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
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
CSTP-NASRDA'S INFLUENCE DIAGRAM

National Space Council

Director-General (NASRDA)

Defence Space Administration

International Cooperation

Policy Planning & Research

Strategic Space Application

Administration & Finance

Media Press & Protocol

Mission Planning And Satellite Data Management

Audit

Council Of Regulatory Office

Procurement

Engineering & Space Systems

Transparency & Anti-Corruption Unit

Technical Advisory Committee (TAC)

Head of Ministry of Science & Technology (HMST)

Highest influence

Higher influence

High influence

Relative influence

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

REQUISITE SYSTEM MODEL

PROCESS A -- PROPULSION SUB-SYSTEM
PROCESS B -- STRUCTURES SUB-SYSTEM
PROCESS C -- AVIONICS SUB-SYSTEM
PROCESS D -- DESIGN&CMP SUB-SYSTEM

FEDERAL GOVERNMENT

NSC
HMST
DDC

COMPANIES

LABS

SYSTEM 5
FRONTAL LOBE
BRAIN OF THE FIRM

SYSTEM 4
CORTEX
ANASTOMOTIC RETICULUM

SYSTEM 3
CEREBELLUM
ALGEDONIC LOOP CONTROL

SYSTEM 2
ALGEDONODE

SYSTEM 1
MEDULLA OBLONGATA
BUFFER CONTROL

PROCESS A
PROCESS B
PROCESS C
PROCESS D

Management A
Management B
Management C
Management D

Vertical variety (direction of system's control)
Horizontal variety (direction of operation)

LC = VV/HH
Variety attenuation and amplification

V = VARIETY (THE BIGGER THE SIZE-V, THE MORE THE VARIETY)
A sensorium resides within a system to register incoming 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 a 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).
REFERENCES


REFLEXIVITY

SYSTEMS THINKING

Process of inquiry

FRAMEWORK OF IDEAS

Framework of problem solving process

Decisions-making in the Nigerian context

WORKER COMMUNICATION

WORKER SATISFACTION

Area of Interest

Decisions-making in complex tech. org.

WORKER RELATIONSHIP

POWER, POLITICS & CULTURE

KNOWLEDGE MANAGEMENT

Effect of motivation, trust, & time allowing

SOFT SYSTEMS THINKING

METHOD

ACTION RESEARCH

CYBERNETICS

HARD SYSTEMS THINKING

ENGINEERED SYSTEMS
Cybernetics

Viable Systems Model
Stafford Beer

Anastomotic Reticulum
A Neurophysiological Model For Decision Making

Ross Ashby’s Law of Requisite Variety

Only Variety can destroy Variety

We attempt to control everything or choose what not to control!

If the controller can generate more variety than the controller, then controlling everything cannot be effective.

< a controller’s alternatives
P = controller’s actions

<table>
<thead>
<tr>
<th>Varieties C</th>
<th>Varieties in P</th>
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<tbody>
<tr>
<td>c1, a, b, c</td>
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<td>c5, a, d, d</td>
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Law of Consequences by Stafford Beer

In a viable system, just we much variety required is required to make the system balanced.
Thank You !