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Value Creation Though Integration

A Holistic Approach to the Design of Assembly Operations for Defense Aerospace Products

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Research Sponsored By the Lean Aerospace Initiative

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GPS Spacecraft

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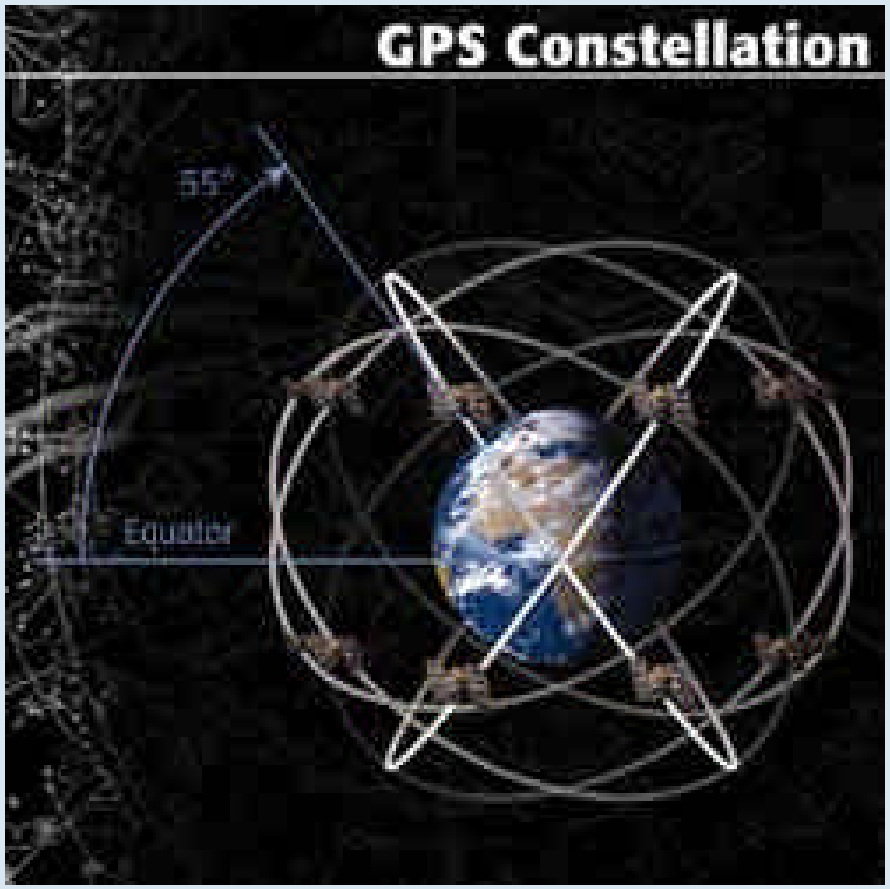
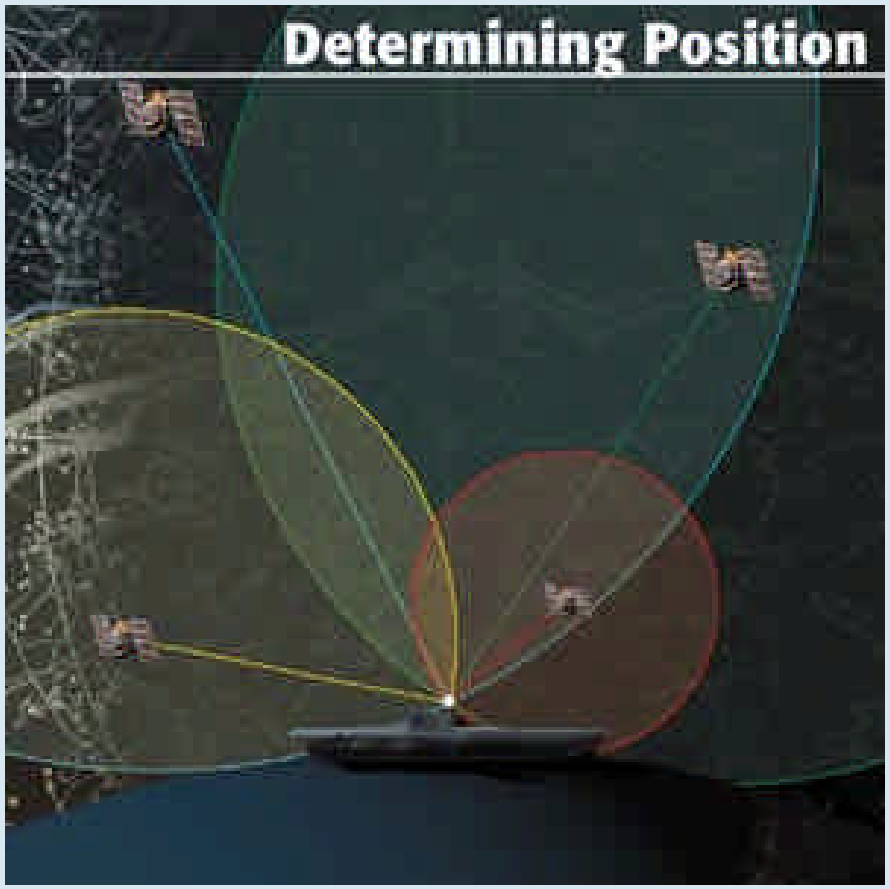
Global Positioning "System"





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GPS "Lost" Architecture

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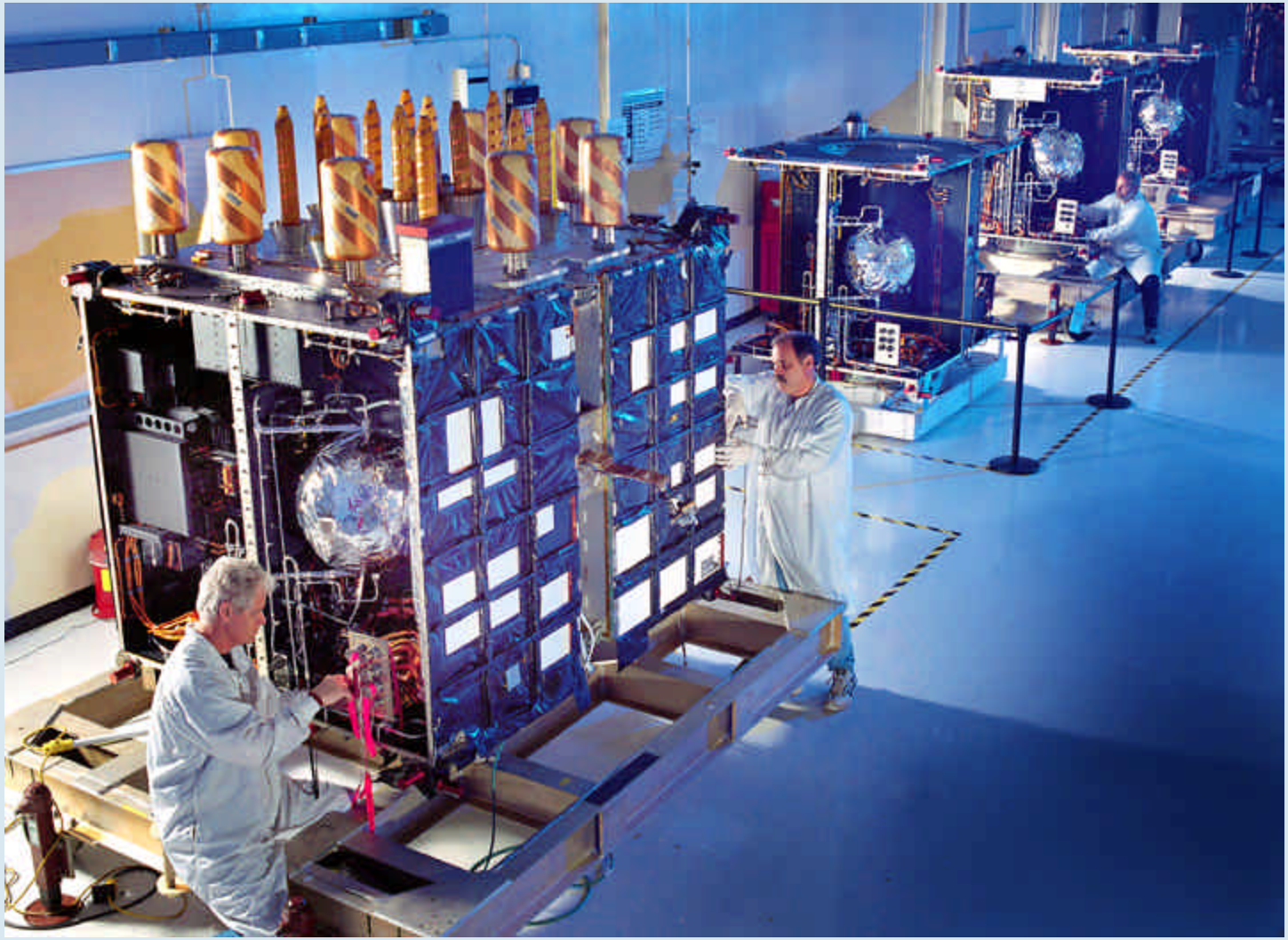
GPS "Lost" Architecture



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Ultra-Quality

- **Ultra-Quality is defined as the limiting case of quality driven to the extreme.**
- **Examples are space craft, nuclear power plants, commercial aircraft, automobiles...**
- **Demands that a system, regardless of size or complexity, should not fail to perform.**

Ultra-Quality

- **Manufacturing systems are ultra-quality systems just like the airplanes and space craft they produce…**
- **Today's challenge is to achieve and maintain ultra-quality levels as systems become more complex.**

Overview

- Research background and objectives
- Manufacturing System Design Framework
- Research Design
- Introduction of the case studies
- Results
- Conclusions

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Research Background

- **Conducted by the Manufacturing Systems Team of LAI**
- **Original motivation - create a quantitative set of guidelines for the manufacture of air and space craft**
- **This ended up being harder than we thought…**

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Research Objectives

- **Goals guiding the research effort:**
  - **Study and improve available tools in use**
  - **Understand the processes used in industry to design manufacturing systems**
  - **Propose a model for industry to use**
  - **Test this model in industry**
  - **Establish key characteristics of this design process**
  - **Create analytical models to predict manufacturing system performance**

Research Design

- **Assembly operations**
  - Span multiple sectors of the aerospace industry
  - Prime contractors are off-loading fabrication
  - Most visible portion of the value stream
  - Greatly simplifies the problem
- **Site selection criteria**

Research Design (cont.)

- **Framework Evaluation Tool**
  - Aimed at the Business Unit level for each case
  - Scored from 0 (worst) -- 100 (best) called "Framework Congruence"
  - Goals of the tool were to determine:
    - Phase Presence
    - Phase Timing
    - Breadth in Phase
- **Performance Metric**
  - Actual/Planned Performance

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Data Collection

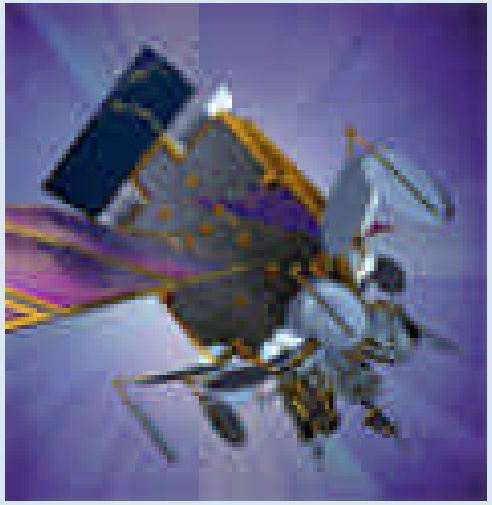
- 30+ site visits since June 2000
- Over 240 interviews ranging from vice presidents to shop floor workers
- Real time “fly on the wall” or retrospective observations

Case Studies - Air

- **Major Aerostructures (6):**
  - **737NG, F-18 E/F EFF, F-16, F-22 (wing/aft, mid), X-35**
- **Electronics (2):**
  - **Wedgetail, TDR-94**

Case Studies - Space

- **Launch Vehicles (2):**
  - **EELV: Atlas V, Delta IV**
- **Space (4):**
  - **A2100, AEHF, Iridium, HVSP**



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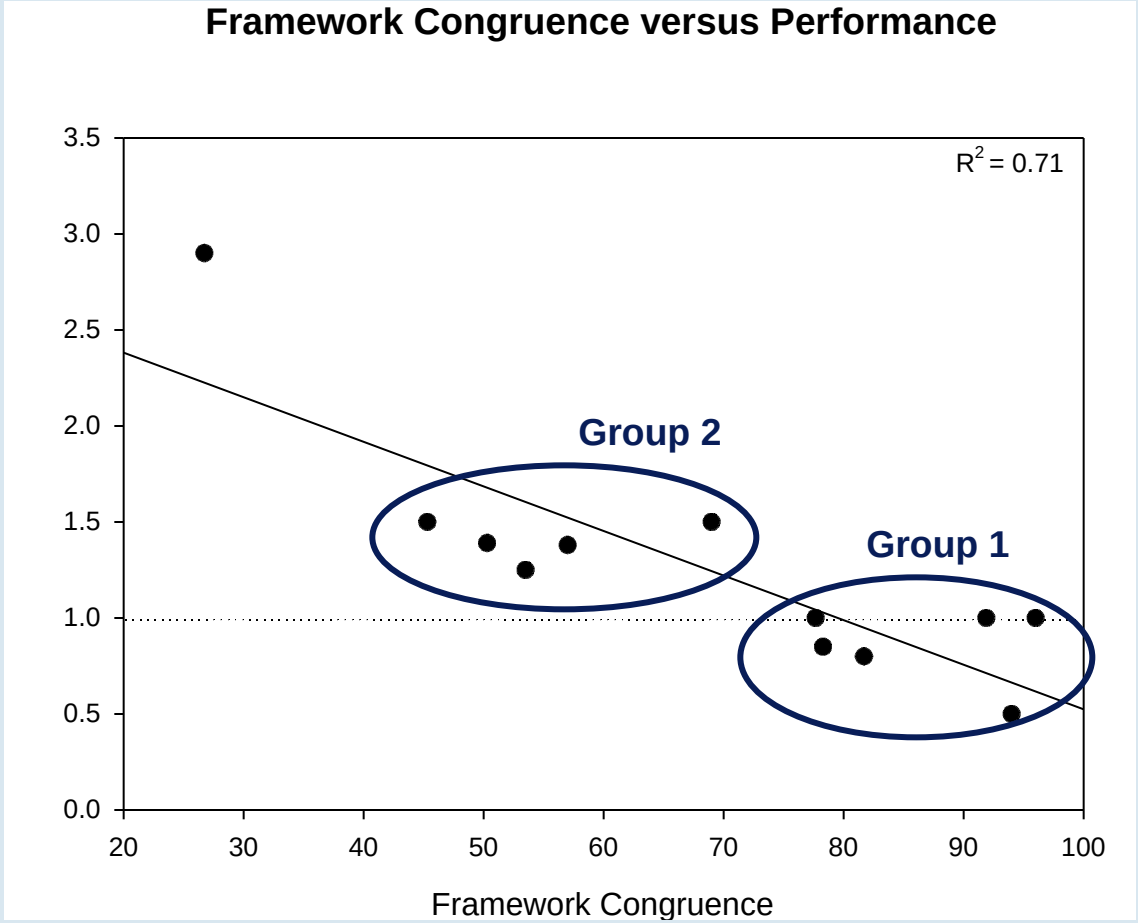
Framework Validation Results



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Scoring Breakdown

Framework Congruence	Phase Presence	Timing	Breadth	
96	25.90	30.71	39.38	Group 1
94	25.90	30.00	38.05	
91.9	22.48	29.00	40.38	
81.7	18.57	26.62	36.62	
78.3	23.24	24.19	30.86	
77.67	20.90	25.90	30.86	
69	21.24	26.62	21.19	Group 2
57	17.24	19.76	20.14	
53.5	13.33	15.90	24.29	
50.3	12.33	17.90	20.14	
45.3	15.00	18.76	12.29	
26.73	7.33	11.76	7.67	

- **How important are the different aspects?**
  - **Which of Phase Presence, Timing or Breadth impacted the ability of the system to meet its planned performance?**

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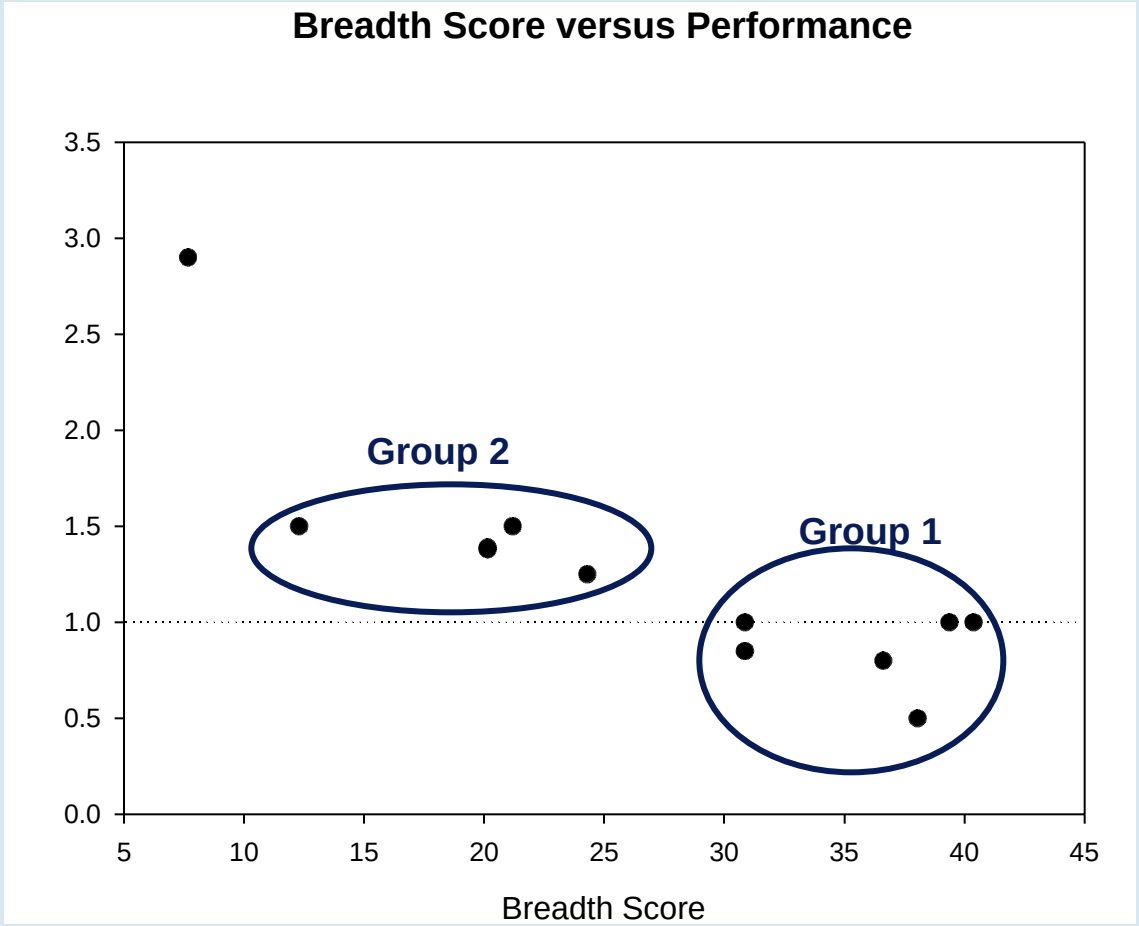
Determinants of Performance



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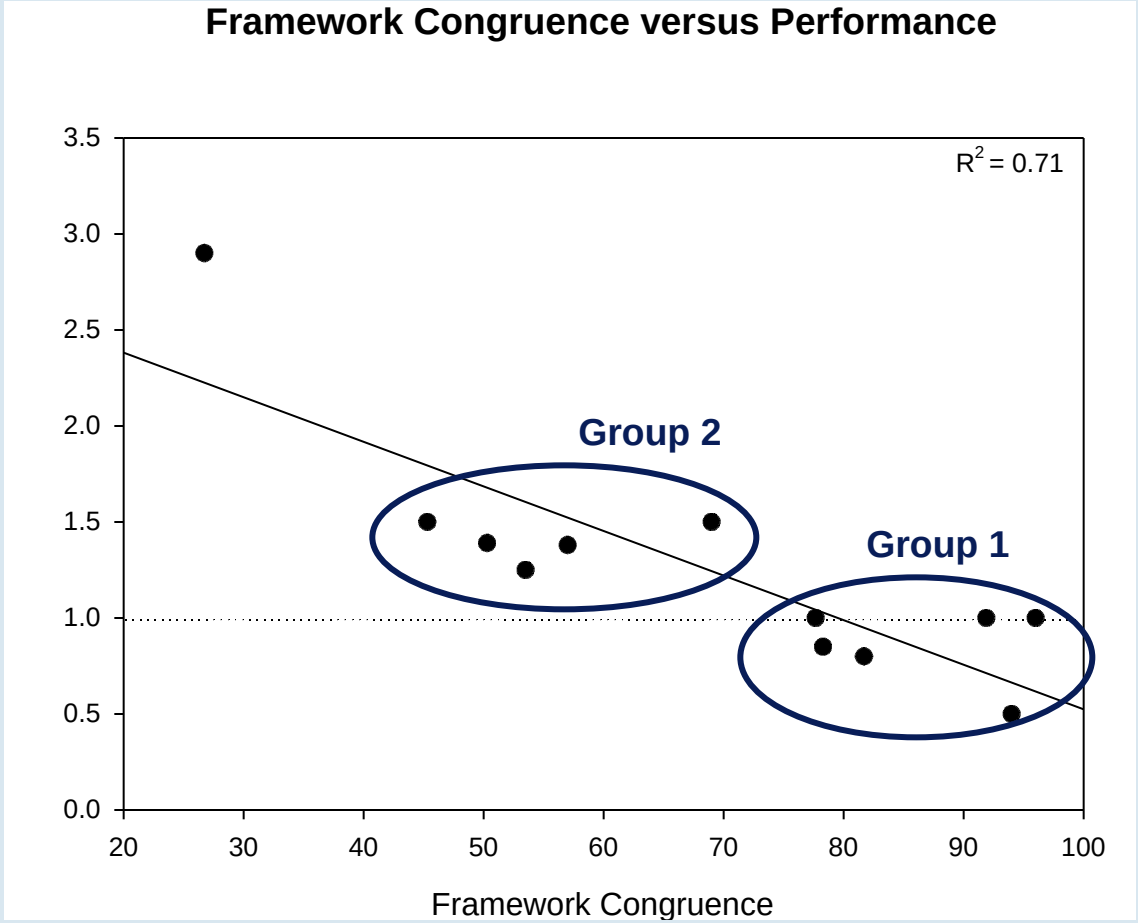
Framework Validation Results



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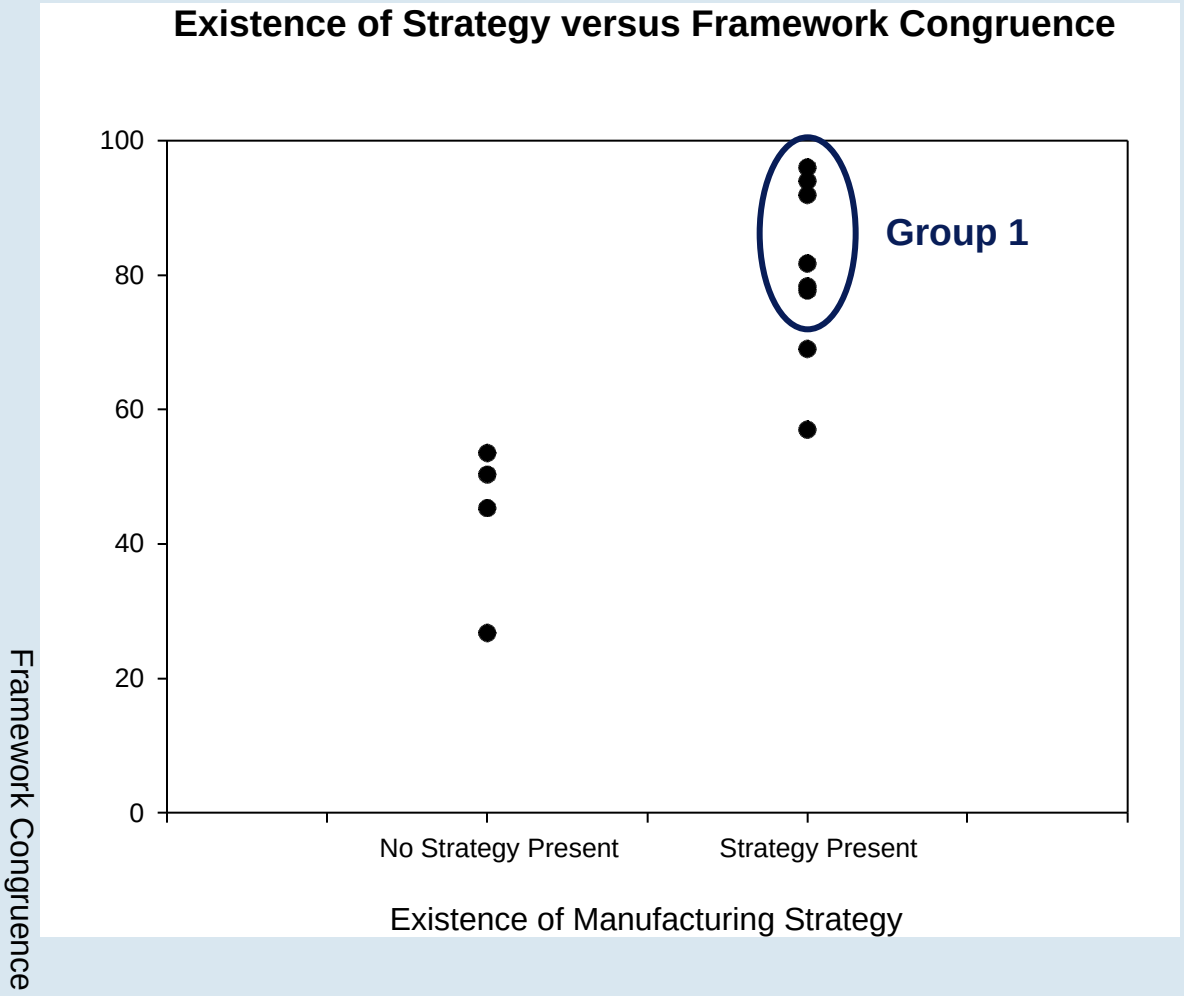
Strategy Presence Results



Conclusions

- **Framework Validation**
  - **Framework congruence and system performance**
- **Key Characteristics**
  - **Breadth**
  - **Strategy**
  - **Status**

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Summary

- Research background and objectives
- Propose a framework
- Test the framework
  - Research design and case studies
- Results
  - Framework validation and key characteristics
- Questions? Comments?

