**PA**

**Aerospace
and Defense**
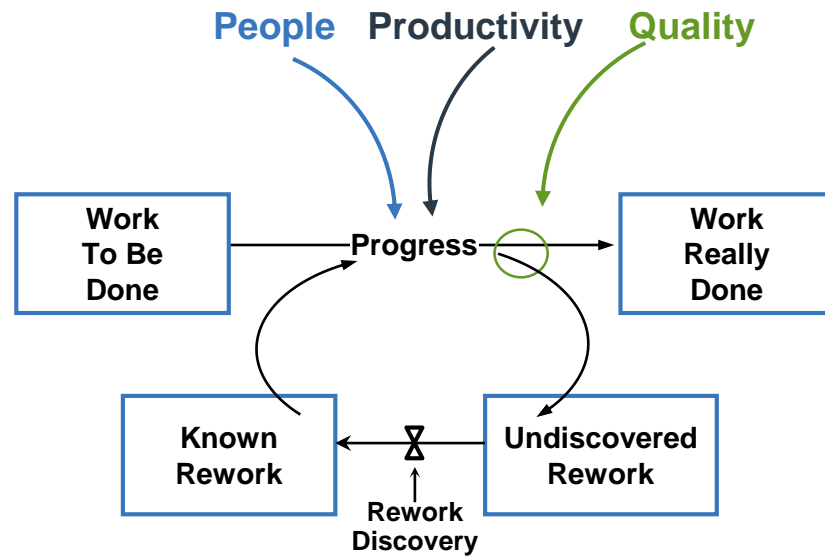
DELIVERING CRITICAL PROJECTS & PROGRAMS

2018 System Dynamics Conference

Most development projects experience substantial cost and schedule overruns, for example:

Development Cost Performance and Average Launch Delay for Major NASA Projects from 2009 to 2018
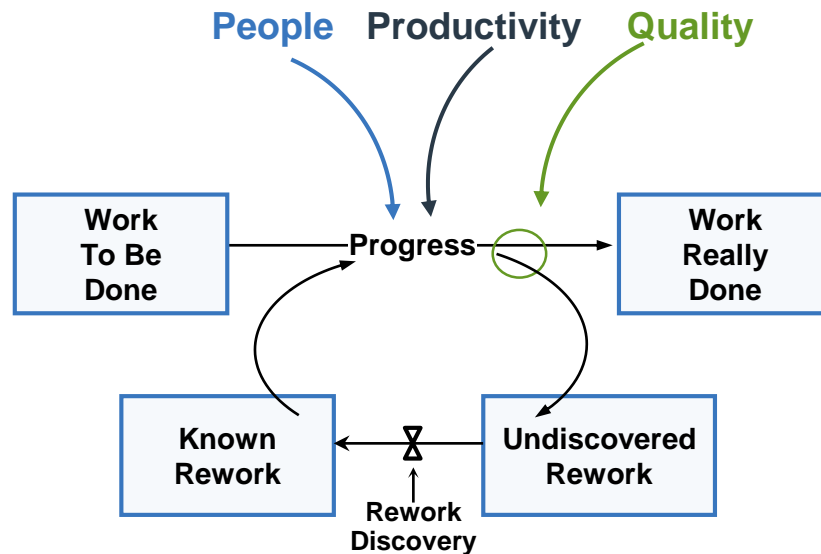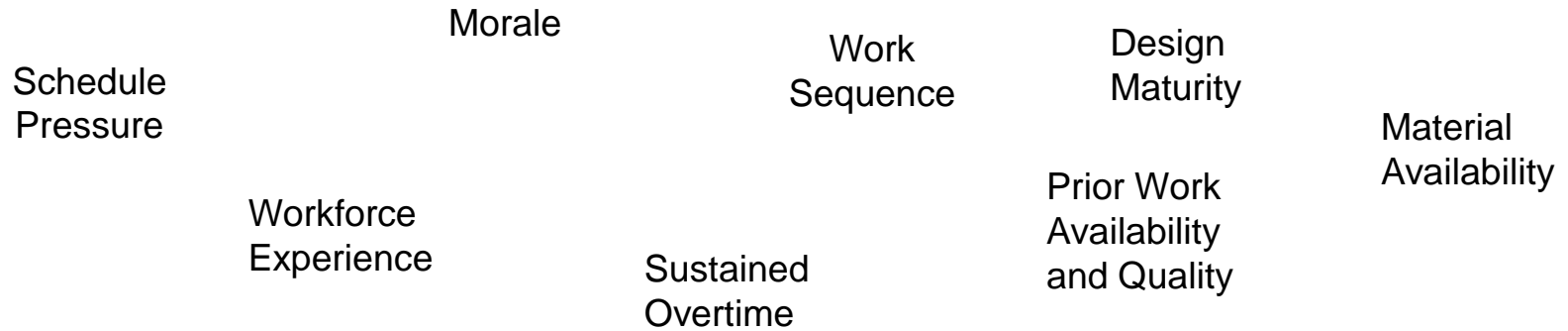

Percentage Cost Growth (blue bar)   **Average Launch Delay (in months)**

Orion program costs unknown
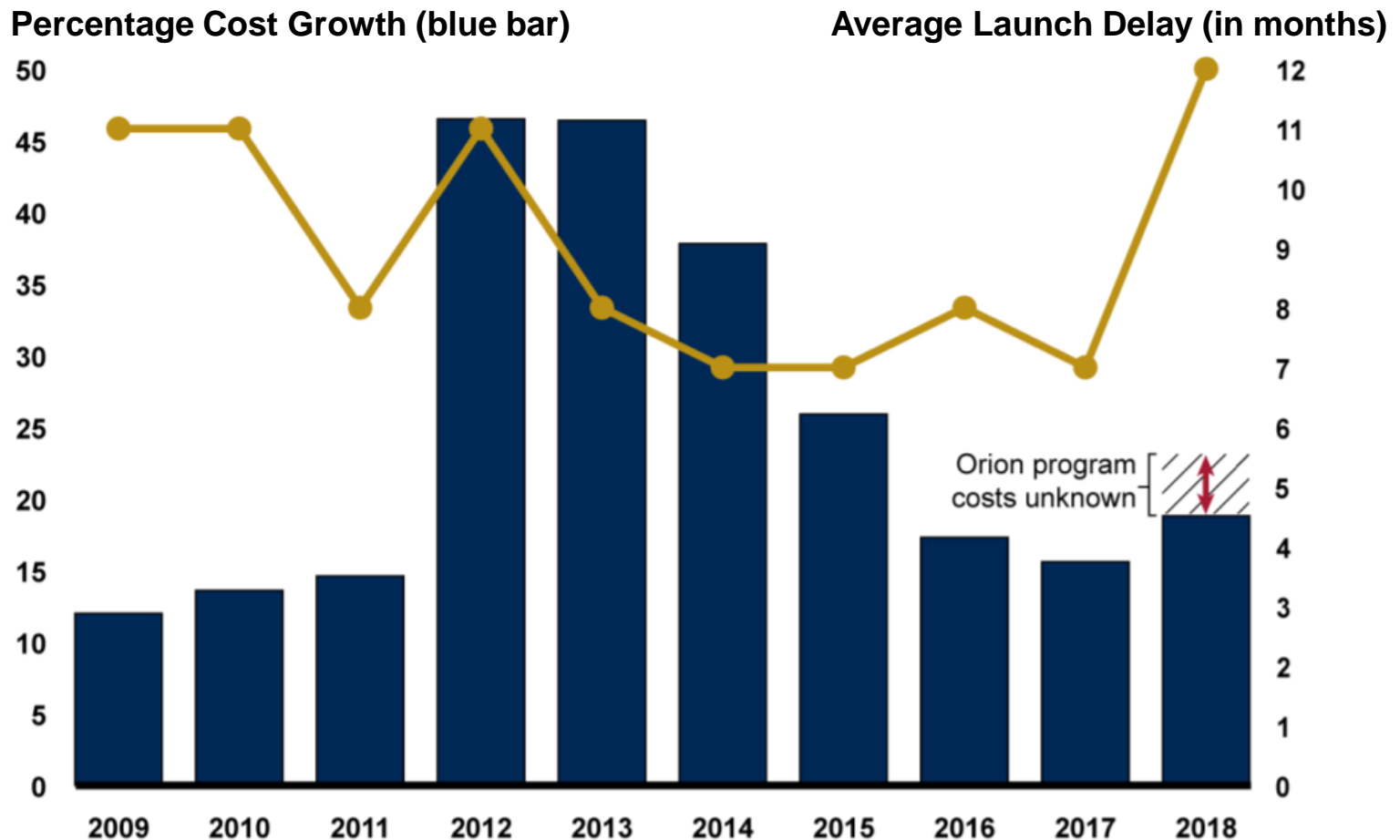
The Project Rework Cycle portrays the real-world phenomenon that work is often executed at varying, but usually less than perfect quality.

People **Productivity** **Quality**

Work To Be Done → Progress → Work Really Done

Progress → Undiscovered Rework → (Rework Discovery) → Known Rework → Progress

It also captures how it often takes time and effort to discover that rework

This structure is the core of a simulation model developed for and applied to hundreds of complex design and construction projects (e.g., power plants, aerospace developments, electronics, software systems, shipbuilding, etc.)

And of course many things impact work productivity and quality

Morale

Schedule
Pressure

Work
Sequence

Design
Maturity

Material
Availability

Workforce
Experience

Prior Work
Availability
and Quality

Sustained
Overtime

People **Productivity** **Quality**

```
Work          Progress              Work
To Be                              Really
Done                                Done

        Known      Rework      Undiscovered
        Rework    Discovery      Rework
```

There are a number of papers and open courseware material online about the rework cycle if you want to learn more.
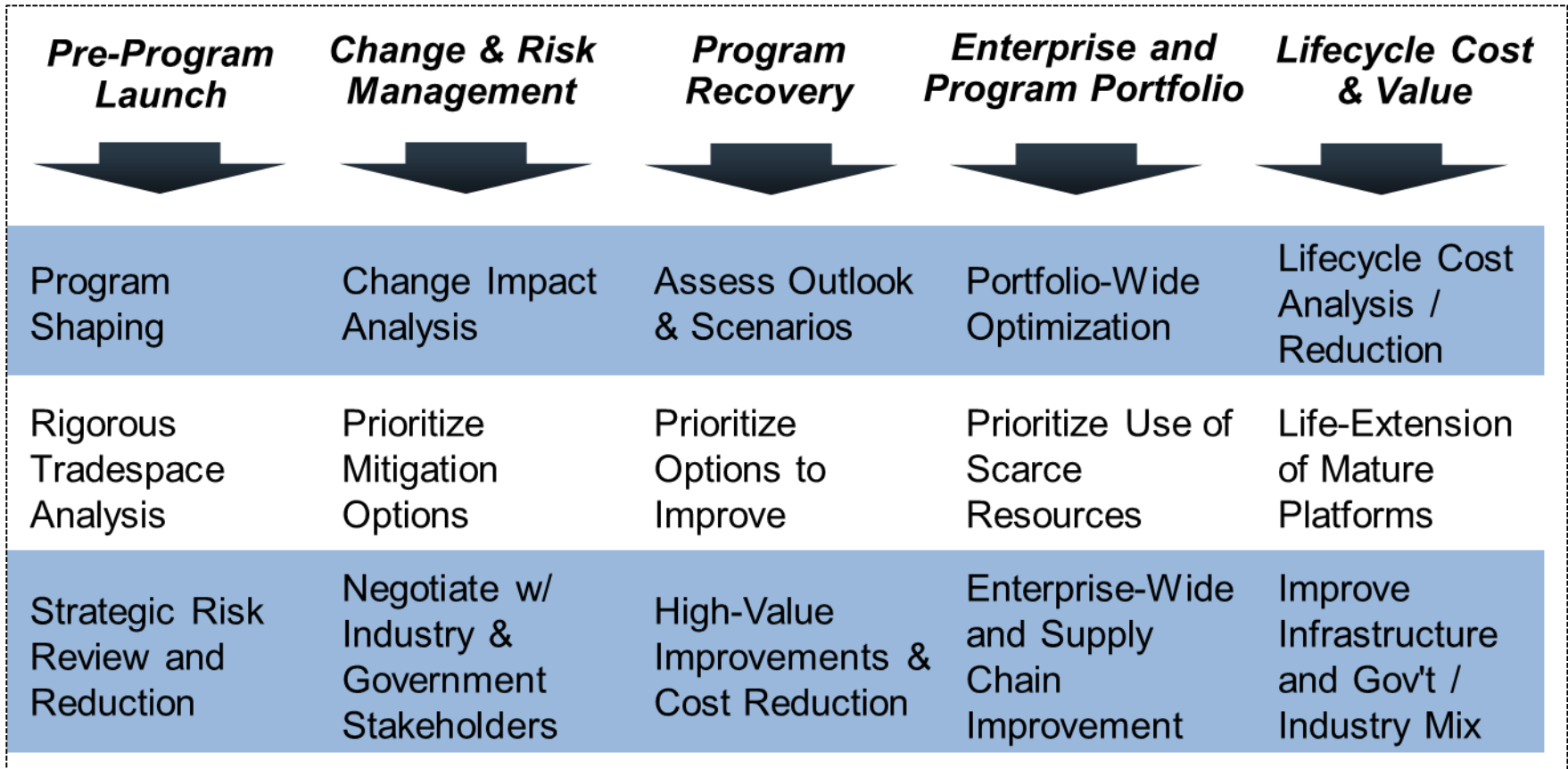
Construction productivity and quality vary with program conditions and resulting work accomplishment drives subsequent program conditions
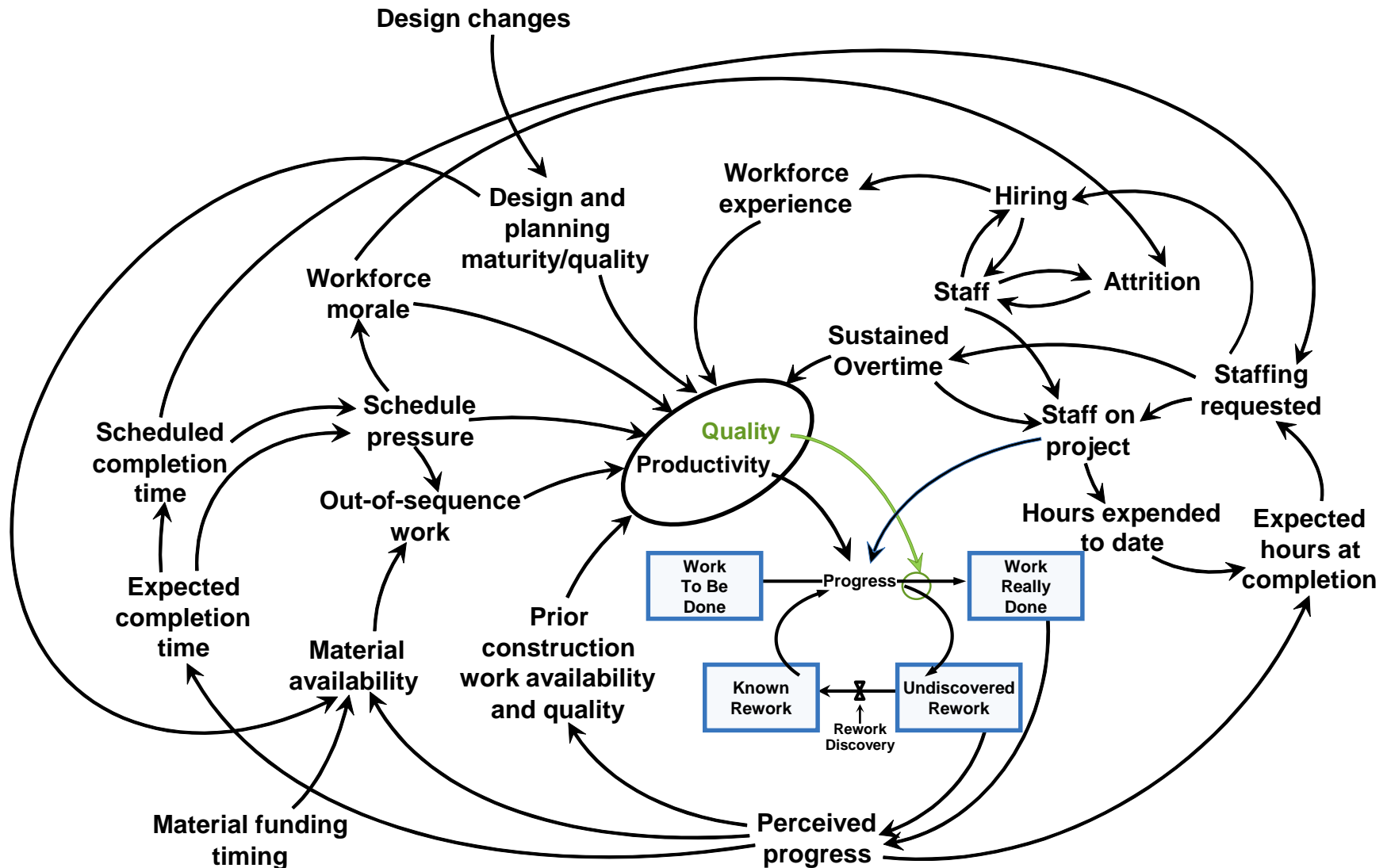
Program simulation model structure represents design, material procurement and delivery, direct construction effort, and support activities
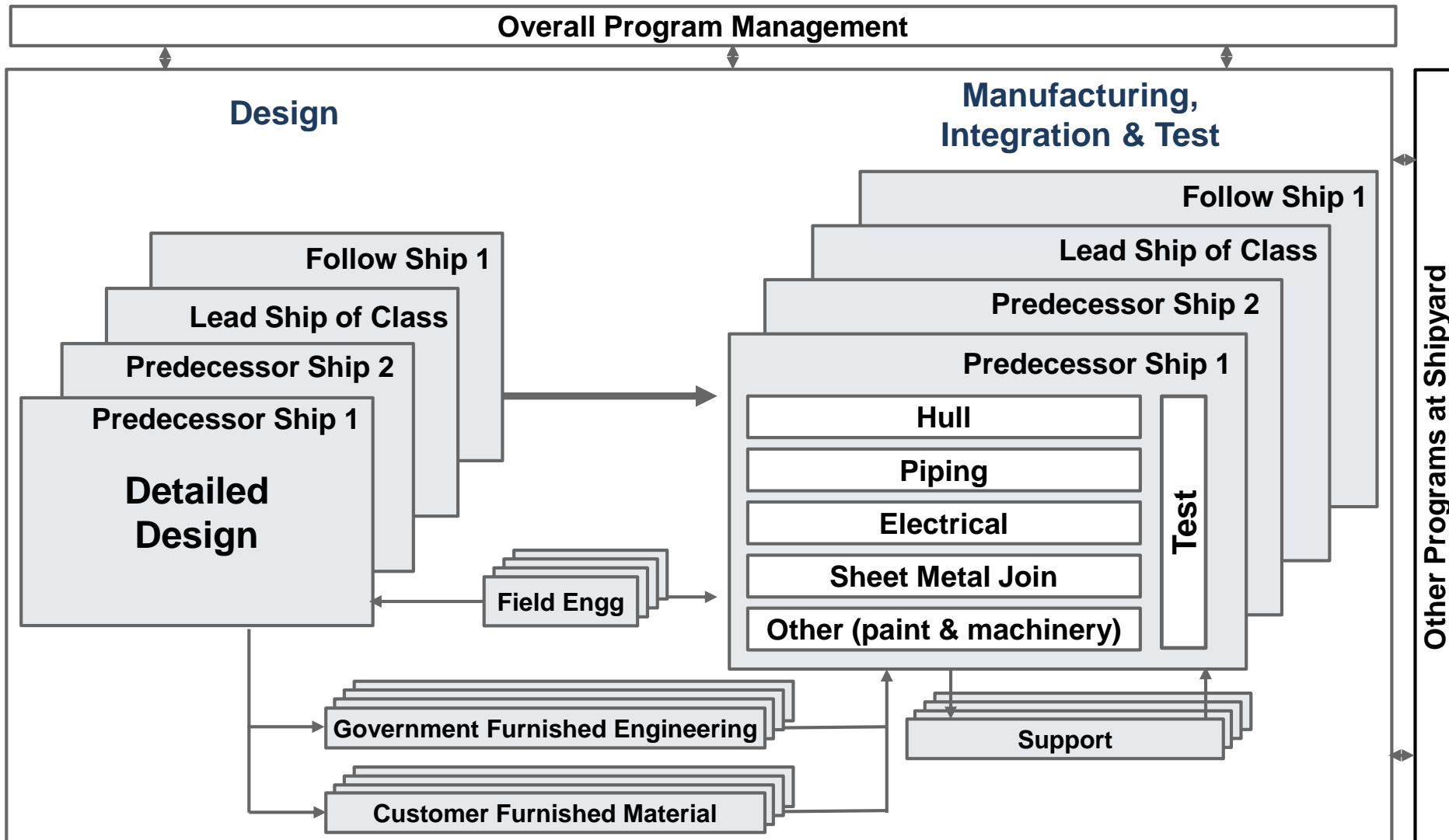
We have worked across the entire lifecycle from early analysis to total lifecycle improvement on hundreds of major programs

Pre-Program Launch	Change & Risk Management	Program Recovery	Enterprise and Program Portfolio	Lifecycle Cost & Value
Program Shaping	Change Impact Analysis	Assess Outlook & Scenarios	Portfolio-Wide Optimization	Lifecycle Cost Analysis / Reduction
Rigorous Tradespace Analysis	Prioritize Mitigation Options	Prioritize Options to Improve	Prioritize Use of Scarce Resources	Life-Extension of Mature Platforms
Strategic Risk Review and Reduction	Negotiate w/ Industry & Government Stakeholders	High-Value Improvements & Cost Reduction	Enterprise-Wide and Supply Chain Improvement	Improve Infrastructure and Gov't / Industry Mix

The approach has been applied to a number of different types of programs: software, aircraft, shipbuilding, missiles, automobiles, civil construction, satellite systems, air defense, oil platforms, power plants, airport development, etc.

Case 1: Quantifying the Impacts of Change and Improving Performance on a Large Software Development Program
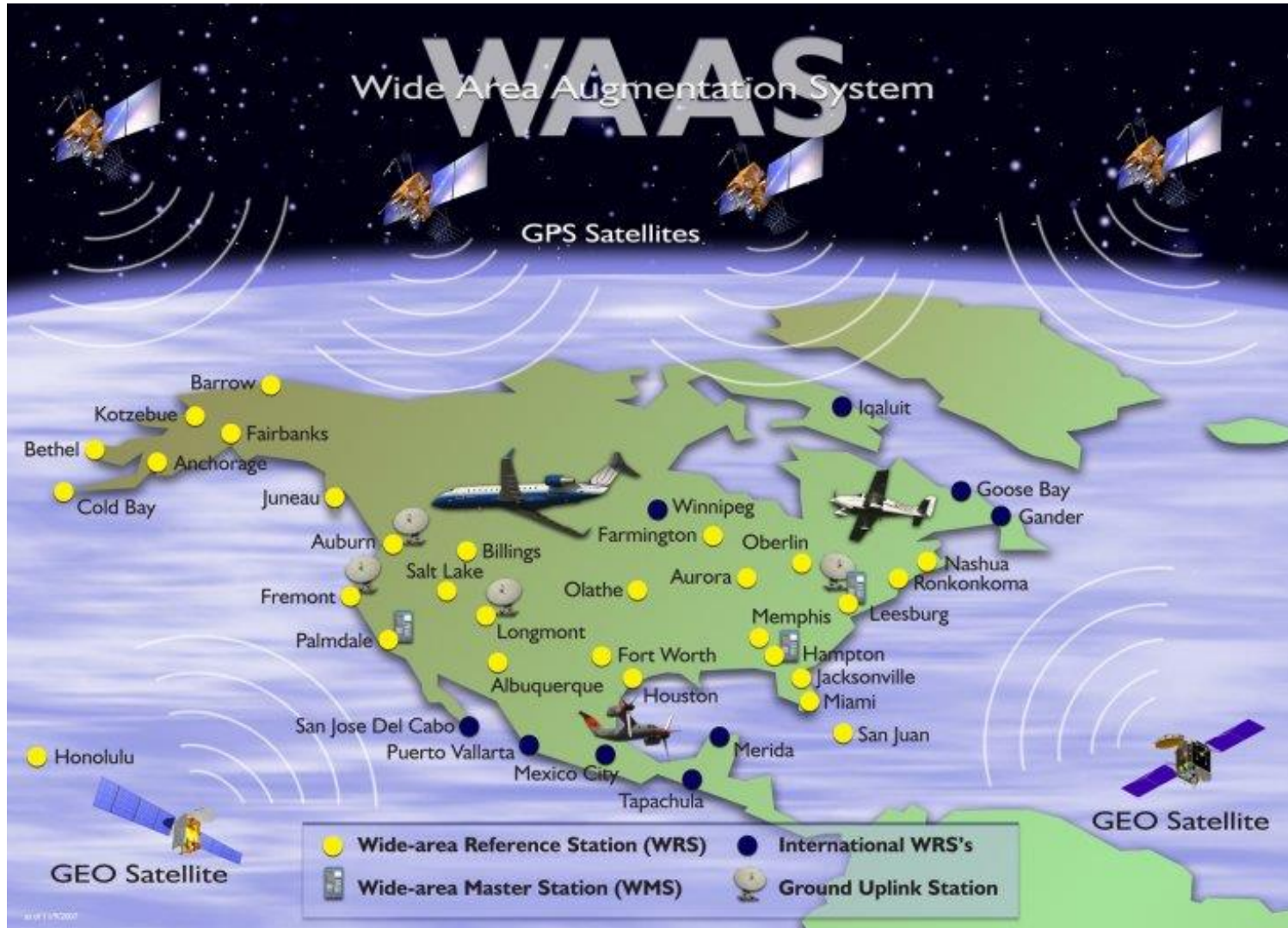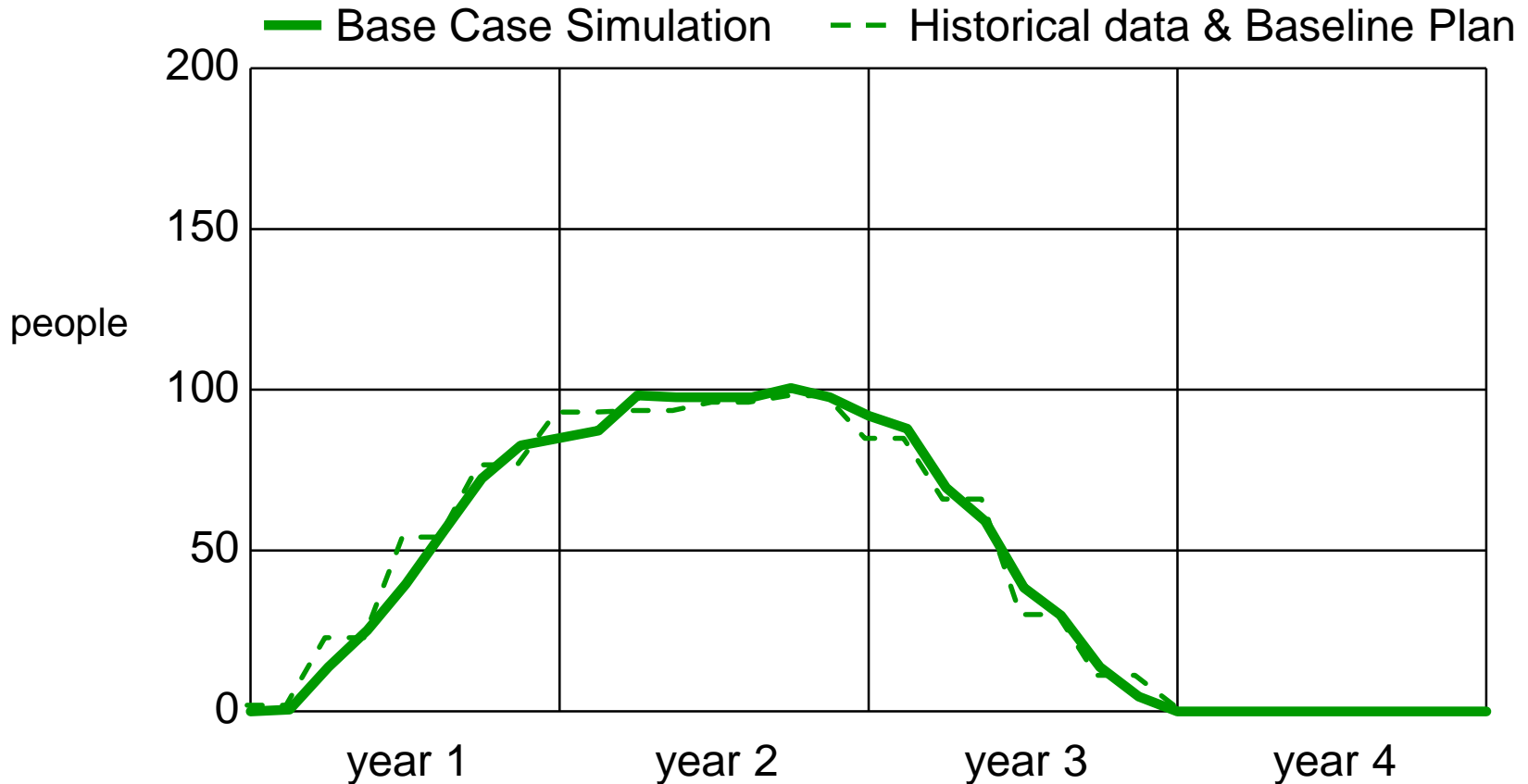
WAAS began under difficult conditions

- The prior contractor had just been terminated for their lack of performance, testifying to the challenges, and ensuring even-greater FAA scrutiny of our client

- Our client was given an aggressive schedule -- without much time to accomplish crucial up-front systems engineering

- Our client had little prior experience in the WAAS technology domain

- Several recent program wins meant resources were scarce

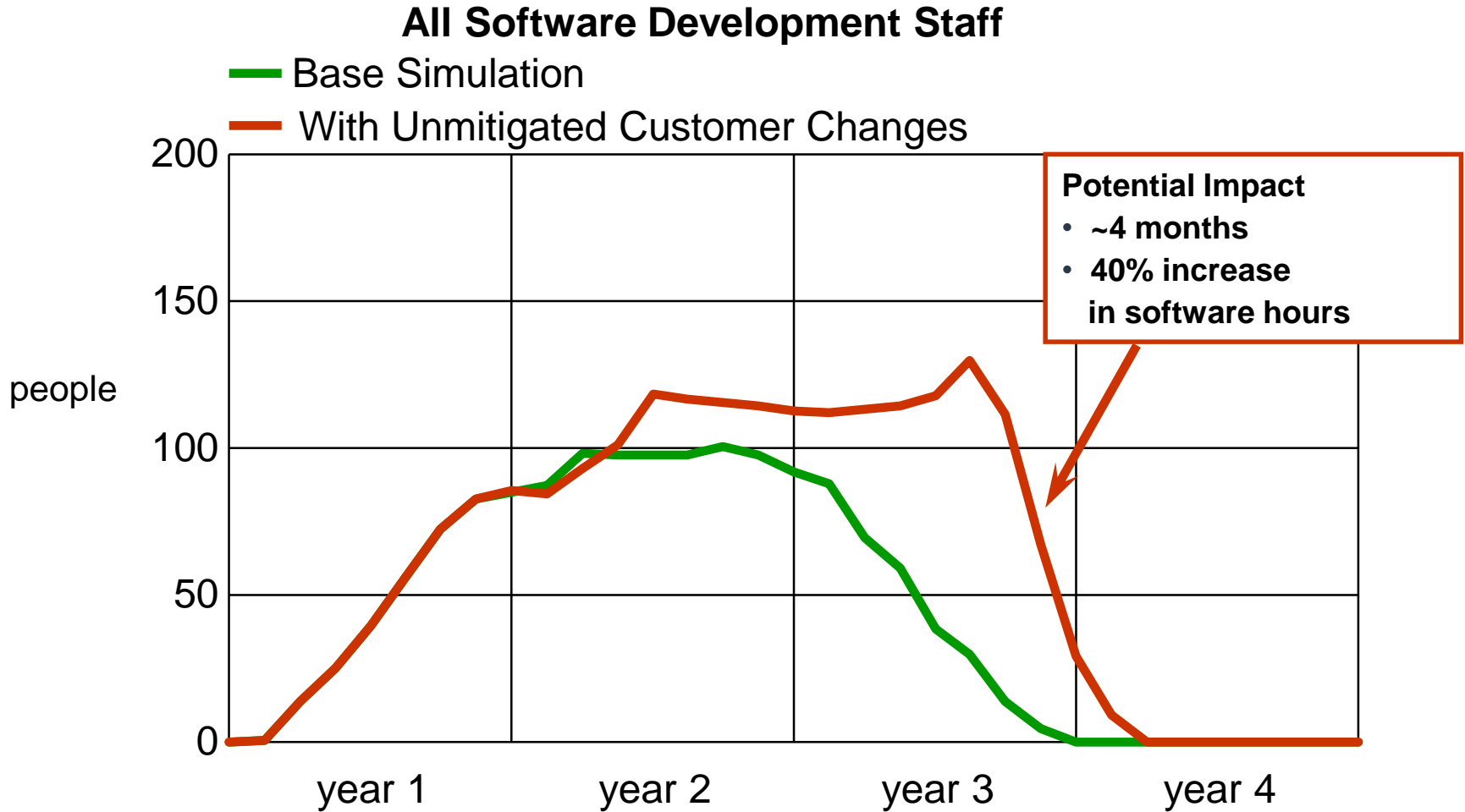We were hired to develop a risk management tool for the program office

The WAAS program team attacked the challenges and made good early progress . . .

All Software Development Staff

Legend: Base Case Simulation (solid green line); Historical data & Baseline Plan (dashed green line)

Y-axis: people (0, 50, 100, 150, 200)
X-axis: year 1, year 2, year 3, year 4

Assumptions required to simulate the planned staffing, schedules, and progress were generally very reasonable based on "ancestor" programs

One year into the program major customer-initiated changes made WAAS much more difficult than planned …

All Software Development Staff

— Base Simulation
— With Unmitigated Customer Changes

Potential Impact
- ~4 months
- 40% increase in software hours

Traditional, bottom-up project planning analyses takes weeks to evaluate a change like this

We Diagnosed How The Changes Hurt Productivity to Determine a Mitigation Strategy
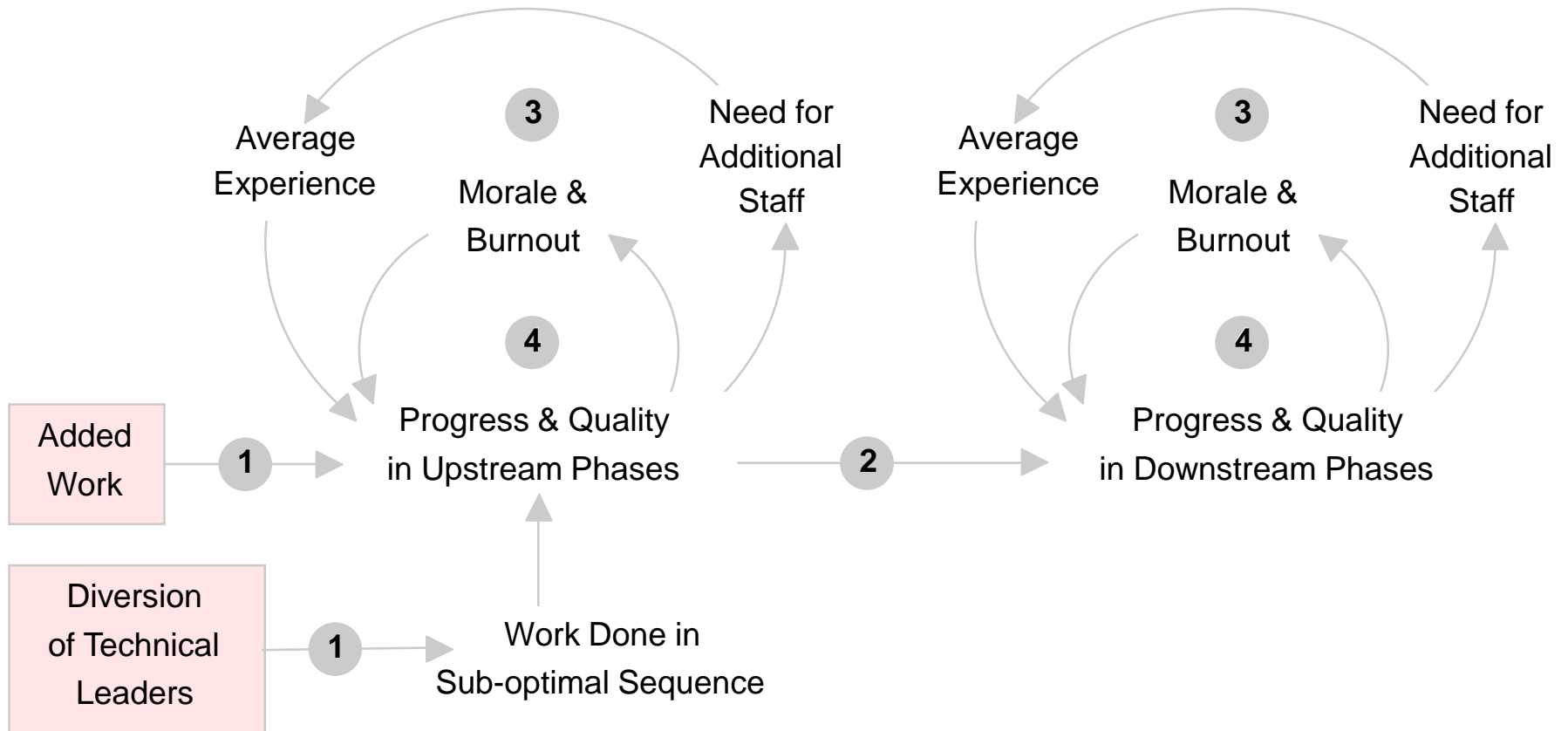
1 – Customer-initiated changes add work and divert staff

2 -- Impacts ripple downstream to coding and integration

3 -- New people are brought on to the program, with less experience

4 -- Sustained pressures and overtime hurt morale and productivity

The Mitigation Works by Preventing the "Delay and Disruption" from the Changes
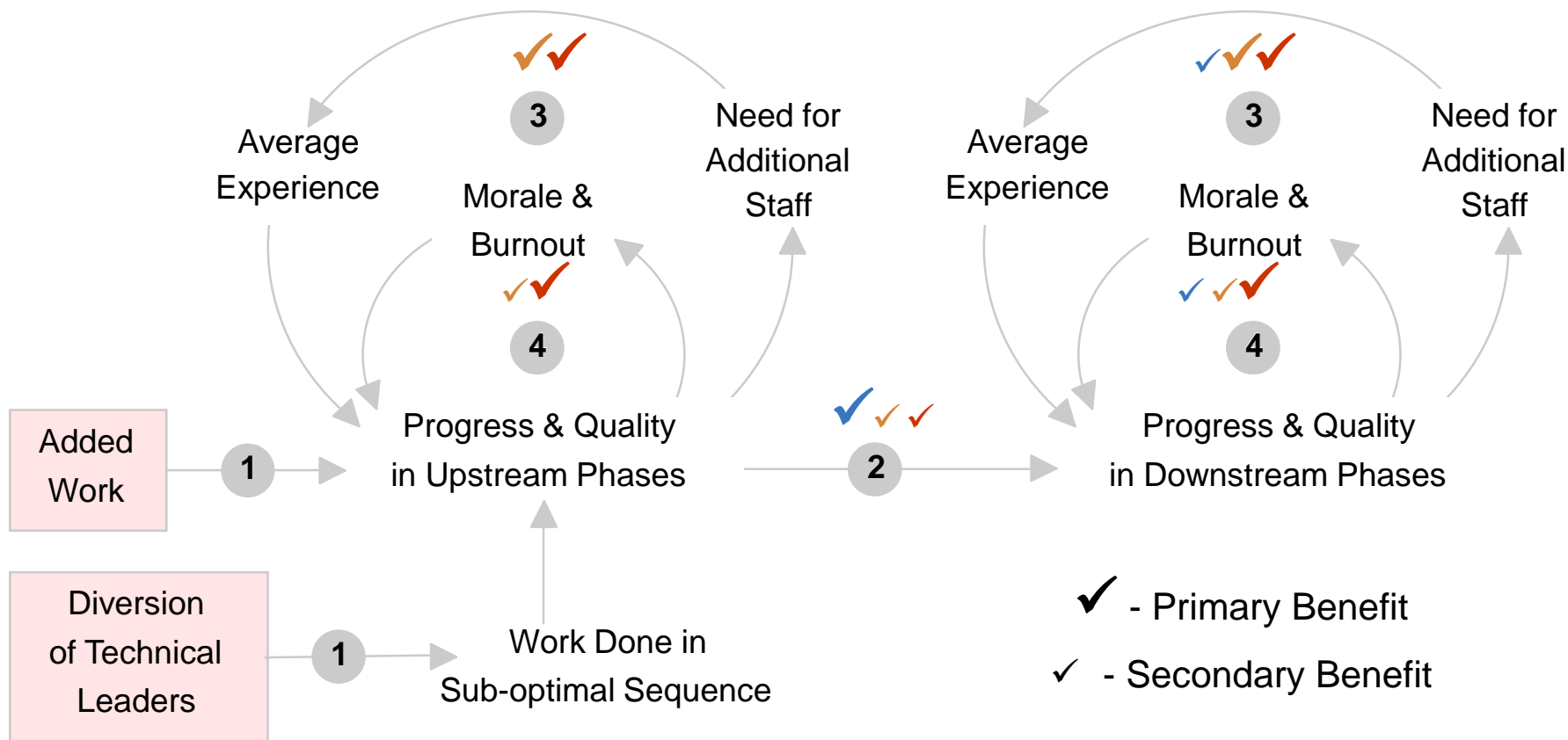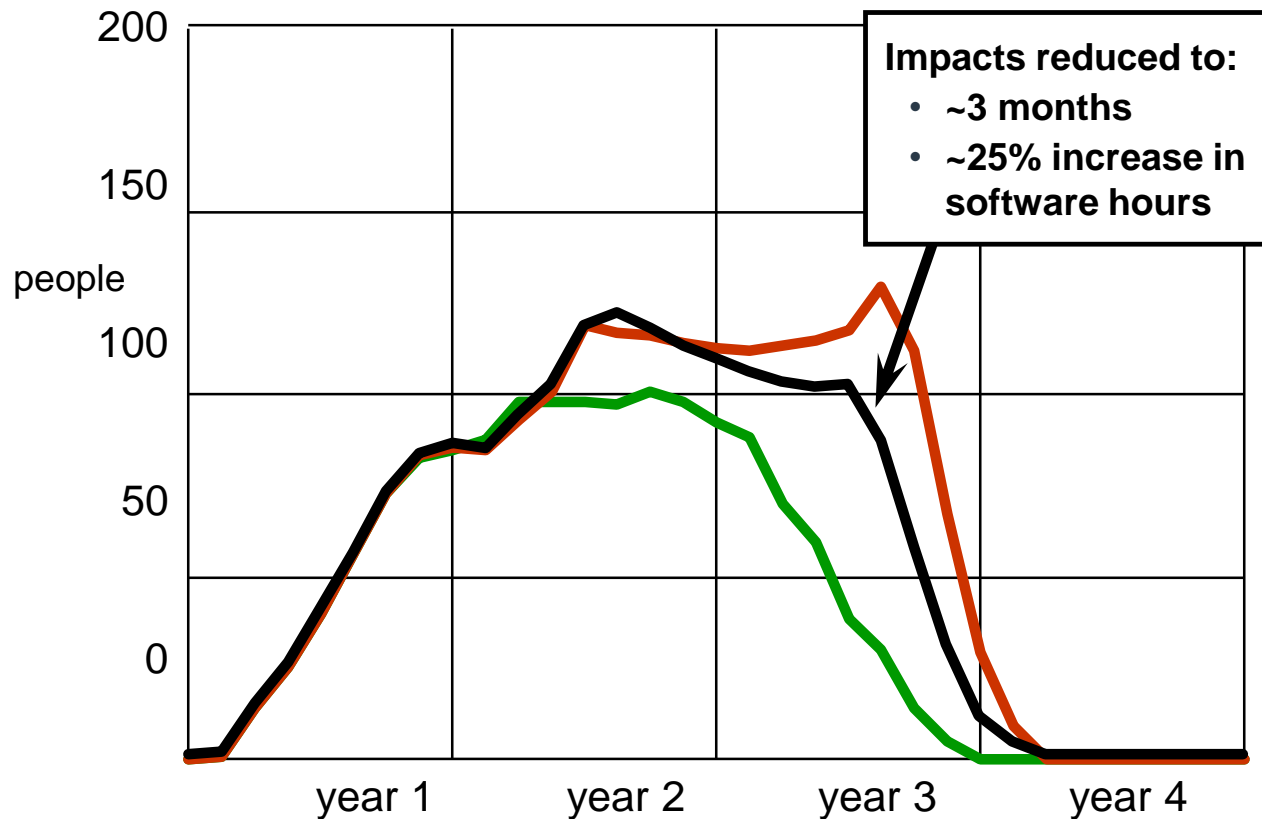

Mitigation Plan

- **Accelerate SRS Rework & Prototyping**
- **Hire Top-Notch Technical Leaders**
- **Schedule Allowance**

✓ - Primary Benefit

✓ - Secondary Benefit

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Working with Program Managers and the FAA, an effective mitigation strategy was developed and implemented

All Software Development Staff

— Base Simulation
— With Customer-Initiated Changes
— Current Simulation with Changes Mitigated

Impacts reduced to:
- **~3 months**
- **~25% increase in software hours**

people

200
150
100
50
0

year 1   year 2   year 3   year 4

Our client was applauded by the FAA for using this approach to rapidly evaluate the impact of the change and potential mitigation ideas.

Helped them reach amicable agreement with customer on pricing of change *in advance* – rather than fight over the full impact after the fact.

Allowed for a proactive schedule slip rather than working to unrealistic original deadlines that would exacerbate the issues.

PA Aerospace & Defense -- Overview

We Make The Difference

PA has helped clients for over 70 years through consulting, technology, and innovation

Our people work with businesses and governments worldwide to create ground-breaking solutions that really work – in practice, not just on paper. We bring the experience and insight to challenge conventional wisdom and create solutions for our clients that best meet *their* needs and *their* priorities.

In everything we do, we don't settle for just making *a* difference. We work to make *the* difference.

We Are Independent and Global

Owned by The Carlyle Group & our employees

70 YEARS

28 OFFICES

2,600+ PEOPLE

We Address Clients' Needs

- Sector insight and competitive strategy
- Business intelligence and strategic analytics
- Technology and business model innovation
- Delivering sustained growth
- Performance improvement
- Enterprise-wide transformation

We Drive Success For Clients

Clients choose us because we bring the right expertise, fresh insights and thinking, and because we work hard to deliver exceptional results that have lasting impact.

❑ The right team

❑ Unconstrained thinking

❑ Exceptional results

❑ Lasting impact