Improving what you deliver & how you deliver it

A Systems Approach to Healthcare

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Objectives

- Convey the importance of a systems approach
- Explore the elements of a systems approach
- Illustrate how a systems approach can be effective with common problems & situations
The universal dilemma

We are all tasked:

- do more
- with less
- faster

against increasing:

- complexity
- constraints
- consequences

despite:

- dedication
- enthusiasm
- strong effort

results still:

- not satisfactory
- not scalable
- not sustainable
The Problem versus “the problem”

Above the waterline
“The perceived problem”

Below the waterline
Most of the actual problem
Boiling the frog...

- “Frog” = methodologies of the Industrial Age
- “Pot” = complexity of the Information Age

What got us here, cannot take us further.

We need more capable/appropriate tools.
“We need to look at it from a systems approach, a human/technology system that has to work together. This involves aircraft design and certification, training and human factors. If you look at [any single factor] alone, then you're missing half or two-thirds of the total system failure...”

— Captain C. B. “Sully” Sullenberger (pilot of US1549 “Miracle on the Hudson”, about AF447)
System: \((n)\)

“an assemblage of interconnected, interdependent and interrelating elements, forming a complex & unitary whole”
Systems Approach

fundamental awareness: elements of a system are interconnected and interdependent with other elements (often in complex, hidden and/or unexpected ways)
When we embrace a systems approach:

… we can better identify, understand & manage the complexity of:

- our goals & objectives
- the requirements that drive them
- the constraints that shape them
- the mechanisms that achieve them
When we embrace a systems approach:

... our end results will be more:

- sustainable
- consistent
- robust
- comprehensive
- reproducible
- scalable
- efficient
- effective

Don’t just survive – thrive!
When we ignore a systems approach:

“the law of unintended consequences”

also known as

“getting bitten in the hindquarters”
When we ignore a systems approach:

- mysterious failures
- deceptive symptoms
- difficult root-cause analysis
- uncertain remediation
- likely recurrence

Critical dependencies are often overlooked, leading to:
“Systems engineering … has often produced dramatically positive results in the small number of health-care organizations that have incorporated it into their processes…

Systems-engineering know-how must be propagated at all levels…

[We recommend] that the United States build a health-care workforce that is equipped with essential systems-engineering competencies that will enable system redesign.”

— President's Council of Advisors on Science and Technology (PCAST) (in May 2014 report to President Obama)
Systems approach:

- Systems thinking
- Systems design
- Systems troubleshooting
Recipe for Systems Thinking

- understand big picture (internally, externally)
  - examine from multiple perspectives
  - employ appropriate abstraction & hierarchy
  - challenge & verify all assumptions & models

- understand behavior & interrelationships
  - observe & analyze data (patterns, trends)
  - identify all dependencies
    - linear (cause-effect) & circular (feedback)
Abstraction & Hierarchy

- “cosmos of quanta” – beyond human brain?
  - “working memory” capacity = 7±2? 4? 3?
  - how to understand/design complex relationships?

- at any one time, consider only one hierarchical “slice” of a complex system
  - lower subsystems abstracted as simple elements
  - higher system abstracted as “external” inputs & outputs (requirements & deliverables)
Abstraction & Hierarchy

- human body consists of systems
- systems consist of multiple organs
- organs consist of multiple tissues
- tissues consist of multiple cells
- cells consist of multiple molecules
Circular dependencies: feedback loops

- negative (compensating)
  (goal-seeking)

+ positive (reinforcing)

∩ oscillation (delay)

find water → drink water → assess thirst 

- feedback loops

water

thirst

oscillation
“I think everyone in this country should learn to program a computer.
Everyone should learn a computer language because it teaches you how to think.
I think of computer science as a liberal art.”

— Steve Jobs
Systems approach:

- Systems thinking
- Systems design
- Systems troubleshooting
Design is …

- Clearly documented objectives
- Thoroughly gathered/analyzed requirements
- Intentional, directed craftsmanship
  - **not** *ad-hoc* emergence
- Applicable to:
  - comprehensive solutions (products/services)
  - processes that create/deliver those solutions
  - corporate structures that encompass them all
Systems Design

- Technical disciplines: systems engineering
  - manage abstract complexity → desired results
    - telecom: world cellular ≈ 5M towers, 7B phones
    - hardware: modern CPU ≈ 10M transistors
    - software: modern OS ≈ 100M lines of code
  - objective basis for judging design & methods

- “Non-technical” undertakings
  - comparable complexity
  - similar meta-methods & skills applicable
Systems Design

1. **Vision:** Define the problem
2. **Vehicle:** Design the solution
3. **Valor:** Implement the solution
4. **Validation:** Test thoroughly & monitor continuously
5. **Variation:** Debug / refine / adjust / improve as needed
Define the problem

inputs → functionality → outputs

- Envision desired results
- Articulate objectives
- Collect & analyze requirements & constraints (including present status)
The System versus “the system”

Above the waterline
Product/service/tool

Below the waterline
Rest of the meta-system

Critical 1\textsuperscript{st} step:
Appropriate scope
Hospital Technology is a System *of other systems*
Healthcare is a System
Design the solution
(mindful of requirements & constraints)

recursive hierarchical decomposition
• top-down (abstract → concrete)
  ➢ to ensure objectives
• bottom-up (concrete → abstract)
  ➢ to ensure reality
• massage up/down until alignment

optimized partitioning (how divided)
• minimal dependencies
• maximum localization
A Hospital is a System
(of other systems, including technology)

each subsystem:
• individually optimized
• collectively aligned

* nurse-call, IPS, EMR, CPOE, etc.
Culture

- *de facto* values defined/communicated by:
  - directions chosen & decisions made
  - behaviors prohibited, tolerated or rewarded

- prioritization / balance / synthesis of:
  - initiative ↔ directed effort
  - flexibility ↔ methodology
  - consensus ↔ control
  - profitability ↔ responsibility
  - accountability ↔ forgiveness
Culture ↔ Organization

“The society which scorns excellence in plumbing because plumbing is a humble activity, and tolerates shoddiness in philosophy because philosophy is an exalted activity, will have neither good plumbing nor good philosophy: neither its pipes nor its theories will hold water.”

— John W. Gardner
Organization: appropriate hierarchy

- “coordinated cooperation” = hybrid/synthesis of
  - command-and-control (top-down)
  - consensus-and-collaboration (bottom-up)

- each/every position is unmistakably valued
  - varying scope (abstract↔concrete), not importance
  - all positions mandate both respect & accountability

- each/every position adds unmistakable value
  - communicates/coordinates upper to lower
  - prioritizes/arbitrates/abstracts lower to upper
Partitioning
Partitioning: many inter-dependencies

(much overhead/inefficiency)
Partitioning: few inter-dependencies

(fewer people, better efficiency/results)
Partitioning: **Overlap & Omission**

1999: Mars Orbiter

2013: healthcare.gov

Lisa!

Mr. Burns? Moe? Krusty?
Partitioning: One-to-One

- interdisciplinary
- object-oriented
- holistic

project management
quality verification & validation

} requisite skills for all, not fiefdoms of a few
Processes

- serve culture & organization, not vice-versa
- include continuous monitoring & improvement
- demand root-cause analysis of failures/issues
- schedule & budget at 80%, not 120%
- avoid “Process Pride” (false sense of security)
Tools & Technology

- Equip/enable/empower organization
- Should facilitate processes, not vice-versa
  - (may accommodate legacy/disruptive tech.)
- Should always be effective means, not end
  - not a “solution looking for a problem”
- Cost-justified via big-picture life-cycle
  - ROI: acquire, install, train, perform, maintain
Training

Specialized/separate set of:
- objectives, processes, tools

Equips organization with skills / knowledge:
- corporate vision / mission / objectives
- culture, organization, processes, tools
- products/services and market/customers
suggested 1st pass: top-down

- objectives → culture
- culture → organization
- organization → processes
- processes → tools
- tools → training

(iterate in both directions)
“Make everything as simple as possible – but no simpler.”

— Albert Einstein, paraphrasing William of Ockham
Systems approach:

- Systems thinking
- Systems design
- Systems troubleshooting
Systems Troubleshooting

- Systemic (holistic) & systematic (methodical)

- Three-fold priority: (avoid quitting early!)
  - alleviate symptoms (not mask!)
  - find/fix specific underlying problem-mechanism
  - address general issues (process, partitioning, etc.)
Troubleshooting Exercise: System

- complaint: “alarm fatigue” in clinical setting
- symptom: nurses overwhelmed by alarms
  - monitors, pumps, ventilators, bed/exit, patient-calls
- possible problem-mechanisms/contributors
  - objectives = ?
  - culture = ?
  - organization = ?
  - process = ?
  - tools & tech = ?
  - training = ?
Fire-fighting < fire-investigation < fire-prevention

“There is nothing quite so useless, as doing with great efficiency, something that should not be done at all.”

— Peter Drucker
Summary

- Systems & complexity are ubiquitous, and they demand a systems approach to manage them.
- Systems approach = thinking, design, troubleshooting
- Align: objectives, culture, organization, process, tools & training
- Embrace: hierarchy & abstraction
- Pursue: parallel/correlated partitioning
- Lather, rinse, repeat
“The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man.”

― George Bernard Shaw