Systemic Quality: Integrating Product, Process, and Organization to Create High Quality and High Performance

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What is quality?

- Crosby: conformance to requirements
- Juran: fitness for use, free of deficiencies
- Deming: translate future user needs into measurable characteristics that can be designed and turned into products that satisfy the customer at a price they will pay

$$Quality = \frac{Results\ of\ work\ efforts}{Total\ costs}$$

The complex benefits structure of the Boston *Big Dig* program

SpaceX: clear success or mixed record?

SpaceX CRS-7 (June 28, 2015)

Falcon 9 Flight 20 (December 22, 2015)
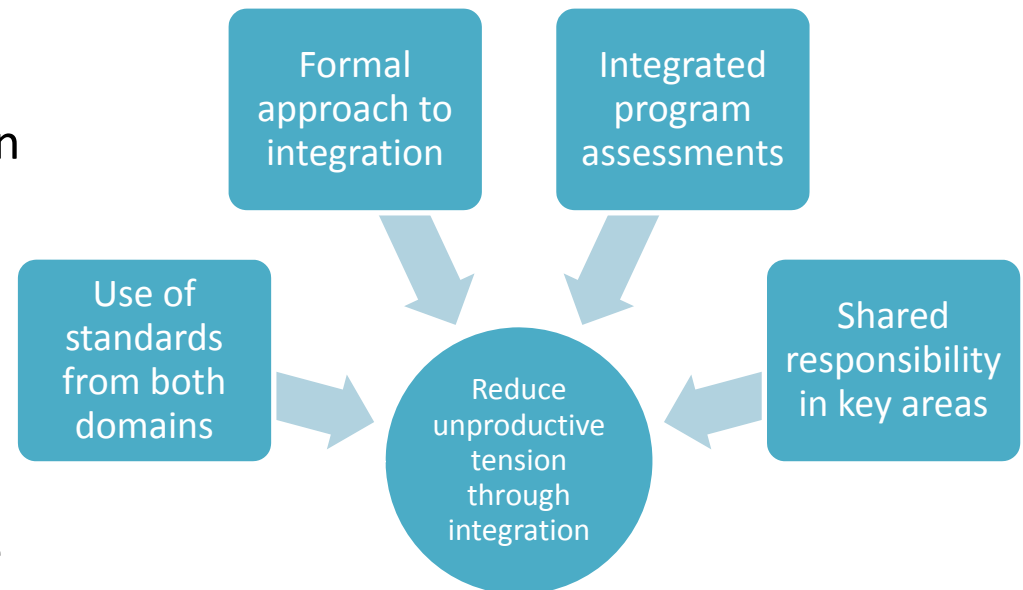
SpaceX CRS-8 (April 8, 2016)

How does SpaceX do it?

- Focus on simplicity in the design
- Colocation of teams and value-adding activities
- Vertical Integration across the entire product
- "Responsible engineer", test-what-you-fly mission assurance
- Culture that promotes teamwork, mutual support, coordination, and communication in the spirit of pushing the boundaries

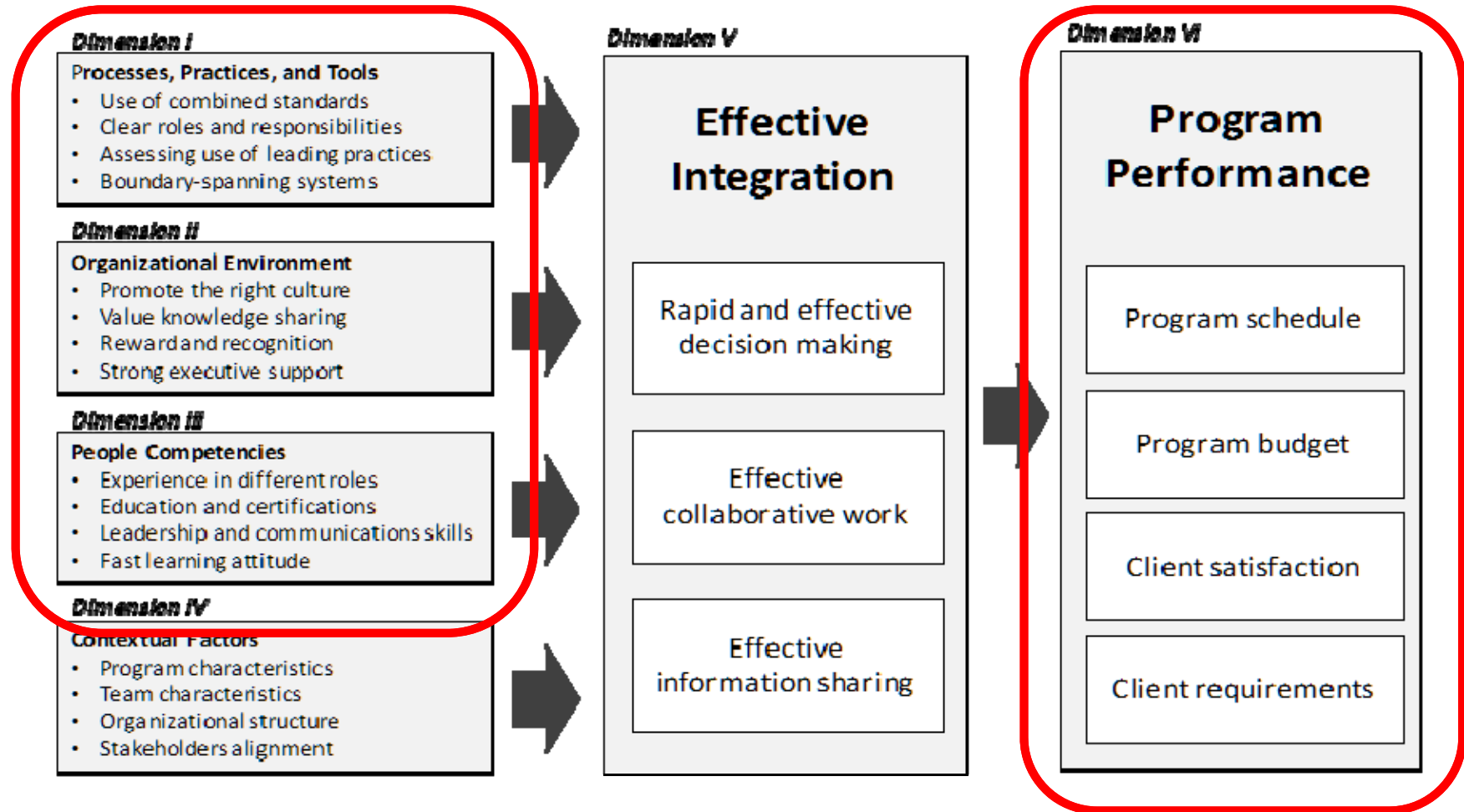- Why don't all organizations do this?

Integrating Program Management and Systems Engineering: how?

1. Using standards from both domains: Training and alignment

2. Formal approach to integration

3. Developing integrated engineering program assessments

4. Effectively sharing responsibility for risk management, quality, lifecycle planning and external suppliers.

Formal approach to integration

Integrated program assessments

Use of standards from both domains

Reduce unproductive tension through integration

Shared responsibility in key areas

~680 Chief Systems Engineers and Program Managers Responded

A framework for integrating program management and systems engineering

Dimension I

Processes, Practices, and Tools
- Use of combined standards
- Clear roles and responsibilities
- Assessing use of leading practices
- Boundary-spanning systems

Dimension II

Organizational Environment
- Promote the right culture
- Value knowledge sharing
- Reward and recognition
- Strong executive support

Dimension III

People Competencies
- Experience in different roles
- Education and certifications
- Leadership and communications skills
- Fast learning attitude

Dimension IV

Contextual Factors
- Program characteristics
- Team characteristics
- Organizational structure
- Stakeholders alignment

Dimension V

Effective Integration

- Rapid and effective decision making
- Effective collaborative work
- Effective information sharing

Dimension VI

Program Performance

- Program schedule
- Program budget
- Client satisfaction
- Client requirements

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MIT Consortium for ENGINEERING PROGRAM EXCELLENCE

Processes, Practices, and Tools

UNITED TECHNOLOGIES (UTC) OVERVIEW

- Multiple business units
- 218,300 Employees
- 4,000 locations in 71 countries
- 1,000+ legal entities
- Conducts business in about 180 countries
- 24th largest US manufacturer
- 48th largest US corporation
- 120th largest company in the world

United Technologies

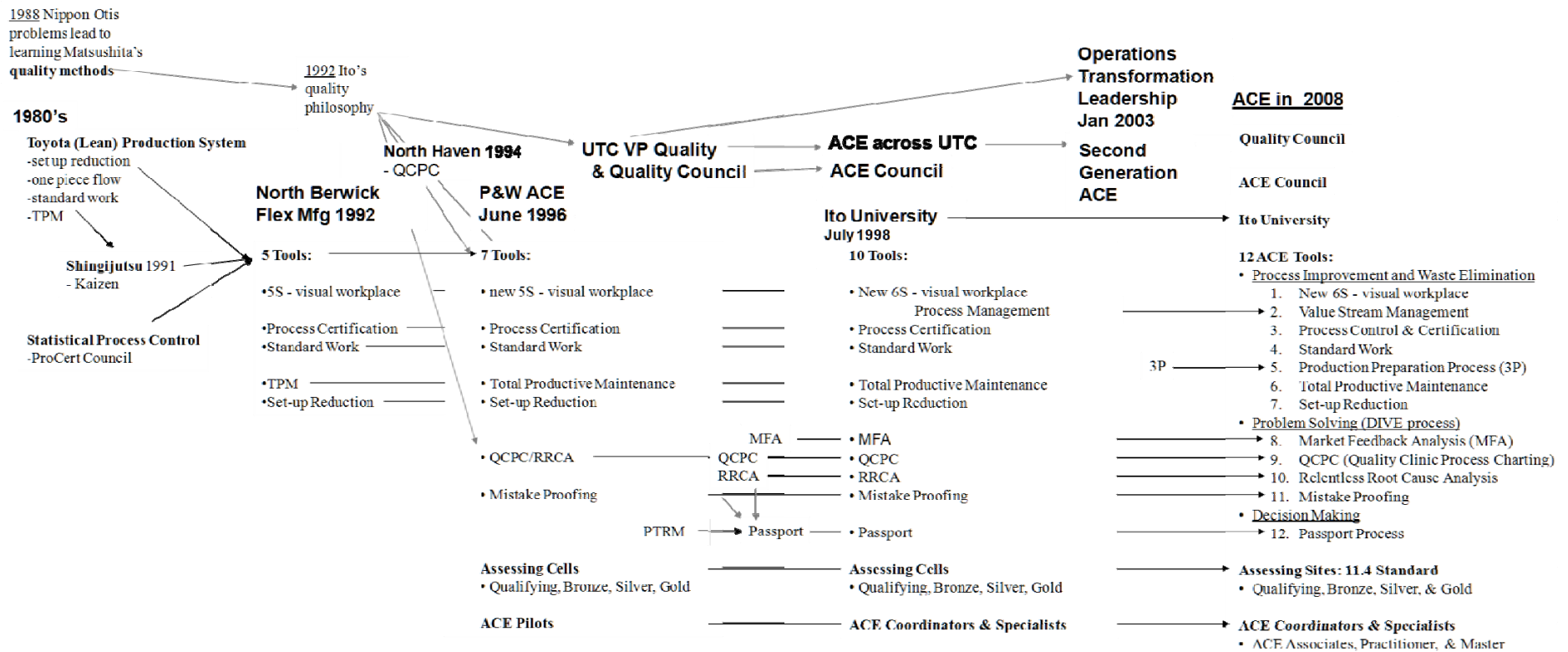**Building & Industrial Systems**

Carrier   Otis

Chubb   Kidde

Aerospace

UTC Aerospace Systems

ACE
Achieving Competitive Excellence
The United Technologies Operating System

Sources: Slideshare.net, UTC.com

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MIT Consortium for
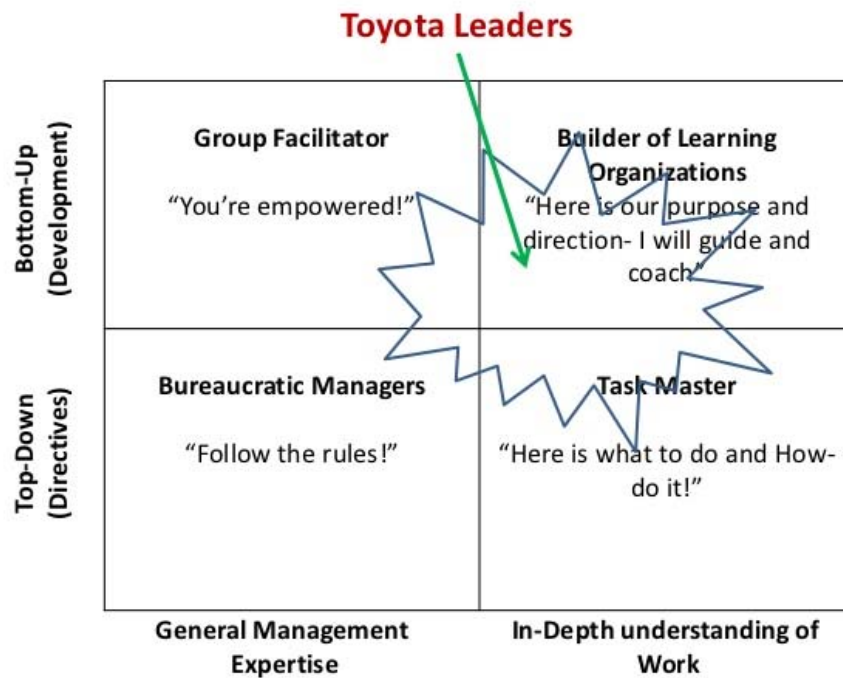**E**ngineering
Program
Excellence

UTC's ACE journey

Source: Roth, 2010, MIT case study

Organizational Environment

Integration Competencies in People

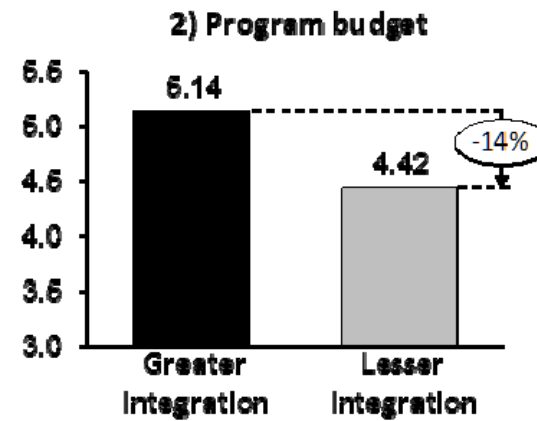## TOYOTA LEADERSHIP MODEL

Toyota Leaders

	General Management Expertise	In-Depth understanding of Work
Bottom-Up (Development)	**Group Facilitator** "You're empowered!"	**Builder of Learning Organizations** "Here is our purpose and direction- I will guide and coach"
Top-Down (Directives)	**Bureaucratic Managers** "Follow the rules!"	**Task Master** "Here is what to do and How- do it!"

Integration has a positive impact on program outcomes

1) Program schedule

Greater Integration: 5.50
Lesser Integration: 4.54
-17%

2) Program budget

Greater Integration: 5.14
Lesser Integration: 4.42
-14%

3) Client Requirements

Greater Integration: 5.72
Lesser Integration: 4.52
-21%

4) Client Satisfaction

Greater Integration: 6.33
Lesser Integration: 5.40
-15%
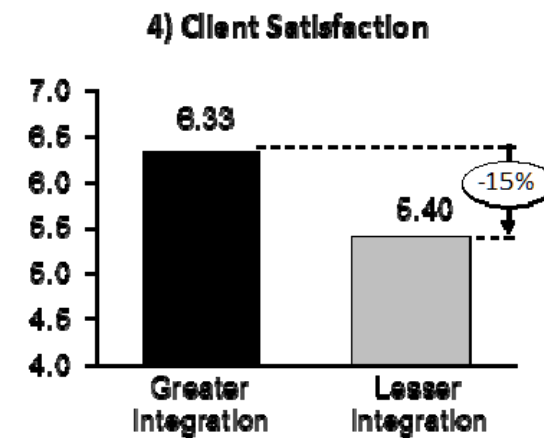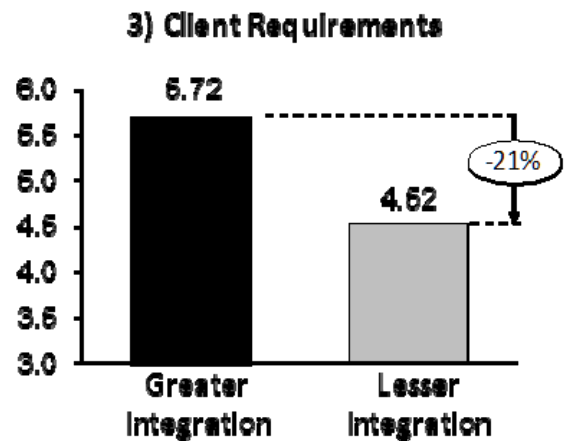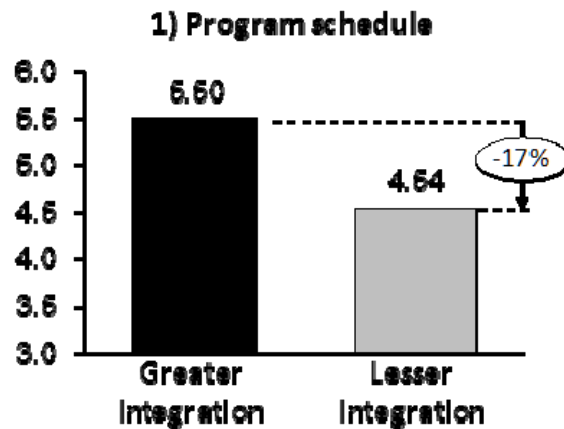
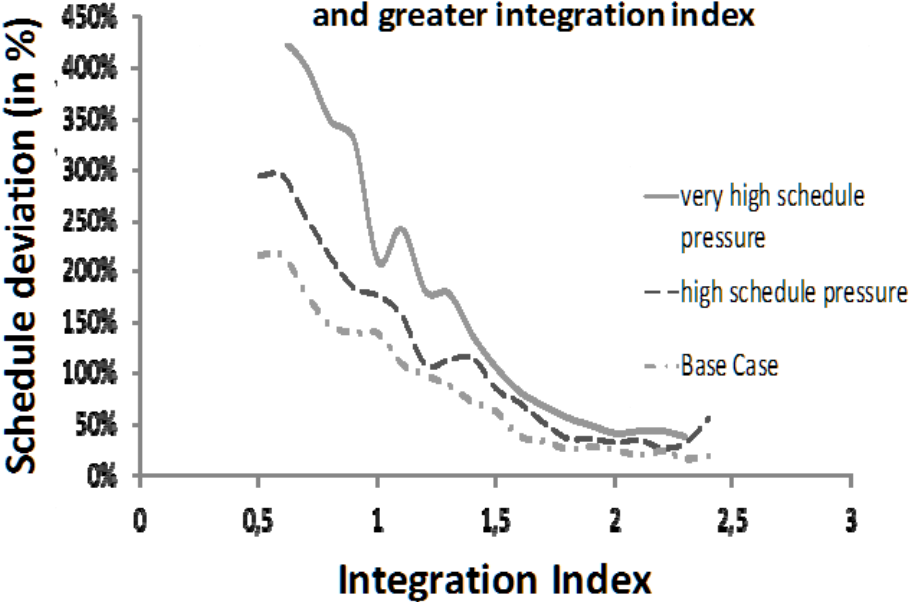Global survey, N=157

Performance is more predictable with greater integration

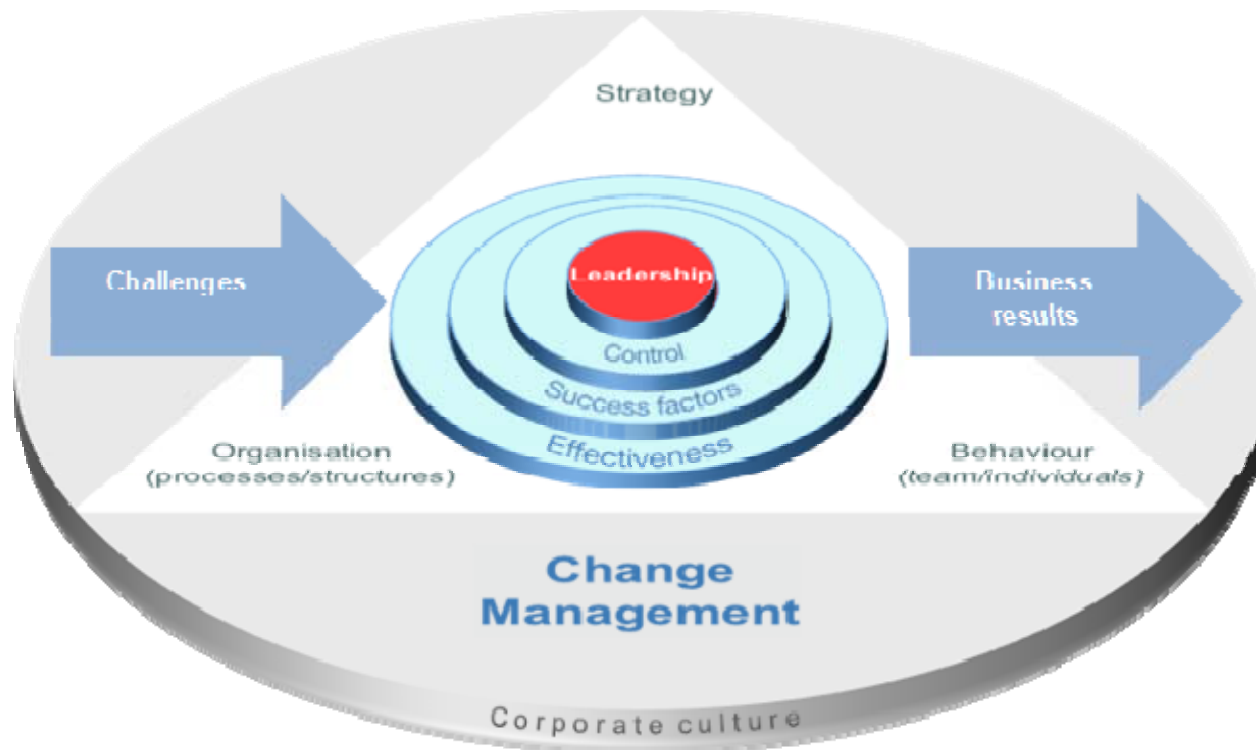Correlation between schedule deviation and greater integration index
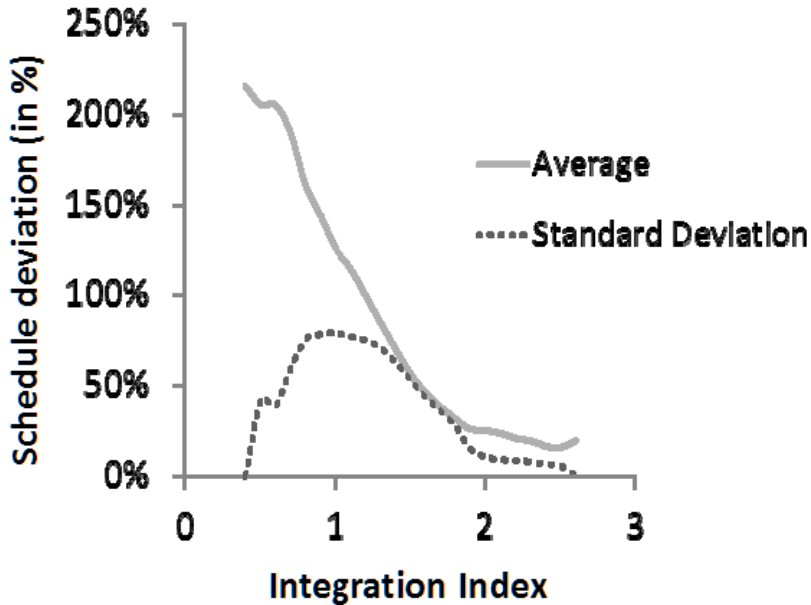
Correlation between schedule pressure and greater integration index

Source: Beceril, 2015

From principles to practice (the hard part…)

Source: BMW

Thank You!

Questions?

Source: ncchild.org