The Berlin Airlift

A systems engineering case study

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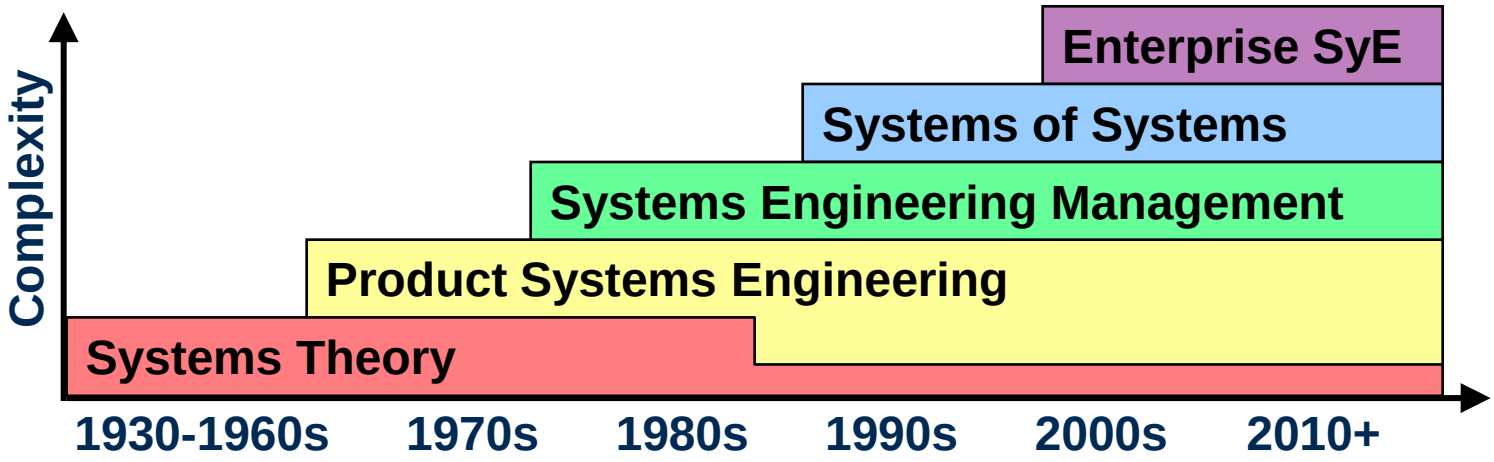
Outline

- Motivation
  - SE Education
  - SE Experiential Learning
  - SE Case Studies
- AFIT Systems Engineering Case Studies
  - Key part of SE introductory studies
  - Example of uses
- Berlin Airlift Case Study
  - Vehicle for training SE Leadership and Management
  - Case Study Learning Principals

Why is this Important?

- System complexity is increasing, affecting more around us
- Issues of Systems of Systems (SoS) and complex systems are pervading all of engineering (not just DoD, but also commercial networks, energy, sustainability, etc.)
- SE education is lacking engineering fundamentals - too much process (management), not enough engineering rigor
- SE research has fallen behind in the need to address complex system problems



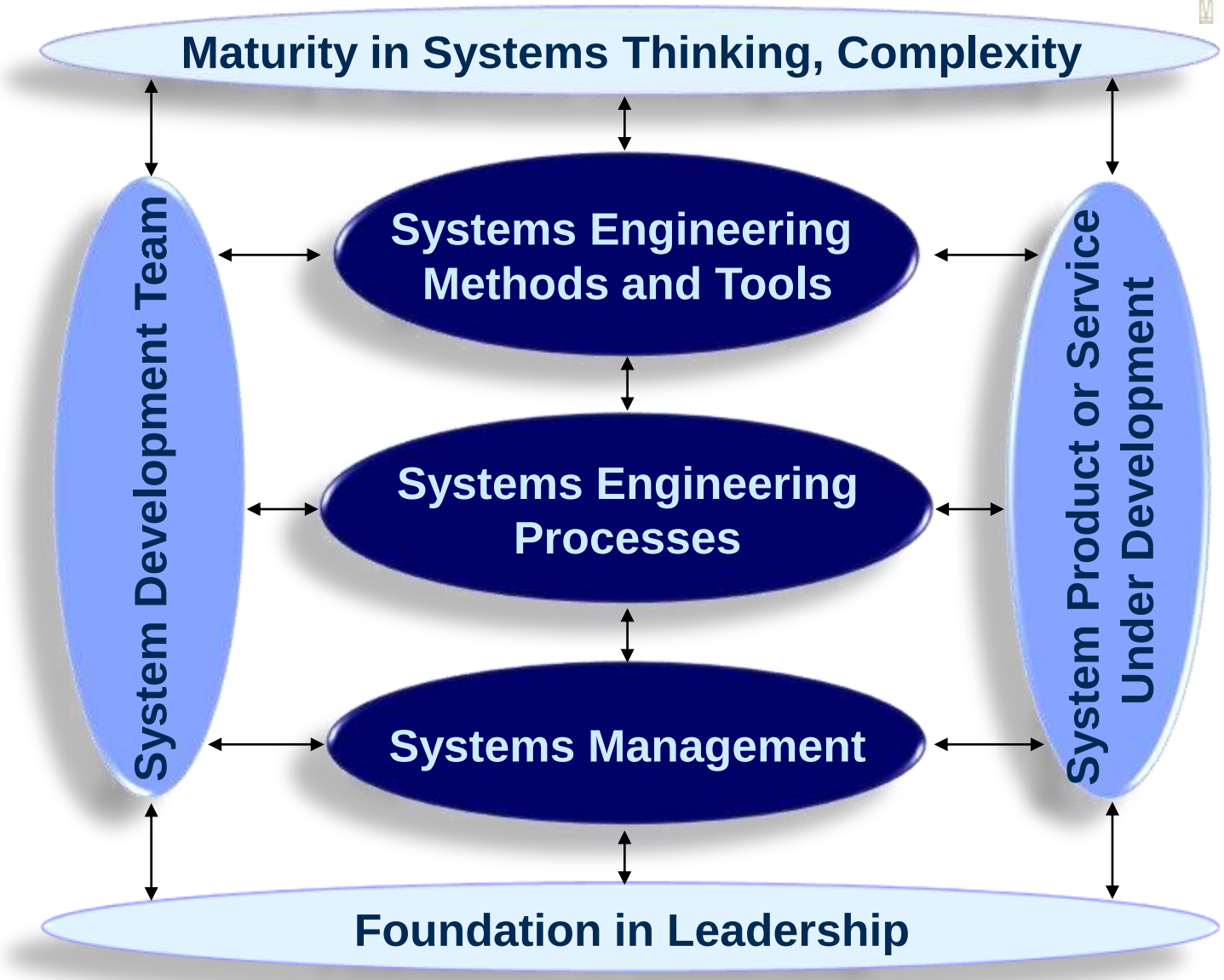
Complexity in Systems Engineering

- Multiple, often inversely related requirements
- Ambiguous and competing visions of solutions
- Constraints in tension: cost, schedule, performance…
- Many sources of information, expertise, & innovation
  - No source has all
  - Almost all sources are required
- Organizational dissonance among participants/stakeholders
  - Conflicting goals (including implicit)
  - Varying levels of commitment/investment
  - Varying levels of risk tolerance
  - Missing or Inadequate resources
- How do we prepare our systems engineers for this?

Why SE Case Studies

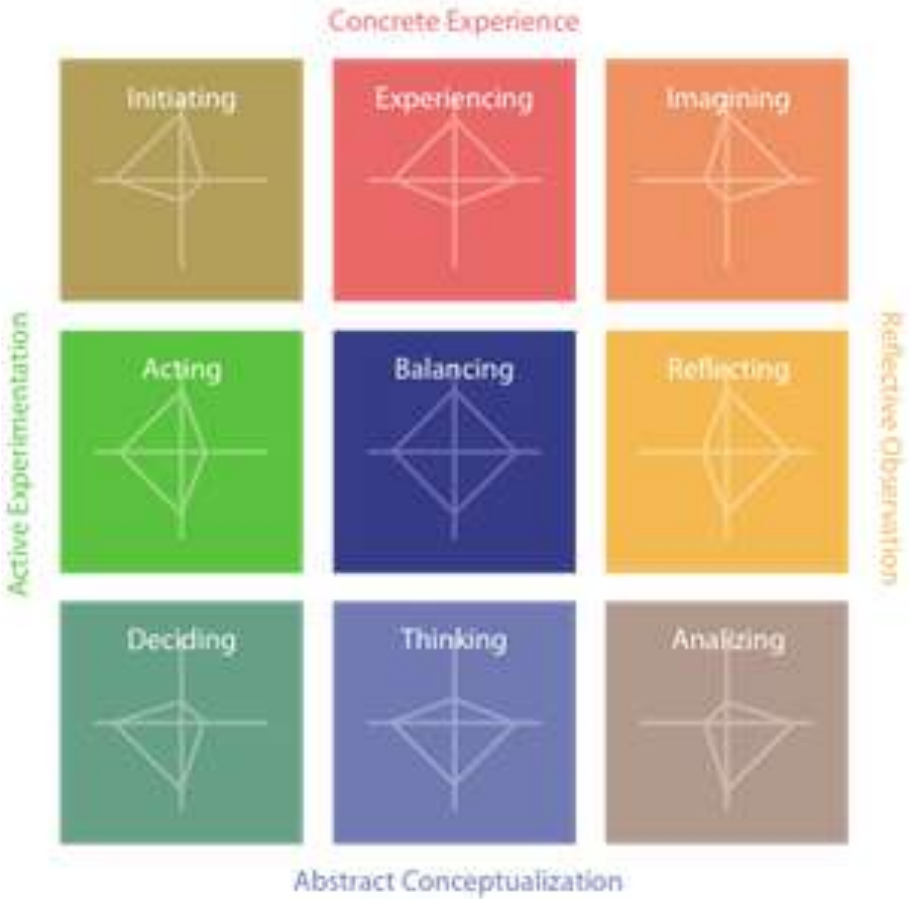
- Case studies in engineering:
  - Used to introduce students to real programs and real problems
  - Presents open ended problems that student teams work and then compare to actual outcomes
  - Allow instructors to introduce topics too difficult to convey through just lectures and homework
- Systems engineering (SE) case studies:
  - Special Category of Engineering Case Studies Focus on Applied SE
  - Air Force Institute of Technology (AFIT) Cases: http://www.afit.edu/cse/cases.cfm
  - Extend Applied Systems Engineering to Berlin Airlift
- The Berlin Airlift :
  - Provides forum for Experiential treatment of SE concepts
  - Promotes innovative, interdisciplinary SE education
  - Melds theory & experience.
  - Advances systems thinking & practice further into technological future

Growing Functions of Systems Engineering



Experiential Learning

- Center of Learning is Experience
- Students can enter the Learning Cycle at any point based on their Experiences and Learning Styles
- We use Case Studies to facilitate Experiential Learning



Experience Based Learning Systems, Inc
http://learningfromexperience.com/

AFIT Case Studies

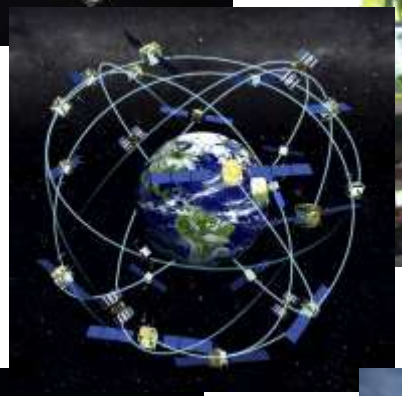
Case Study Learning Principals

- Applied Systems Thinking
- Organizational Behaviors
- Leadership and Decision Making
- Requirements and System Architecting
- Project Management for Complex Systems

AFIT Case Studies

- Hubble
- A-10
- GPS
- TBMCS
- ISS
- Global Hawk



http://www.afit.edu/cse/cases.cfm

AFIT Case Study Objectives

- Identify conditions that foster good SE practices.
- Identify conditions that impede good SE practices.
- Identify long term consequences of the SE and programmatic decisions on program success.
- Extend case study results to your programs.
- Set Stage for Systems Thinking.

Professional Masters Degree in Applied Systems Engineering
Sample Case Study Assignments

Georgia Institute of Technology

ASE 6001 – Fundamentals in Modern SE

- TBMCS, GPS, ISS, Hubble
  - Introduction to Systems Engineering
  - Case Study Questions to Guide Reading
  - Student presentations
- GPS Extended to:
  - Requirements Analysis Lab
  - Functional Analysis and Architecture Lab
- A-10 Extended to:
  - Analysis of Alternatives Lab

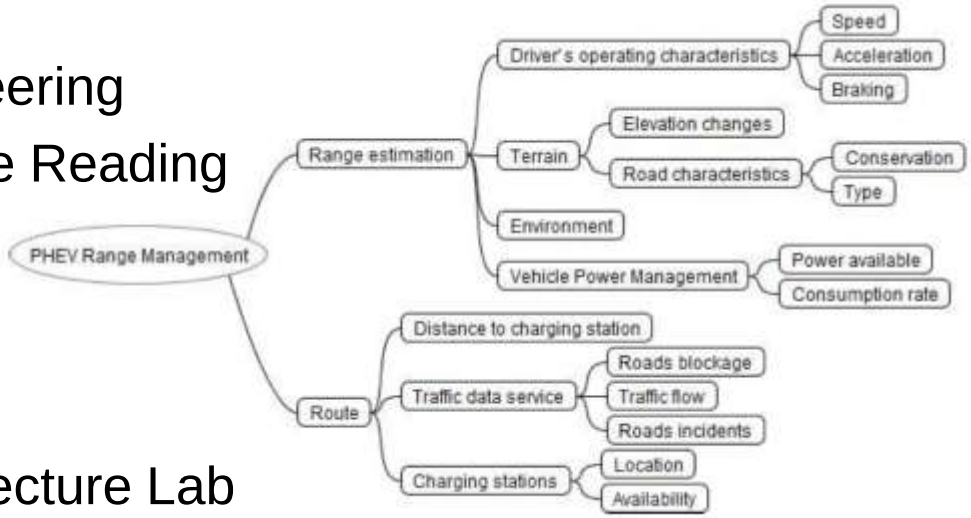
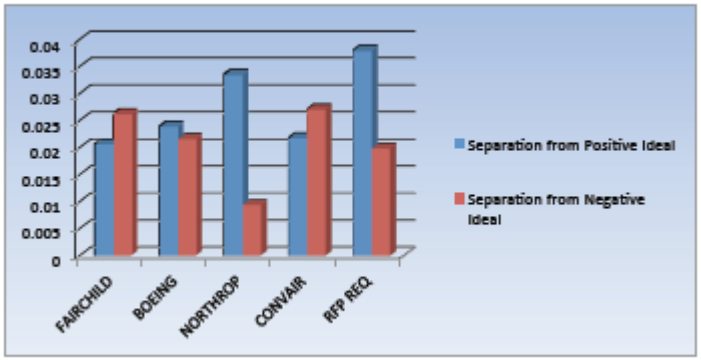


Figure 4. TOPSIS separations.



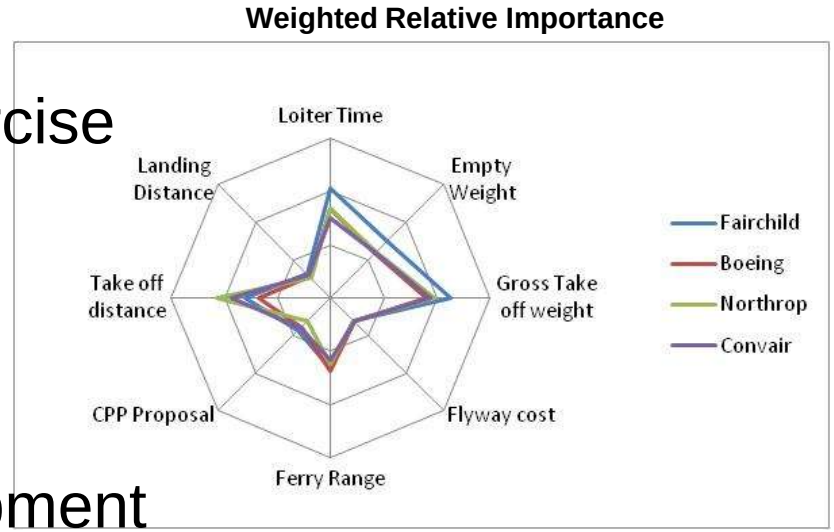
Professional Masters Degree in Applied Systems Engineering Sample Case Study Assignments

ASE 6004 – Leading SE Teams

- Global Hawk
  - Focus on Organizational Factors contributing to SE
  - Evaluate Advance Concept Technology Dev Phase
  - Evaluate Engineering & Manufacturing Dev Phase
  - Evaluate transition from ACTD to EMD phases
  - Student Case Study Briefings
  - Extend to Rapid Reaction Development Course Project

Continuing Education Short Course Sample Case Study Assignments

- Fundamentals in Modern SE
  - TBMCS, GPS, Hubble
    - » Introduction to Systems Engineering
    - » Case Study Questions to Guide Reading
    - » Student presentations
  - A-10 Extended to:
    - » Analysis of Alternatives Exercise
- Advanced Problems Solving
  - GPS Extended to:
    - » Wicked Problems
    - » GPS User Segment Development



Berlin Airlift Case Study

Case Study Learning Principals

- Applied Systems Thinking
- Organizational Behaviors
- Leadership and Decision Making
- Requirements and System Architecting
- Project Management for Complex Systems

Berlin Airlift Case Study Objectives

- Experience Learning by Doing
- Identify conditions that foster good SE practices.
- Identify long term consequences of the SE and programmatic decisions on program success.
- Exercise Team Leadership
- Develop a “System” Architecture
- Exercise your Systems Thinking

Video Clip

- http://www.youtube.com/watch?v=UOsqxp1ZDts

Operations Vittles

- **Setting the Stage:** At the conclusion of WWII, the Soviets, Americans, British and French divided Germany into occupation zones. A delicate balance of power surfaced between the once united allies. Although Berlin was located in the Soviet zone, it was also divided among the four powers. As western Germany was rebuilding and preparing to govern itself, the political tension between the Soviets and their former allies was escalating. By 1948 the Soviets cut off all ground travel into and out of Berlin essentially isolated it from the rest of the world. Airlift was the only way to supply West Berlin and its people. Berlin became a symbol of the United States resolve to stand up to the Soviet threat of expansion without being forced into a direct conflict[1].
- **The Mission:** The official U.S. mission directive from the commanding general, United States Air Forces Europe (USAFE), to the project commander of the USAFE Berlin Airlift Operation was to: "Insure that the maximum number of missions are flown and that optimum overall efficiency of the operation is maintained ..."[1].

Operation Vittles Concept Brief

- Your mission, should you decide to accept it, is to build the concept briefing for “Operation Vittles”.
- Audience:
  - Brigadier General Joseph Smith, Commander of the Wiesbaden Military Post, Task Force Commander, Operation Vittles
- Include:
  - Development Plan
  - Risks and Mitigation Plan
  - Organization and Team
- Your planning/briefing team consists of the team leader and subject matter experts

Leading Systems Engineering Teams
Case Study Execution

- Divide class into 5 person IPTs
- Student Team Members Select Roles:
  - Team Lead
  - Airfield Operations
  - Logistics and Cargo
  - Airlift
  - Maintenance and Servicing

- Students have “fact sheets” for each role
  - They become the SMEs
  - Develop Concept Briefing for Short Term Mission
- Subject Students to Change by
  - Extending to Long Term, Sustainment Mission
  - Reorganize teams into centralized operational units
  - Update presentation for extended, reorganized mission

Berlin Airlift Case Study Deliverables

- Identify the project constraints -- SWOT analysis
- Identify Stakeholders (who leads, who benefits, who supports)
- Assign Roles within Organization
- Lifecycle Selection and Baseline Development
- Document team/project vision & purpose, goals, and values
- Identify the critical success factors & measures of success
- Develop the use cases and concept of operations
- Identify driving requirements
- Develop an architectural view
- Create your development plan/strategy
- Identify risks and mitigation plans
- Provide an answer to the general!

Example - Identify Project Constraints

Strengths:

- Available Workforce
- Political Will
- Airlift Dominance

Opportunity

- Public Relations
- Allied Cooperation

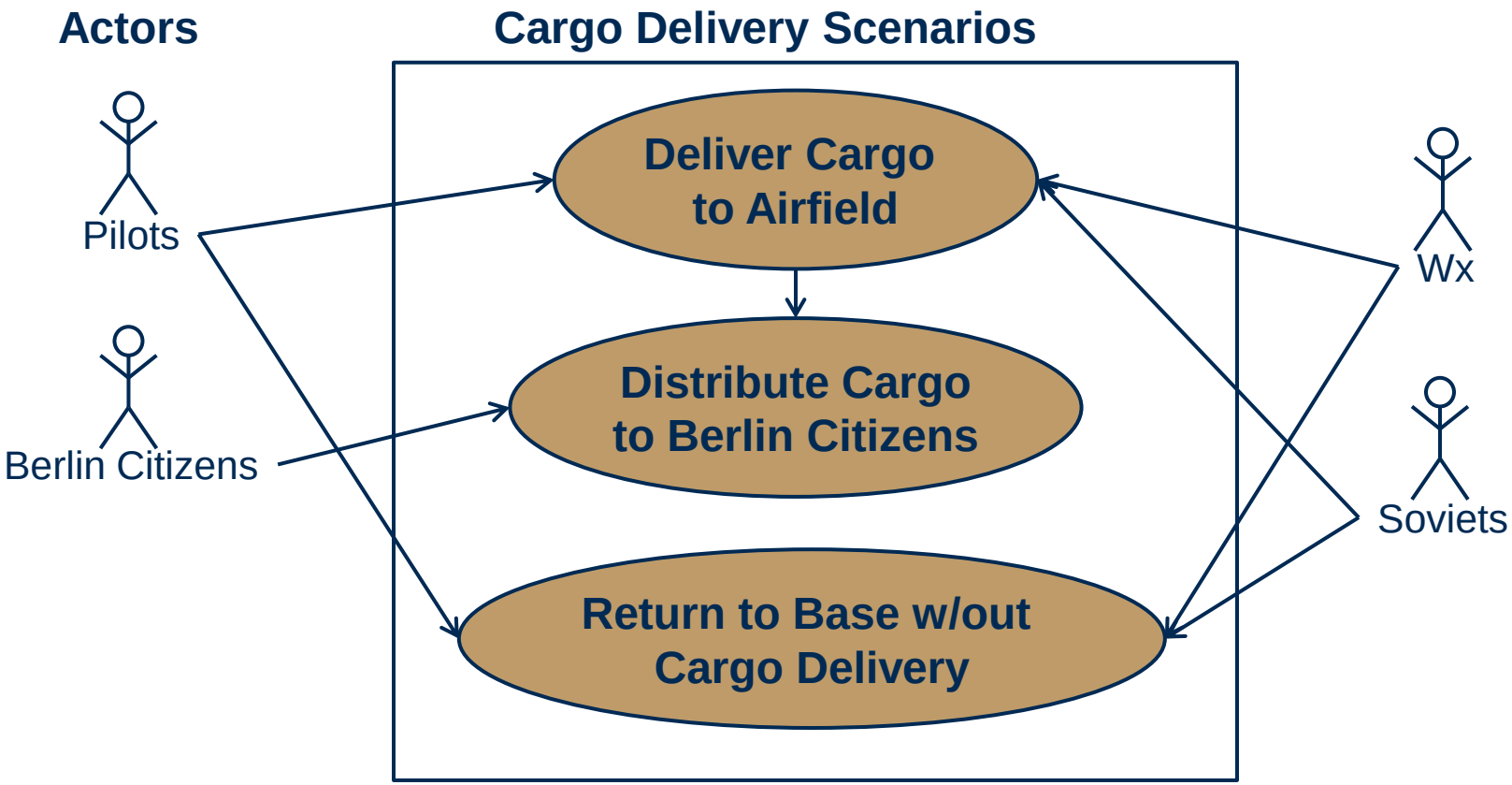
Weakness

- Limited Air Corridors
- Limited Airfields
- Limited Aircraft

Threats

- Weather
- Soviet Closure of Corridor

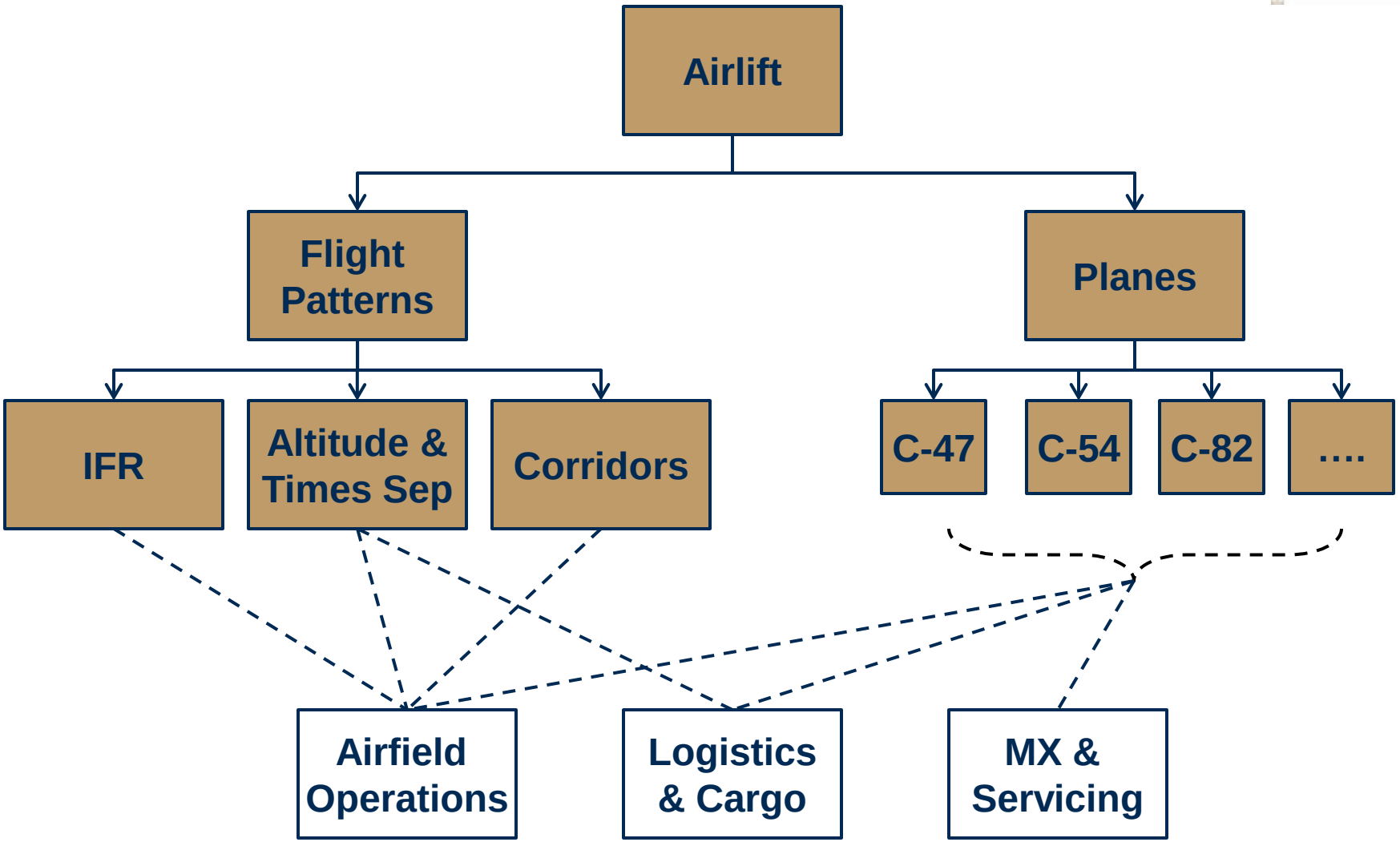
Example - Berlin Airlift Use Case



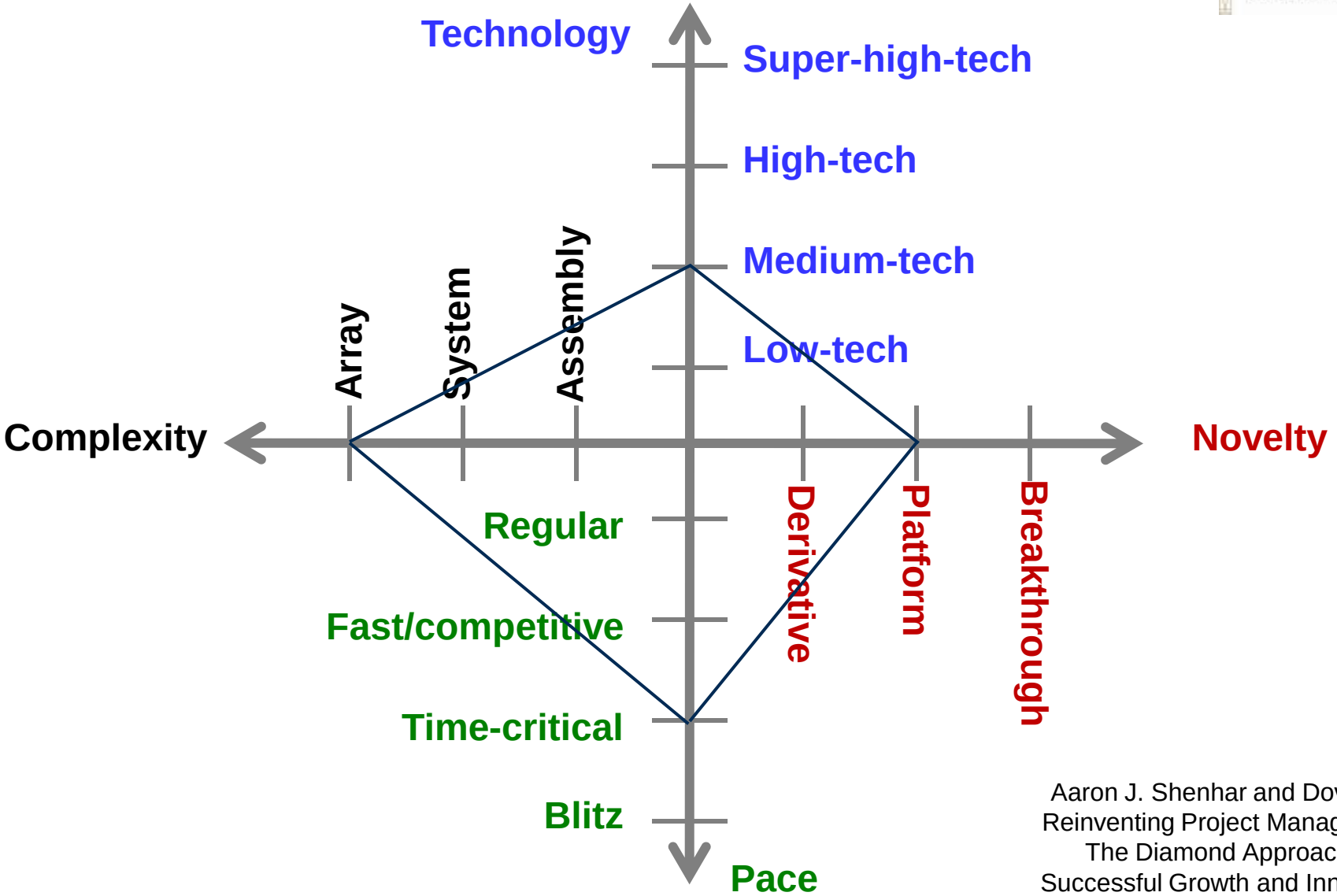
"System" encompasses

- **Aircraft**
- **Cargo**
- **Airfields**
- **Service**

Example - Architecture View - Airlift



Example - NTCP Model



Aaron J. Shenhar and Dov Dvir , Reinventing Project Management: The Diamond Approach to Successful Growth and Innovation

Conclusions and Summary

- Systems engineering (SE) case studies:
  - Extension of traditional engineering case studies
  - Expose students to open ended problems
  - Enable Experiential Learning
  - Foster Systems Thinking
  - Focus on Applied Systems Engineering
- Air Force Institute of Technology (AFIT) Cases:
  - Wealth of resources
  - Extend to other exercises & SE labs
- The Berlin Airlift :
  - Experience Learning by Doing
  - Exercise Team Building & Leadership
  - Develop a “System” Architecture
  - Exercise your Systems Thinking

Questions