AfroLeap-21Podcast

"Africa Leapfrogging to the 21st Century"

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Systems thinking for managing complexity

What are the different definitions of a systems?

- ***Mechanical definition:*** A set of things working together as parts of a mechanism or an interconnecting network, (machines)
- ***Organizational definition:*** A set of principles or procedures according to which something is done and/or accomplished; (an organized scheme or method)
- ***Engineering definition:*** a process or a unit delineated by a clearly defined boundaries and classified as open and closed system based on the input and output relationship

Background of systems thinking

- Systems thinking started to emerge at the turn of the 20th century but picked pace since the 1960s
- It evolved in the subsequent decades as a transdisciplinary science that deals with complex issues from systems dynamics perspective
- As much as it is recognized as a science of complexity, its key principles resonate very well with traditional knowledge systems

Why systems thinking?

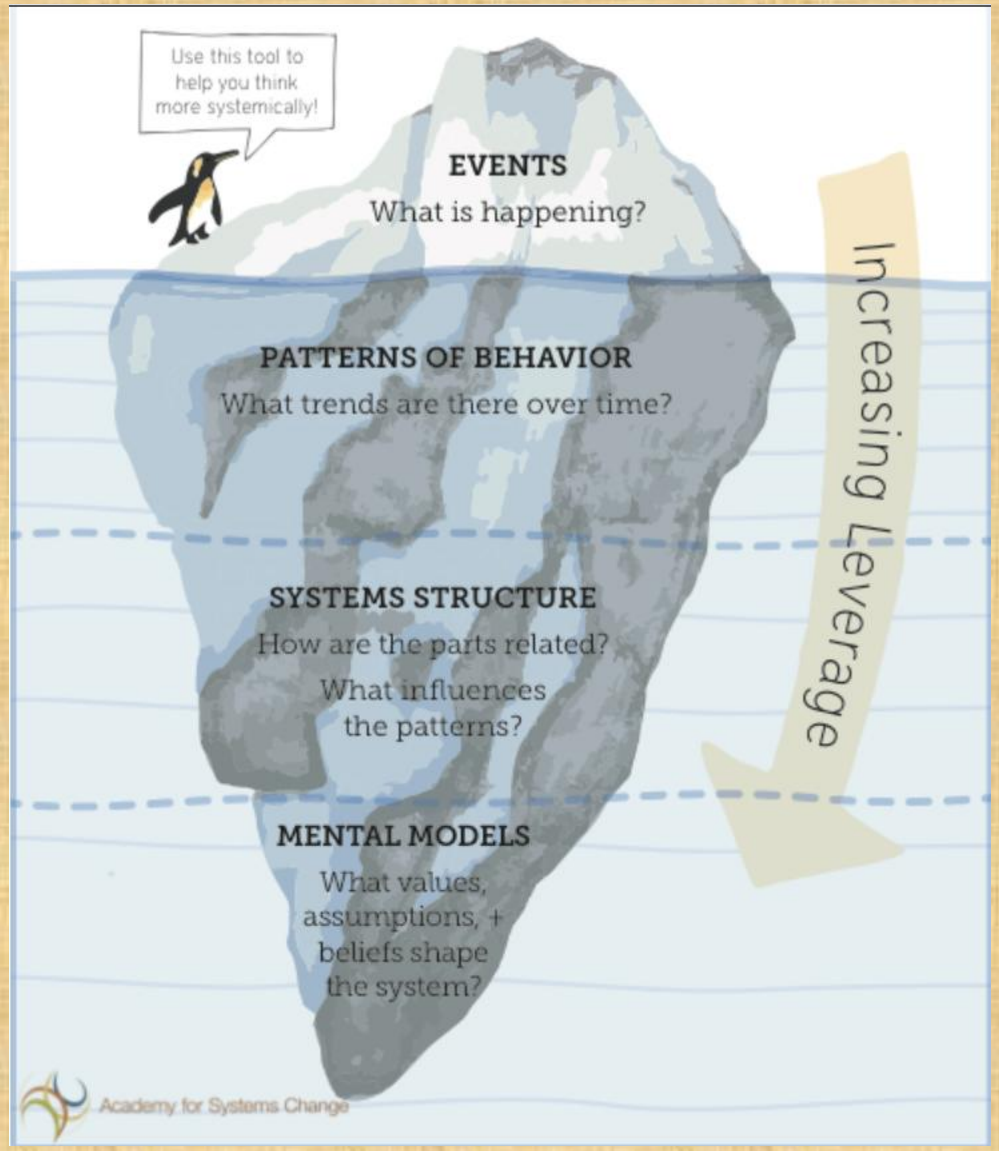
The socio-economic and socio-ecological crisis we are facing today are ***extremely complex*** and may lead to existential threat to humanity

The ***fast pace of deterministic deployment*** of disruptive technologies, including AI and robotics, is adding new dimensions of complexity

The ***linear thinking model based on reductionist simplification,*** which is currently dominant is inherently deficient to understand such complexities

Systems thinking that primarily focuses on the ***dynamic interconnection and interaction*** is key to understand and effectively manage complexity

The Iceberg Model of systems thinking



https://donellameadows.org/systems-thinking-resources/

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General and Relative systems thinking

- Distinction between General Systems Thinking and Specialized systems thinking (Weinberg,1975);
  - ***General systems thinking***: evolved with the purpose of overcoming the limitation of reductionist simplification in the organized complex region
  - ***Relative systems thinking***: is based on separating the entity from its environment by an imaginary boundary and describing its interaction with the environment in terms of distinct input-output relationships

Systems thinking is not a ***mechanical summation*** *of linear thinking*

Systems definition of a system

- A system consists of two principal components and their dynamic interaction which needs to be considered as a whole (Ayres, 1994 & Mebratu, 2004):
  - An organized ***physical entity*** (unit) with a specific functional purpose and manifestation that is characterized by the information embodied in it (the Distinguishability (D) factor)
  - The ***field of significance*** (environment) within which the unit conducts its functional purpose characterized by multidimensional survival relevant (SR) factors
- The functional capacity of any system is defined by the interaction between the Entity (D) and Survival Relevant (SR) factors

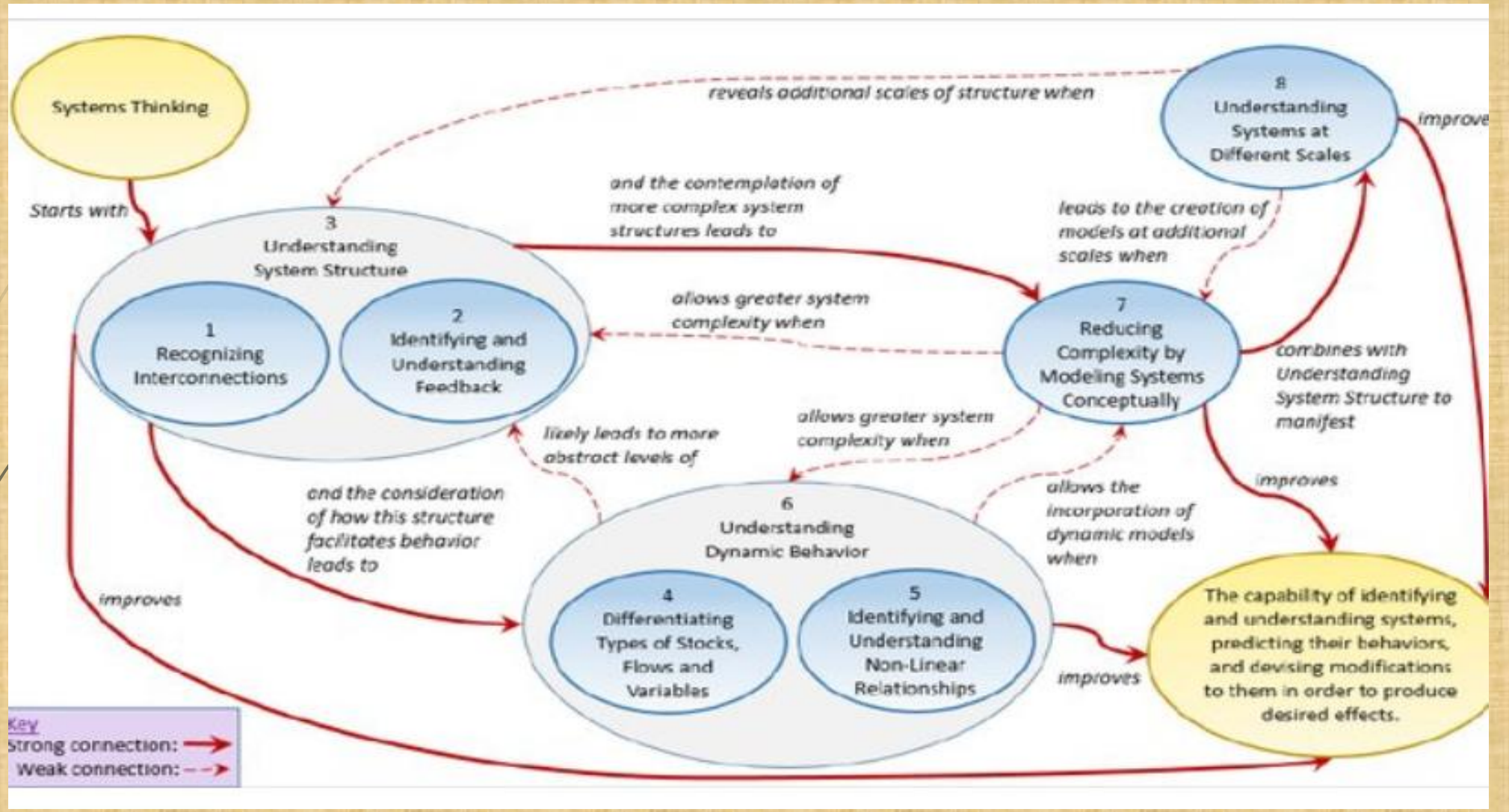
Systems level and hierarchy

- ***Simple system:*** systems that consist of one or two feedback loops and single function (eg: a cell);
- ***Complicated System:*** system that consists of more than two feedback loops and higher function (eg: organs such as the heart, liver, stomach etc.);
- ***Complex system:*** systems that consists of multiple feedback loops and multiple systemic functions (eg.: digestive, respiratory, cardiac systems, etc);
- ***Complex adaptive system***: systems with multiple layers of functions and adaptive feedback loops (eg.: a human being with natural, social and economic functions and adaptive layers).

Key stages of systems understanding

- Understanding ***the systemic structure*** by recognizing interconnections and identifying key feedback loops
- Understanding the ***dynamics of the non-linear relationships*** by differentiating the main stock, flows and variables that constitute the system
- Understanding systems at ***different scale and reducing complexity*** through systems modelling
- Defining the ***required actions and modifications*** at various levels in order to reduce the undesirable effects and enhance the desirable outcomes

Systems Thinking Systemigram (R.D.Arnold & J.P. Wade, 2025)



Systems thinking & indigenous knowledge systems

- Most of the indigenous knowledge systems, as the highest form of collective common sense (wisdom), are in harmony with the essence of systems thinking
- The African philosophy of UBUNTU which is based on the concept of "I am because we are" aligns with the definition of a system as a function of the interaction between the entity factor and survival relevant factor as the field of significance
- Everyone of us as individuals who are bourn with the capacity of common sense have the potential to be systems thinkers and practitioners
- We only need to overcome the mental barriers that are imposed by the reductionist and stereotype thinking that are dominant in our education and information infrastructure

Further readings

i. Arnold, R.D. & Wade, J. 2015. A Definition of Systems Thinking: A Systems Approach. Procedia Computer Science, 44:669-678. Elsevier B.V. DOI: 10.1016/j.procs.2015.03.050

ii. Ayres, R.U. 1994. Information, Entropy and Progress: A New Evolutionary Paradigm. New York: American Institute of Physics.

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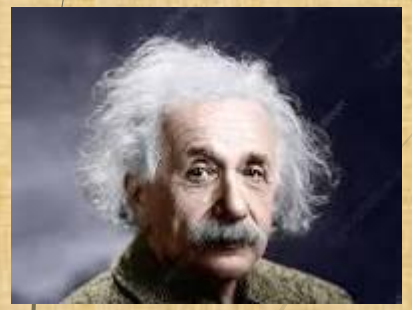
vi. Weinberg, M.G. 1975. An introduction to General Systems Thinking, New York: Wiley-Interscience.



"One can not solve a problem by using the same method that created it"

Albert Einstein

In both political and scientific development the sense of malfunction that can lead to crisis is a prerequisite to revolution and paradigm shift.

Thomas S. Khun