SAND2013-1118P

(Week 1/Day 3)

(Critical Thinking and) **Systems Analysis Approach**

SAND xxxxxxxx

Gulf Nuclear Energy Infrastructure Institute – 2013 Fundamentals Course
Sandia National Laboratories
Developed by Dr. Faraj Ghanbari

Week #1 Learning Objectives and Take-aways

Week 1 Learning Objectives:

- **Critical Thinking, Systems Analysis Approach & Scientific Method**

Week 1 Take-Away:

- A Responsible Nuclear Energy Program (RNEP) **with** a Strong Safety, Security, and Safeguard (3S) Framework Can Be Developed and Maintained Through Utilization of Systems Analysis Approach and Critical Thinking

Week 1 Daily Take-Away:

- **Day 1:** Connections between the GNEII curriculum, attributes of a responsible nuclear energy program (RNEP) and a strong 3S Framework
- **Day 2:** Importance of Fair-Minded Critical Thinking in a strong 3S Culture
- **Day 3:** Importance of Systems Analysis Approach and use of Scientific Method in a strong 3S Culture
- **Day 4:** Impact of history and utilization of nuclear energy on the 3S global norms, guidelines, and obligations
- **Day 5:** Conceptual knowledge, critical thinking and system analysis skills learned in GNEII are useful tool for addressing the 3S issues

(Week 1/Day 3)

Lecture #1: System Thinking and Scientific Method

Lecture Outline

1. Introduction
2. Definition of a Typical System
3. Objective(s) of a System
4. Types of Systems
5. Systems Thinking and Systems Approach
6. Systems Analysis and System Solution
7. Critical Thinking Relation to System Thinking
8. Scientific Method: A Tool for Formalized Critical Thinking and System Analysis, or System Solution, Approach
9. RNEP and 3S Framework as Systems

Recall: To Impact the 3S Culture, WE

- **Must impact at the Basic Assumption level (deepest level);**
- **Make a positive impact on individual's "values, beliefs and assumptions"**
- **<u>Learn and utilize Fair-minded Critical Thinking to provide a process for consistent evaluation of thought process and examination of values, beliefs, and assumptions</u>**
- ***<u>Learn and use Systems thinking / Approach</u>* <u>to develop the complex mental models required to analyze the mutual interaction of elements and components.</u>**

This Lecture:

- Must impact at the Basic Assumption level (deepest level);
- Make a positive impact on individual's "values, beliefs and assumptions"
- Learn and utilize Fair-minded Critical Thinking to provide a process for consistent evaluation of thought process and examination of values, beliefs, and assumptions

This Lecture:

- ***Learn and use Systems thinking / Approach*** **to develop the complex mental models required to analyze the mutual interaction of elements and components.**

When to Use System Analysis Approach?

Some indicators that we are dealing with a system:

- Multiple interdependent parameters exist;
- Need for balancing or reinforcing feedback;
- There are multiple perspectives on just what the situation is, and how to deal with it;
- No Balanced Approach – endless oscillation;
- Previously applied fixes have created problems elsewhere
- A tendency to allow an established standard to slip
- Partners for growth become adversaries – Competing interests
- Growth in one area leads to decline elsewhere

Questions:

- **What is the definition of a System?**
- **Are RNEP and Integrated 3S Frameworks Systems?**

Define a Typical System

- According to the Webster's New Dictionary:

  1. A regularly interacting or interdependent group of items forming a unified whole;

  2. An organized set of doctrines, ideas, or principles usually intended to explain the arrangement or working of a systematic whole

- Many other definitions

Define a Typical System

- What is NOT a System?
- However; Not every set of items, facts, methods, or procedures is a system; For example:
  - *A random group of items in a room would constitute a set with definite relationships between the items, but it would not qualify as a system because of the absence of unity, functional relationship, and useful purpose.*

Definition of a Typical System

An assemblage of <u>interacting or interdependent components, each with its own attributes, and relationships forming a unified whole(system) to serve an stated purpose</u>

- ***<u>Components:</u>*** are the operating parts of a system consisting of input, process, and output. Each system component may assume a variety of values to describe a system state as set by some control action and one or more restrictions.
- ***<u>Attributes:</u>*** are the properties or discernible manifestations of the components of a system. These attributes characterize the system.
- ***<u>Relationships:</u>*** are the links between components and attributes of components.

Properties of System Components

As they work together toward some common objective or purpose (System Objectives), a set of interrelated **components** has the following properties:

- The properties and behavior of each component of the set has an effect on the properties and behavior of the set as a whole [feedbacks].
- The properties and behavior of each component of the set depends on the properties and behavior of at least one other component in the set [Interplay, Relationships].
- Each possible subset of components has the two properties listed previously; the components cannot be divided into independent subsets [Interdependent].

Definition of System for GNEII's Curriculum

A regularly interacting or interdependent group of items each with its own attributes forming a unified whole to serve an stated purpose or objective

- **Components = group of items** (Lectures, Activities, Instructors, Stakeholders, Fellows, KUSTAR, ….)
- **Attributes: items' attributes** (Characteristics and Requirements for each Components Listed Above)
- **Relationships:** interaction or interdependence of items (All the relationships, agreements, expectations, … among the components)

Types of Systems: Natural Systems

Classification of system based on its origin:

- Natural Systems are those that came into being by natural processes – without interference from human
- Attributes of Natural Systems include:
  - Exhibit a high degree of order and equilibrium: seasons, food chain, water cycle
  - Adapt themselves to maintain an equilibrium with the environment: Organisms and plant life
  - Material flow are cyclic, no dead ends, no waste
  - Continual recirculation
- Relationships – Examples
  - Rainfalls impact the rivers, seasons, food chain, plant life,..
  - Plant life impact the environment, organisms, animal life,..

Conceptual Systems are those represented by symbols that describe the attributes of their components; for example:

- Ideas, plans, concepts, and hypotheses
- Mathematical models

Set of plans and specifications for a physical system before it is brought into being is a conceptual system

Physical Systems manifest themselves in physical form. They are composed of real components

- Occupy or consume physical space
- Examples: Cars, a Nuclear Power Plant

Types of Systems: Human-Made Systems

Classification of system based on its origin:

- Human-Made Systems are those in which human beings have intervened through components, attributes, and / or relationships

- Attributes of Natural Systems include:
  - Are embedded into the natural world, therefore,
  - They always interface with natural systems, hence,
  - Their impact on the natural system must be carefully examined
    - Example: impact of building a dam on a river and on its surrounding environment (e.g. agriculture)
  - **Impacts could be positive or negative – consider both**

System Objective and Effectiveness

- The **objective or purpose** of a **system must be explicitly defined and understood** so that system components may be selected to provide the desired output for each given set of inputs.

- Once defined, the objective or purpose makes it possible to establish a given measure of effectiveness indicating how well the system performs.

Connection to Critical Thinking: Recall

- The first step in critical thinking is to clearly understand the objective or purpose of thinking; hence,
- We referred to thinking as a "Thought System,"
  - Discussed the "elements" or "components" of Thought

Example: Types of questions we ask about an RNEP

- What is (are) the objective (s) or purpose of current Nuclear Safety, Security, and Safeguards (SSS) regime *(system)* at a typical commercial nuclear power plant?
  - Or what these objectives *should be?*
- How can one measure the effectiveness of the current SSS regime *(system objectives)*?
- Is the current SSS regime [in a certain country or nuclear power plant] effective *(as a system)*?

System Boundaries and Environment

- In any particular situation, it is important to define the system under consideration by specifying its:
  - limits,
  - boundaries, or scope.
- Everything that remains outside the boundaries of the system is considered to be the *environment*.
- However, no system is completely isolated from its environment.

Static and Dynamic Systems

One system dichotomy is the distinction of static and dynamic systems.

- A *static system* is one having structure without activity, as exemplified by a bridge
  - Does not rise its height when the water level rises
  - Does not warm itself when ice forms on its surface

- A *dynamic system* combines structural components with activity. An example is a school: combining a building with students, teachers, books, and curricula.

Closed and Open Systems

- A *closed system* is one that does not interact significantly with its environment (works in isolation?), that is, the environment provides only a context for the system.
- Closed systems exhibit the characteristics of equilibrium resulting from internal rigidity that maintains the system in spite of influences from the environment.

Open System

Open systems interact with their environment, examples being plants, ecological systems, and business organizations:

- They exhibit the characteristics of *steady state*, wherein a dynamic interaction of system components adjusts to changes in the environment. Because of this steady state, open systems are self-regulatory and often self-adaptive.

…..exhibit the characteristics of *steady state*, …. dynamic interaction of system components adjusts to changes in the environment…

Don't these attributes remind of us of our Balanced and Integrated 3S Framework?

Connection of System Approach to Critical Thinking

- ***Analytic thinking,*** an explanation of the whole is derived from explanations of its parts.
- ***Synthetic thinking,*** something to be explained is viewed as part of a larger system and is explained in terms of its role in that larger system.
- ***Neither negates the value of the other, but by synthetic thinking one can gain understanding that cannot be obtained through analysis, particularly of collective phenomena.***

Synthetic Thinking / Analysis

- **The synthetic mode of thought, when applied to systems problems is called the *systems (analysis) approach*.**
- This way of thinking is based on the observation that, when each part of a system performs as well as possible, the system as a whole *may not* perform as well as possible.

[Q: Why is that? What is missing here?]

  - **This follows from the fact that the sum of the functioning of the parts is seldom equal to the functioning of the whole.**
  - **Accordingly, the synthetic mode seeks to *overcome the often observed predisposition to perfect details and ignore system outcomes.***

For an Open and Dynamic RNEP (System) we need to "clearly understand the synergy between its components."

System-Approach Analysis

- The System Analysis Approach looks at a system from the top down rather than from the bottom up

  1. Objective of the System
  2. Role of each component or sub-system in supporting the objective of the system
  3. Required attributes of component or sub-system in order to support the objective of the system
  4. Interactions and relationships (synergies and conflicts) between component or sub-system

- By focusing on systems, subsystems, and components in a hierarchy, one is forced to consider all pertinent functional relationships.

Our Approach to Nuclear Safety, Security, and Safeguards (3S)

Our Approach to Analyze this Complex System

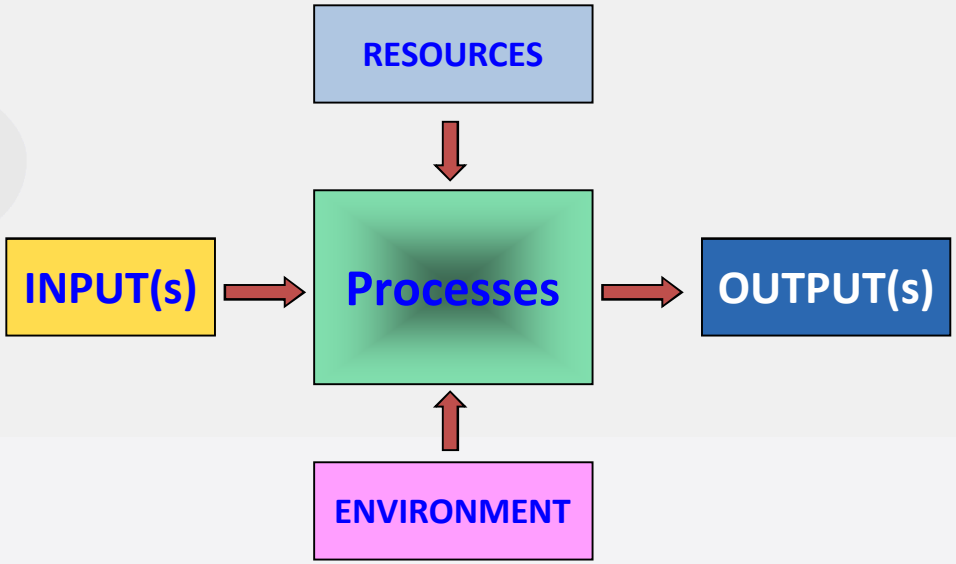
- System Analysis/Solution approach
- Goal of GNEII Curriculum is to:
  - Identify the major components of the 3S system
  - Provide suggestions to analyze, and understand the system and components attributes
  - Guide students in recognizing the interactions between the system (Integrated 3S) and its components/sub-system (Nuclear Safety, Nuclear Security, Nuclear Safeguards)
- Our 3S Framework Model
  1. Integrated 3S is a SYSTEM
  2. Integrated 3S System has two components / sub-systems
     1. 3S Culture Component / Subsystem
     2. 3S Enabling Tools Component / Subsystem

Analyzing a System:

One Way is to Examine the Attributes of a Typical System

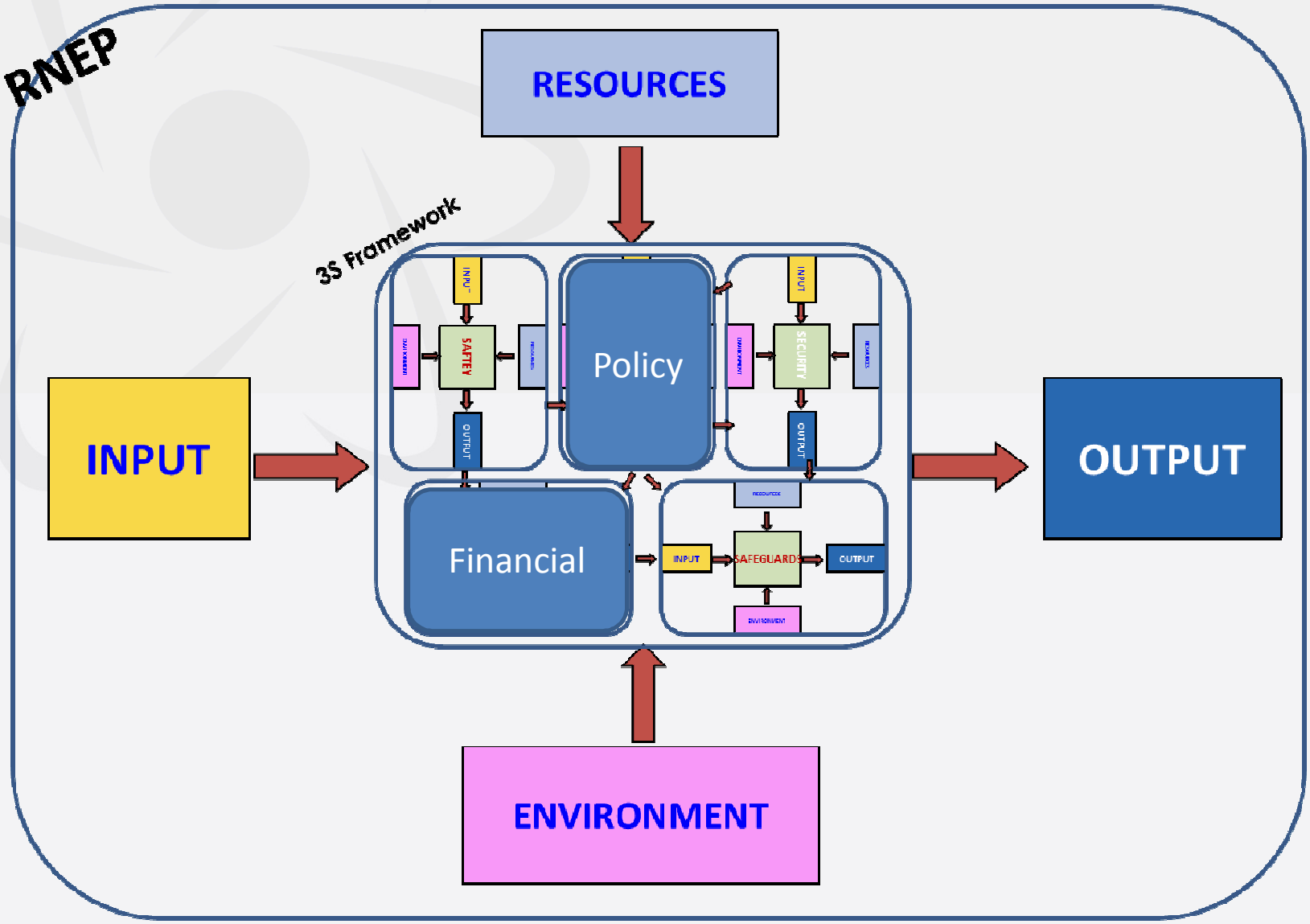
Example: Attributes of a Typical System Can be:

- Input (s)
- Resources
- Environment (Physical, Political, Economical, ..)
- Output(s) – we want these to match the "objective(s)" of the system



- **Processes**
  - Can be a combination of many interacting processes
    - Example: 3S System Processes are made up of Safety, Security, and Safeguards Processes
  - Interaction among processes results in feedbacks among them

3S Framework is a System of Systems –



Examples of the System Resources

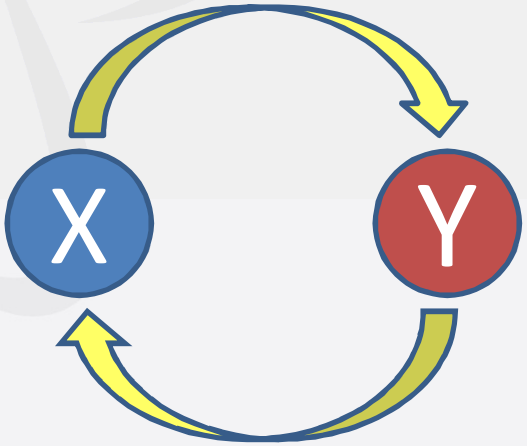
- Human
- Technology
- Information
- Facilities
- Equipment (Hardware) / Software
- Materials
- Maintenance Support

Examples of the System Environment

- Natural
- Social
- Political
- Economical
- Historical
- Cultural

Simple Component / Sub-system Feedbacks

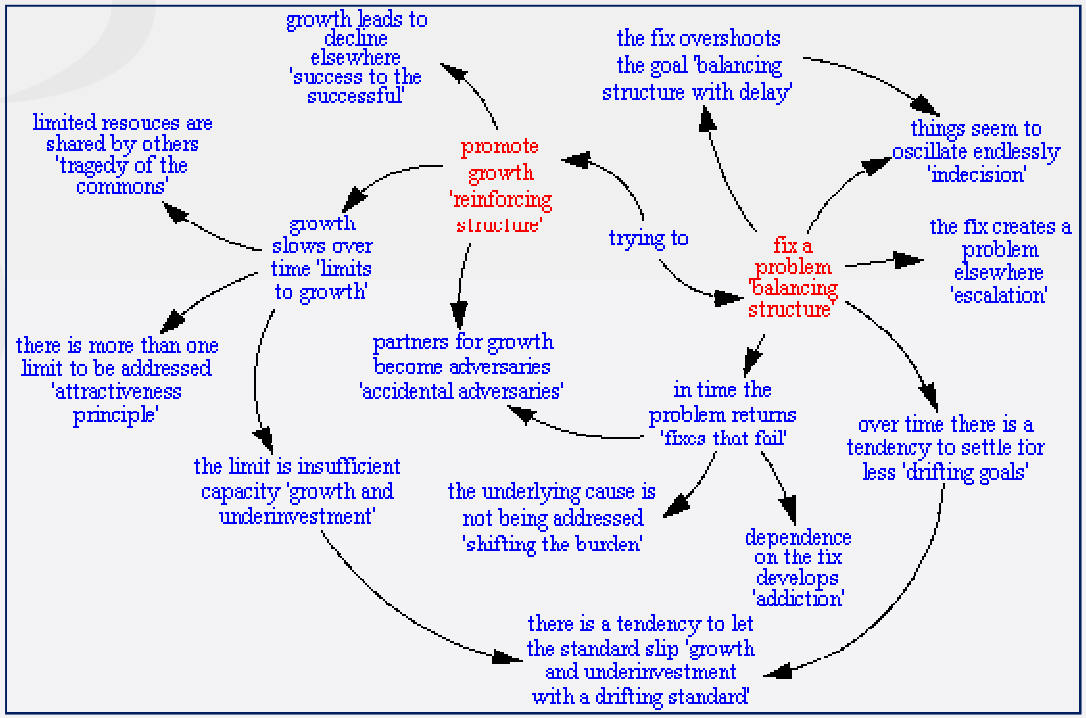
Sometimes called “mutual interaction” or “interrelationships”



Feedback: X affecting Y and Y in turn affecting X

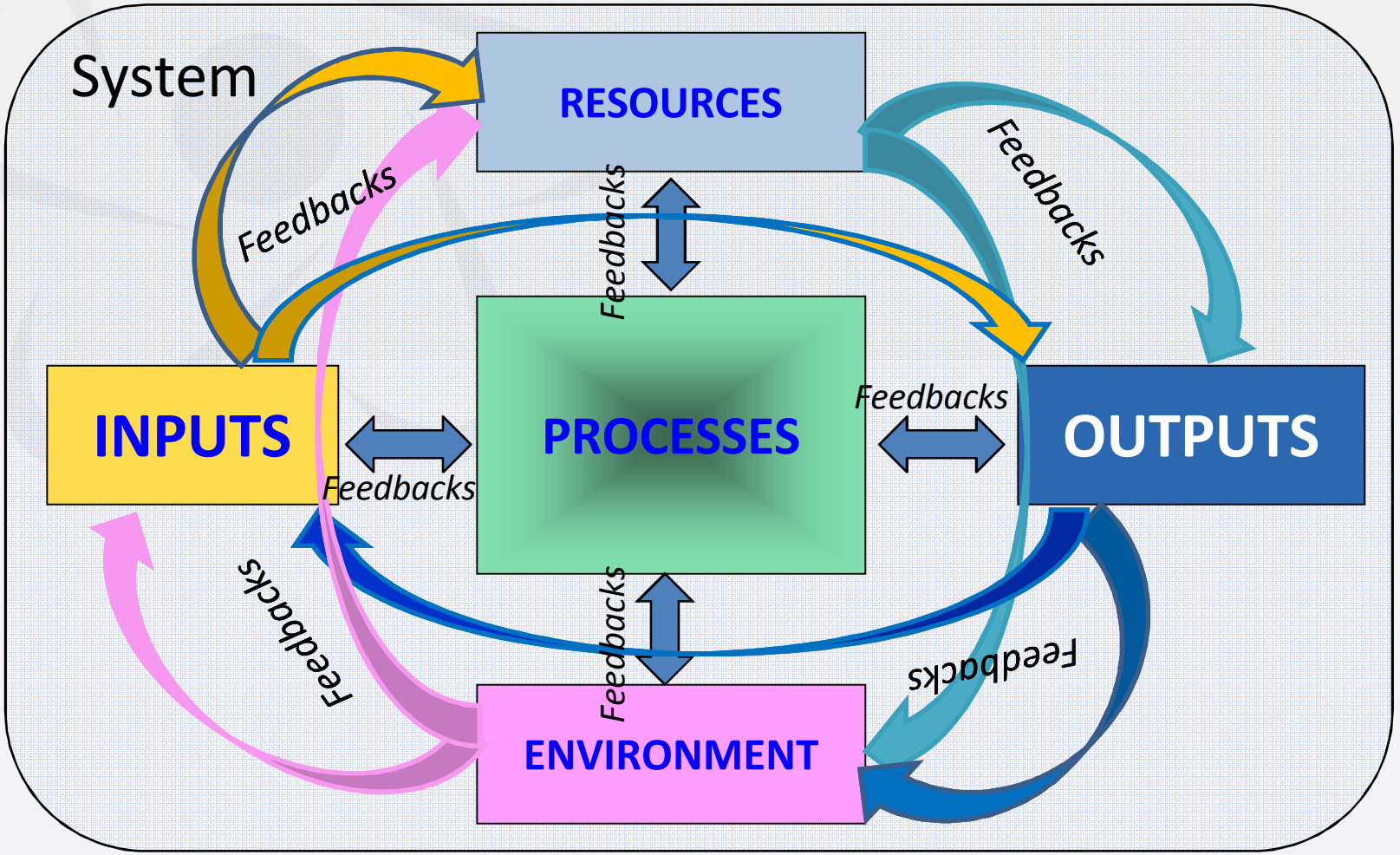
Complex Component / Sub-system Feedbacks

- Studying and understanding the feedback is crucial in system analysis
- Feedbacks in complex systems are sometimes called feedback systems
  - System dynamics is a methodology for studying and managing them



Complex Component / Sub-system Feedbacks

Interactions/Interplays



System Analysis and System Solution

- Up to now we have provided the foundations on which we will build the system solution approach
- First we need to analyze the problem – as a system
- Next we will discuss the major steps in developing *a* solution – as a system
- Notice the role of critical thinking in these processes

System Analysis / Solution Approach

- Determine if problem / issue constitutes a system:
  - Components
  - Attributes
  - Relationships

- Additional indicators include:
  - multiple perspectives on just what the situation is, and how to deal with it
  - previously applied fixes seem to overshoot the goal, or created problems elsewhere
  - tendency to allow an established standard to slip
  - progress slows over time
  - more than one limit to growth
  - Fixing on problem results in a problem elsewhere
  - …..

System Analysis / Solution Approach

- Determine the system:
  - Type
  - Objective(s) / Goals / Scope
  - Environment
  - Component attributes
  - Relationship between components
  - Role of each component
  - Component Feedbacks

- Use Scientific Method to Examine / Test Hypothesis / Solution
  - We discuss the Scientific Method (process) next

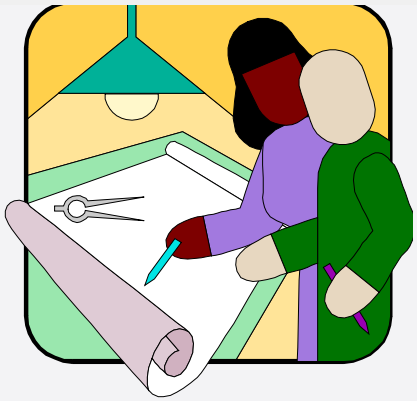
Scientific Method

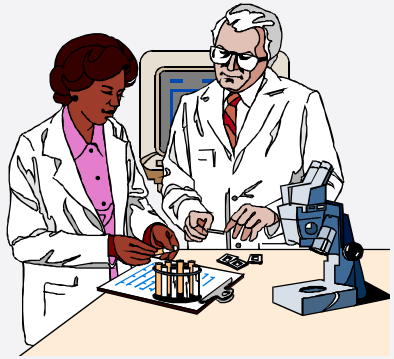
- A Tool for Formalized Critical Thinking and System Analysis, or Solution, Approach
- A tool for implementation of Critical Thinking and System Analysis Approach to Test Proposed Solutions

The Scientific Method

Q: What is Scientific Method?

A: A means or manner of procedure that scientists use to conduct their research and work. It is a systematic way of accomplishing goals of any research.

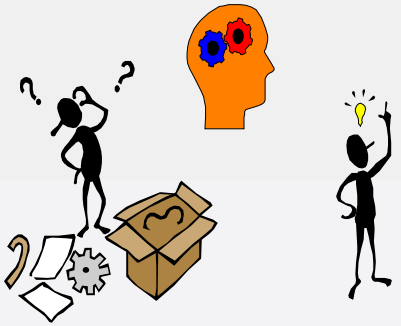




Scientific Method

Q: What is the Goal (Objectives) of a Research or Scientific Work?

A: Ask a question, find an answer and Compare the Answer to What Scientists Already Know About the World.



Questions:

- **Can this method be applied**
  - **In System Analysis?**
  - **To Social, political, and economical "Sciences" as well?**
- **Is this method compatible with critical thinking?**
- **We discuss the Scientific Method and its compatibility with Critical Thinking and application to System Analysis Approach.**

Scientific Method

Connection to Critical Thing and System Analysis Approach

1. **Ask a question or state a problem. (one of elements of Thought)**

2. **Propose an "Educated " answer /opinion/ view for /on the question /issue/topic/ or to solve the problem (Hypothesis). (requires collection of data/information and check assumptions before developing a view or opinion – an element of critical thinking)**

3. **Provide supporting arguments / evidence for your answer /opinion/ view AND those against ;**
   - **Provide arguments against other views – why you disagree? Why they will not work? What are their risks / un-intended consequences? (similar to elements of Thought and Critical Thinking).**

4. **Summarize your analyses/ results; and provide potential challenges with implementation/adoption of your answer /opinion/ view (similar to elements of Thought and Critical Thinking).**

5. **Draw (make) Conclusions *(How does the conclusion compare to the hypothesis?) What are the unintended consequences?* (similar to elements of Thought and Critical Thinking).**

Scientific Method: How to Start?

"The greatest challenge to any thinker is stating the problem in a way that will allow a solution."(Bertrand Russell)

- Clearly state the problem / or issues (Clarity)
- Is this an important or critical issues or problem (Significance)
- Is the problem solvable?
- Is the issue focused enough to allow a manageable system solution approach?
  - If so, are you considering its interactions with other issues in the system, and the system itself?

Scientific Method:
How to Develop a Hypothesis?

- *Educate yourself on the topic by researching the existing information on the topic (develop a background);*
- *"Best Educated Guess", that is, a "Hypothesis", is developed based on this research on the subject;*
- **Hypothesis: Propose:**
  - **an answer for the question**
  - **an opinion or view on the issues / topic**
  - **A solution for the problem**

The key is to educate oneself before guessing!

Scientific Method: Test Your Hypothesis

(connection to critical thinking)

- **Note**: Remember that when you TEST your Hypothesis, you are NOT trying to PROVE or DISPROVE your HYPOTHESIS – so, **be objective**; you are trying to find the true answer to your hypothesis (Intellectual Integrity).

- Your research/experiment must be doable, **relevant** (Relevance) to your hypothesis, and **repeatable (Precision)**

- Clearly identify and examine the variables: 1) Independent Variables , and 2) Dependent Variables **(components and their attributes)**

- **Clearly identify the data or information** to be recorded before, during, and after your research/experiment. **Record data AND observations.(data, evidence)**

Scientific Method: Analyze the Test Results

- Apply the concepts, techniques and methods to gathered data and information to interpret, evaluate, and assess them, or to calculate results
- Determine what the results of the experiment / research show:
  - Use Tables, Charts, and Graphs to organize and display the results.
  - **Utilize any additional observations you made**.
- Try to explain any discrepancies if possible. It is not unusual for the results of an experiment / research to raise additional questions, some of which can be answered by additional experimentation / research.

Scientific Method: Draw Conclusion

- **Reach a conclusion based on your data and analysis.**

- **Does the data support your hypothesis?**
  - **If so, to what degree, provide a brief explanation**
  - **If not, what does it show? Explain**

Scientific Method:

Communicate Your Findings and Conclusions

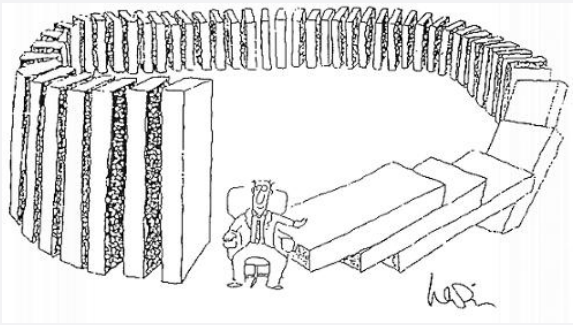
Your report, paper, or presentation must include the following sections:

- Statement of the question, the problem, or the issue.
- Statement of your hypothesis and reasoning behind it,
  - Show the information you researched and used in developing your hypothesis
- Describe your experiment / research method and procedures / process
  - Critical requirement: Research and arguments MUST BE RELEVANT to the issues / topic / view / position
- Present a summary of your results (graphical, tabular)
  - Don't forget your observations
- State your conclusion (s) AND challenges / implications.

System Solution Approach Requirements

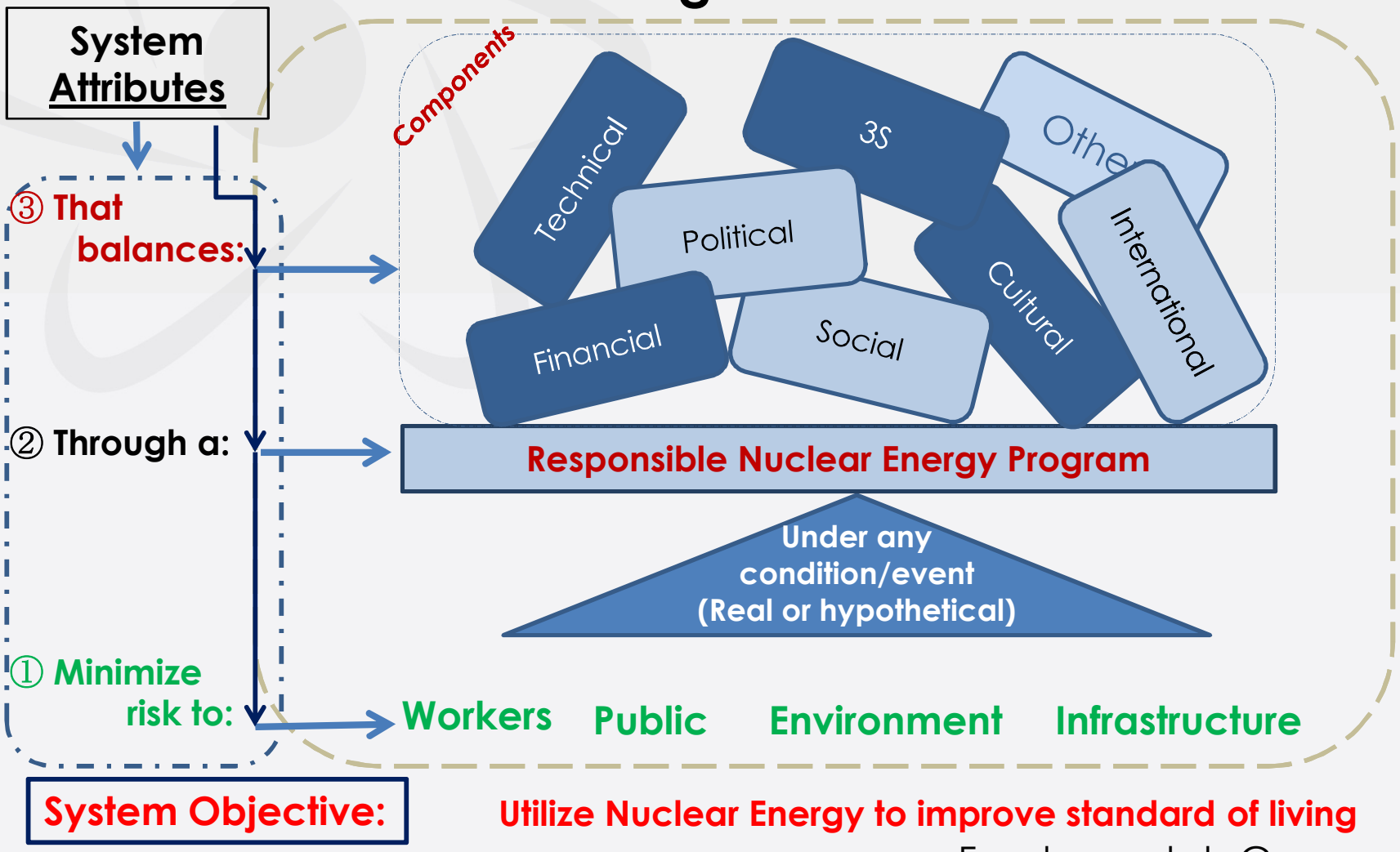
"It's so much easier to suggest solutions when you don't know too much about the problem."
--Malcolm Forbes

- Think Critically Throughout
- Define the System Goals / Objectives
- Gather Information and Data
- Analyze Desired System
- Include System Dynamics - Feedback
- Develop Several Possible Solutions
- Evaluate the Risk and Consider the Unintended Consequence
- Develop Mitigation Plans for Risks
- Rank Solutions
- Make Recommendation / Decision



Examine Our Model for RNEP – Is it a SYSTEM?

SYSTEM: Responsible Nuclear Energy Program



System Objective: Utilize Nuclear Energy to improve standard of living

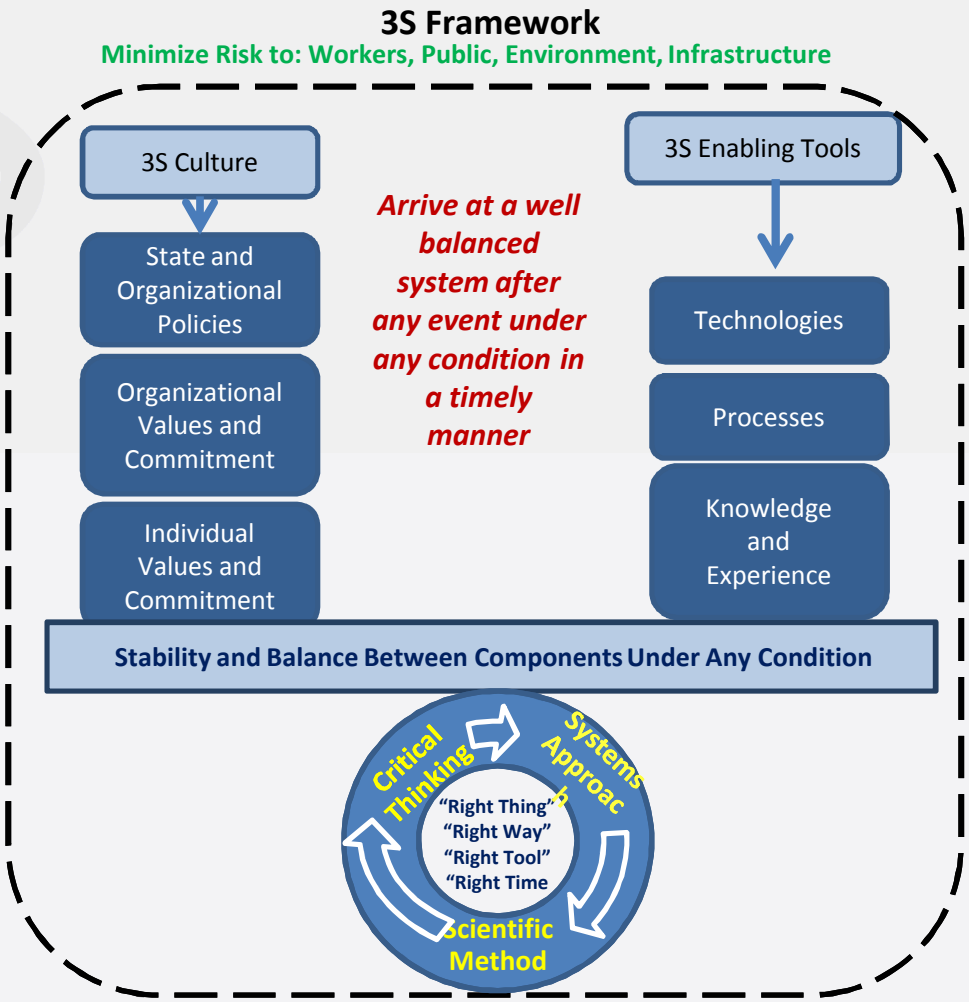
Is Our Proposed Model for Integrated 3S Framework a SYSTEM?

Now that we have covered the critical thinking, systems approach, and scientific method, use these approaches and tool to answer the following question:

Question

Does our proposed model for Integrated 3S Framework represent a SYSTEM? (This is first step in Scientific Method)

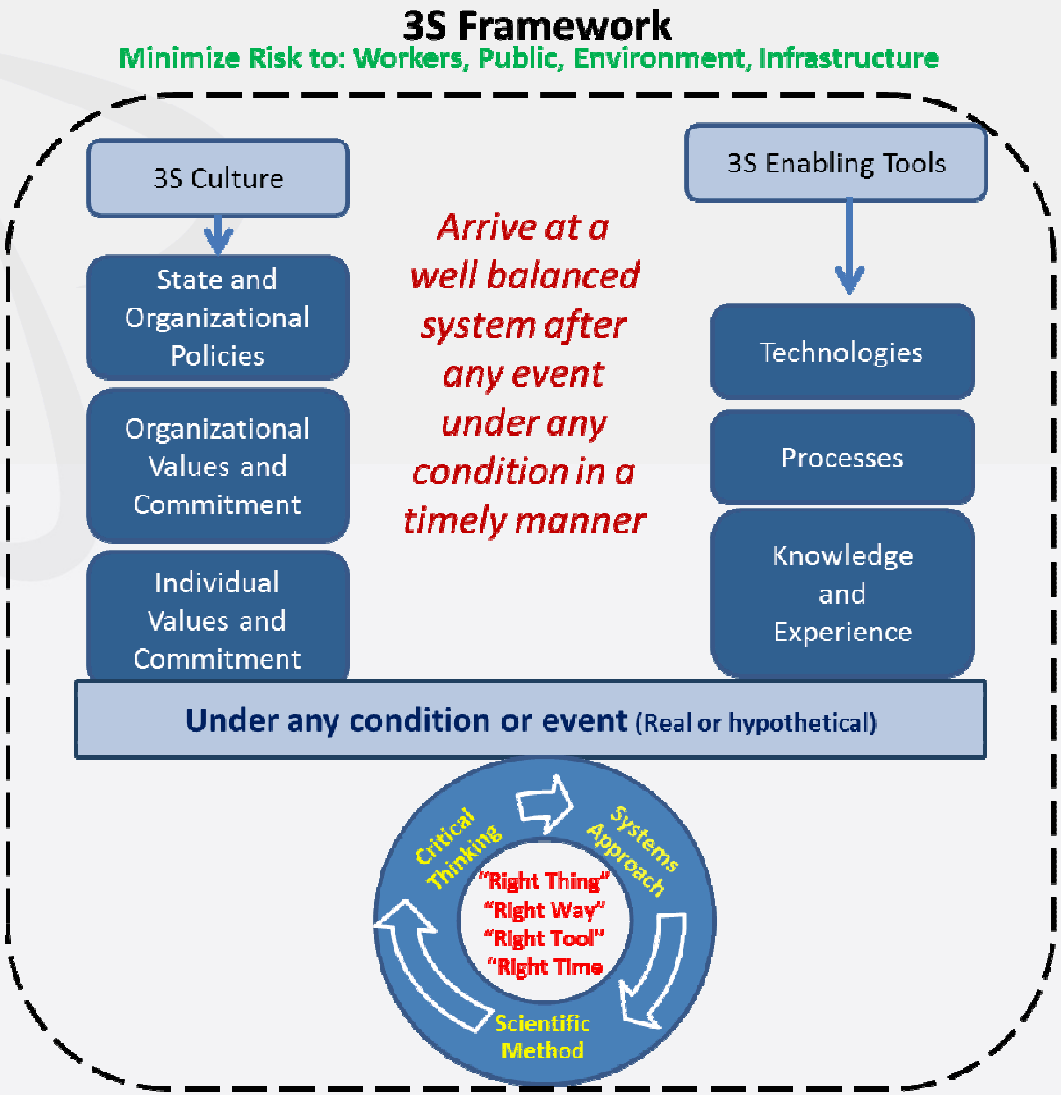
Follow the remaining steps in the Scientific Method and prepare a two-page report on your work. (see the next few slides for some reminders on our model).



Attributes of Our Proposed Model for Integrated 3S Framework

Attributes of Our Integrated 3S Framework Model System

- **Dynamic**
  - Flexible,
  - Adjust to Changes in the Conditions
- **Adaptive**
  - Able to easily (and dynamically) find the balance; focuses on integrating necessary components of culture/tools
  - Feedback capable
- **Proactive**
- **Comprehensive understanding across areas of expertise**
  - **Arrive at a Well Balanced System after any Event Under any Condition in a Timely Manner**



Review of our 3S Framework

Strong 3S is a component of RNEP, and

- **Must serve a Responsible Nuclear Energy Program**
  - **All of these can be built based on Fair-minded Critical Thinking, System Analysis Approach, and Scientific Method**
    - **"Right Thing"**
    - **"Right Way"**
    - **"Right Time"**
    - **"Right Tools"**

Responsible Nuclear Enterprise

Review of our 3S Framework

Strong 3S is a component of RNEP, and itself has two components

3S Culture

3S Enabling Tools

- **Has two main components**
  - **3S Culture**
  - **3S Enabling Tools**
- **3S Culture – itself has three components**
  - **Safety Culture**
  - **Security Culture**
  - **Safeguards Culture**

Attributes of 3S Culture Components

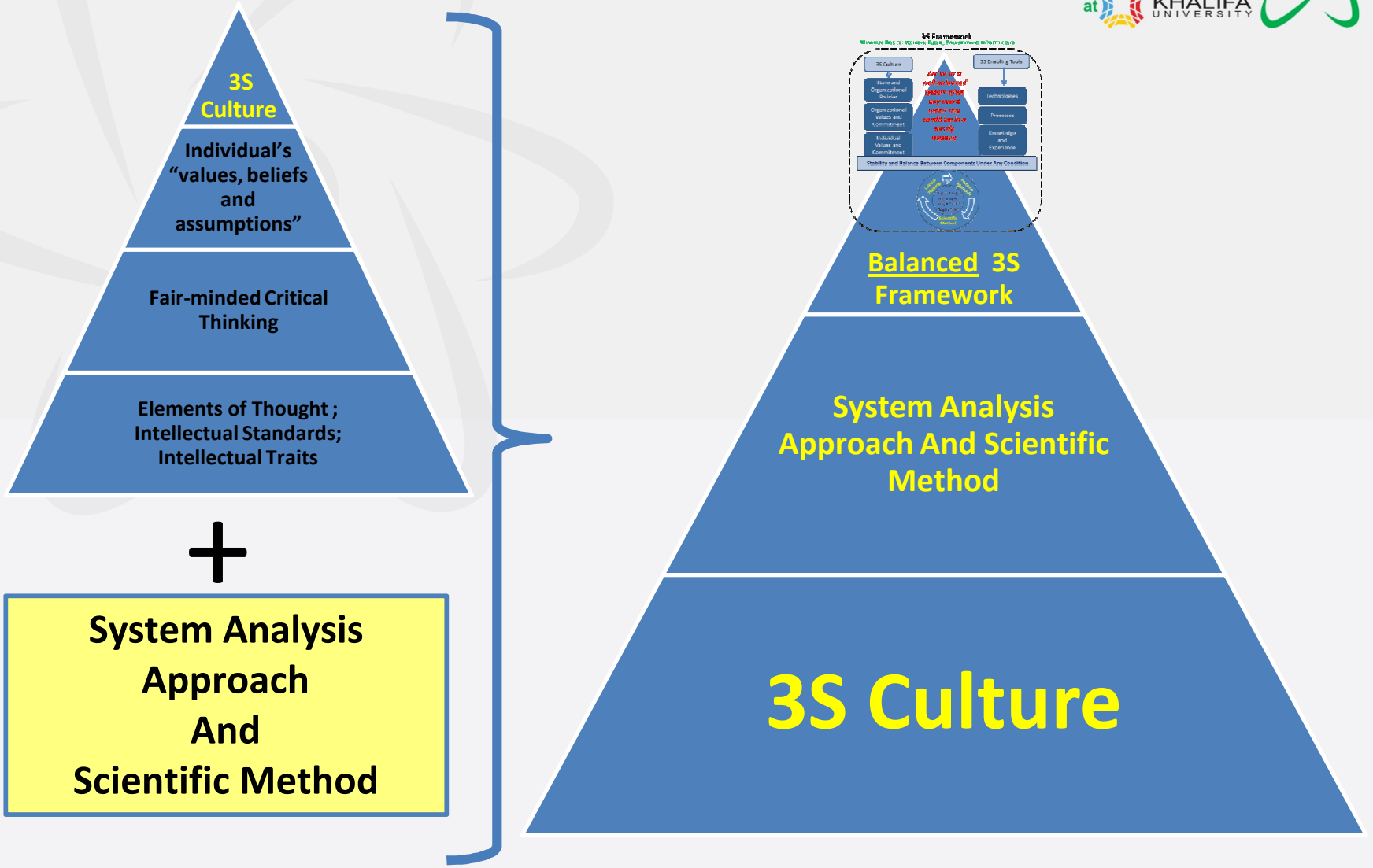
- **"3S Culture"**
  - Individual Values and Commitment
  - Organizational Values and Commitment
  - State and Organizational Policies
- **All of these can be built based on Fair-minded Critical Thinking**
  - **"Right Thing"**
  - **"Right Way"**
  - **"Right Time"**

Review of our 3S Framework

Attributes of 3S Enabling Tools Components

- **Enabling Tools**
  - **Technologies**
  - **Processes**
  - **Knowledge and Experience**
- **All of these will be utilized based on Fair-minded Critical Thinking, System Analysis Approach, and Scientific Method**

Our Approach to Create an Integrated 3S Framework



References

1. B. S. Blanchard and W. J. Fabrycky; "System Engineering and Analysis," Third Edition, 1998; chapter 1.
2. http://www.systems-thinking.org/index.htm
3. http://www.systems-thinking.org/stada/stada.htm#anchor909268
4. Systems Thinking, Systems Practice; by Peter Checkland, John Wiley & Sons, Reprinted November 2000

Concluding Remarks

- System thinking is one of the most important reasoning capabilities available to us;
- Systems Analysis (Solution) provides a holistic approach to deciding *what we want;* and *getting it with resource constraints;*
- Decision analysis and risk analysis are very useful in that context (don't forget dependencies!)
- When facing sequential decisions, consider the future effects of your actions: think forward, then back to initial decision

KEEP IN MIND THE BIG PICTURE

Day 2 – Homework Questions

- What compose a typical system?
- Question / issue are one of the elements of thought system. What are the attributes of this element?
- Information is one of the elements of thought system. What are the attributes of this element?

List of Required Texts

The following books and material will be the required:

1. The Aspiring Thinker's Guide to Critical Thinking by Dr. Linda Elder and Dr. Richard Paul; The Foundation for Critical Thinking
2. The Thinker's Guide to Engineering Reasoning by Dr. Linda Elder, Dr. Robert Niewoehner, and Dr. Richard Paul, and ; The Foundation for Critical Thinking
3. The Miniature Guide to Critical Thinking, Concepts and Tools, by Dr. Linda Elder and Dr. Richard Paul; The Foundation for Critical Thinking

End of Lecture 1
End of Day 3 of Week 1

(Week 1/Day 3)

Assignments, Activities, Exercises for Lecture on Systems Thinking

Assignments, Activities, Exercises

- Some activities are listed in the note-pages below each slide.
- Some of these activities will be assigned as homework to be completed by students and submitted for grading – see the embedded questions.

Questions and Exercises

- **Is GNEII Curriculum a System? If so;**
  - **What are its components?**
  - **What are the attributes of its components?**
  - **What are the attributes of the GNEII system?**
  - **What are some of the relationships between its components and attributes?**
- **List three impacts of a nuclear power plant on the natural system around it.**
- **What contingencies should be considered to minimize the potential negative impacts?**
- **What constitutes the GNEII *environment*?**
- **What constitutes the environment for SSS at a typical nuclear power plant?**
- **Should GNEII be treated as a static system or a dynamic one? Why?**
- **Should operation and management of a nuclear power plant be treated as a static system or a dynamic one? Why?**
- **Should GNEII be treated as a closed system or an open one? Why?**
- **Should operation and management of a nuclear power plant be treated as a closed system or an open one? Why?**
- **What are the main objectives / purpose of GNEII System?**
- **List the parameters that should be used to measure the effectiveness of GNEII.**
- **Which parameters can be quantitatively measured?**
- **How can we measure the qualitative parameters?**

Questions and Exercises

- **What is (are) the objective (s) or purpose of current Nuclear Safety, Security, and Safeguards (SSS) regime *(system)* at a typical commercial nuclear power plant?**
  - **Or what these objectives *should be?***
- **How can one measure the effectiveness of the current SSS regime *(system objectives)*?**
- **What constitutes the GNEII *environment*?**
- **What constitutes the environment for SSS at a typical nuclear power plant?**
- **Should GNEII be treated as a static system or a dynamic one? Why?**
- **Should operation and management of a nuclear power plant be treated as a static system or a dynamic one? Why?**
- **Should GNEII be treated as a closed system or an open one? Why?**
- **Should operation and management of a nuclear power plant be treated as a closed system or an open one? Why?**
- **Should GNEII be treated as a static system or a dynamic one? Why?**
- **Should operation and management of a nuclear power plant be treated as a static system or a dynamic one? Why?**

Day 3 – Homework Questions

- List some of the signs that indicate a systems thinking approach is most likely warranted
- List three impacts of a nuclear power plant on the natural system around it.
- What contingencies should be considered to minimize the potential negative impacts?
- List and describe the 5 main steps in the Scientific Method.
- What national infrastructure and major capabilities are needed in order for a country to be able to implement a successful nuclear energy power production program?

Day 3 – Homework Questions

For question below use ALL the information in the reference book to develop your answers; however, provide the specific information that is asked in each question:

- Select one of the following disciplines related to Nuclear Power generation:
  - Nuclear Power Plant Control room supervisor;
  - Nuclear Power Plant Reactor Operator
  - Instrumentation and Control Engineer;
  - Nuclear Power Plant Operation Manger;
  - Nuclear Power Plant Quality Assurance Manger;
  - Nuclear Engineer;
  - Nuclear Material Manager;
  - Radiation Protection Supervisor;
  - Nuclear Safety Engineer;
  - Physical Security Supervisor;
  - Regulatory Compliance Manager

Use the examples on pages 17-20 of the reference book "Engineering Reasoning", as guides to analyze the discipline you selected.

Day 3 – Homework Questions

- **Search the internet and read the NASA Report cited on page 41 of the reference book "Engineering Reasoning", – report by Gehman, HW, et al shown in the footnote.**
  - Write a summary of the report - maximum of 250 words.
  - Use the instructions on pages 12 and 13 of the reference book "Engineering Reasoning", to analyze the document. Complete items 1 through 8 – that is write each sentence in items 1 through 8, and fill in the blank for each one.