



SEARI Short Course Series

Course: PI.26s Epoch-based Thinking: Anticipating System and Enterprise Strategies for Dynamic Futures

Lecture: Lecture 6: Building Anticipatory Capacity

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Lecture Number: **SC-2010-PI26s-6-1**

Revision Date: July 24, 2010

This course was taught at PI.26s as a part of the MIT Professional Education Short Programs in July 2010 in Cambridge, MA. The lectures are provided to satisfy demand for learning more about Multi-Attribute Tradespace Exploration, Epoch-Era Analysis, and related SEARI-generated methods. The course is intended for self-study only. The materials are provided without instructor support, exercises or “course notebook” contents. Do not separate this cover sheet from the accompanying lecture pages. The copyright of the short course is retained by the Massachusetts Institute of Technology. Reproduction, reuse, and distribution of the course materials are not permitted without permission.



Systems Engineering Advancement Research Initiative

***[PI.26s] Epoch-Based Thinking: Anticipating System
and Enterprise Strategies for Dynamic Futures***

**Lecture 6
Building Anticipatory Capacity**

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Outline

- Anticipation and anticipatory systems
- Anticipatory capacity
- Relationship to value robustness
- Enablers for anticipatory capacity
- Historical and contemporary approaches
- Forward directions

What is Anticipation?

- Ability to look forward in order to take a future decision or action
- Visualization of a future event or state

The natural process of anticipation has always been a part of the design process

Systems scientists have long recognized that humans possess unique abilities for anticipation rather than simple reactive response

Anticipatory Systems

Fundamental work developed within biology and systems science:

An anticipatory system is “*a system containing a predicative model of itself and/or its environment, which allows it to change state in an instant in accord with the model’s prediction of itself and/or its environment*” (Robert Rosen, 1985)

Anticipatory Capacity

designing systems

Anticipatory Capacity is the capacity to continuously develop and apply knowledge acquired through a structured approach to anticipate: (1) changing scenarios as stakeholder needs and systems context change over time; (2) to consider their consequences; and (3) to formulate design decisions in response.

Rhodes and Ross 2008

Anticipatory Capacity in Engineering Enterprises

Prediction – a representation of a particular future event

Anticipation – a future oriented action, decision, or behavior based on a prediction

Anticipatory capacity provides organization with ability to make decisions based on predictive models it creates and utilizes during the 'design' process

Models include:

- System being developed
 - (or Enterprise Architecture being transformed)
- Environment of organizational entity doing design
- External environment in which system/enterprise will operate

Value Robustness

.....an underlying motivation for anticipatory capacity

Value robustness is the ability of a system to continue to deliver stakeholder value in the face of changing contexts and needs.

Ross 2006

“Personal Banking System”

ATM Network, ATMs, Bank Card

Changes in Context

- Withdraw funds in Boston at morning
- Withdraw funds in Montreal in evening

Changes in Need

- Withdraw funds
- Deposit funds

Changing Expectations

- Get US dollars in Boston
- Get Canadian dollars in Montreal

A value robust system is one perceived to be successful by stakeholders who continue to receive value from the system over time

Designers do an adequate job of understanding value perceptions in the short run...but to do so in the long run requires:

- effectively anticipating what the future will bring
- incorporating this knowledge into present decision

Designers can not predict the future in its entirety, but they can anticipate possible and probable scenarios for the future, and predict sequential orderings for these scenarios in order to design value robust systems

Three Enablers for Anticipatory Capacity

1. Existence of appropriate dynamic systems **competencies** in workforce
2. **Methods** for performing anticipatory thinking, analysis, and decision making in design of systems
3. Model-based **environment** to enable anticipatory design and decision making

Competencies

Four Examples

1. Ability to think deeply about systems in their context or environment
2. *Situational Leadership* – make decisions at multiple system levels and across time periods
 - Local versus global value delivery trade
 - Understanding context in which decisions are made
3. Enhanced ability to think about ‘systems in time’ in more rigorous and extensive manner
4. Collaborative systems thinking at team level

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Anticipatory Methods

- Decades of anticipatory methods but...
 - Oriented toward business strategies
 - Generally high level graphical/narrative
- Model-based approach offers enhanced possibilities
 - Ability to parametrically derive possible ‘futures’ and run simulations
 - Potential to aid decision making

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Enabling Environment

Enhancing Anticipatory Capacity

Dynamic tradespace exploration performed by multi-disciplinary teams using model-based environments:

- Physical collaboration venue to bring together relevant stakeholders
- Provides computing power and toolsets need to enact anticipation methods
- Enables effective display of complex data sets and analyses to facilitate communication



Anticipatory capacity of an engineering organization will be enhanced by

Tradespace exploration laboratories for creating models so that dynamic futures can be elaborated and their implications considered

Storey's Gate: Historical Example of Center for Anticipatory Thinking

- Three most important rooms in complex were: Cabinet War Room, Map Room, and Winston Churchill's room
- Cabinet War Room was center of collaboration at most senior levels and inner sanctum of British government
 - a real-time decision-making environment at most senior levels

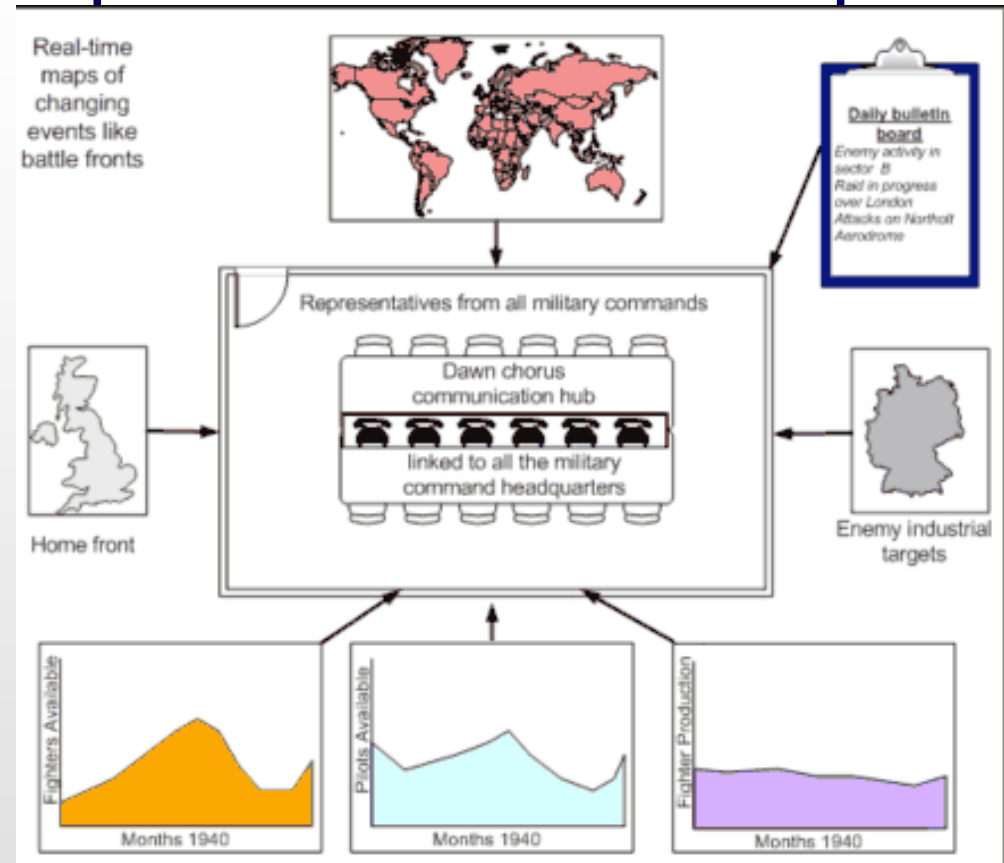


Source: Kozak-Holland, M., Information Management Special Report, 2007

Cabinet War Room and Map Room Relationship

Cabinet War Room had close relationship to the Map Room

- basis for decision-making is good, reliable intelligence
- Map Room acted as an executive dashboard in providing real-time synthesized information and key performance indicators



Churchill had to transform his organization to the modern-day equivalent of an Adaptive Enterprise so that it could adapt to this unexpected situation. He did this using the emerging technologies of the day...

Kozak-Holland, Churchill's Adaptive Enterprise: Lessons for Business Today)

Modern Venue: T-Xchange Cell University of Twente, NL

Established to advance the collaboration between research and innovation
Facilitates multi stakeholder / multi issue interaction, helping to prove to the customer the added value of the concept and to test the acceptance of this concept by the end user

Virtual Reality equipment enables real time visualization, brainstorming, benchmarking, scenario generation and serious gaming in a synthetic environment

Participants engage in what has been termed **“responsive visualized situation awareness”**, which means **interaction with a “living”, shared image in a virtual environment related to its context**

This method has been termed EBS (Effect Based Solution) process.



How Organizations Have Implemented Forward Looking Decision Analysis

- Strategic Planning Function (typically business development oriented)
 - Annual Cross-Functional Work Groups
 - Standing group in organization
- “War Room”
 - Often for short term use for critical program
- Concept Design Centers
 - Used for special studies for technology
- Others?

Going Forward...

- Growing need for anticipatory approaches that link technological system and enterprise system
 - Legacy approaches tend to be for only technology or only organization
- Increasing potential to leverage model-based approaches and computational power
- Need for methods that are scalable, effective, usable by multiple decision makers

Summary

- Design (systems and enterprises) inherently involves anticipation
- *Anticipatory capacity* increasingly important given complexities of systems and environments
- Model-based approaches open new possibilities for anticipatory capacity

Key research directed at solutions encompassing competency, methods, environment