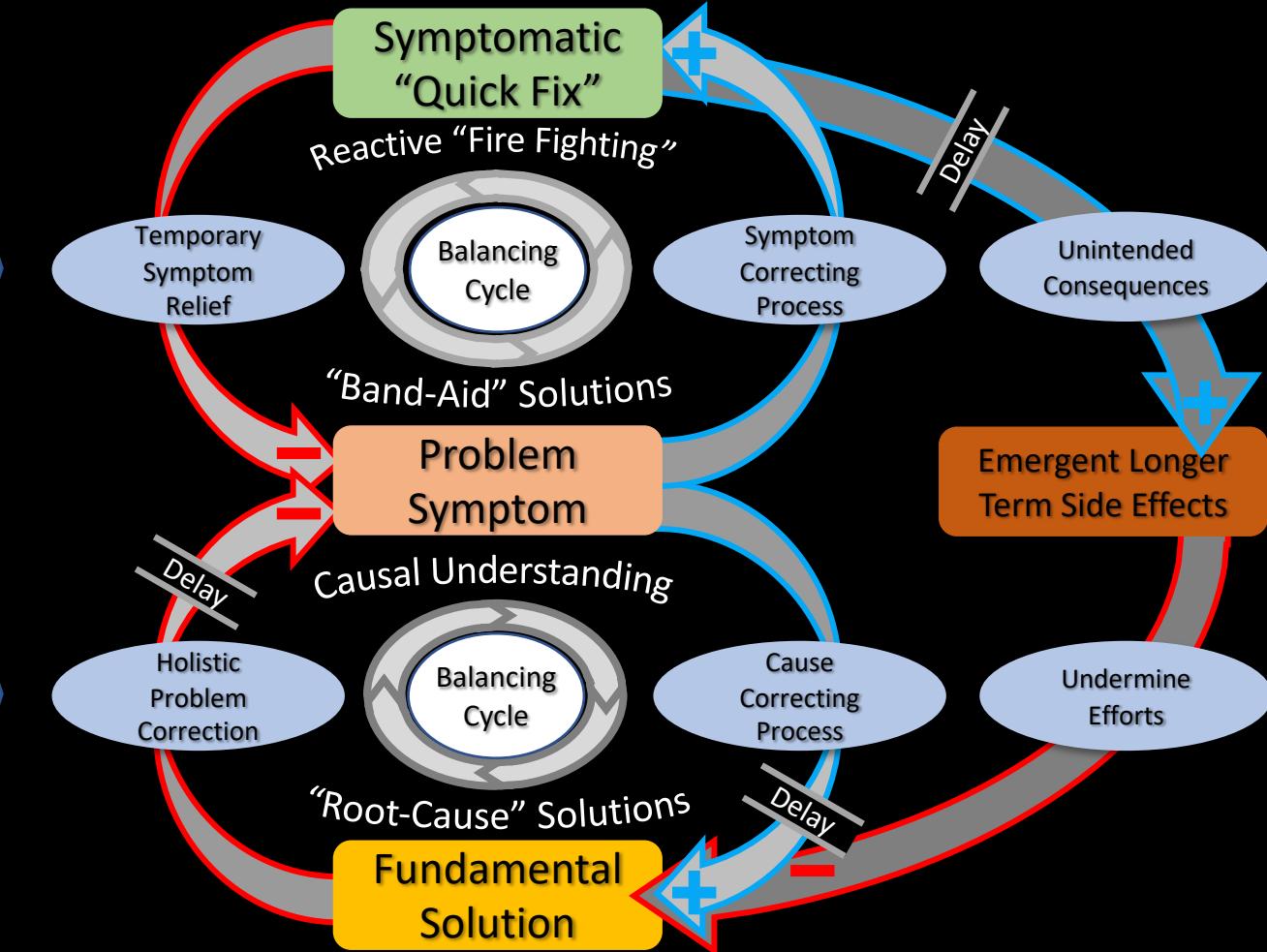




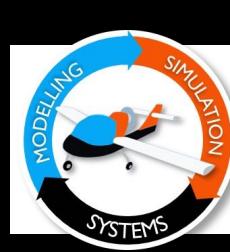
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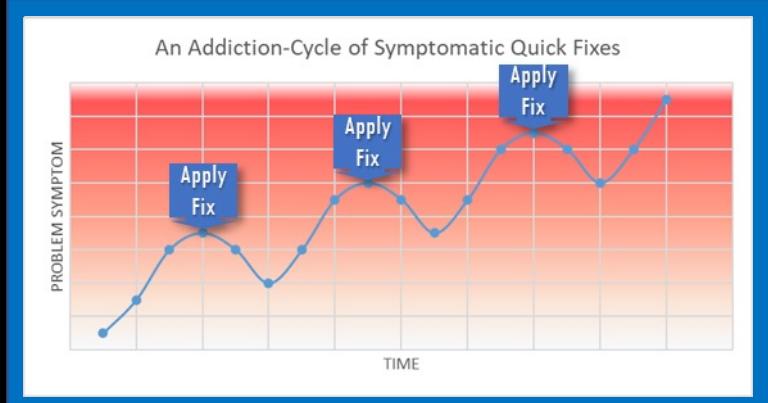
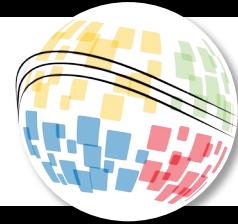
The longer we delay focusing on the fundamental solution, the more complex and harder it gets from unintended emergent consequences from our symptomatic “quick fixes”



<https://youtu.be/Ezu0U-ofldc>



Systems Archetypes - “*Shifting the Burden*”

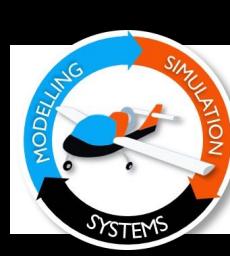


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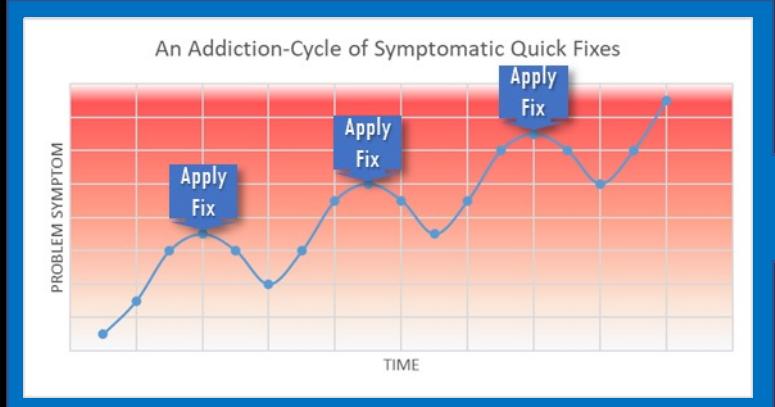


Image Credit - une.edu

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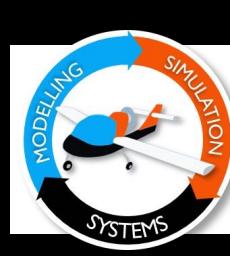
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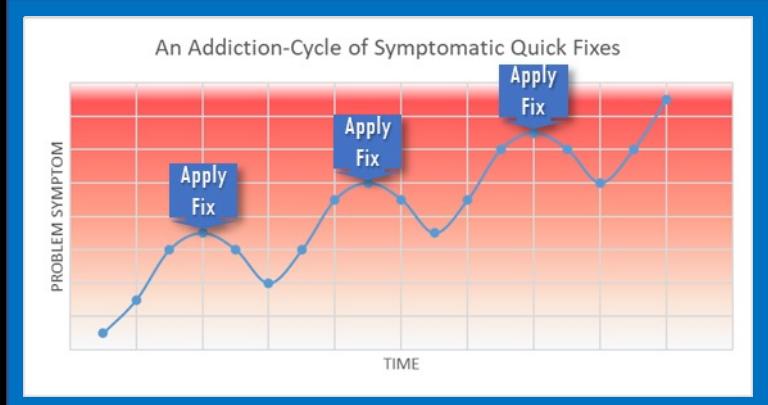
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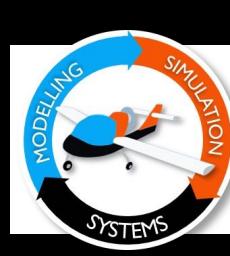
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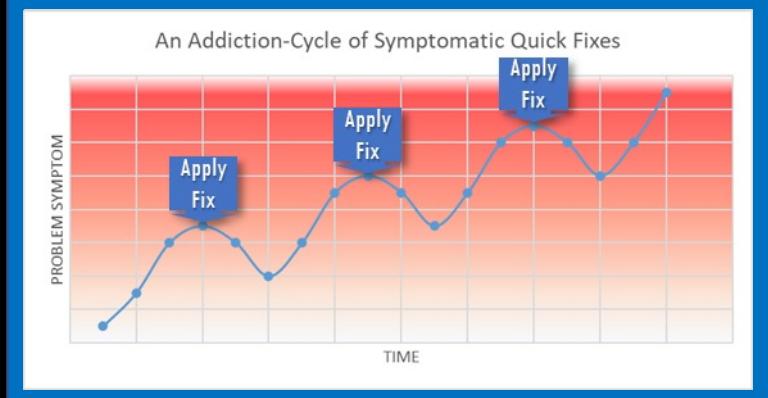
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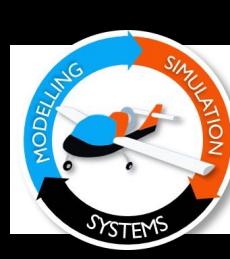
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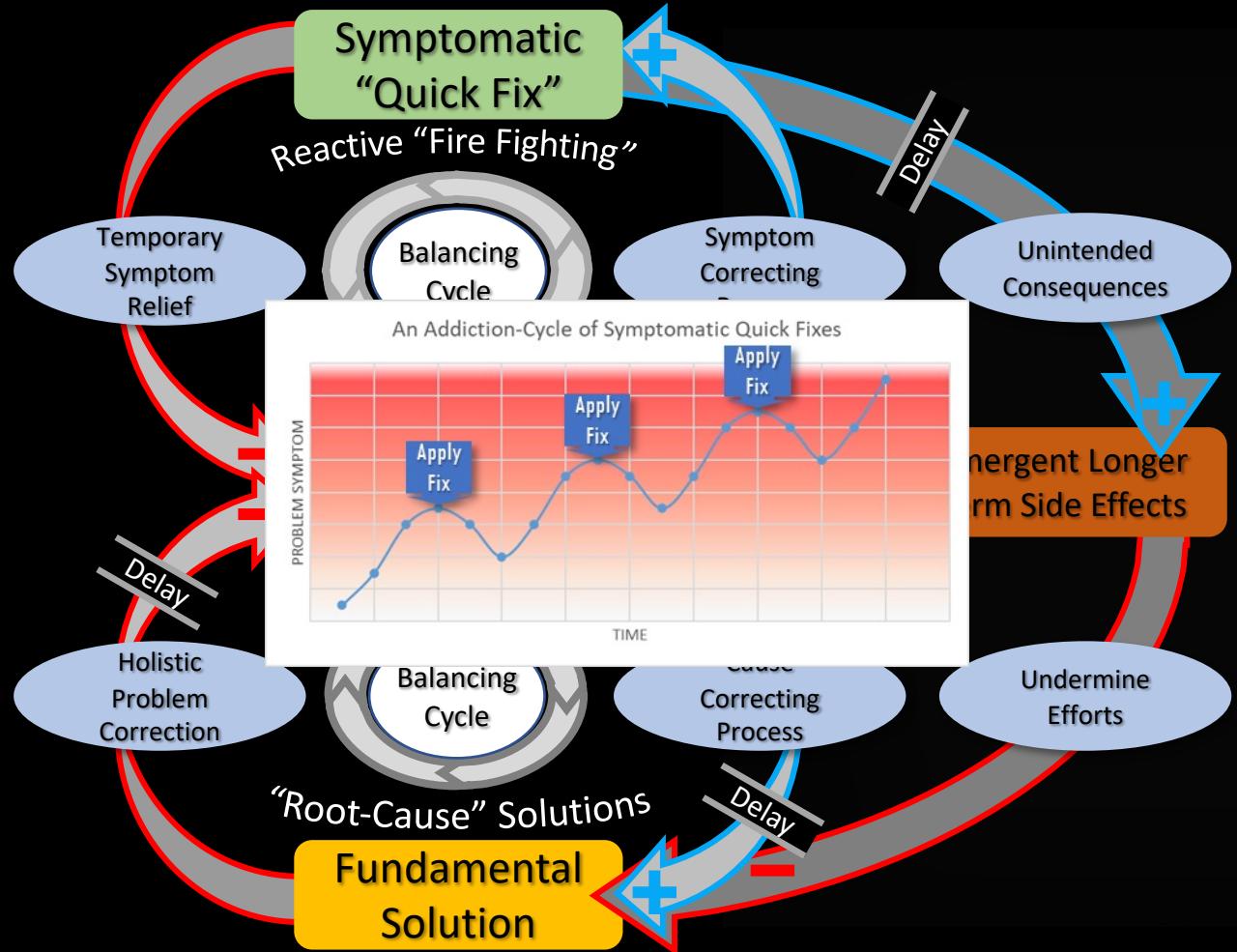
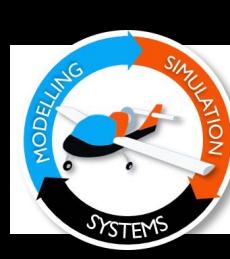
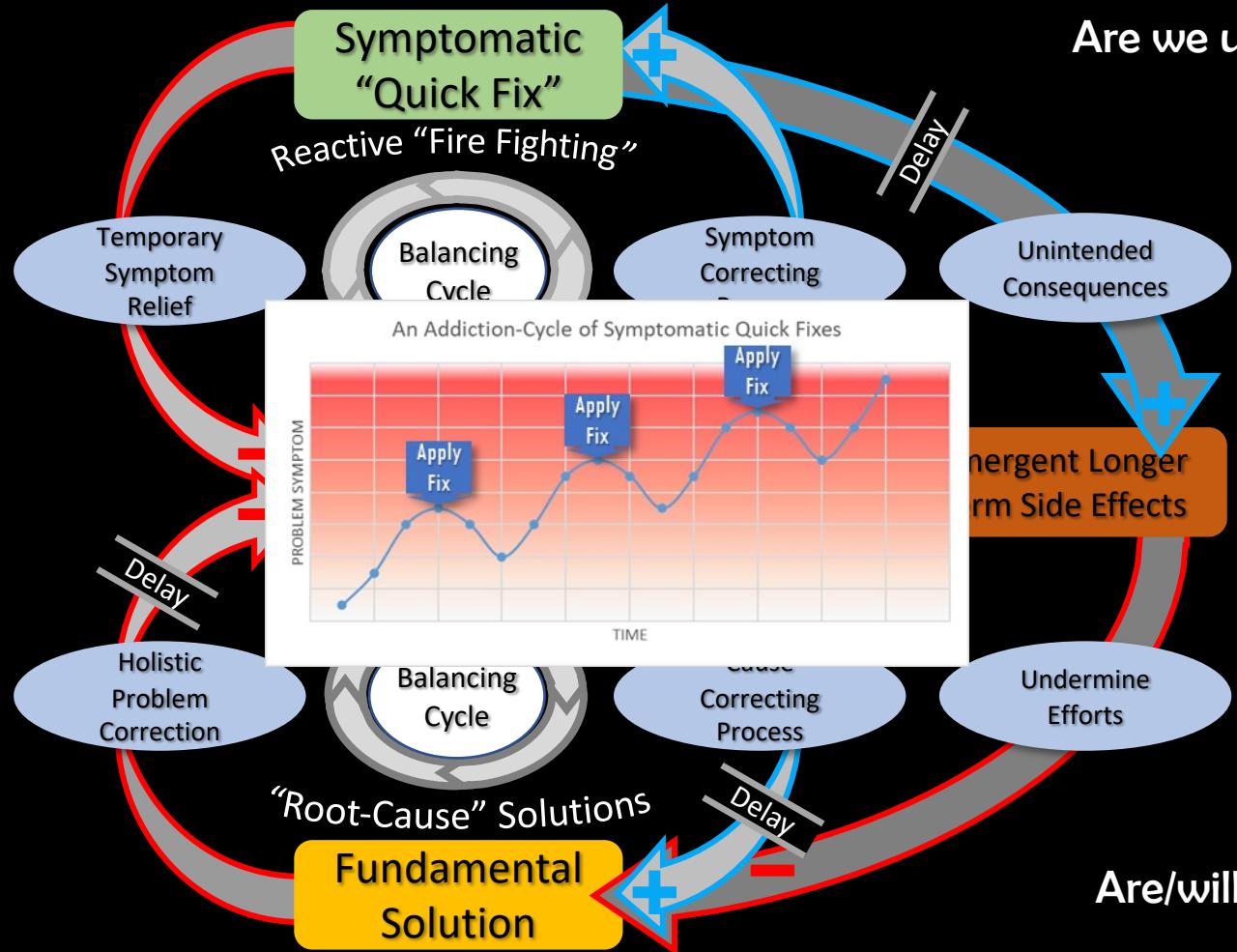


Image Credit Pixabay - Pete Linforth



Systems Archetypes - “*Shifting the Burden*”

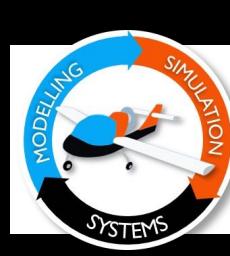


Are we understanding and dealing with our challenges holistically?



Are/will we leave a “quick-fixes” legacy for future generations ?

Image Credit Pixabay – Gerd Altmann



Systems Thinking...(*Understanding Systems*)

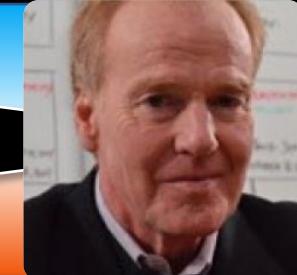
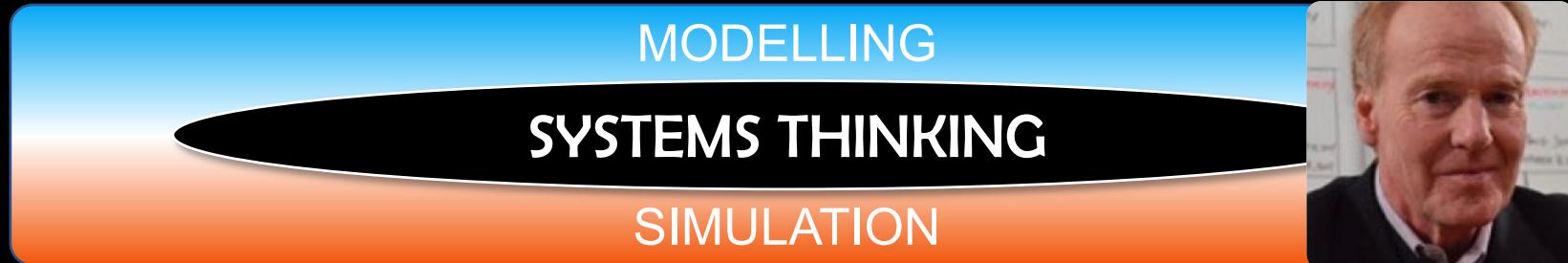


WHAT?

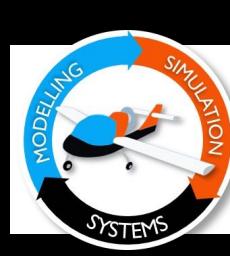
HOW?

WHY?

Peter Senge → “Systems Thinking is a *conceptual framework*, a *body of knowledge* and *tools* that have been developed over the past fifty years, to make the full patterns clearer, and to help to *change them effectively*.”



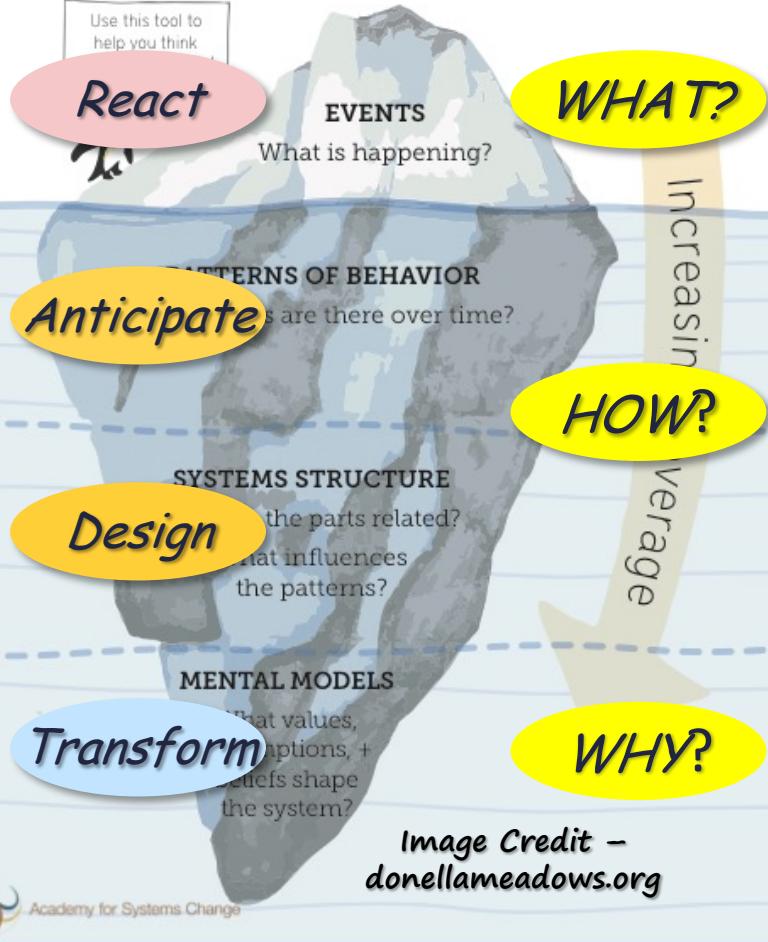
Personal view → Systems Thinking is a *conceptual framework* to *understand and make sense* of the world we live in, to deal *efficiently* and *effectively* with the *challenges we perceive* and *create the reality we desire*.



Systems Thinking...(*Understanding Systems*)



THE ICEBERG MODEL



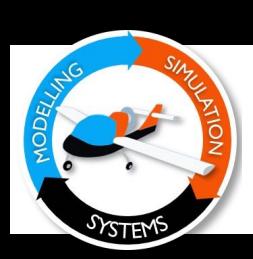
The Iceberg Model is a **Systems Thinking** tool that helps us discover and deal **efficiently** and **effectively** with “*events*” through understanding **patterns of behaviour**, **structures/architectures** and **underlying mental models**, helping identify the **greatest leverage solution options** for holistically solving problems while **minimising unintended emergent consequences**.

MODELLING

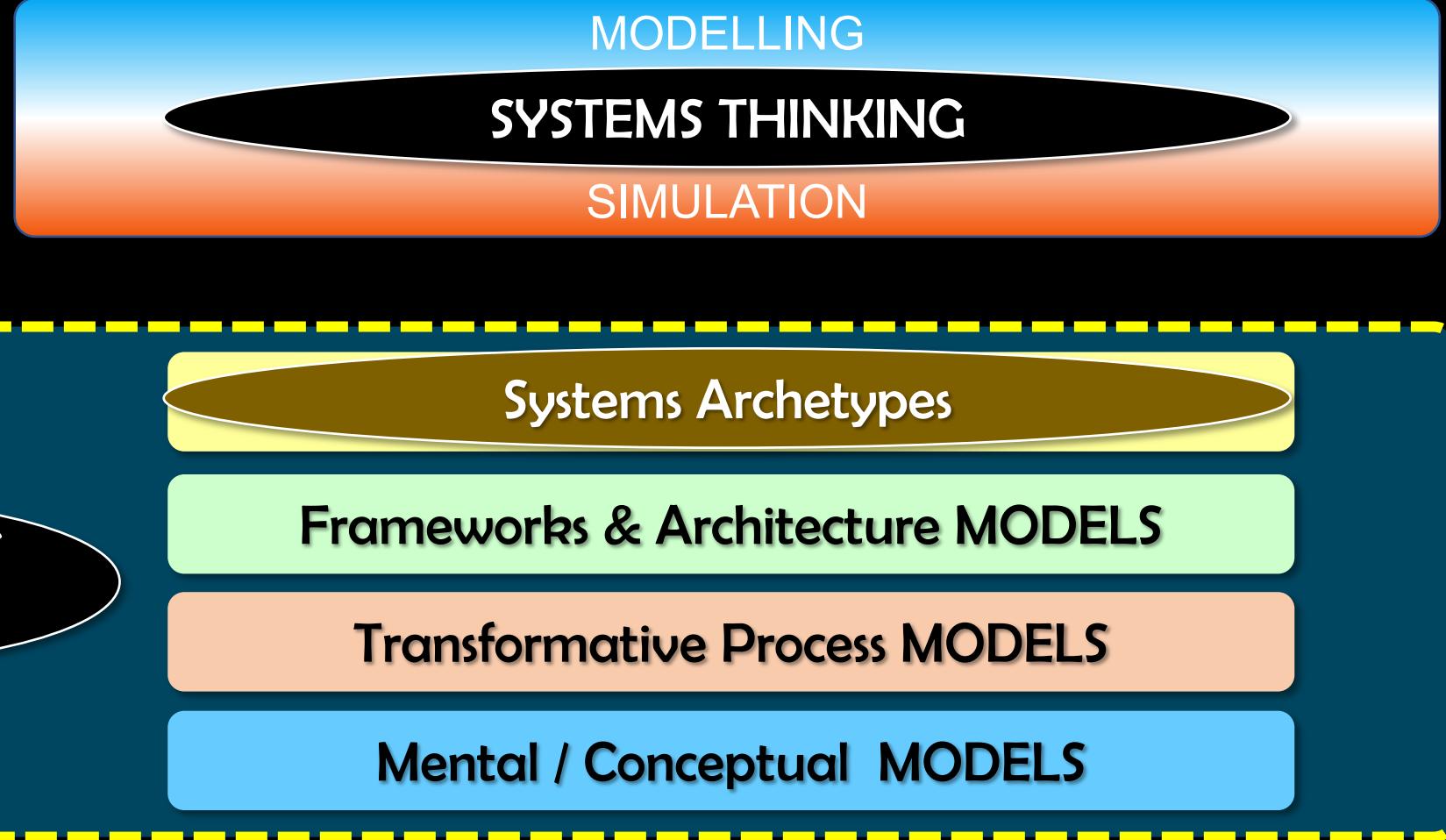
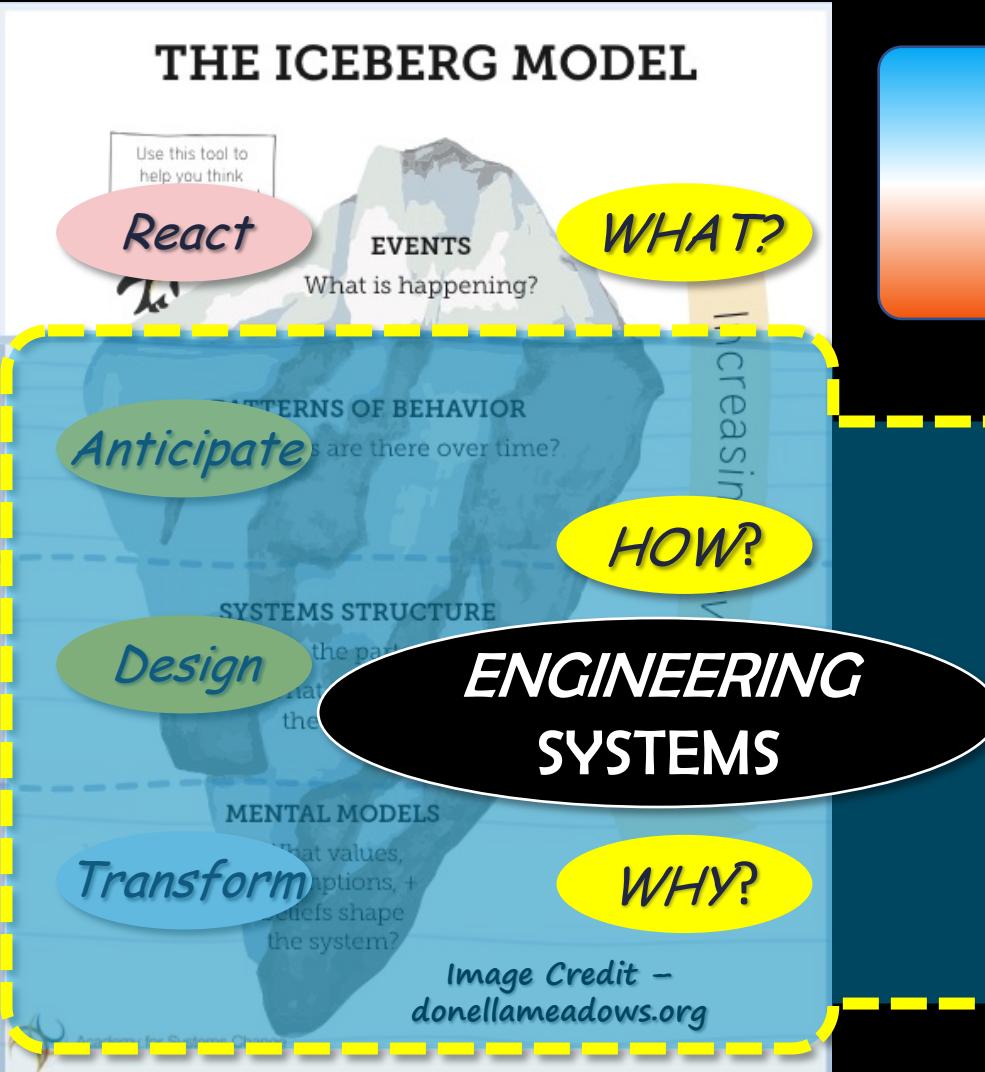
SYSTEMS THINKING

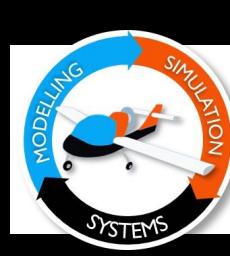
SIMULATION

Personal view → Systems Thinking is a **conceptual framework** to **understand and make sense** of the world we live in, to deal **efficiently** and **effectively** with the **challenges we perceive** and **create the reality we desire**.



Systems Thinking...(*Understanding Systems*)





Modelling &
Simulation

Mental / Conceptual
MODELS

Framework /
Architecture MODELS

Transformative
Process MODELS



Simulation = Model(s) + Execution

A **Model** is a Physical, Mathematical or Logical abstraction (of a System, Entity, Phenomenon, Activity or Process) for a particular purpose (i.e. a suitable representation)

A **Simulation** is an **Enactment** (Method of Implementing) a **Model** over Time

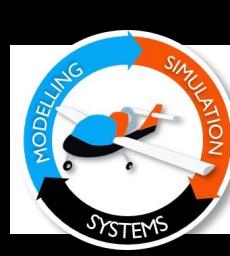


A Map (**model**) of Japan

Real-Time GPS navigation
(**simulation**) using “map **models**”



A Simulator → The Tool that Executes the **Simulation**



Modelling & Simulation

Mental / Conceptual MODELS

Framework / Architecture MODELS

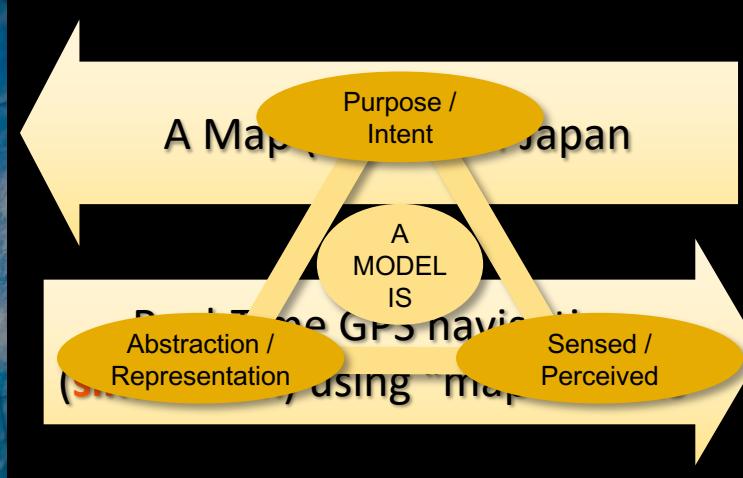
Transformative Process MODELS



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A **Simulator** → The Tool that **Executes** the **Simulation**



Modelling &
Simulation

Mental / Conceptual
MODELS

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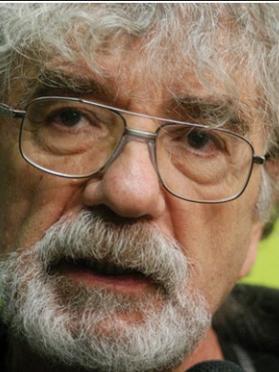
Santiago theory of cognition

"The living system reacts with its environment to bring forth a sense of awareness...." –
Humberto Maturana

"We don't perceive the world we see, we see the world we perceive"
– Humberto Maturana

Mental Models are deeply ingrained assumptions, generalizations, or even pictures of images that influence how we understand the world and how we take action." – Peter Senge

"When one human being tells another human being what is real, they are actually making a demand for obedience" – Humberto Maturana



Only love expands intelligence. To live in love is to accept the other and the conditions of his existence as a source of richness, not as opposition, restriction or limitation.

— Humberto Maturana —

AZ QUOTES



MENTAL Models



A learning organization is an organization that is continually expanding its capacity to create its future.

— Peter Senge —

AZ QUOTES



Modelling & Simulation

Mental / Conceptual MODELS

Framework / Architecture MODELS

Transformative Process MODELS



Santiago theory of cognition

"The living system reacts with its environment to bring forth a sense of awareness..." – Humberto Maturana

DOING!

Wisdom

Understanding



Data

LEARNING

"We don't perceive the world we see, we see the world we perceive"
- Humberto Maturana"

EFFECTIVENESS

"Why"

EFFICIENCY

Instrument

Procedure

Raw - Symbols, Properties

VALUE

Meaningless

Wisdom

Explanatory

Doing

SYSTEMIC

SYSTEMATIC

Efficiency is
Doing things right

One of the most important ways to live in love is to accept the other and the conditions of his existence as a source of richness, not as opposition, restriction or limitation.

— Humberto Maturana —

AZ QUOTES

KNOWLEDGE Vs WISDOM

"Autopoiesis"

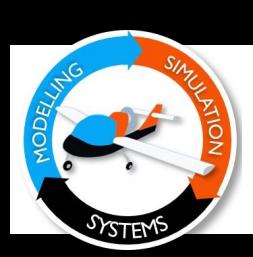
Effectiveness is
Doing the right thing

A learning organization is an organization that is continually expanding its capacity to create its future.

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AZ QUOTES

MENTAL Models

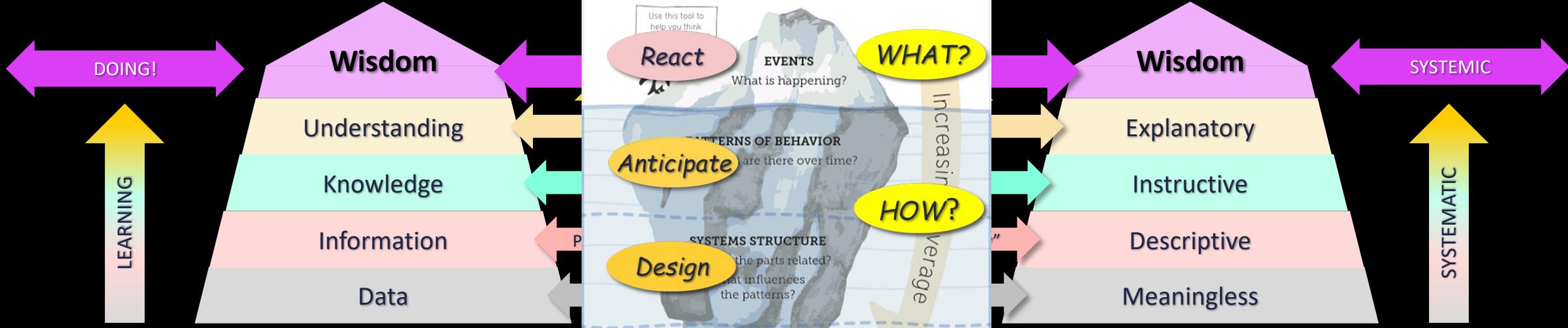


Modelling &
Simulation

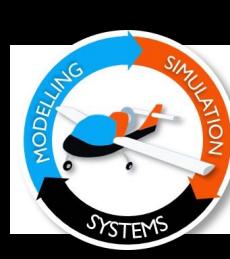
Mental / Conceptual
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MENTAL Models

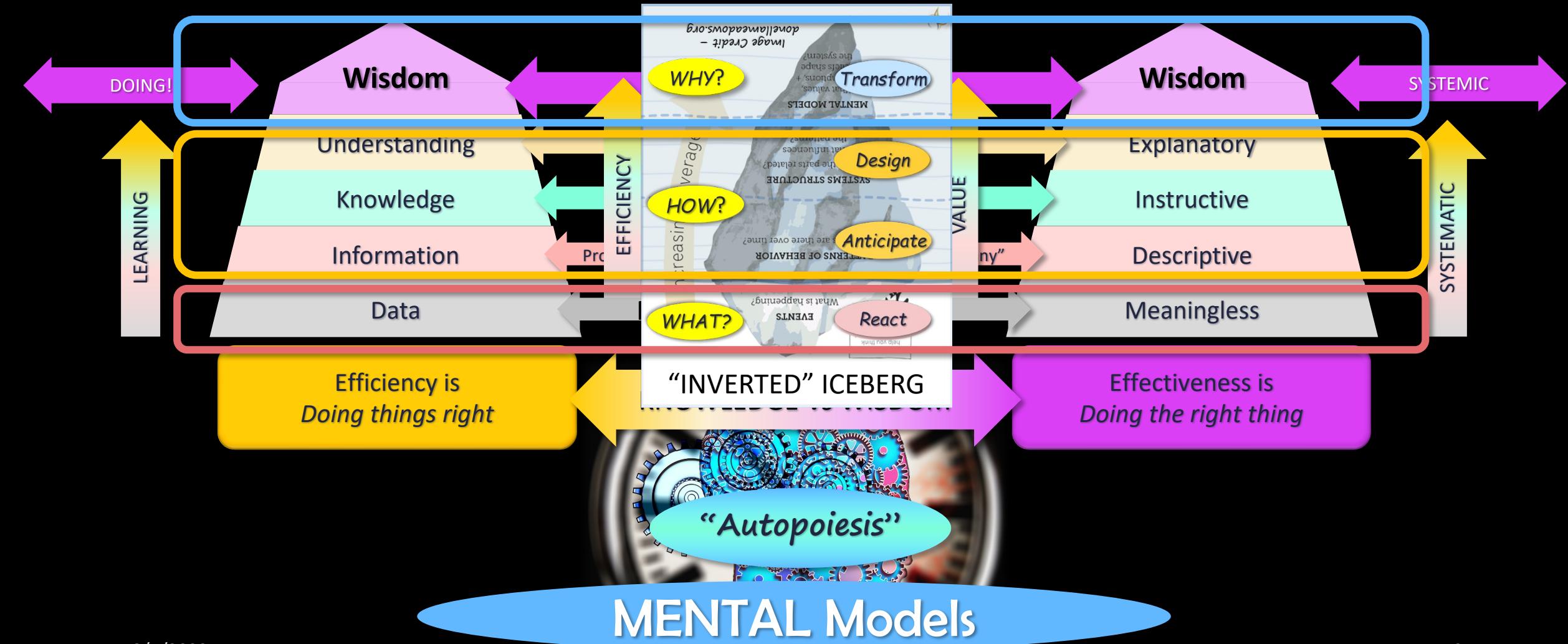


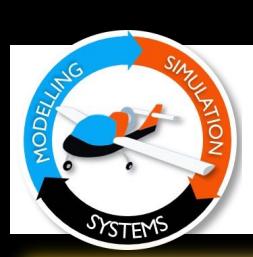
Modelling & Simulation

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Modelling &
Simulation

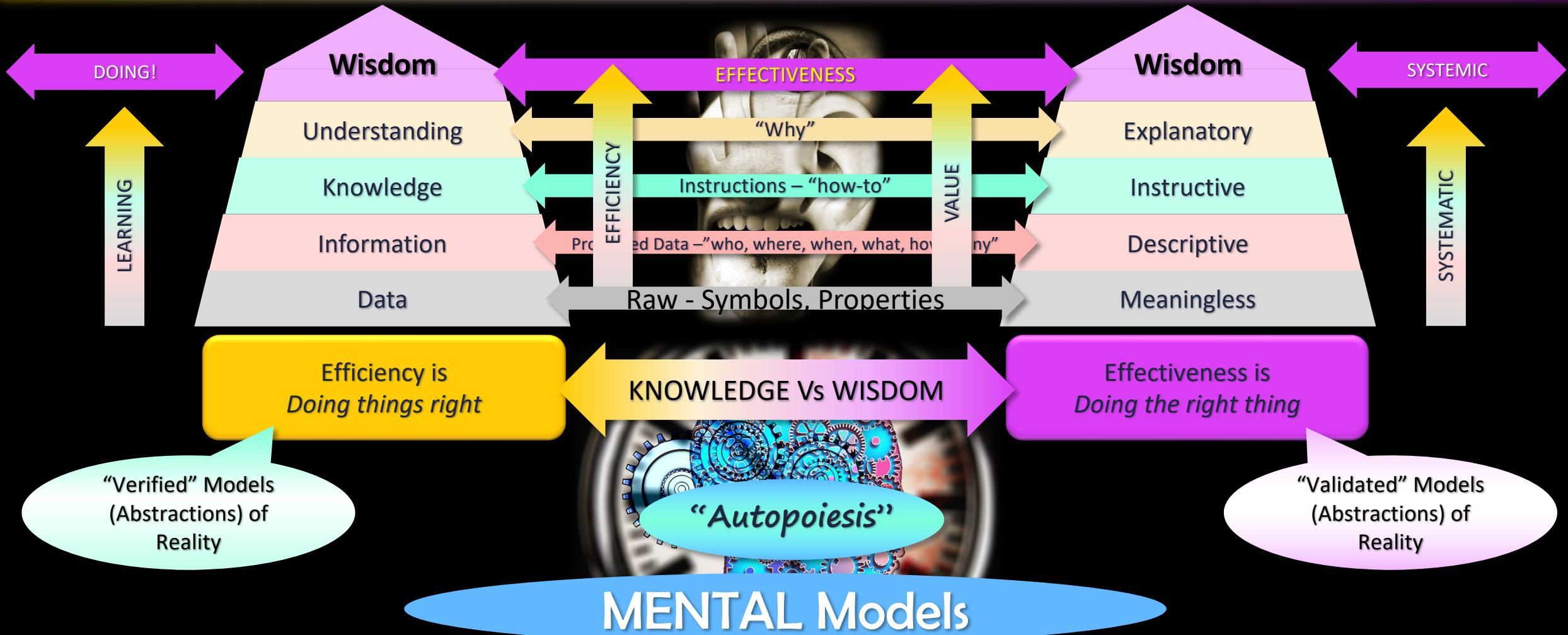
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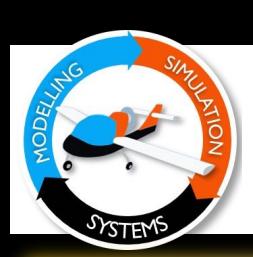
Framework /
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Knowledge = Knowing “HOW” \leftrightarrow Wisdom = Knowing “WHY”





Modelling &
Simulation

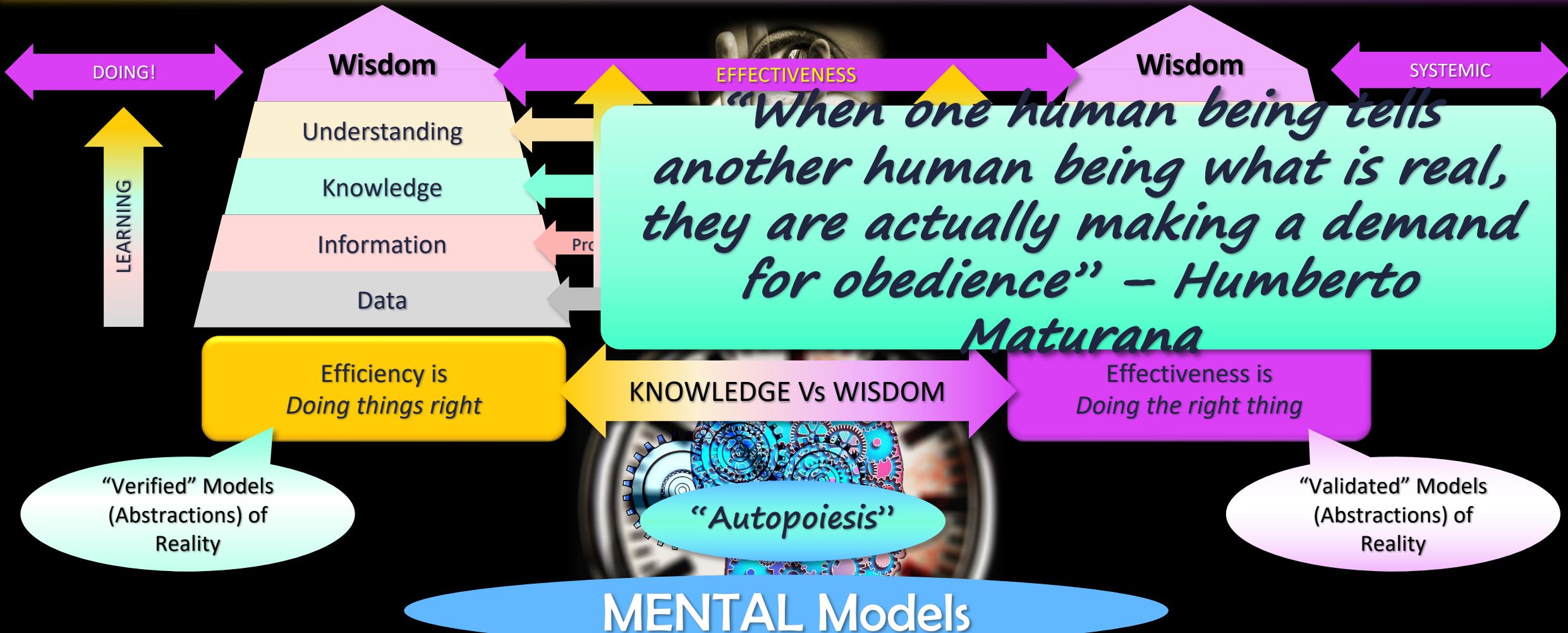
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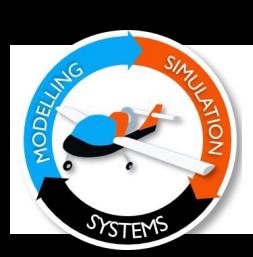
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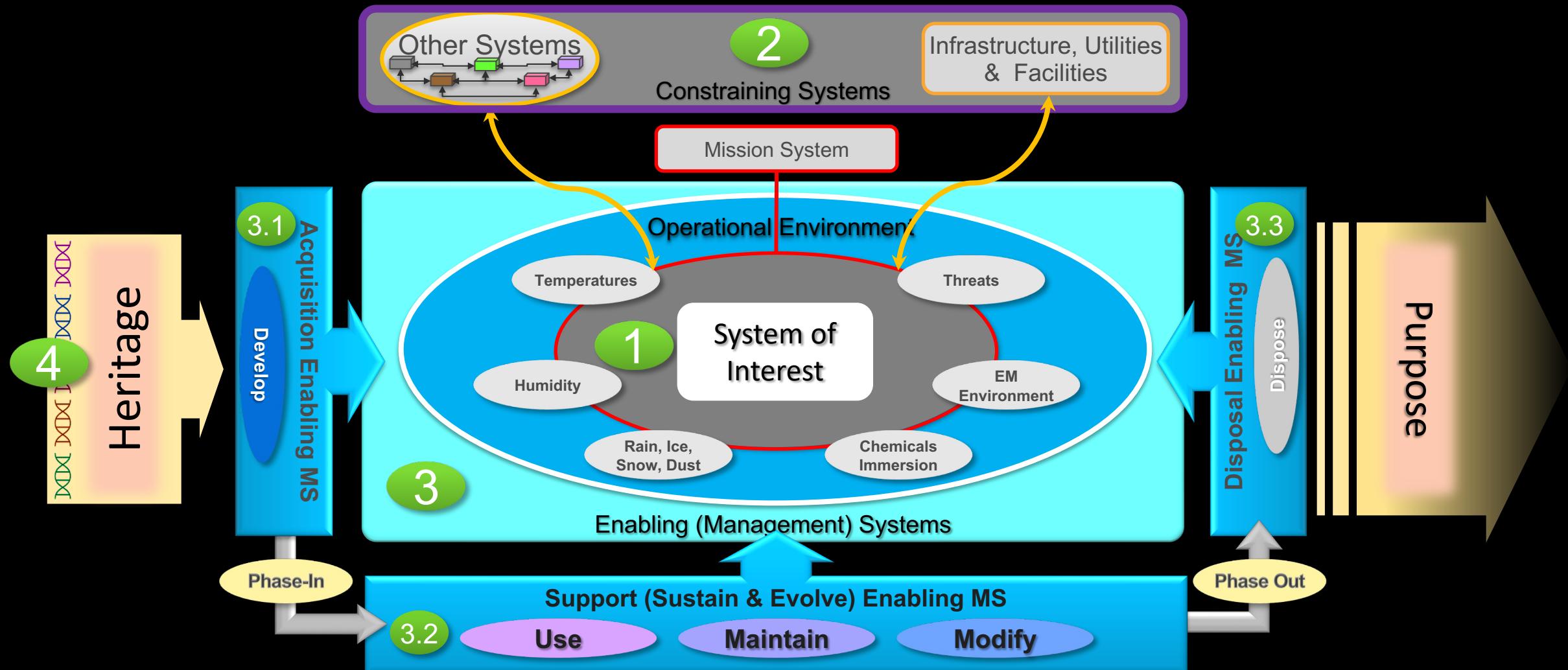


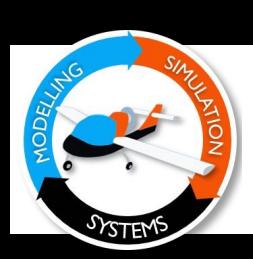
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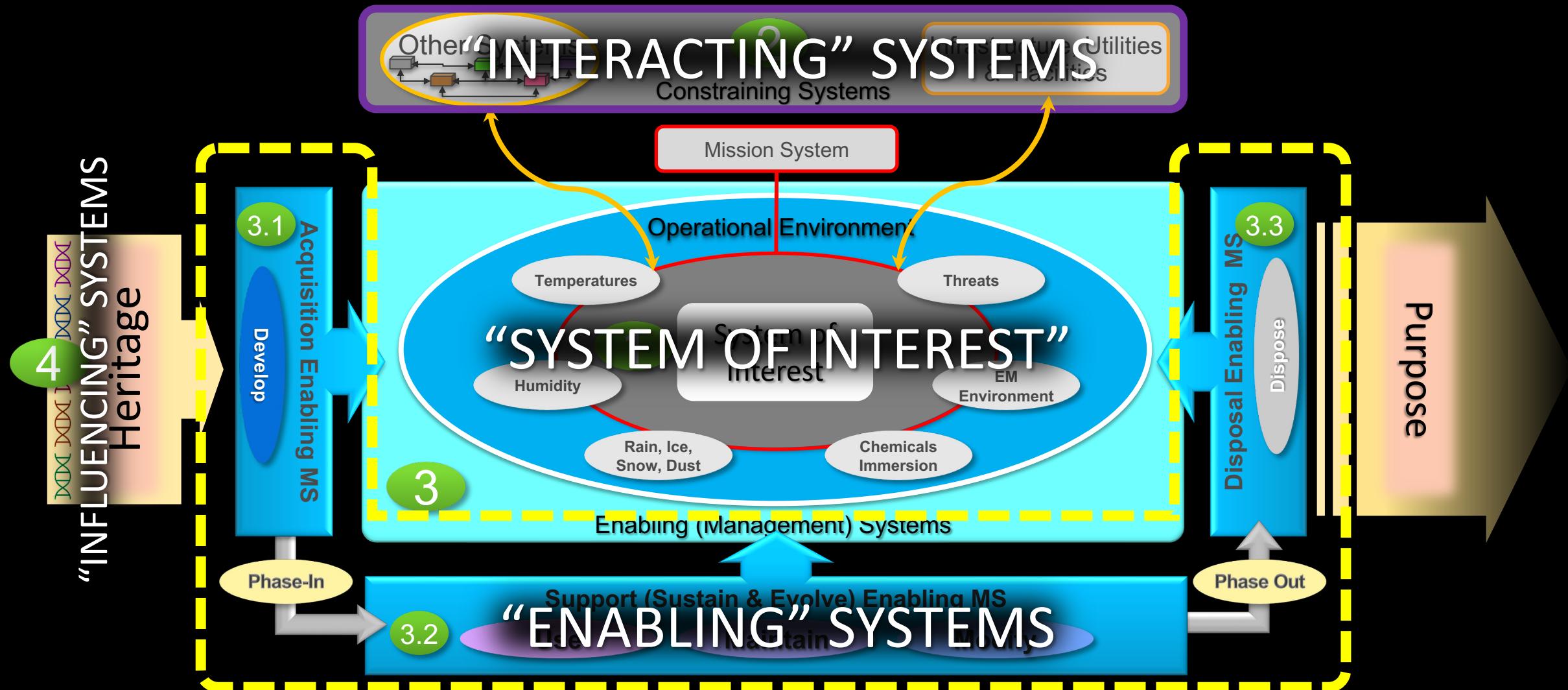


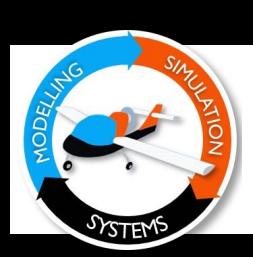
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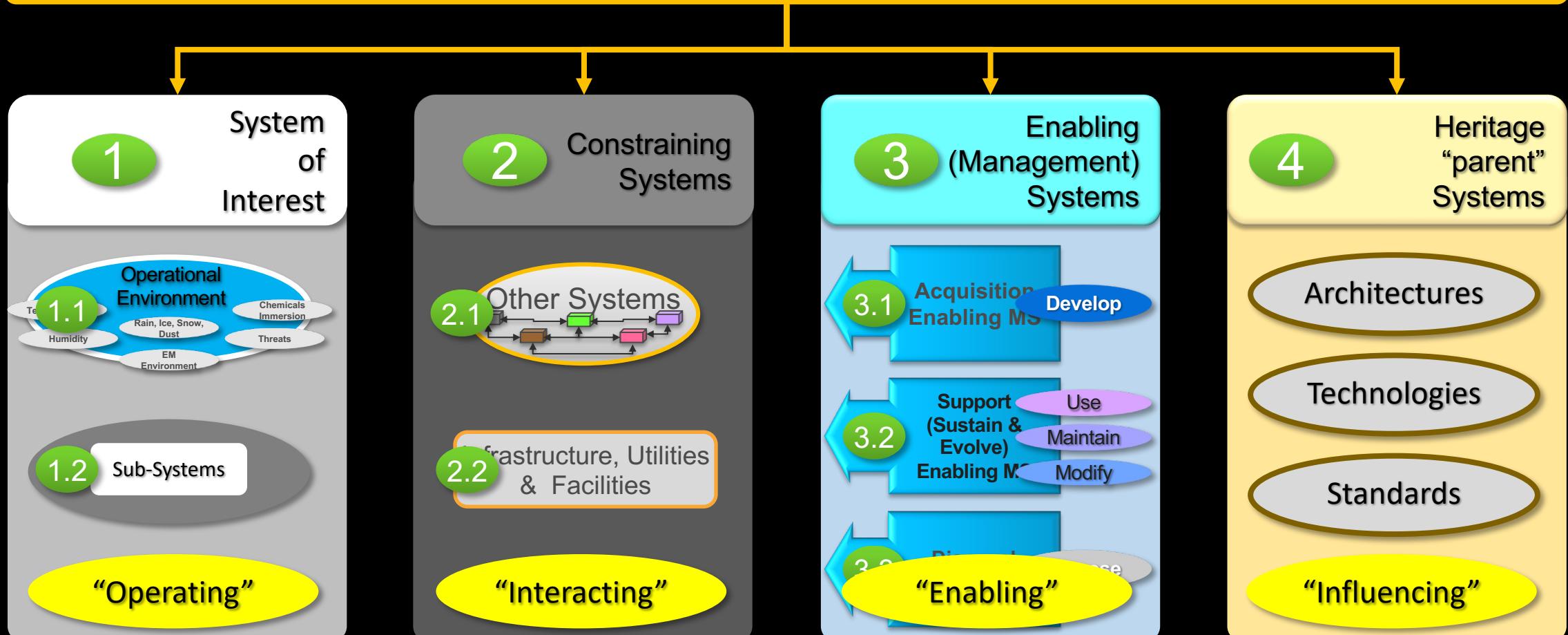
Framework /
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An Example (Reference Whole-Of-Life) Systems Model





Modelling &
Simulation

Mental / Conceptual
MODELS

Framework /
Architecture MODELS

Transformative
Process MODELS



What

Focuses on
Effectiveness

What intent

VALIDATION

systems?

Enabled by Systems Thinking (GAS)

Build the Right System

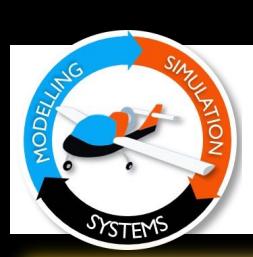
*Enable the **efficient** and **effective** realization, sustainment and retirement of complex concepts into tangible capabilities!*

Build the System Right

Complimented by Modelling & Simulation

VERIFICATION

Focuses on
Efficiency



Modelling &
Simulation

Mental / Conceptual
MODELS

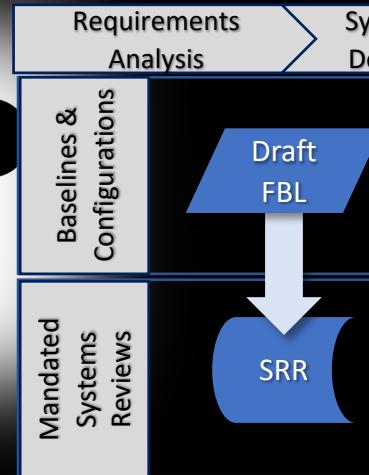
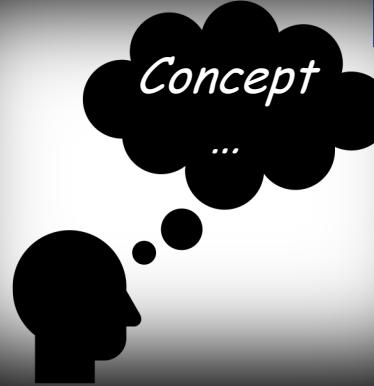
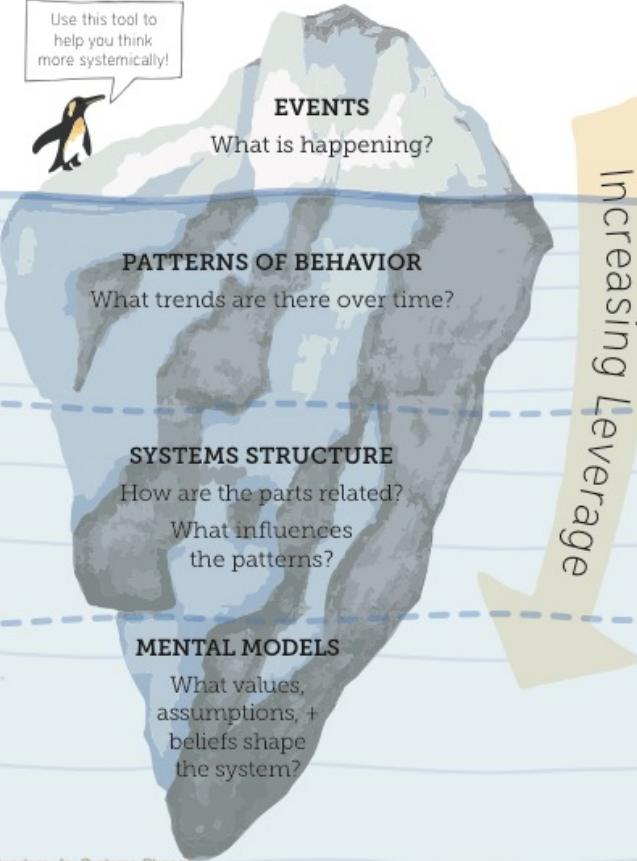
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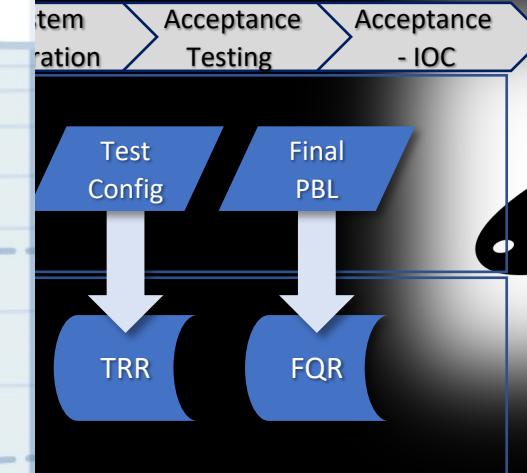


What is our

THE ICEBERG MODEL



... engineer systems?





Modelling & Simulation

Mental / Conceptual MODELS

Framework / Architecture MODELS

Transformative Process MODELS

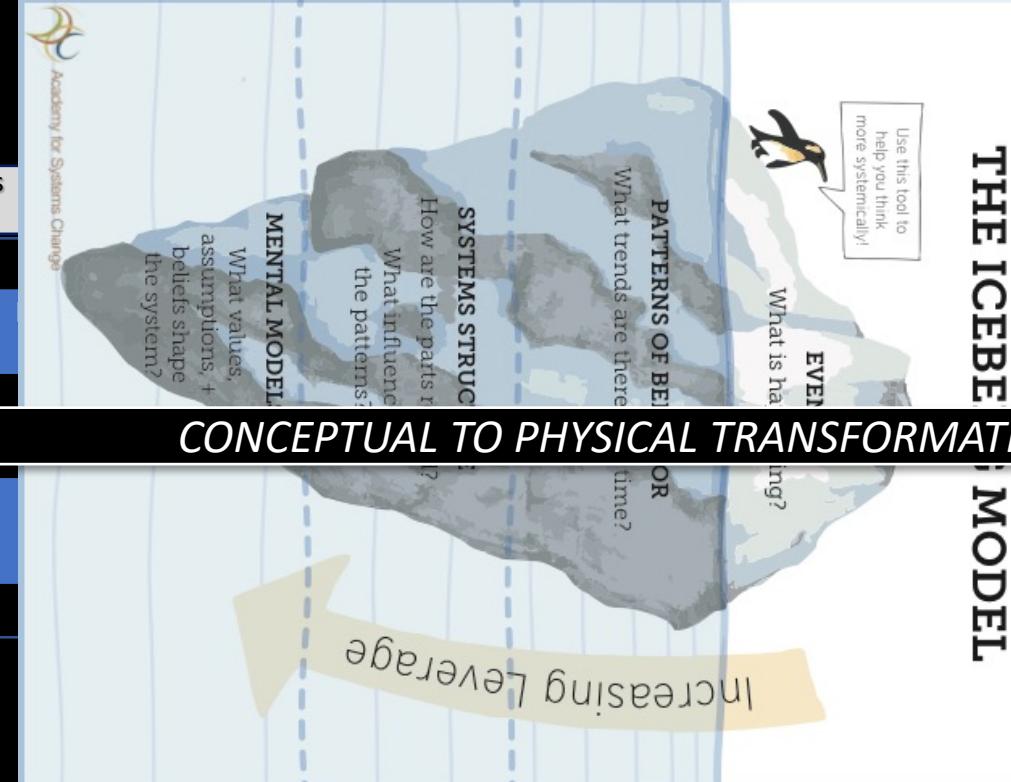
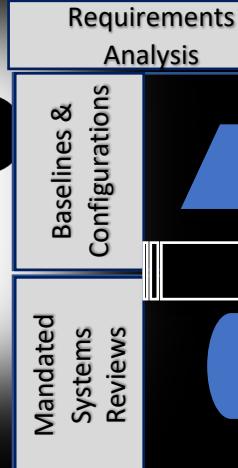
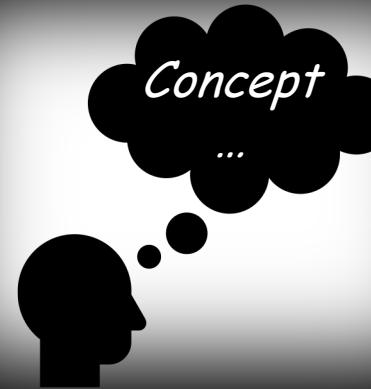


What is our un

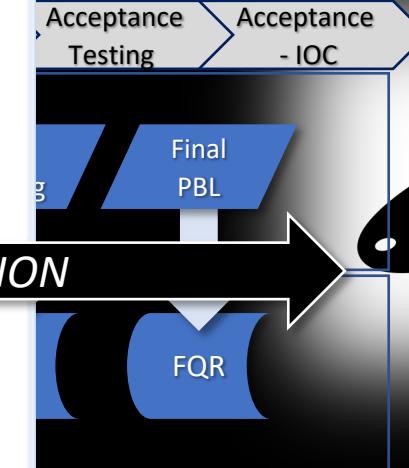


Everything has been created twice
once on a mental plain and once on
a physical plain.

engineer systems?



THE ICEBERG MODEL





Modelling & Simulation

Mental / Conceptual MODELS

Framework / Architecture MODELS

Transformative Process MODELS

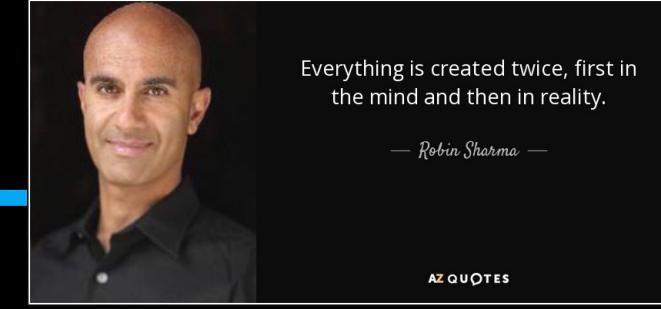


Implementation Agnostic

1

Concept

3



Concept Capture

SDR

Effectiveness (Validation)
Building the Right Model/s

Design & Development
Traceability / Allocation / Integrity

Efficiency (Verification)
Building the Model/s Right

4

Capability Realisation

2



Conceptual Model of the Sol [C-SBS]

Functional Model of the Sol [F-SBS]

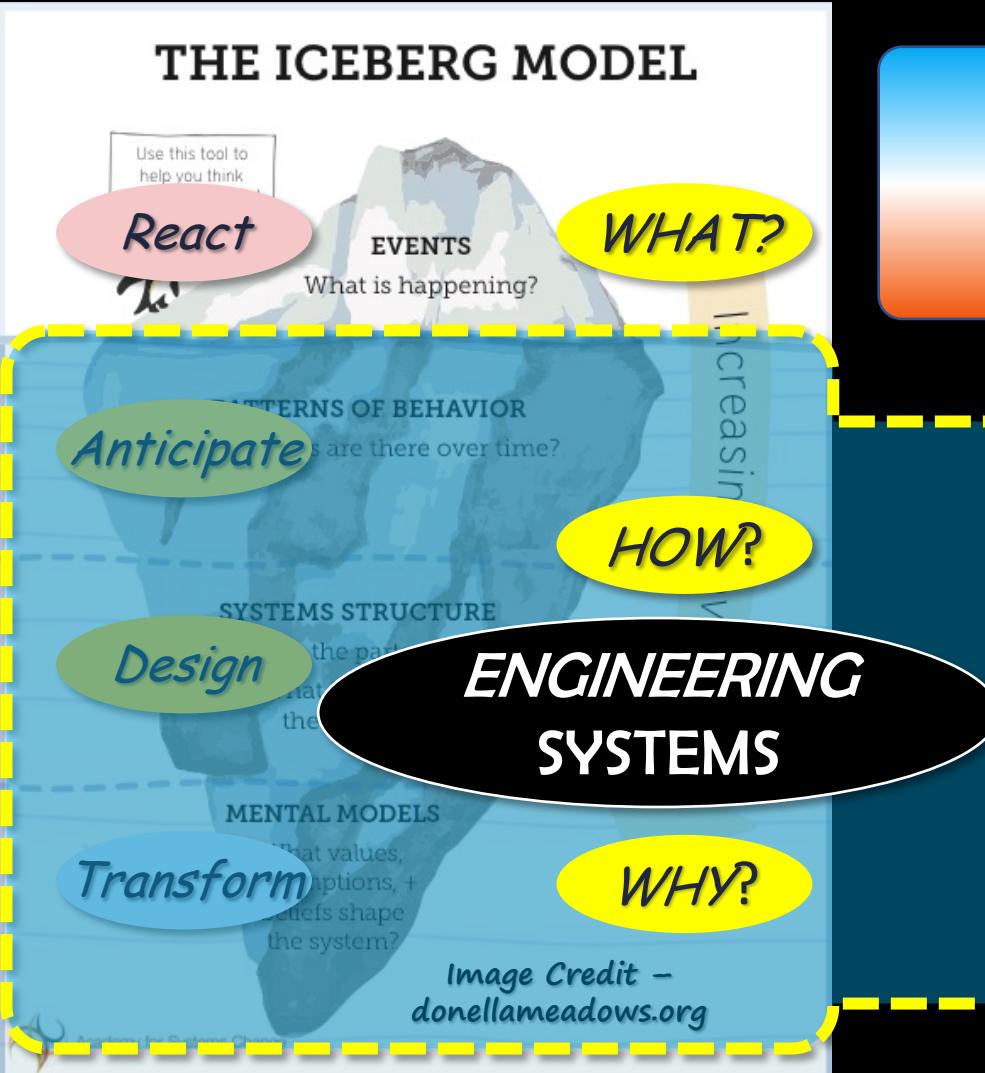
Integrity (should be) Preserved Through-Life

Physical Model of the Sol [P-SBS]

Tangible (Fielded) Sol [As-Built]



To Summarise ... Its all about Models!

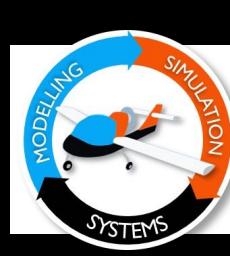


Systems Dynamics MODELS

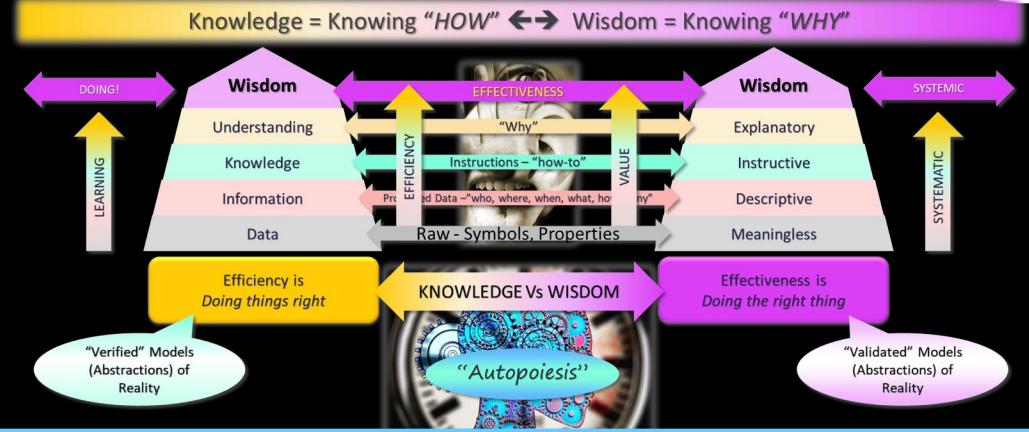
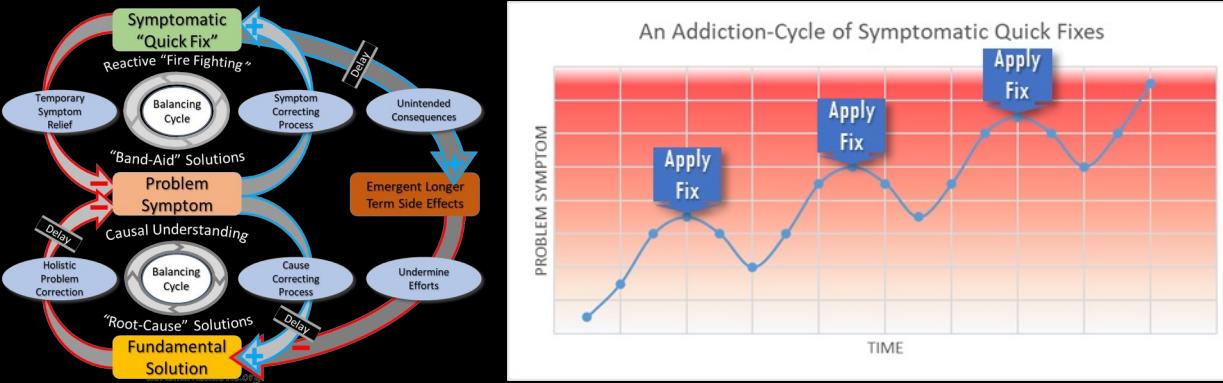
Frameworks & Architecture MODELS

Transformative Process MODELS

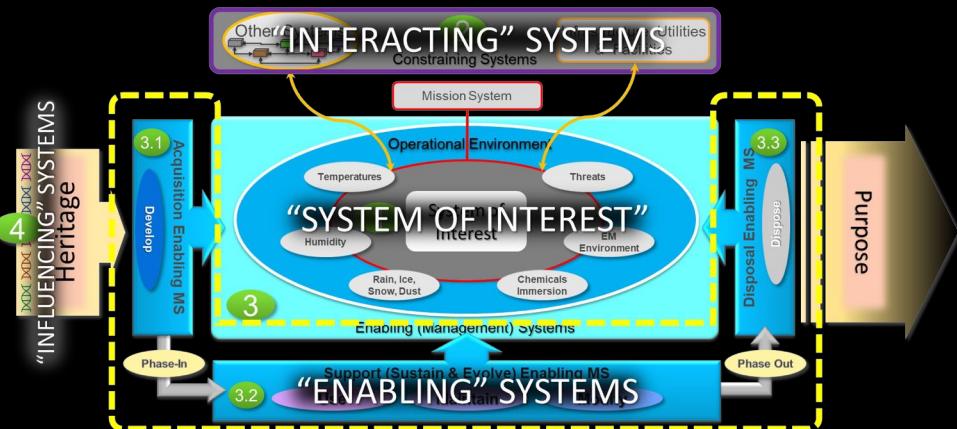
Mental / Conceptual MODELS



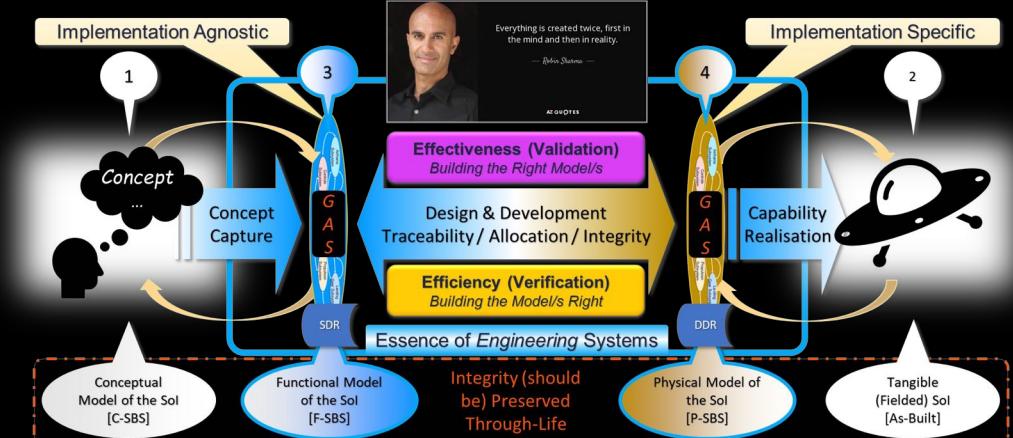
To Summarise ... Its all about Models!



Systems Dynamics MODELS

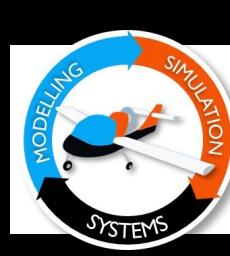


Mental / Conceptual MODELS



Frameworks & Architecture MODELS

Transformative Process MODELS



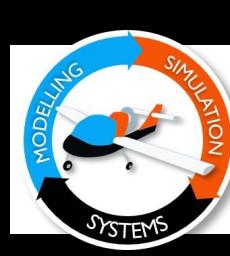
To Summarise ... Its all about Models!



“Remember, always, that everything you know, and everything everyone knows, is only a model. Get your model out there where it can be viewed. Invite others to challenge your assumptions and add their own.”

Donella Meadows : Thinking in Systems

Disclaimer – the concepts expressed in this presentation are personal opinions and insights that continue to evolve based on theoretical and experiential learning and should not be associated with any organisation that I have been part of or that I am presently affiliated with, nor should they be taken as suggesting the truth.



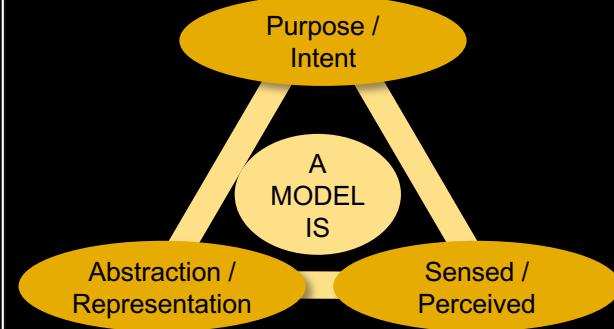
To Summarise ... Its all about Models!



The scarcest resource is not oil, metals, clean air, capital, labour, or technology. It is our willingness to listen to each other and learn from each other and to seek the truth rather than seek to be right

— Donella Meadows —

AZ QUOTES



The sustainability revolution will be organic. It will arise from the visions, insights, experiments and actions of billions of people. The burden of making it happen is not on the shoulders of any one person or group. No one will get the credit, but everyone can contribute.

— Donella Meadows —

AZ QUOTES

“When one human being tells another human being what is real, they are actually making a demand for obedience” – Humberto Maturana

No Mandates, No lockdowns.
No digital passports and currencies.
Freedom of speech and expression.
Distributed, organic governance.



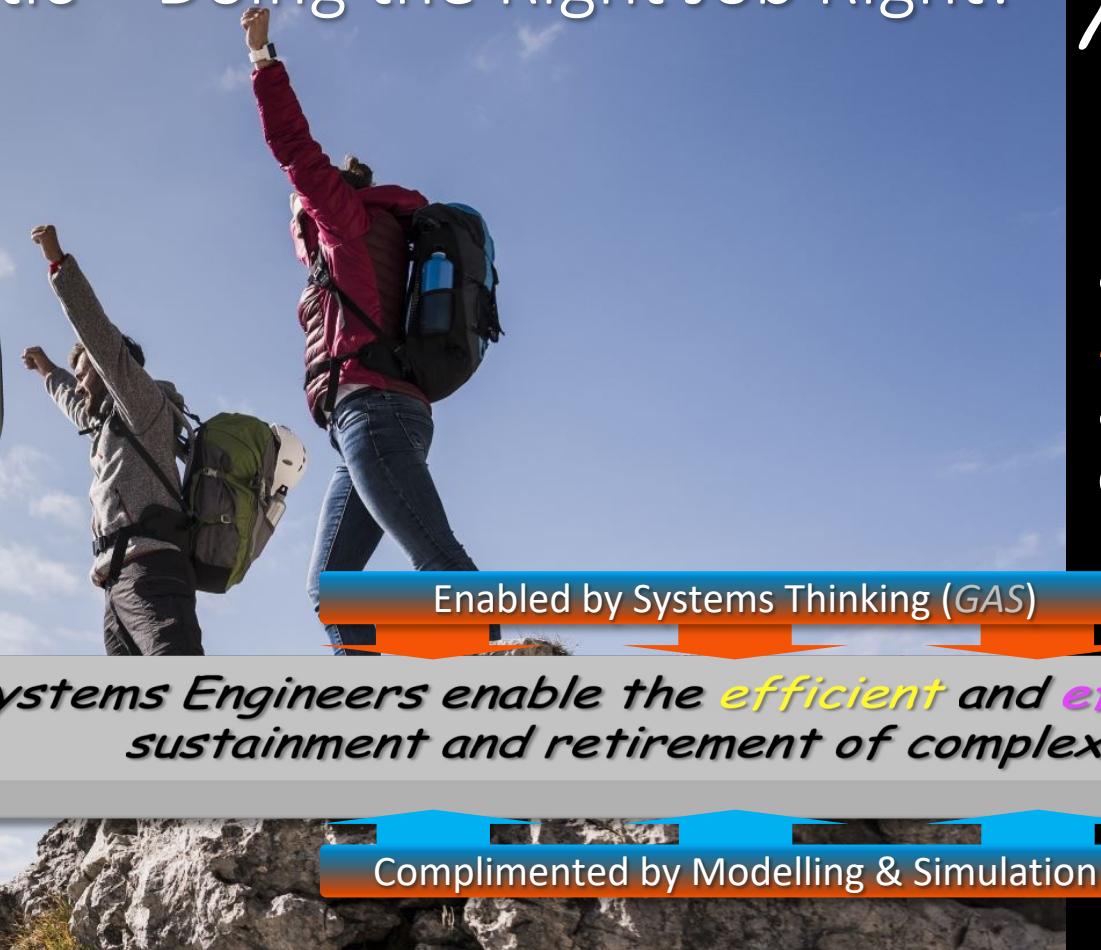
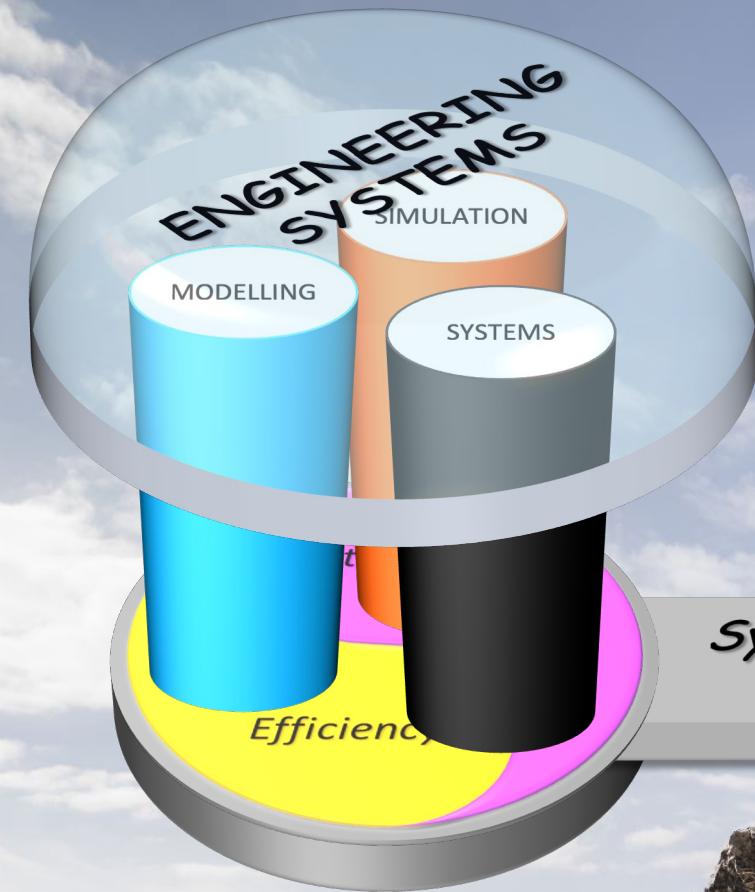
Only love expands intelligence. To live in love is to accept the other and the conditions of his existence as a source of richness, not as opposition, restriction or limitation.

— Humberto Maturana —

AZ QUOTES

A moratorium on genetic medical intrusion and on gain-of-function research.
Governance on AI research and engineering, and on Assurance for use.

Systemic and Systematic – Doing the Right Job Right!

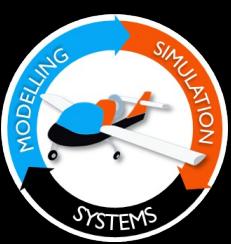


Enabled by Systems Thinking (GAS)

*Systems Engineers enable the **efficient** and **effective** realization, sustainment and retirement of complex capabilities!*

Complimented by Modelling & Simulation

Motivation...

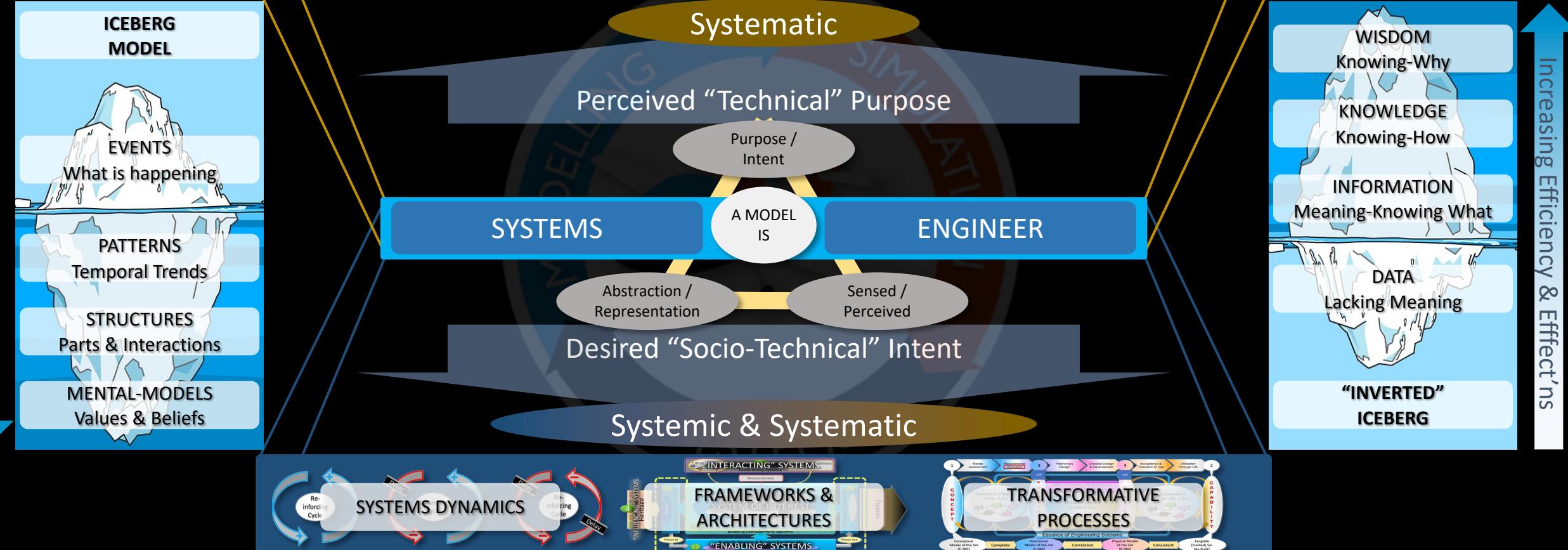


Elevate the application and understanding of the *Engineering of Systems* and the relative-standing of *Systems Engineers*

The **foundational responsibility of Systems Engineers** is to **maximise the right emergence** while **minimising the wrong emergence** and associated unintended outcomes **in the engineering of systems** through **Systemic Thinking**, complimented by **Modelling and Simulation**



Science, Technology, Engineering, Maths



Systems Science, Technology, Engineering, Maths, Arts

Are we in a Simulation?



Image Credit – giphy.com