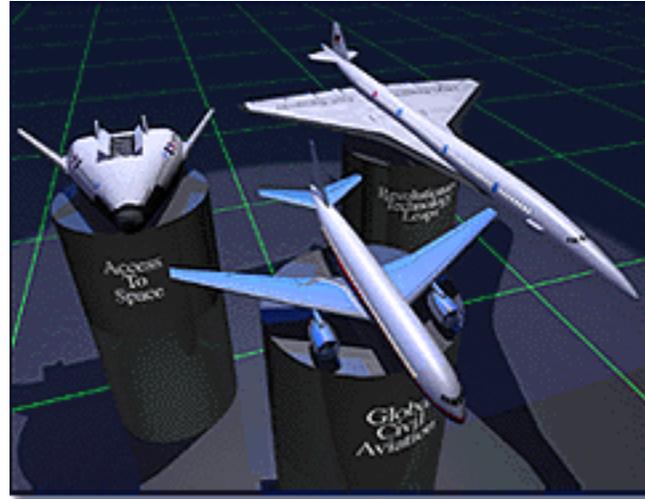


Modeling and Analysis of Multidiscipline Research Teams at NASA Langley Research Center: *A Systems Thinking Approach*



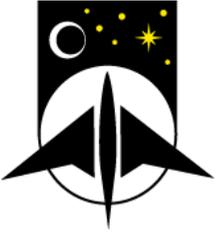
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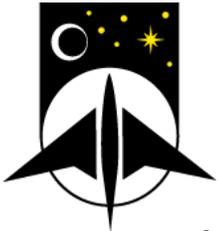
Outline

- **Motivation: Multidisciplinary Research at Langley**
- **Systems Thinking Overview**
- **Application to Multidiscipline Teams at Langley**
 - Approach
 - Synopsis of Model Elements and Key Features
 - Examples of Model Elements
 - Complete Model
- **Benefits: Using the Model / Analysis**
- **Concluding Remarks**



Multidiscipline Research at Langley

- **Multidisciplinary research involves technologies and people**
- **Efforts at Langley have focused on technologies**
- **Few Langley efforts have focused on teams**
 - **Note: organizational behavior researchers have studied diverse teams extensively.**
- **Many problems are associated with the dynamics of teams**
- **Study the factors that influence effectiveness of teams**
- **Systems Thinking was the method chosen**



What is Systems Thinking?

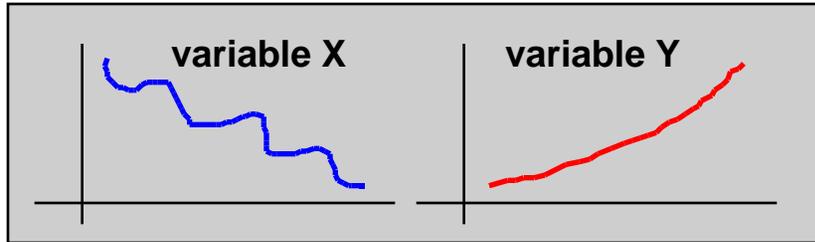
- A technology based on application of feedback control concepts to every day kinds of systems
- Focuses on *dynamic complexity* rather than *detail complexity*
 - detail complexity
 - » associated with dealing with large numbers of variables
 - » the realm of sophisticated analysis and management tools
 - dynamic complexity
 - » associated with situations where cause and effect are subtle or separated in time and where actions to produce desired response are not immediately obvious
 - » the realm of Systems Thinking
- “Systems thinking is a sensibility – for the subtle interconnectedness that gives living systems their unique character.”

– Peter Senge, “The Fifth Discipline”



How Does Systems Thinking Work?

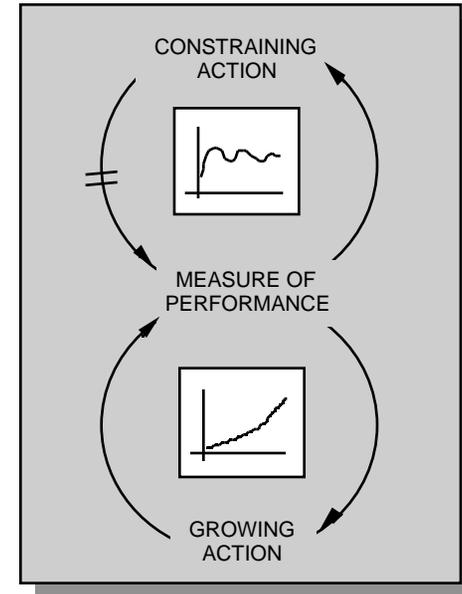
- Tell the story
- Identify patterns and trends



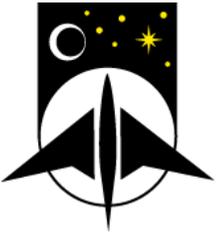
- Identify the *structure*

Events	
Patterns and Trends	
<u>Structure</u>	
<ul style="list-style-type: none">• heirarchy• processes• protocols• skills• attitudes• perceptions• culture• ...	

- Draw the *diagrams*

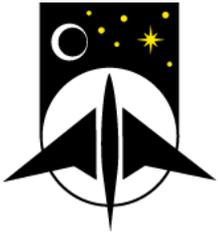


- Select an *archetype*
 - Fixes that Backfire
 - Limits to Growth
 - Shifting the Burden
 - Tragedy of the Commons
 - Accidental Adversaries
 - ...
- Identify interventions



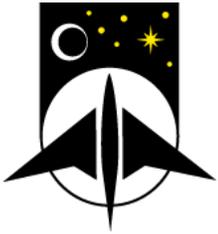
Approach

- **Select recent multidiscipline teams with a “rich” history**
 - extensive interaction of several technical disciplines
 - operated over a significant period of time
 - recent enough to recount history
 - characterized positive and negative dynamics
- **Interview cross-section of team members to determine influential factors affecting success**
 - objectives
 - expectations
 - significant events, results
 - influential factors
- **Apply the Systems Thinking process**



Focusing Question / Key Variable

- What are the barriers to developing highly effective multidiscipline research teams at NASA Langley?
- The key variable central to understanding the system is Team Effectiveness
- Represents a variety of desired characteristics of highly successful teams
 - ability to meet milestones and deadlines
 - high quality products
 - long-term impact
 - exceed expectations (sponsor, organization, customers)
 - effective communication
 - high productivity and efficiency
 - . . .



Model Elements / Principal Archetype

- A very rich interconnected structure was evident
- Six distinct scenarios were identified

Clarity of Mission

Involvement of Key Experts

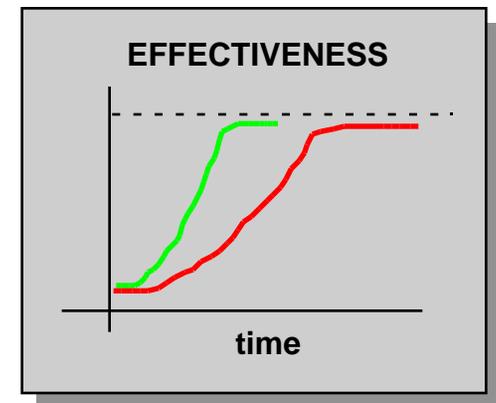
Multidiscipline Teaming Experience

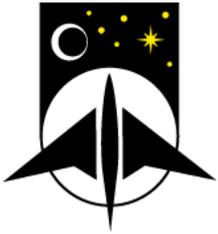
Willingness to be a Team Player

Effectiveness of Team Processes

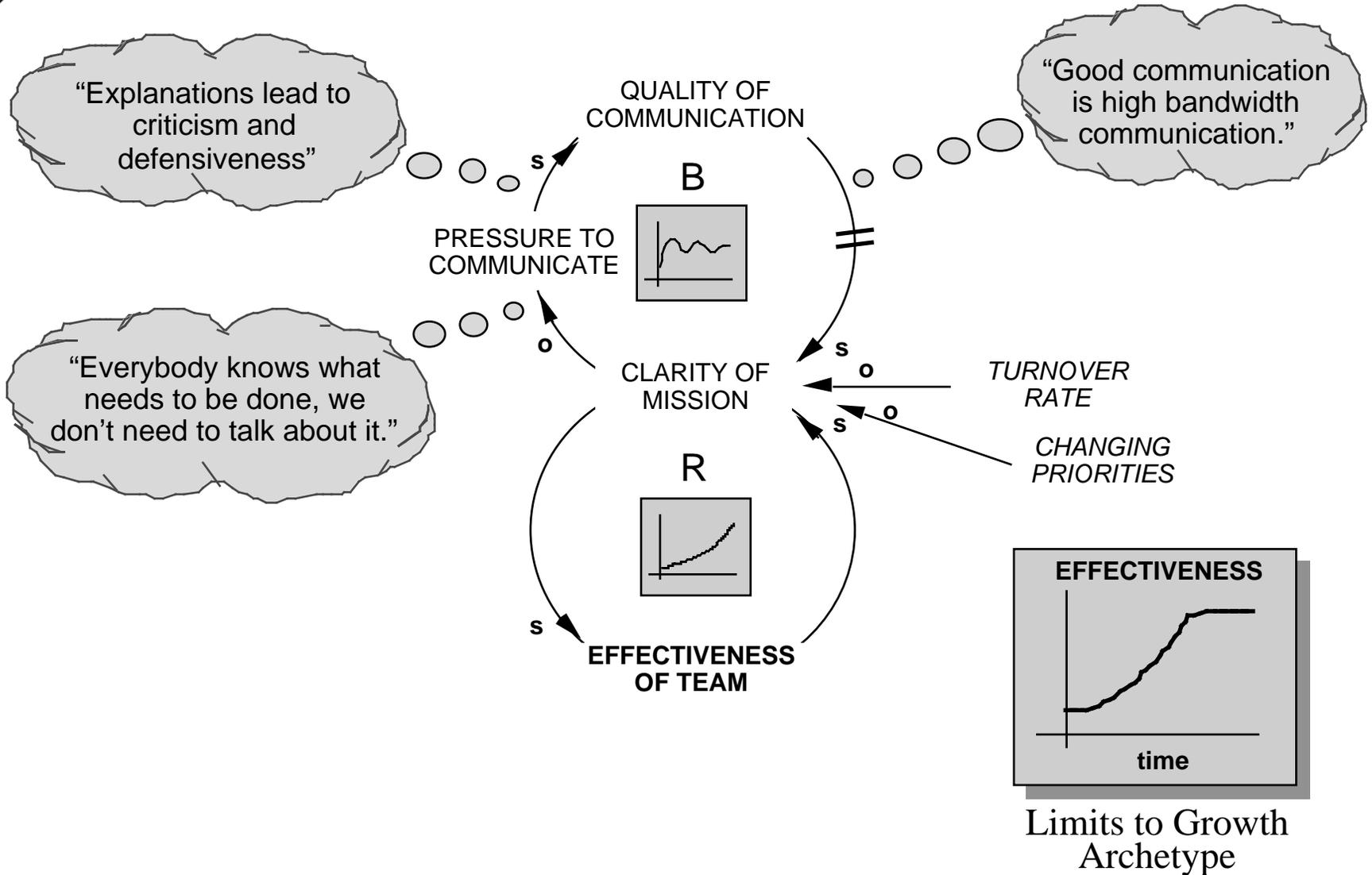
Balanced Level of Technology

- Principal archetype was “Limits to Growth”
 - nothing grows forever
 - multiple limiting forces
- High leverage interventions
 - manage the limits and constraints
 - anticipate latent constraints before they become active
 - eliminate constraints
 - little leverage in pushing harder (i.e., trying to accelerate growth)



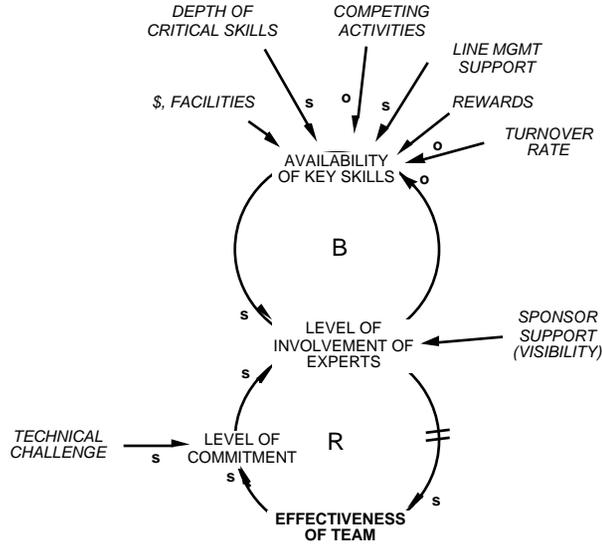


Clarity of Mission - Diagram

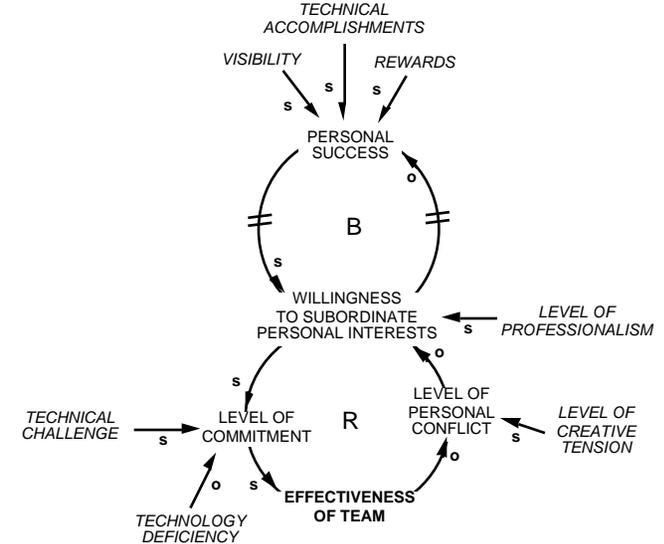




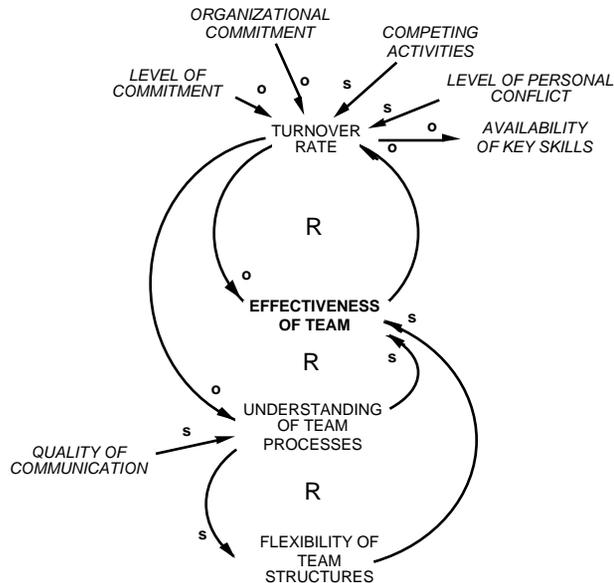
Other Scenarios



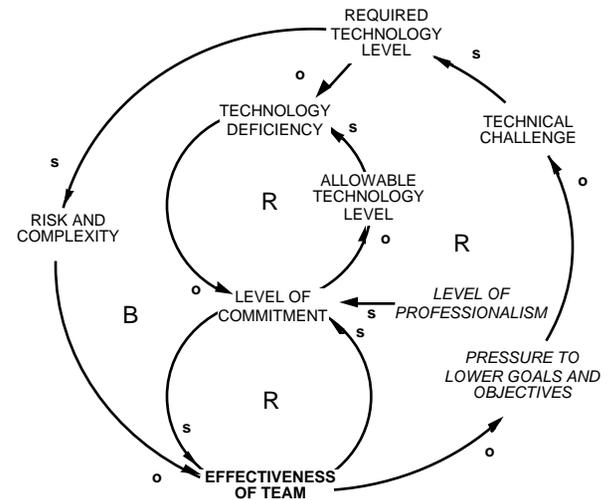
Involvement of Key Experts



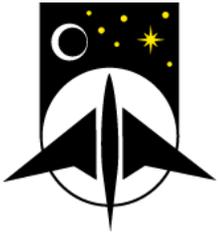
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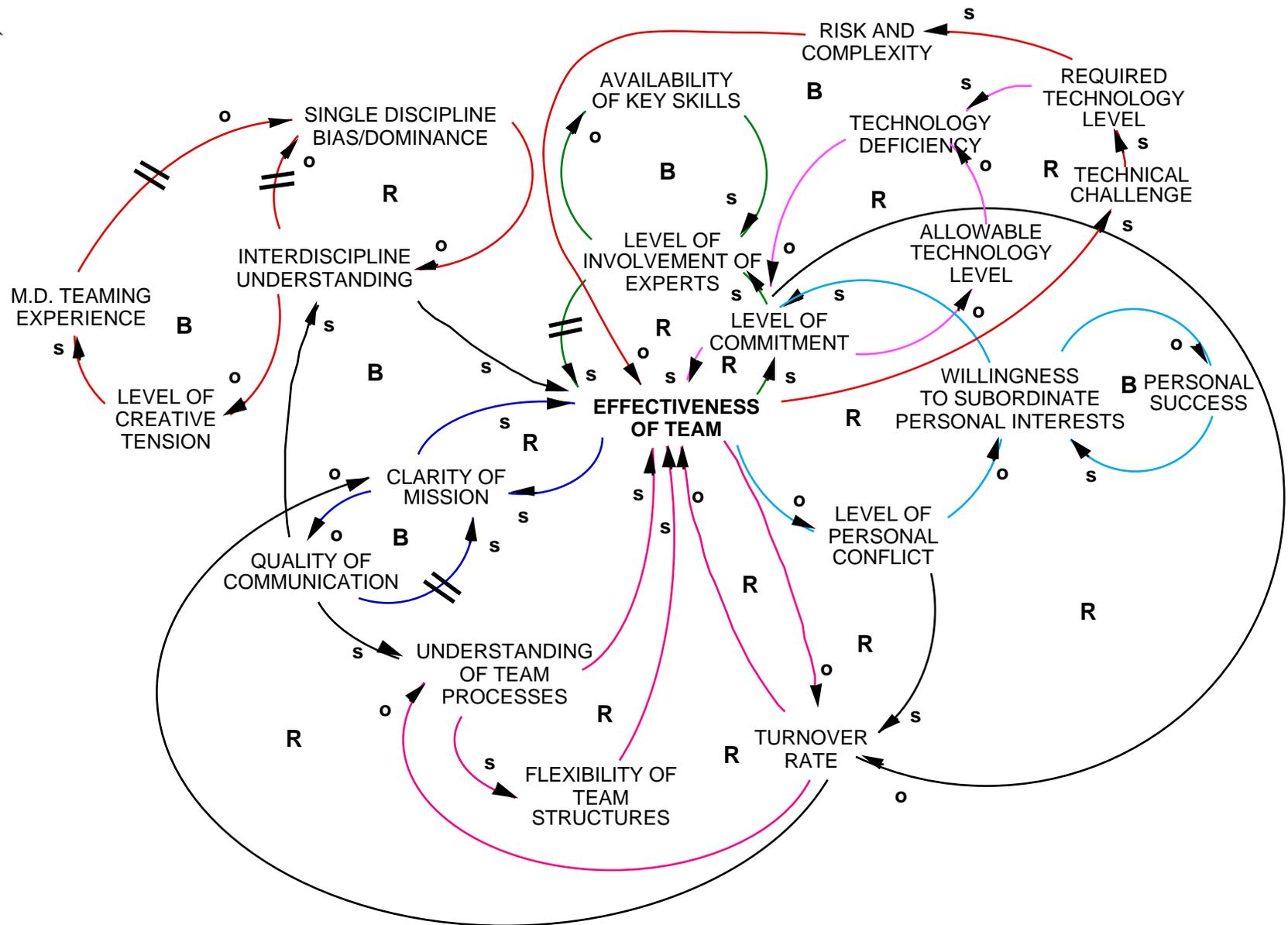
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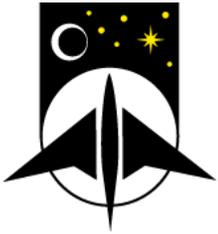


Balanced Level of Technology

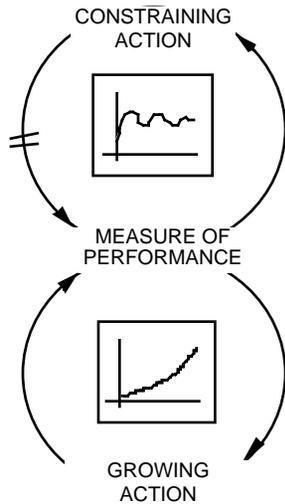


Integrated Multidiscipline Team Model





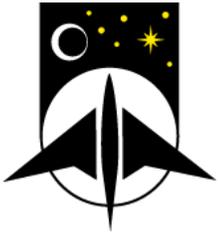
Benefits



- **Models provide –**
 - a shared visual reference for developing insight into team dynamics
 - basis for development of more sophisticated and comprehensive models of team dynamics

- **Analysis provides –**
 - means to separate symptoms from causes and clarify underlying issues
 - guidance for selecting high leverage, proactive ways of improving team effectiveness





Concluding Remarks

- **It's Just Common Sense**

- “Common sense is not so common.”

- *Voltaire*

- “Simple solutions seldom are. It takes a very unusual mind to undertake analysis of the obvious.”

- *Alfred North Whitehead*

- **Caveats**

- All models are approximations of reality (additional development and validation are needed)

- Results are –

- » representative of the Langley teams that were studied

- » representative of significant aspects of team dynamics

- » likely to be representative of most multidisciplinary teams

- » the creation of the group that developed the model

- Additional assessment of suggested interventions within context of entire interconnection structure is warranted