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TOWARDS BUILDING AN INTELLIGENT SYSTEM BASED ON CYBERNETICS AND VIABLE SYSTEMS MODEL

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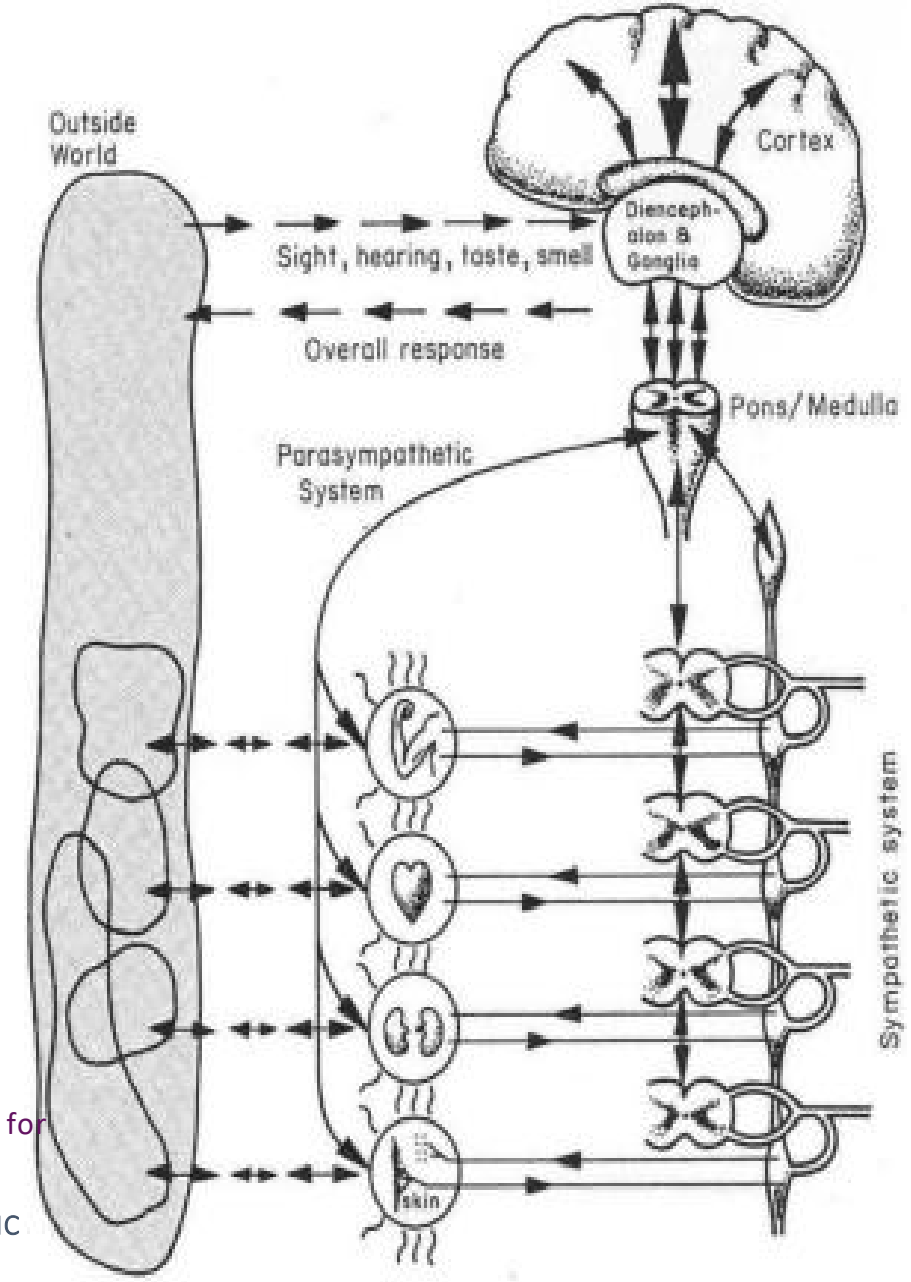

KEY WORDS: Cybernetics; Variety Attenuation; Autonomy; ANS, Purpose, CSTP-NASRDA- Centre for Space Transport and Propulsion - National Space Research and Development Agency

RESEARCH TITLE: IMPROVING DECISION MAKING IN COMPLEX ENGINEERING ORGANIZATION: A CYBERNETIC APPROACH

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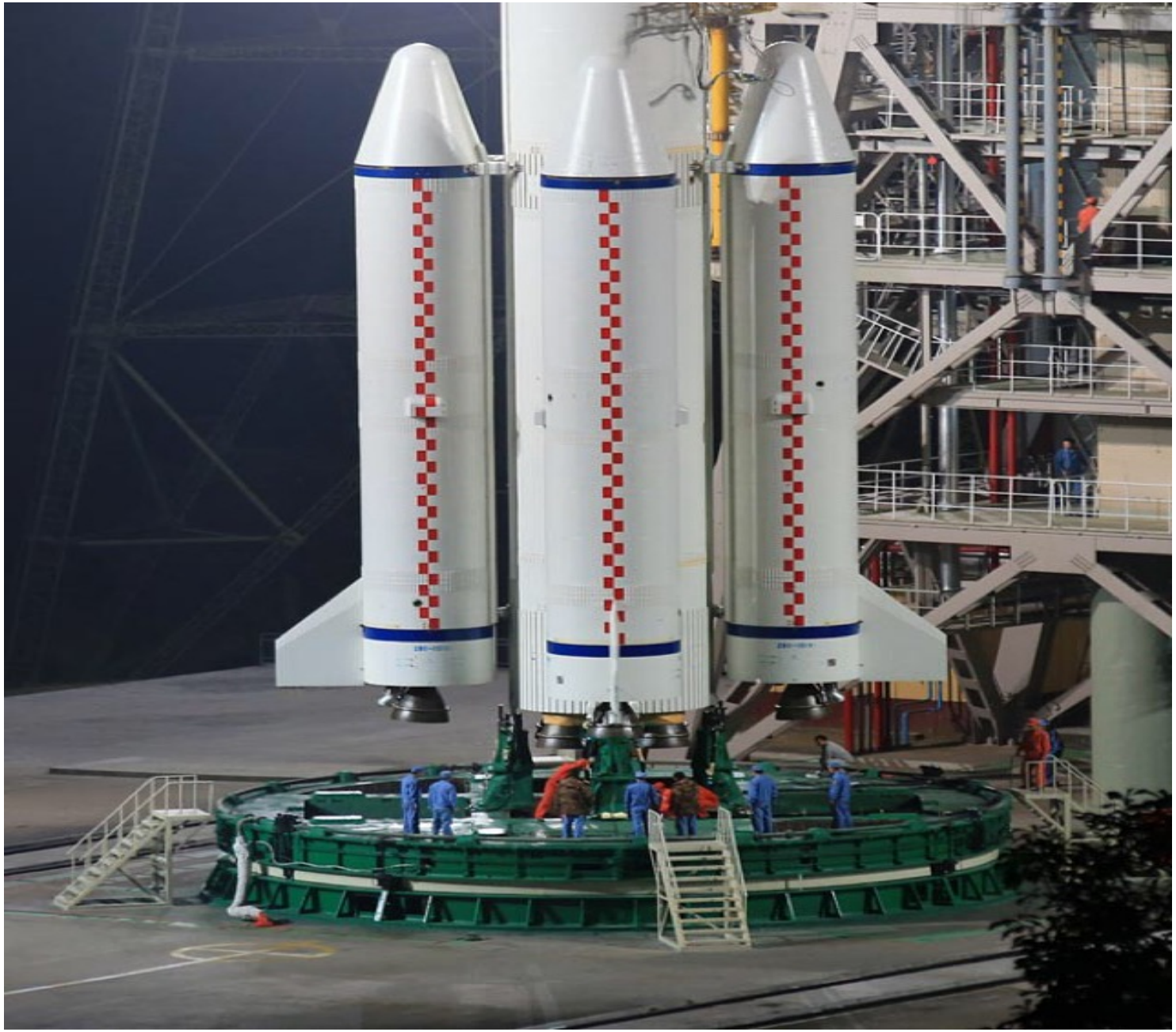
OBJECTIVES OF THIS TALK

- An intro into the area of interest; the opposing epistemology of VSM and SSM; and the justification of VSM
- Why it is important
- To revisit cybernetics
- To synergize Ross Ashby's Law of requisite variety and Viable System Model (VSM) for the development of a cybernetic model specifically for CSTP-NASRDA
- To demonstrate the model as an objective recommendation in my research

Area of Interest: CSTP-NASRDA



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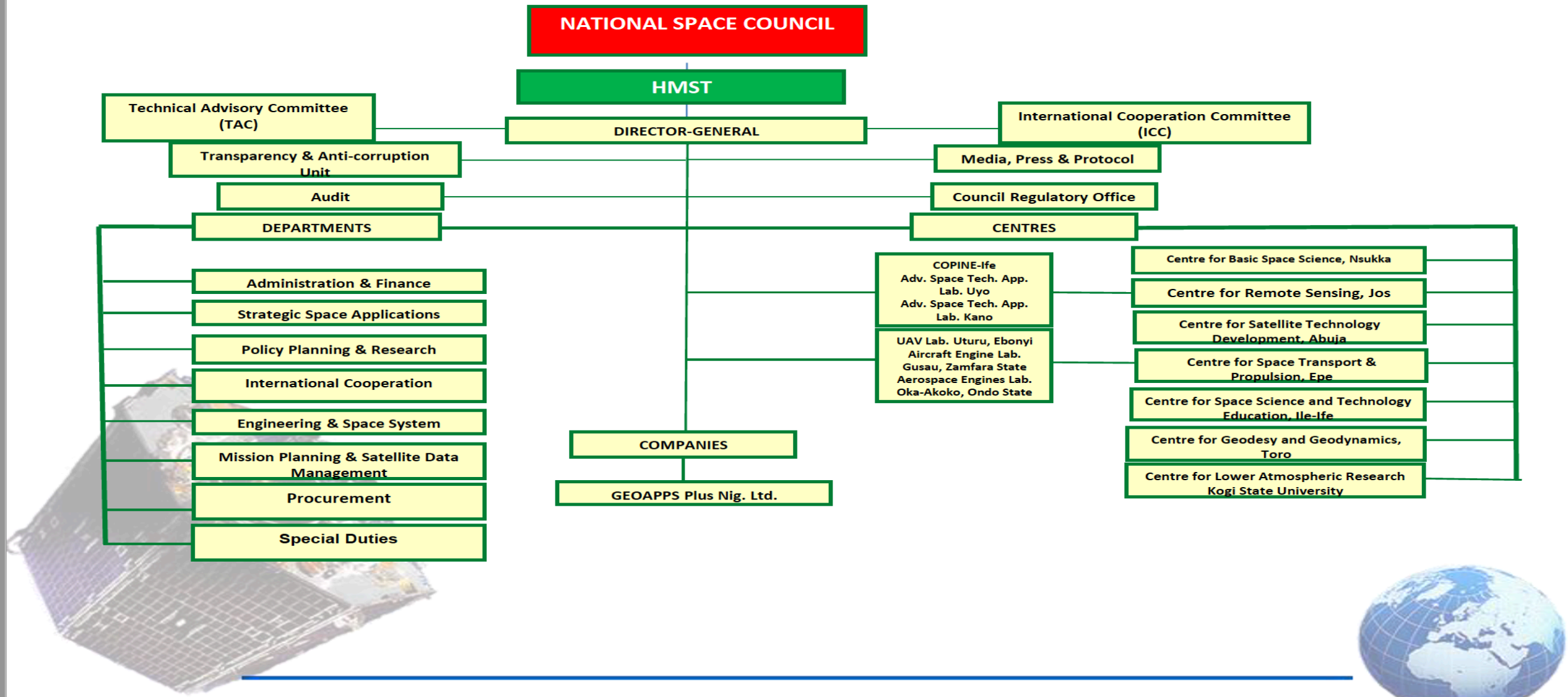
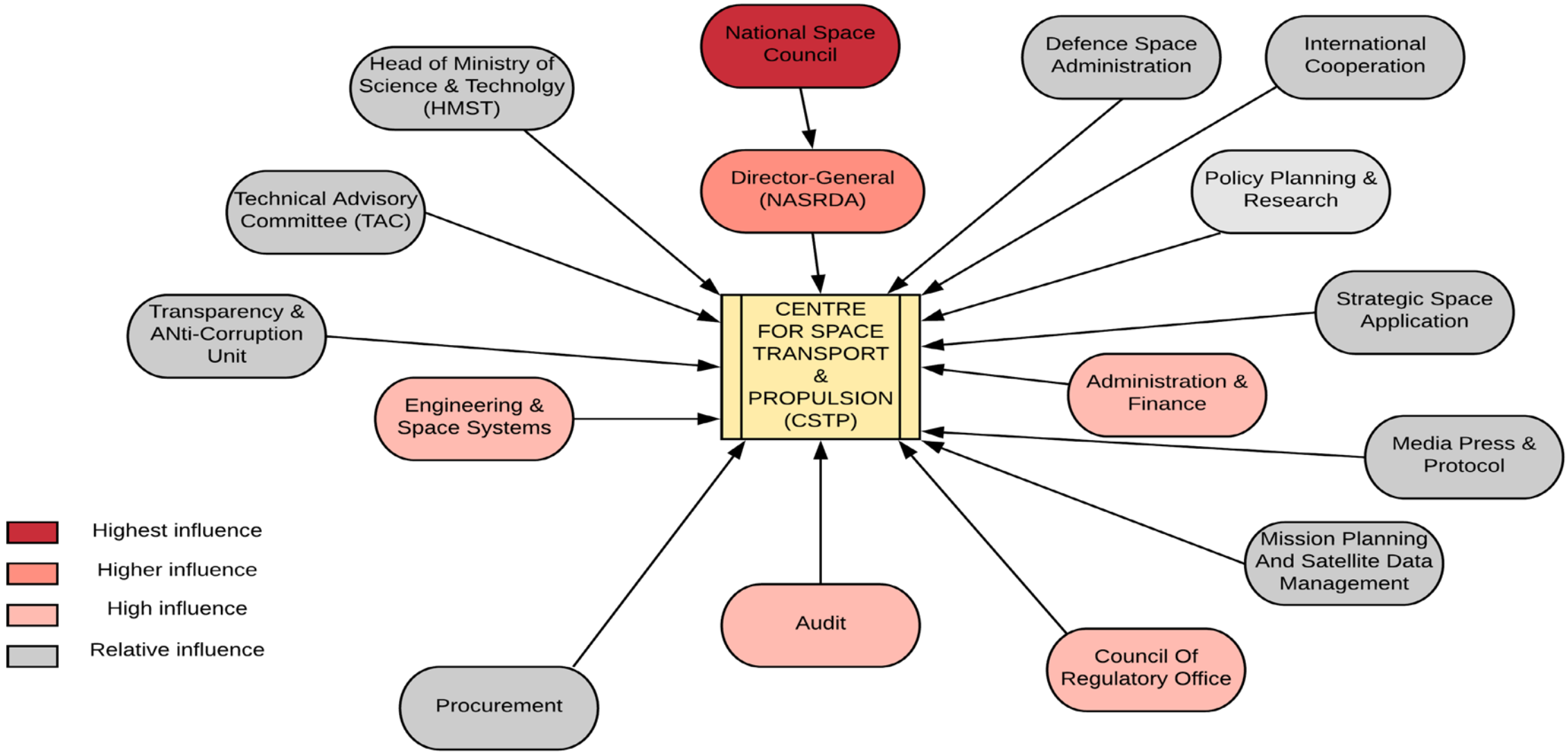
Institutional Arrangement



CSTP-NASRDA'S INFLUENCE DIAGRAM



Akinola Kila

Cybernetics

- Cybernetics was defined by Norbert Wiener to be the field addressing communication and control in animal and machine (N. wiener, 1962) .

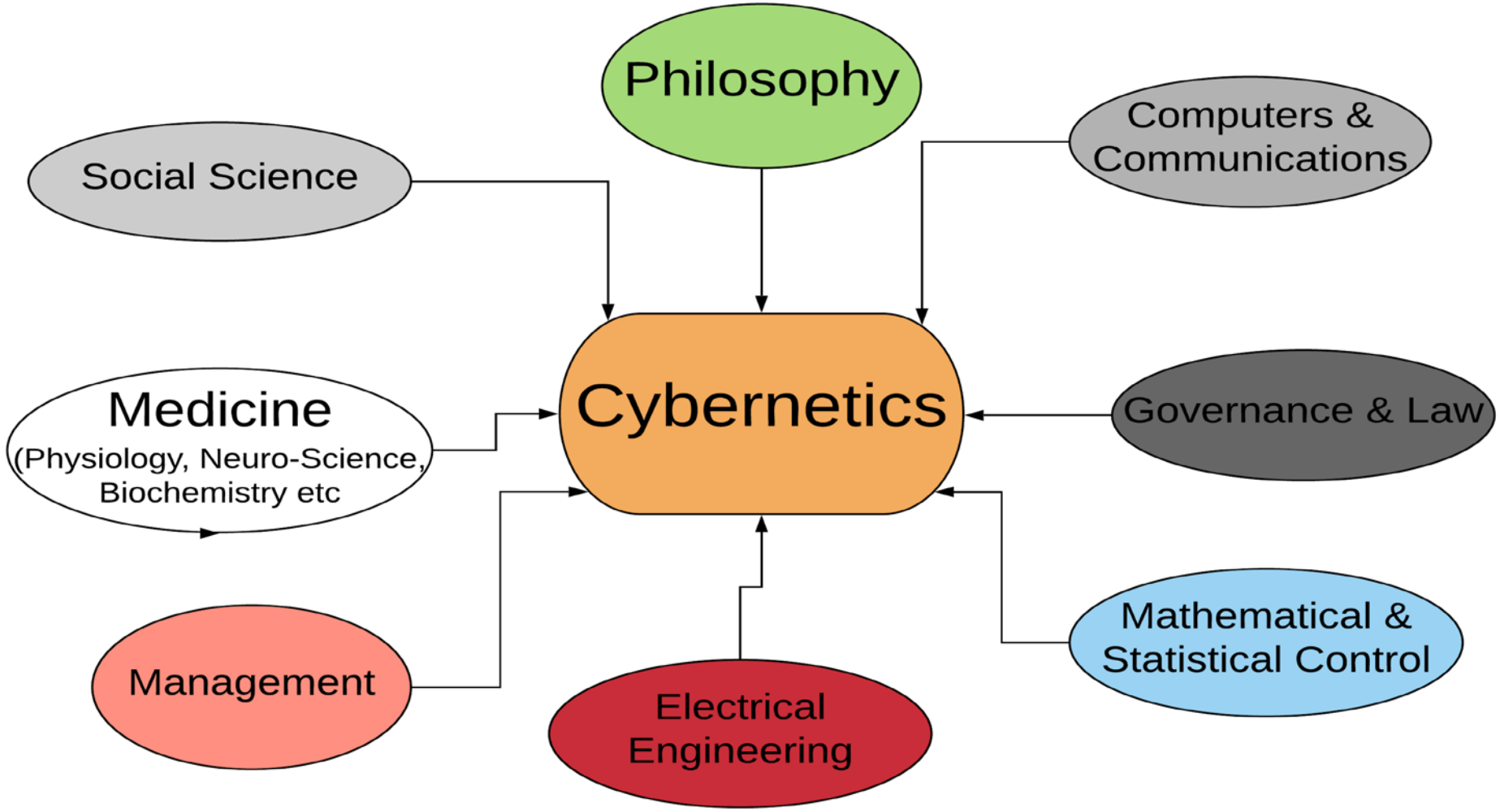
- Ashby indicates that cybernetics can be applied to many systems including biological organisms, ant hills as functioning societies, and economic systems. He wrote "Prominent among the methods for dealing with complexity is cybernetics" (R, Ashby & Young, 1961).

- Heylighen and Joslyn write: "Cybernetics is the science that studies the abstract principles of organization in complex systems. It is concerned not so much with what systems consist of, but how they function. Cybernetics focuses on how systems use information, models, and control actions to steer towards and maintain their goals, while counteracting various disturbances“(] F. Heylighen and C. Joslyn, 2001).

- It can be applied to the three types of problems, those of type organized simplicity, disorganized complexity (randomness), and organized complexity (R, Ashby & Young, 1961).

Cybernetics

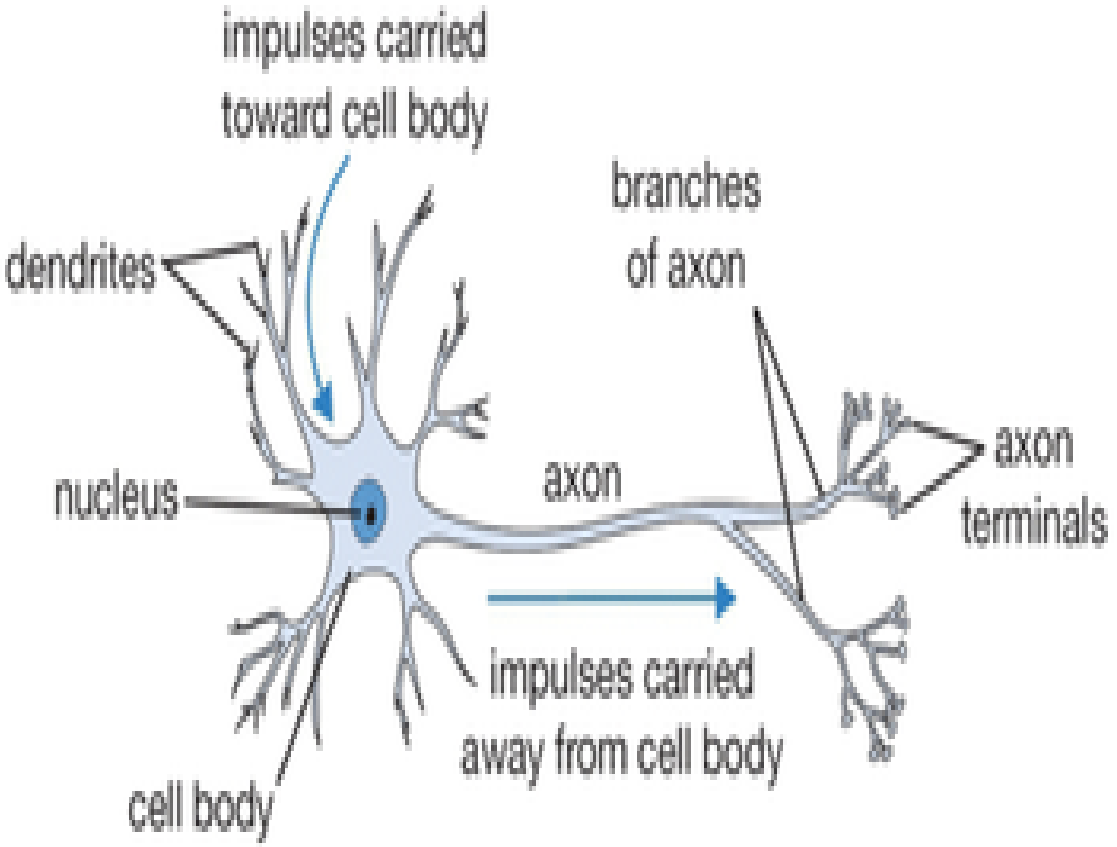
the science of control & communication; the science of effective organization; the science of interconnectedness; the science of purposeful systems.

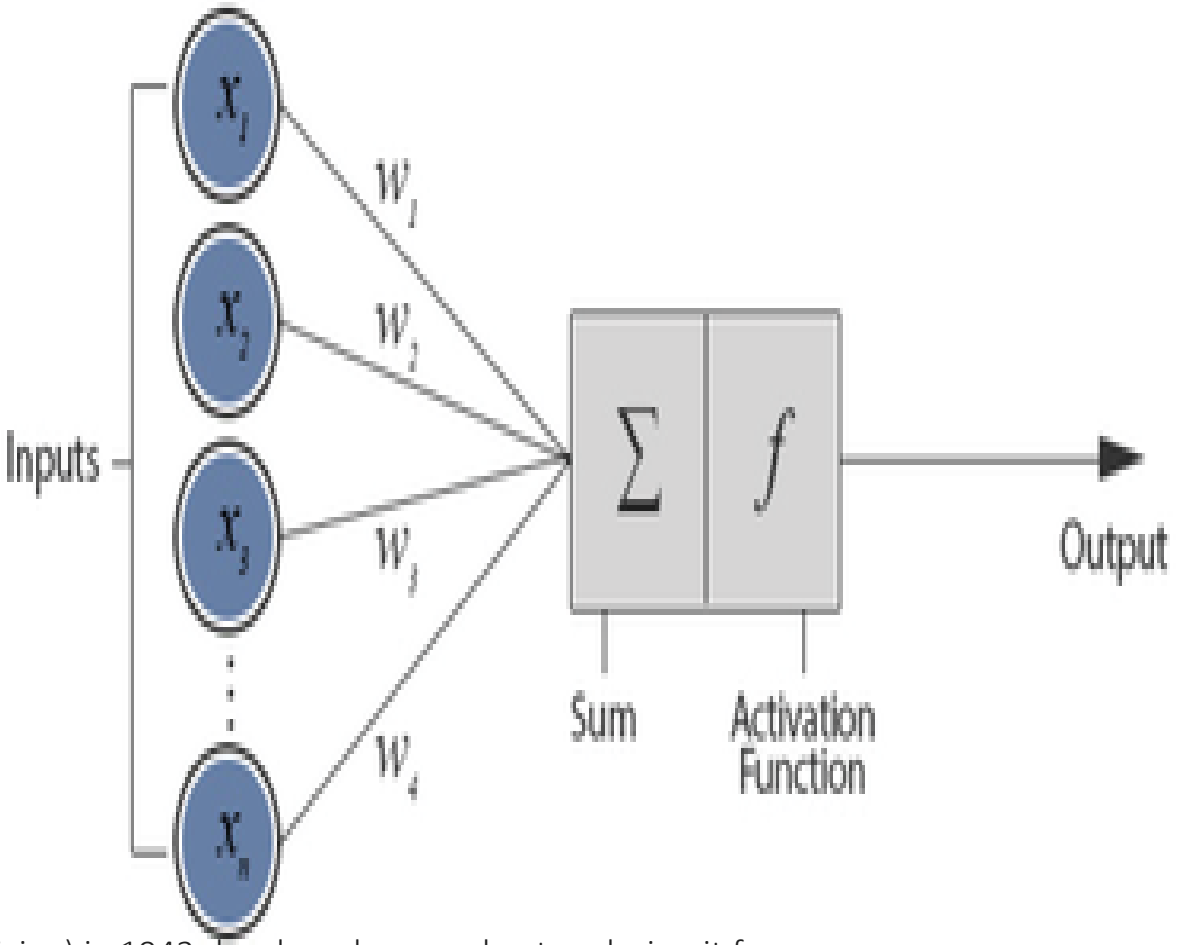


Cybernetics and some areas of use

- Systems/organization development, management and control
- Artificial Neural networks
- Political communication
- Construction of machines and building of robots (Engineering)
- Sustainable development & social dimensions of cognitive science
- Living systems

Biological Neuron versus Artificial Neural Network

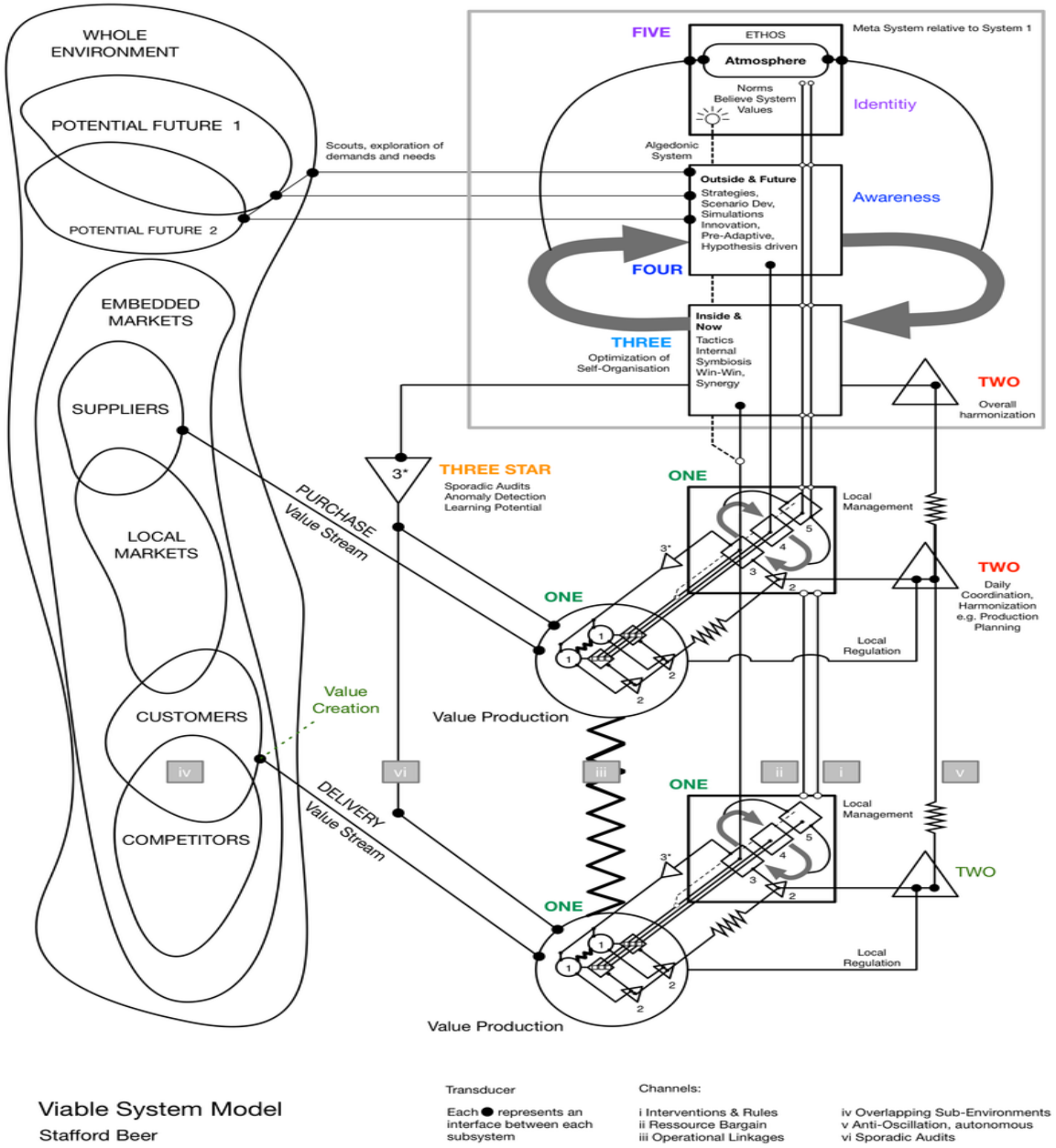


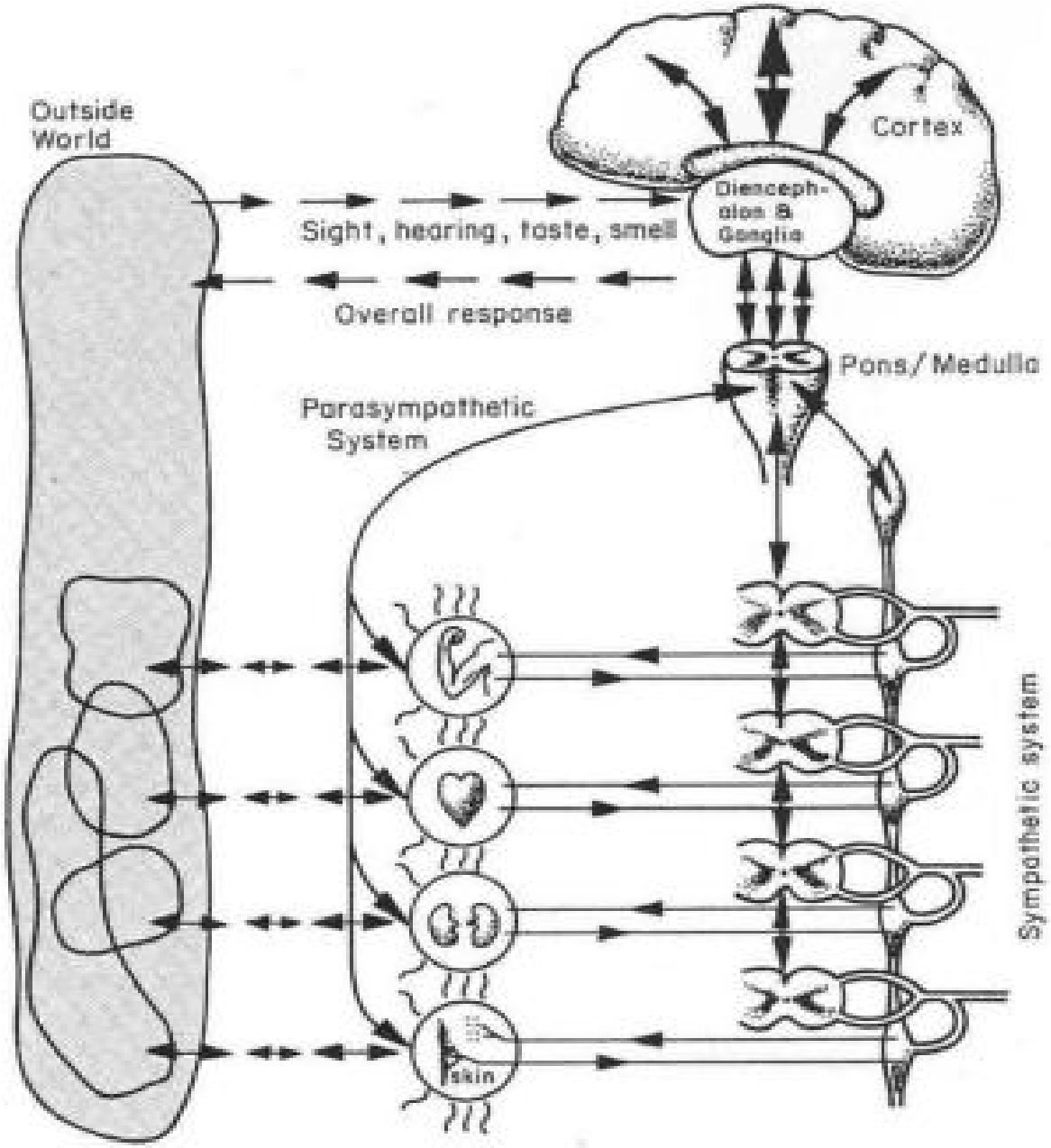


Warren McCullock (Cybernetician & Neurophysioligist) and Walter Pitts(Mathematician) in 1943 developed a neural network circuit from studying how neurons in the brain works (Abraham, 2002**).**

Datacamp. (2019). Biological Neurons vs Neural Network. Retrieved from https://www.datacamp.com/community/tutorials/deep-learning-python

VIABLE SYSTEM MODEL & SYMPATHETIC SYSTEM





Key laws to building a viable system

- Ross Ashby's law of requisite variety states that:

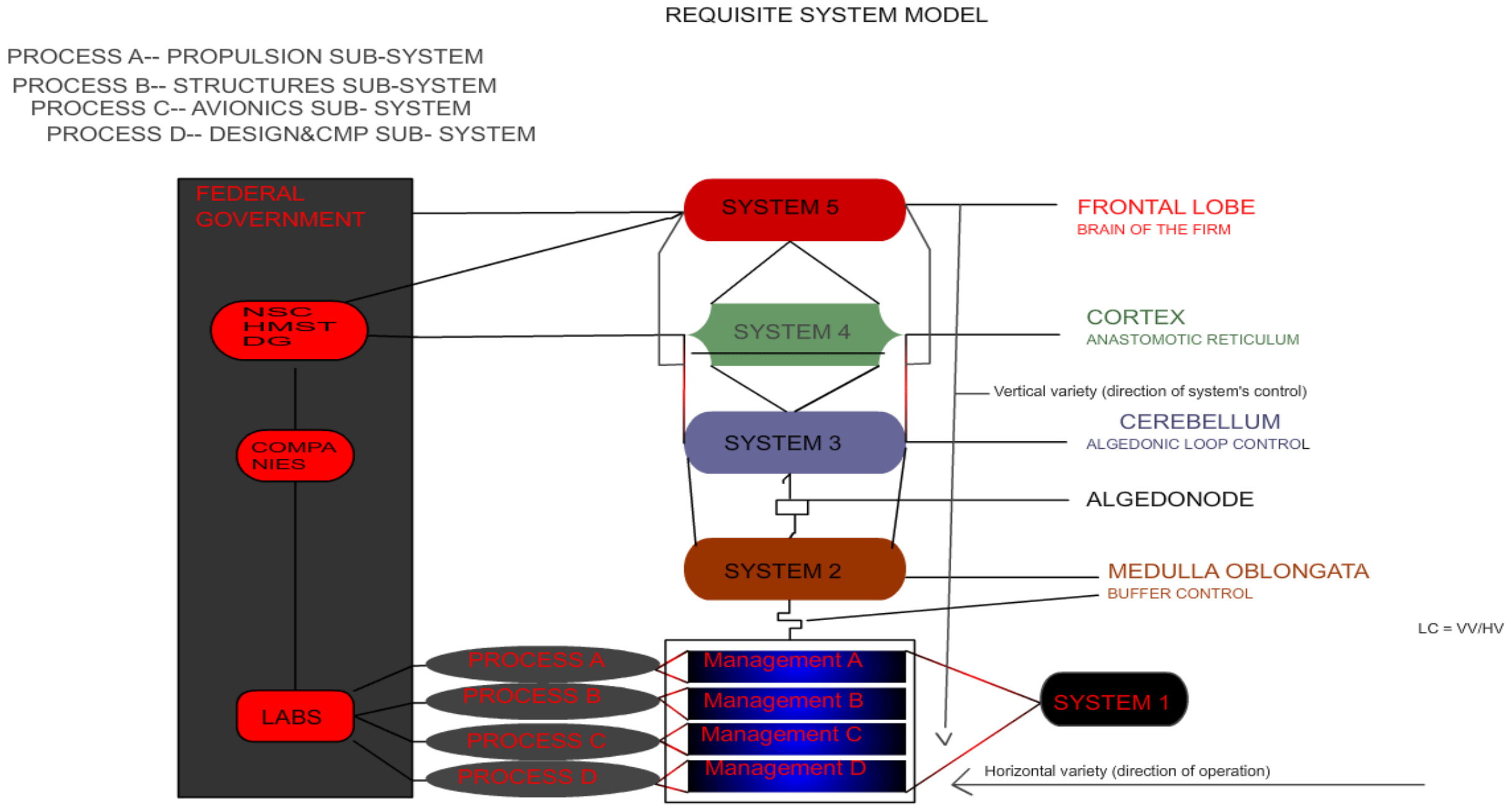
❖only variety can absorb/nullify variety (Stowell & Welch, 2012).

❖We cannot effectively control everything within a system, hence we choose what to control effectively (Stowell & Welch, 2012) .

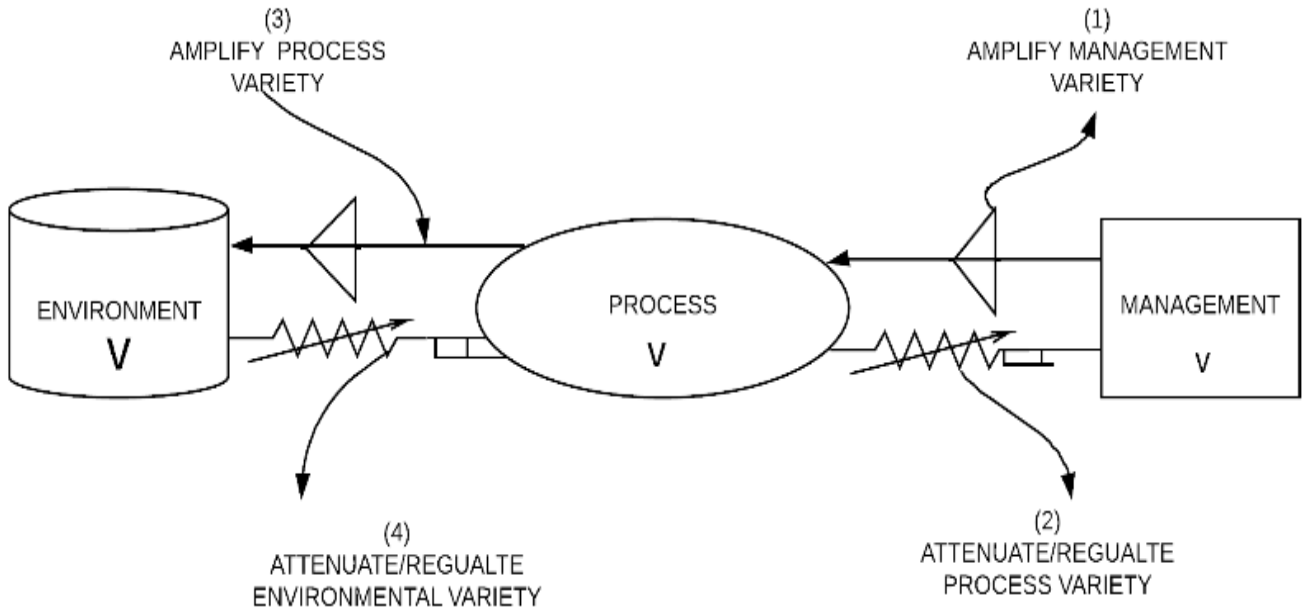
- Law of cohesion by Stafford Beer:

❖In a viable system, just as much variety attenuation is needed to maintain a balance within the system (Beer, 1995).

CSTP-NASRDA Through the Lenses of VSM and Ross Ashby's Law of Requisite Variety



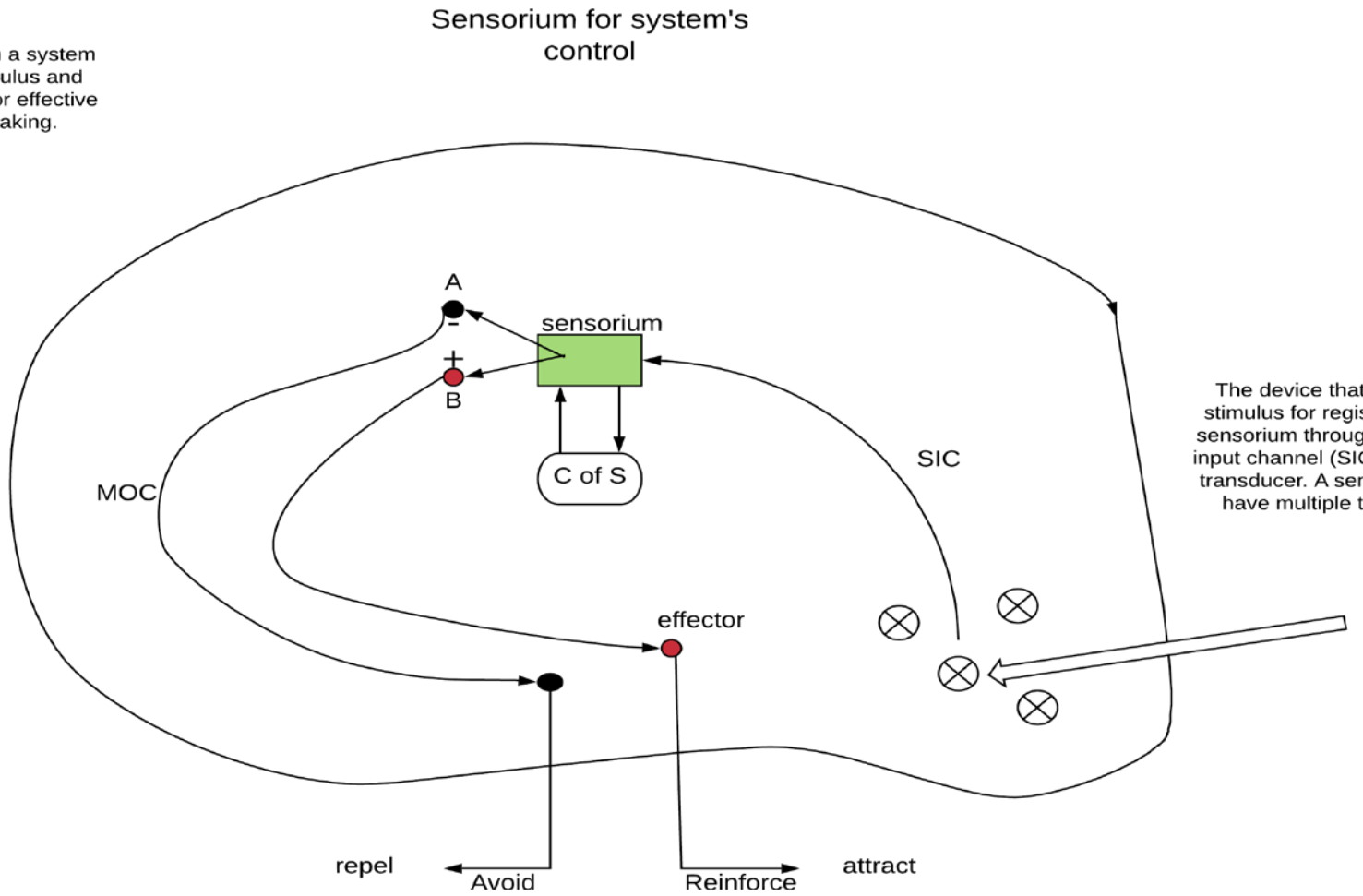
Variety attenuation and amplification



V = VARIETY (THE BIGGER THE SIZE-V, THE MORE THE VARIETY)

Cybernetics: The super-science of system's control

A sensorium resides within a system to register in-coming stimulus and classify existing stimulus for effective control and decision making.



The device that detects the stimulus for registration in the sensorium through the sensory input channel (SIC) is known as transducer. A sensorium might have multiple transducers

For a decision to be made, the controller then must compare the outcomes of making the choice against its criterion of stability (C of S)

Research in progress

- An original contribution to VSM by enhancing its effective use and respond to its criticism.
- Evaluation of multi-method approach in VSM; SSM/AIM.
- Effective decision making model within the sub-systems for an effective operation and performance within a purposeful system(organization).

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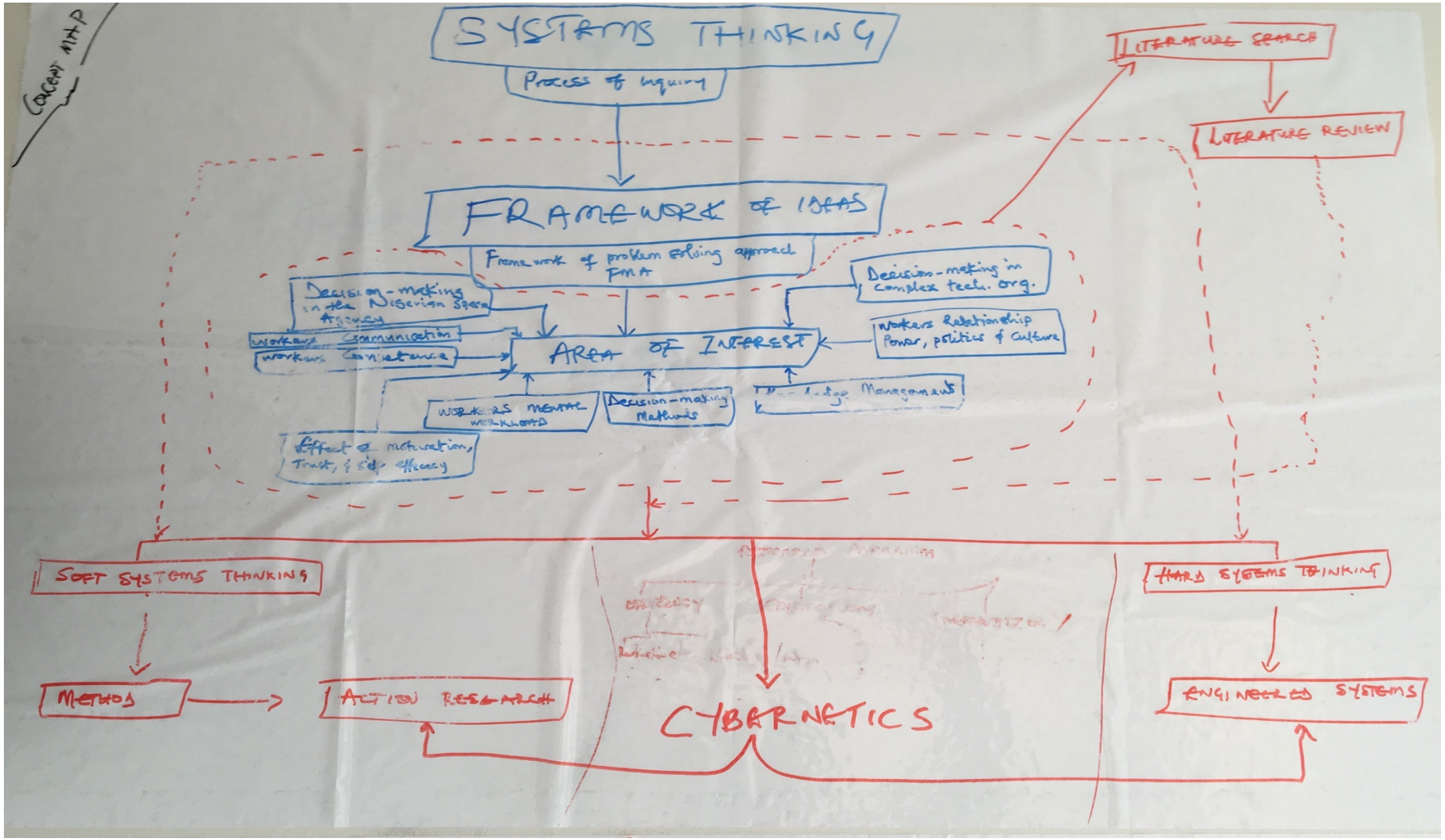
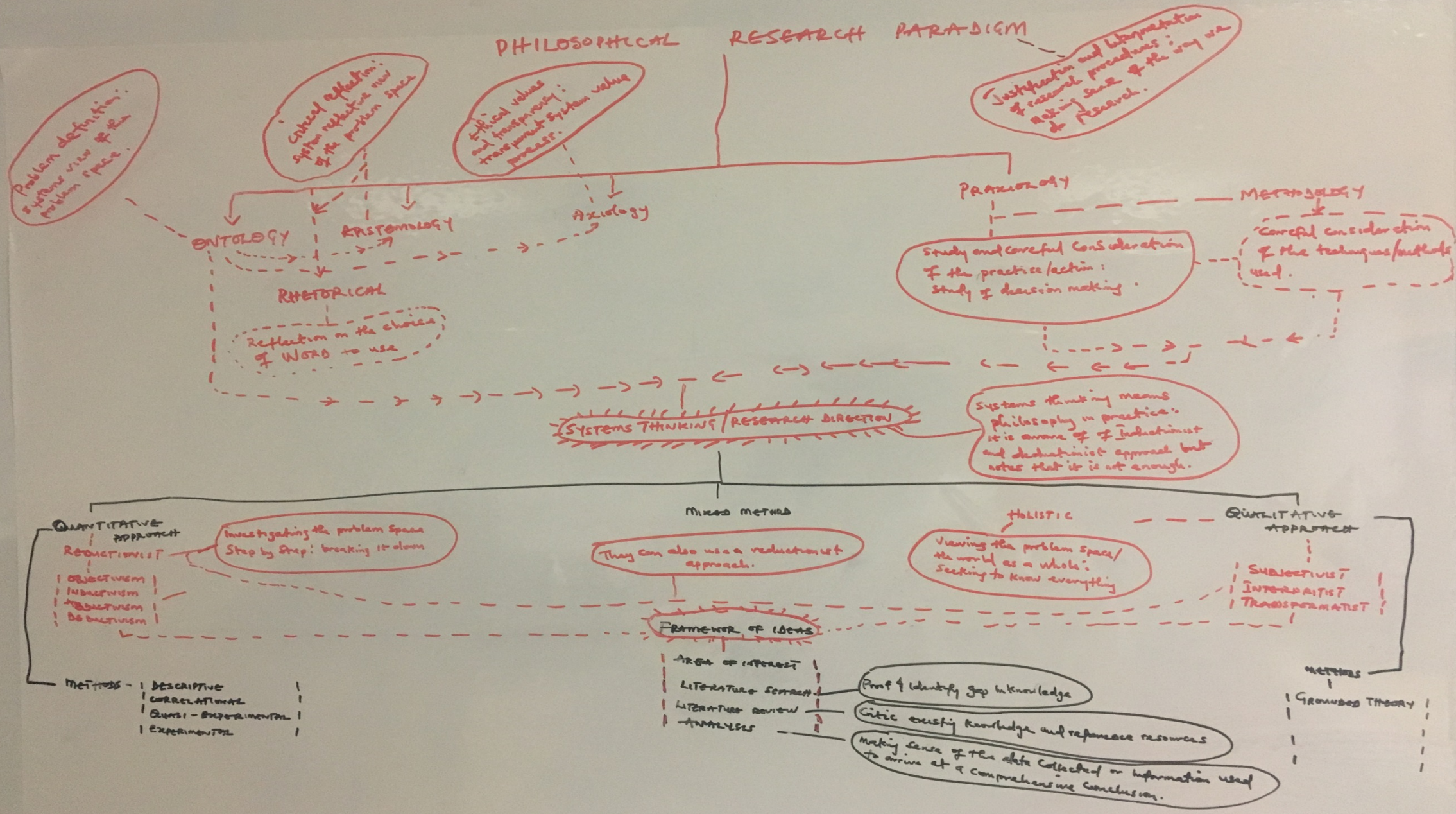



PHILOSOPHICAL RESEARCH PARADIGM
Problem definition: a systems view of the problem space.
Critical reflection: system reflective view of the problem space.
Ethical values and transparency: transparent system value process.
Justification and interpretation of research procedures: making sense of the way we do research.
ONTOLOGY
EPISTEMOLOGY
Axiology
PRAXIOLOGY
METHODOLOGY
RHETORICAL
Reflection on the choice of WORD to use
Study and careful consideration of the practice/action: study of decision making.
Careful consideration of the techniques/methods used.
SYSTEMS THINKING/RESEARCH DIRECTION
Systems thinking means philosophy in practice: it is aware of of Inductivist and deductivist approach but notes that it is not enough.
QUANTITATIVE APPROACH
REDUCTIONIST
OBJECTIVISM
INDUCTIVISM
TRIANGULATION
DEDUCTIVISM
Investigating the problem space Step by Step: breaking it down
METHODS
DESCRIPTIVE
CORRELATIONAL
QUASI-EXPERIMENTAL
EXPERIMENTAL
MIXED METHOD
They can also use a reductionist approach.
HOLISTIC
Viewing the problem space/ the world as a whole: Seeking to know everything
QUALITATIVE APPROACH
SUBJECTIVIST
INTERPRETIVIST
TRANSFORMATIVIST
FRAMEWORK OF IDEAS
AREA OF INTEREST
LITERATURE SEARCH
LITERATURE REVIEW
ANALYSES
Proof & identify gap in knowledge
Critic existing knowledge and reference resources
Making sense of the data Collected or information used to arrive at a comprehensive conclusion.
METHODS
GROUNDED THEORY

CYBERNETICS

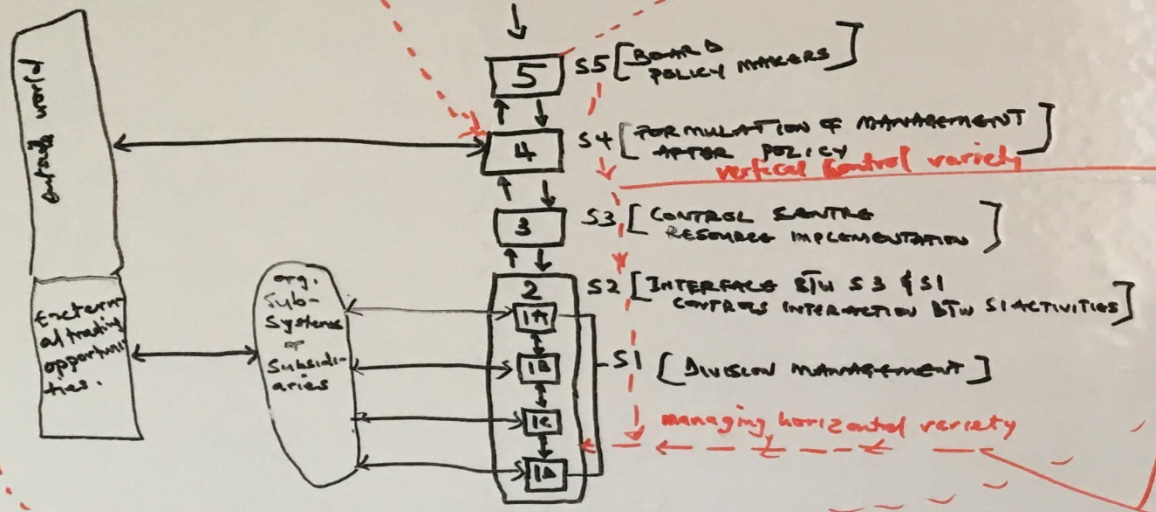
VIABLE SYSTEMS MODEL
STAFFORD BEER

The way decision processes operate

ANASTOMOTIC RETICULUM
A NEUROPHYSIOLOGICAL MODEL FOR DECISION MAKING

Brain box

Inspired by human biological science called - Autonomic Nervous System because it operates without conscious intervention



ENVIRONMENT ↔ PROCESS ↔ MANAGEMENT

ROSS ASHBY'S LAW OF REQUISITE VARIETY

ONLY VARIETY CAN DESTROY/ VARIETY ABSORB

WE ATTEMPT TO CONTROL EVERYTHING OR CHOOSE WHAT NOT TO CONTROL!

IF THE CONTROLLED CAN GENERATE MORE VARIETY THAN THE CONTROLLER, THEN CONTROLLING EVERYTHING CAN NOT BE EFFECTIVE

C = Controller's alternatives
P = Controlee's actions

Based on Ashby's law of requisite variety

Vertical variety = horizontal variety

Operational variety

	P_1	P_2	P_3
C_1	a	b	c
C_2	b	c	c
C_3	c	c	a
C_4	d	d	d
C_5	a	b	d

$$\frac{\text{Variety in } C}{\text{Variety in } P}$$

LAWS OF COHESION BY STAFFORD BEER
IN A VIABLE SYSTEM, JUST AS MUCH VARIETY REDUCTION IS REQUIRED TO KEEP THE SYSTEM BALANCED

Thank You !