



## SEARI Short Course Series

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

Lecture: Lecture 4: Case Examples of Epoch Shifts and Their Impact

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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 4**

**Case Examples of Epoch Shifts and Their Impact**

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# Fighting a Monolithic Enemy

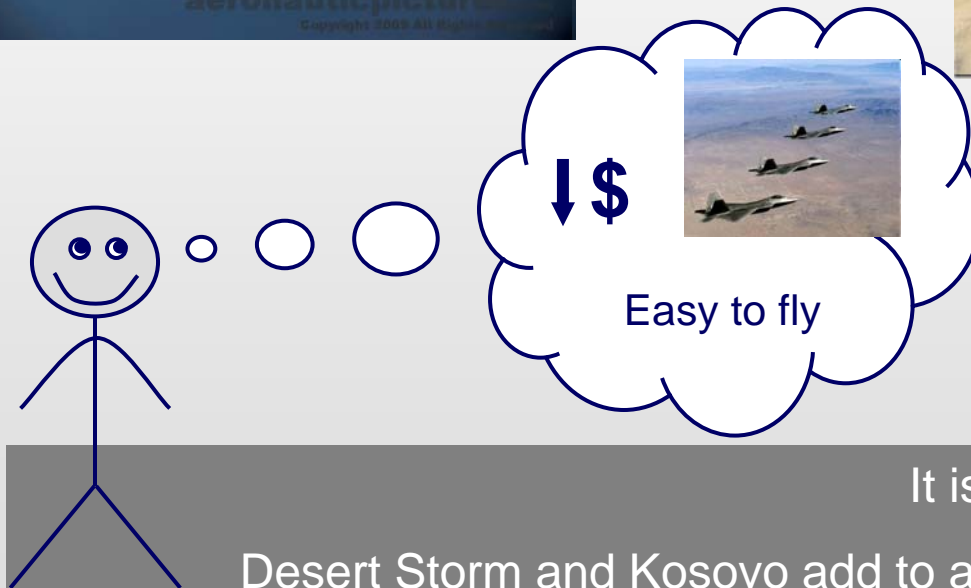


(U.S. Air Force photo by Master Sgt. Thomas Meneguini)



It is 1981, the U.S. seeks air superiority over the Soviet Union  
The current solution, F-15, had major reliability/maintainability issues  
A new, far superior fighter was desired that would be easier, cheaper, superior

# Evolving Theaters



It is 1991, the Soviet Union collapses  
Desert Storm and Kosovo add to argument for general air superiority  
The F-22 reaches production, and few question the program continuing

# New Threats



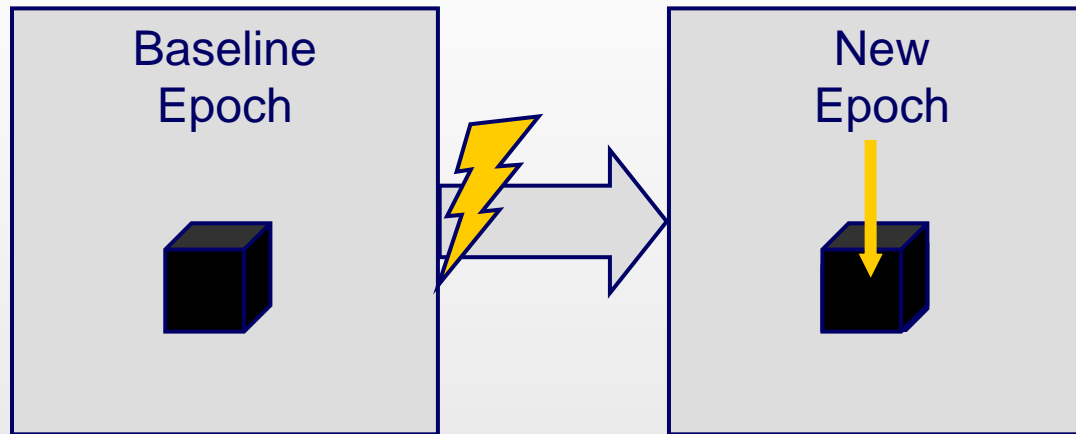
It is 2007, threats no longer come from the air  
UAVs rise to prominence as a very inexpensive alternative to combat aircraft  
F-22 program "truncated"



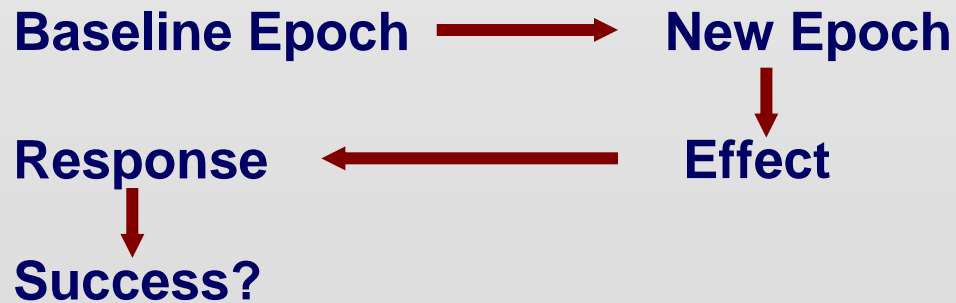
# Outline

- Single epoch shift construct
- Illustrate examples of epoch shifts across a variety of system types and epoch categories
  - Disruptive change in “context” or “needs” that affect system “success”

# Basic Epoch Shift Construct



## System Definition





“Finger-lickin’ Good”



# Setting the Stage



## Context

“fried” food =  
negative  
connotation

02-21-1991 Peter O. Keegan (). "KFC shuns 'fried' image with new name – Kentucky Fried Chicken has changed its name to KFC". Nation's Restaurant News. [http://findarticles.com/p/articles/mi\\_m3190/is\\_n8\\_v25/ai\\_10403447/](http://findarticles.com/p/articles/mi_m3190/is_n8_v25/ai_10403447/).

Past Epoch



## Context

Desire for comfort  
food

05-01-2005 "KFC Resurrecting Old Kentucky Fried Chicken Name, With New Image". [buzzle.com. http://www.buzzle.com/editorials/4-30-2005-69337.asp](http://www.buzzle.com/editorials/4-30-2005-69337.asp).

Baseline Epoch

**The “System”:**

The Kentucky Fried Chicken Brand and Image

**Baseline Epoch:**

A market that is looking for comfort food

**Past response:**

Changed name from “Kentucky Fried Chicken” to “KFC” to diversify image

**Current response:**

Develop new brand image playing up “Southern Cooking”, resurrecting old name, mixed branding depending on market

# Epoch Change!



05-01-2005 "KFC Resurrecting Old Kentucky Fried Chicken Name, With New Image". [buzzle.com](http://www.buzzle.com). <http://www.buzzle.com/editorials/4-30-2005-69337.asp>.

## Context

Desire for comfort food



## Baseline Epoch



## Context

Health conscious!

One breast	Calories	Fat (g)	Sodium (mg)
Grilled (skinless)	130	1.5	77
KFC grilled (with skin)	180	4	440
KFC fried (no skin or breading)	140	2	510
KFC fried (with skin)	370	5	1,050

11-01-2009 "Kentucky Grilled Chicken Launch Was a Success for KFC". Brandweek. [http://daveibsen.typepad.com/5\\_blogs\\_before\\_lunch/2009/07/kentucky-grilled-chicken-launch-was-a-success-for-kfc.html](http://daveibsen.typepad.com/5_blogs_before_lunch/2009/07/kentucky-grilled-chicken-launch-was-a-success-for-kfc.html).

## New Epoch

Images from: [www.kfc.com](http://www.kfc.com)

**The "System":**

The Kentucky Fried Chicken Brand and Image

**New Epoch:**

Health conscious customer base

**Response:**

"Kentucky Grilled Chicken" introduced

**Success?**

CEO David Novak called the launch the most successful in KFC's history and now accounts for 40% of KFC's chicken-on-the-bone sales



# New York Transportation at Turn of the Century

# Setting the Stage

Photo: The New York Times Photo Archives



## Context

Horse-based transit pollution problems

100k-200k horses in late 1800s to early 1900s

22 lbs manure, 1 qt urine /day/horse = 3-4 million lbs/day

**McShane C.** *The Centrality of the Horse to the Nineteenth-Century American City.* New York, NY: SR Publishers, 1997.

## Dilemma of the day:

Fear of death from flies related to horse manure and carcasses (est. 20,000 deaths/yr in 1908)



**Lee J.** When Horses Posed a Public Health Hazard New York Times. <http://cityroom.blogs.nytimes.com/2008/06/09/when-horses-posed-a-public-health-hazard/>. [November 2009].

“In 1894, the *Times of London* estimated that every street in [New York] city would be buried 9 feet deep in horse manure by 1950.”

## Baseline Epoch

**The “System”:** NYC urban transportation infrastructure

**Baseline Epoch:** Horse-drawn vehicles principal mode; major health concerns

**Current response:** Add-hoc horse waste and body clean-up;

# Epoch Change!

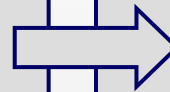


## Context

Horse-based transit pollution problems

100k-200k horses in late 1800s to early 1900s  
22 lbs manure, 1 qt urine /day/horse = 3-4 million lbs/day

**McShane C.** *The Centrality of the Horse to the Nineteenth-Century American City.* New York, NY: SR Publishers, 1997.



## Context

The Automobile (1920s)

**Lee J.** When Horses Posed a Public Health Hazard New York Times. <http://cityroom.blogs.nytimes.com/2008/06/09/when-horses-posed-a-public-health-hazard/>. [November 2009].

## Baseline Epoch

## New Epoch

Photo: Wired.com

**The “System”:**

NYC urban transportation infrastructure

**New Epoch:**

Availability of the automobile

**Response:**

NYC embraces the auto, reconfigures roads, develops traffic codes

**Success?**

At least in the short term, the city avoided being buried in manure; created host of new problems





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## “Full-Cost” Accounting at NASA

# Setting the Stage



1950s through FY2003

## Context

Salary allocated from “pools”, freedom to pursue “experimental” side projects

## Baseline Epoch

- |                          |  |
|--------------------------|--|
| <b>The “System”:</b>     | NASA innovation stream   |
| <b>Baseline Epoch:</b>   | Salaries allocated separately from projects  |
| <b>Current response:</b> | Ad-hoc innovation possible, when scientists, engineers and technicians free to work collaboratively outside of main projects |



# Epoch Change!



1950s through FY2003

## Context

Salary allocated from “pools”, freedom to pursue “experimental” side projects



## Context

“Full cost” accounting

“Full cost accounting requires each engineer or scientist to be supported by a program and ... **all but eliminates the agency’s ability to build and retain its technical and scientific expertise.**”

Abbey, G., Lane, N., and Muratore, J., “Maximizing NASA’s Potential in Flight and on the Ground: Recommendations for the Next Administration”, Inst. For Pub. Policy, Rice University, Jan. 2009.

FY2004+

**Baseline Epoch**

**New Epoch**

**The “System”:**

NASA innovation stream

**New Epoch:**

Implementation of “full cost” accounting

**Effect:**

All time allocated to projects, no side projects or “creative” time; managers beg for FTEs

**Success?**

Innovation is widely considered to have plummeted as a result, since projects don’t want to pay for “extra” work

P.S. “full cost” accounting to be cancelled for FY11!

“Farewell Full Cost Accounting”, Feb 2010, <http://www.nasawatch.com/archives/2010/02/farewell-full-c.html>



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# Helicopters in the Desert

# Setting the Stage

Photo: by Cherie A. Thurlby (DoD)



## Context

Intended mission contexts

## Baseline Epoch

**The “System”:** UH-60 Sikorsky Blackhawk helicopter

**Baseline Epoch:** Urban, mountain, forest, jungle uses

**Current response:** Current design very effective

# Epoch Change!

Photo: by Cherie A. Thurlby (DoD)



## Context

Intended mission contexts



## Context

New mission needs: desert



Baseline Epoch

New Epoch

**The “System”:**

UH-60 Sikorsky Blackhawk helicopter

**New Epoch:**

Missions in desert, with sand like powder

**Effect/Response:**

Major efficiency losses, damage to blades/engine; ad-hoc fixes eventually replaced by design modification

**Success?**

The short term fix only delayed the problem, but kept helicopters in operation longer; design modification eliminates problem



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# Revising an Education System

# Setting the Stage



## Context

Minimal OJT; schools produce “usefully” trained workforce

11-05-08. *What's New in German Higher Education*. Magazin-deutschland.de.

## Baseline Epoch

- The “System”:** German education system
- Baseline Epoch:** Close academia-industry ties result in job-specific training during education; strong job stability in workforce
- Current response:** Focused education system creating immediately “useful” students for the workforce

# Epoch Change!



## Context

Minimal OJT; schools produce “usefully” trained workforce

11-05-08. *What's New in German Higher Education*. Magazin-deutschland.de.

**Baseline Epoch**



## Context

EU harmonization

Employers and universities rail against the “half-engineers” that the 3-year bachelor system would produce; some bachelor students face curricula that call for 100 hours of work per week

**New Epoch**

**The “System”:**

German education system

**New Epoch:**

EU harmonization for education

**Effect:**

Long term: unknown; short term: industry and student concerns for adequately trained and appropriate workforce

**Success?**

Unknown. Remains to be seen, as diversity of economic types in Europe require different workforce types (e.g. liberal market economies vs. coordinated market economies)





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# Developing the Ultimate Communication System

# Setting the Stage

Photo: USAF illustration



## Context

Cold War

**Banke J.** Milstar Safely Arrives in Orbit Following Titan 4B Rocket Ride  
[http://www.space.com/missionlaunches/titan4\\_launch\\_020115.html](http://www.space.com/missionlaunches/titan4_launch_020115.html). Jan 2002.

## Baseline Epoch

- |                          |   |
|--------------------------|---|
| <b>The “System”:</b>     | Milstar satellite system  |
| <b>Baseline Epoch:</b>   | Cold war, strategic need for secure, worldwide communications even in event of nuclear war        |
| <b>Current response:</b> | Extremely hardened, high power, expensive constellation of satellites; terminals; mission control |

# Epoch Change!

Photo: USAF illustration



**Banke J.** Milstar Safely Arrives in Orbit Following Titan 4B Rocket Ride  
[http://www.space.com/missionlaunches/titan4\\_launch\\_020115.html](http://www.space.com/missionlaunches/titan4_launch_020115.html). Jan 2002.

## Context

Cold War, must launch on STS

Source: Space.com



Source: Army Logistician



**Friedman M.** First Lockheed Martin-Built Milstar Satellite Marks 15 Years On Orbit  
[http://www.lockheedmartin.com/news/press\\_releases/2009/021209ss\\_milstar.html](http://www.lockheedmartin.com/news/press_releases/2009/021209ss_milstar.html). Feb 2009.

## Context

Post-cold war, no STS

Baseline Epoch

New Epoch

**The “System”:**

Milstar satellite system

**New Epoch:**

High bandwidth, tactical communication

**Response:**

Upgraded ground stations and software; later: new payload, relaxed structural req'ts

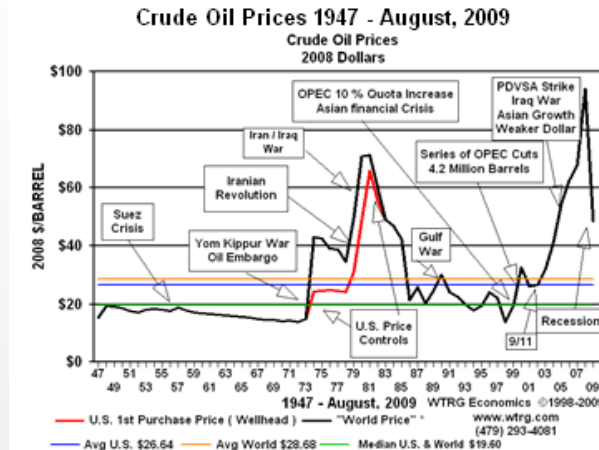
**Success?**

Yes, though still runs into bandwidth limitations; very expensive since based off of a very “hardened” design



## Other Examples

# Public Transit Planning Dilemma



Crude oil prices across context change (source: WTRG Economics. <http://www.wtrg.com/prices.htm> 10/13/2009)

## System Definition

Public transportation

## Baseline Epoch

Low oil price; low demand

## Response

New/upgraded system planning

## Success?

Usually no; epochs often change faster than planning, budgeting, execution of public transit projects

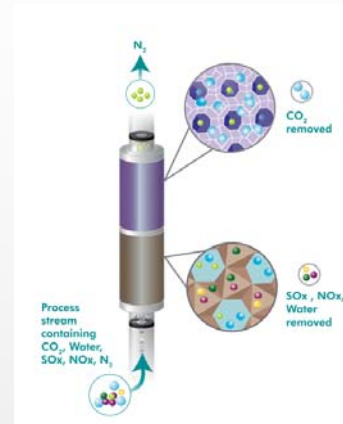
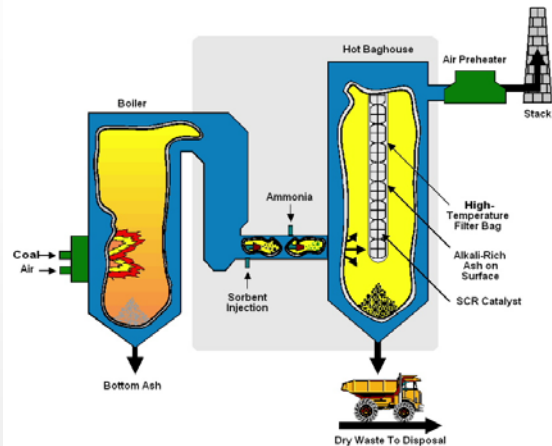
High oil price; high demand

## New Epoch

## Effect

Overcrowding and wearing on public transit systems

# Rise of environmentalism



## System Definition

Coal power industry

**Baseline Epoch**  
Lax pollution standards

**Response**  
Retrofit with “scrubbers”;  
design new plants

## Success?

Maybe; coal is still major source of energy in U.S. and abroad;  
“clean coal” efforts reduce emissions (>80 projects in U.S.)

“Clean Air Act” and other emissions reductions

**New Epoch**

## Effect

Increases in cost of coal power; reduction in pollution

# Class Examples

Do you have any examples of epoch shifts that disrupted your organization, business, or technology?



# Summary

- Epoch shifts occur all of the time
- Definition of whether a disruption is an epoch shift is whether it is a change in “exogenous factors” that influence success
- Systems can succeed or fail across an epoch shift
  - Some require a “response”; some fair well even left alone
  - You will use these concepts in the next exercise