

# Introducing SE Principles to the Commercial Product Development Cycle

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**Randall C. Iliff – Vice President, InSight Services**

[riliff@bjorksten.com](mailto:riliff@bjorksten.com)

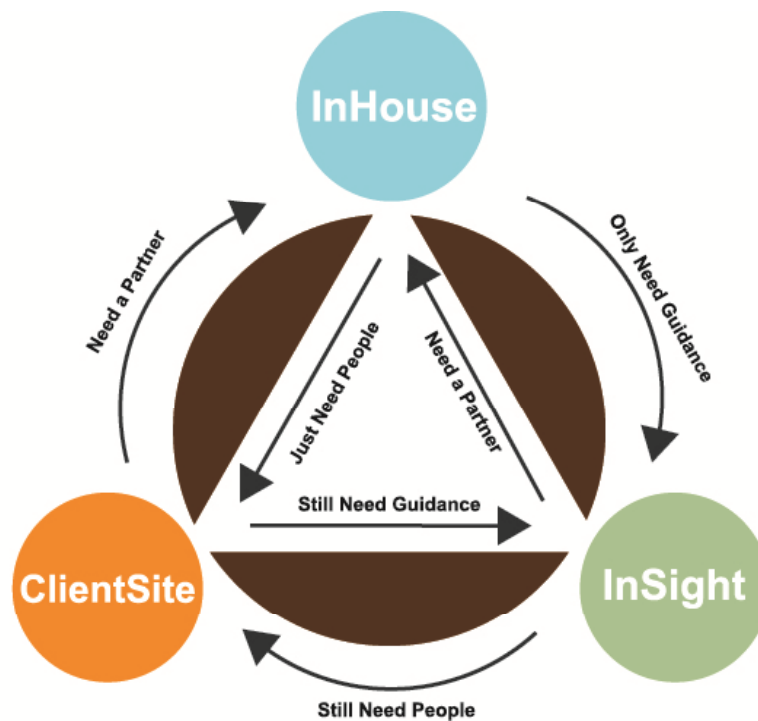
## About Bjorksten | bit 7

*We create unique opportunity through simultaneous excellence in Brand, Technology and Product areas.*

- 65 year history
- 200+ projects / year
- Everything from FMCG to highly complex systems
- 80% make it to market
- 94% client retention



# We Consist of Three Major Business Units



InHouse = *Resources*

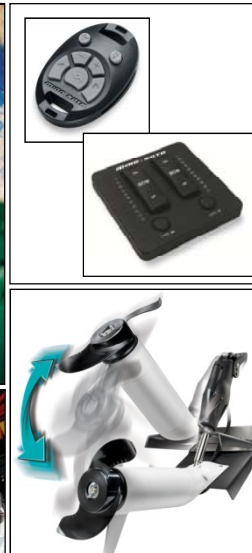
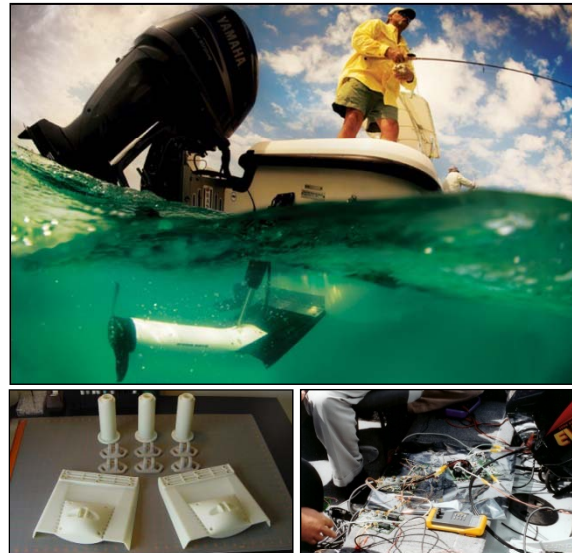
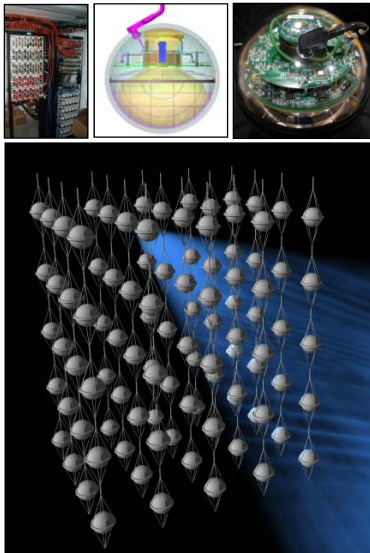
ClientSite = *People*

InSight = *Knowledge*

Together, this combination allows us to quickly respond to virtually any product development need that our clients may encounter.

# How We Use SE on Commercial Projects

- As an overall design management process
- A rich toolbox of individual methods
- A remarkably effective “innovation engine”



# Presentation Outline

- I. Introduction
- II. SE Potential
- III. Implementation Challenges
- IV. Recommendations
- V. Conclusion

# I. Introduction

*“Systems Engineering originated in aerospace, but will likely fulfill its true potential only when routinely applied in the commercial product sector.”*

# The Commercial Market is Tough!

- Customer expectations are constantly increasing
- Traditional competitors are slowly getting smarter
- Strong new competitors are emerging worldwide
- Hard to design truly dominant products
- Hard to make money even when you do
- Hard to repeat successes
  
- *Repeating failures is deadly*

## Does This Sound Familiar?

- You can be confident of success when:
  - It's a lot like something you've designed before,
  - you put your best people on the project,
  - they work night and day to solve problems,
  - you “own” the customer and marketplace,
  - nobody changes anything,
  - and you don't get surprised during testing
- The rest of the time it's a challenge!

## A Good Idea vs. a Good Product

- *Good ideas* are easy, but usually worthless
- It takes a lot of hard work to turn even great ideas into decent *products*
  - Satisfy conflicting needs
  - As part of an overall business strategy
  - Throughout the entire market life cycle
  - In an efficient and reliable manner
  - Leaving no major competitive weakness
- The simultaneous nature of these goals precludes strategies that are limited to sequential development

## II. Potential

*“Systems Engineering offers tremendous technical, economic and cultural potential when properly applied in the commercial product sector.”*

# Widely Varying Commercial Involvement

- Access to Basic SE Insight
  - Can only alert others to risk or opportunity
  - Frustratingly small contribution to project
- SE Within a Traditional Product Development Team
  - Offers broader requirements / alternatives insight
  - Valuable, but severely limited by non-SE project plan
- SE as the Model for Product Development
  - Full access to SE discipline and benefits
  - More efficient utilization of non-SE team members
  - Contribution limited only by skills and resources

# Recognize the Potential

- SE is capable of delivering true “Innovation on Demand”
  - Dominant products and defensible market share
  - First to lock up IP
  - First to reach market
- The transition is long overdue, and will do for Design what statistical process control did for Manufacturing
- Early adopters always hold the advantage
  - Time to refine and improve processes
  - Time to train and develop staff
  - Competitive head-start

## III. Challenges

*“While the potential is immense, so are the transition challenges involved.*

*If these challenges were merely difficult, SE would already be in common use worldwide.”*

## Respect the Challenge

- Discontinuity from past methods and practices
- Status quo acceptable to many
- Limited examples to demonstrate value
- At odds with manufacturing based culture
- Conflicting incentives and rewards
- Time lag between investment and return
- Political risk for many- even when SE works well

# Discontinuity

- SE is a fundamental change- not just the next tool or management fad
- Marks historical transition from ad hoc to predictable design processes
  - Replaces guesswork with engineering
  - Can be planned, monitored, and refined
  - Raises the “bar” for all non-manufacturing effort
- But less “fun” than semi-formalized design methods
  - Requires discipline and hard work
  - Rewards different skills and personalities

## Status Quo Acceptable to Many

- Low expectations = No urgency for change
- When need for change *is* recognized, tendency to build on previous informal methods
- Better alternative is to take powerful proven methods and use a tailored subset

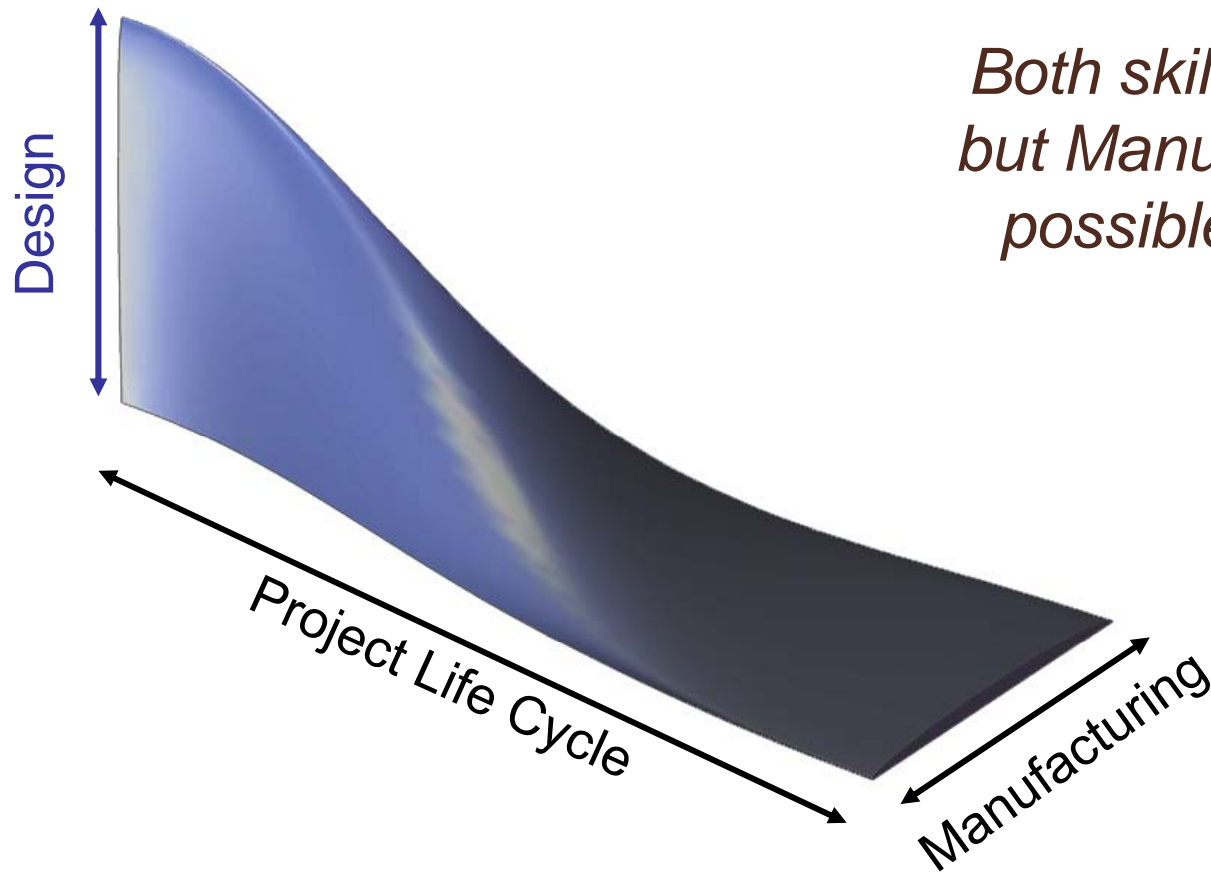
## Limited Examples to Demonstrate SE Value

- Aerospace not a credible comparison
  - Felt needed only in more complex situations
  - Challenged as “cost-plus” overhead
  - Not all that well understood even in aerospace
- Medical products
  - Treated as an unavoidable FDA requirement
  - Documentation and reviews considered “additional work”
- SE confused with bits and pieces under varying names
  - DFSS, TQM, TRIZ, Design Pillars, Score Cards, Ideation
  - Feels like more are being added every month

## At Odds with Manufacturing Culture

- Manufacturing strives to *eliminate* variance
  - 100% defined at the start
  - Variance equal cost and quality issues
- SE strives to *create and apply* variance
  - 0% defined at the start
  - Variance equals improvement over past solutions
- Beware of “anti-creativity” initiatives
  - Fixed processes, templates, checklists, metrics
  - Pretty much anything sold as “Lean”

# From Design to Manufacturing



*Both skills are essential,  
but Manufacturing is only  
possible when Design  
ends.*

# Don't Blame Manufacturing

- The methods are fine, the problem is that they are being applied out of context
- Success depends upon artificial conditions found only within Manufacturing
  - Stable, comprehensively defined objective
  - Suppression of external variables
  - Repetition and successive refinement
- The universal skill of Design can be constrained to fit Manufacturing
- ...but the special case of Manufacturing lacks attributes essential to Design!

# Conflicting Incentives and Rewards

- Minimum cost
  - Value results only from products shipped
  - Everything else viewed as *cost* of goods sold
  - Barrier driven - stay below cost targets
- Maximum return
  - Value results from net revenue at end of product life cycle
  - Everything else is an *investment* to be optimized
  - Threshold driven - must pass minimum attractive rate of return

## Disconnect Between Investment and Return

- Future accounting period return creates problems for most corporate accounting systems
  - Adds cost to current period
  - No proof of future benefit
- Even worse if one group pays and others benefit
  - Creates penalty for paying group
  - Breaks the return on investment connection
- Creates enormous opportunity for privately held companies to lead / profit from commercial SE

# Political Risk

- Risk exists regardless of outcome
- If SE *doesn't* live up to expectations
  - Risk for advocates and practitioners of SE
  - Risk for everyone that depends on the market results
- Even if SE *does* work well
  - Risk for everyone vested in prior practices
  - Risk for leaders who failed to implement SE sooner

## IV. Recommendations

*“Just as process tailoring is essential to SE conduct, the strategy of SE introduction must also respond to conditions that exist in the organization and marketplace.”*

## Strategies for Initial Roll-out

- Reduce SE to the Fundamentals
- Minimize or Defer SE Tool Investments
- Seek Strategic Project Situation
- Create Realistic Expectations

## Reduce SE to the Fundamentals

- Comprehensive Requirements
- Traceability / Validation / Verification
- Rigorous Interface Control
- Functional Analysis
- Trade Studies and Decision Support Aids

# Comprehensive Requirements

- Strive to expose the true task complexity
- Breadth first
  - All stakeholders / market success drivers identified
  - Considered over full project life cycle
- Depth second
  - Critical design drivers / performance thresholds
  - Direction that represents improvement / benefit
  - Dependencies, trade-offs, and interactions
- Requirements Maturity is a powerful concept

## Traceability / Validation / Verification

- Know where all requirements come from
- Know how they flow down to any part or subsystem
- Have a basis for determining if they are correct
- Have a basis for determining when they are met
- All of this must be a continuous process, not just a front-end activity

## Rigorous Interface Control

- Seek the fewest, simplest, interfaces the nature of the task will allow
  - Interface control is additional work
  - But makes division of labor on large tasks possible
  - Modularity of tasks also minimizes risk spread
- Make sure all interface types get proper resource priority
  - Physical subsystems
  - Software routines
  - Business processes
  - Product roadmaps
  - Market and technology trends

# Functional Analysis

- “*What*” is more important than “*How*”
- Functions have unique value
  - Basis for strong IP and patent rights
  - Stable over long time periods
- Creates a “one to many” logic bridge:
  - Internal to project as a creative tool
  - External to project as competitive assessment tool
  - External to market for additional opportunity identification
- Establish functions first, *only then* shop for ways those functions can be performed

## Trade Studies and Decision Support Aids

- The goal is to make better decisions, not fancier charts
- Favor tools that help quickly organize available data
  - Highlight, not hide, missing / incomplete data
  - Readily confirm that no key aspects overlooked
  - Provide confidence in underlying logical approach
  - Are easy to present and defend
- Resist the temptation to reduce insight to numeric scores
  - Non-reversible compression takes place
  - Scores hide useful memory of uncertainty and range of views

## Minimize or Defer SE Tool Investments

- SE Tools are great, but take time and money to implement
  - Up-front cost makes easy target for opponents
  - Significant distraction from basic SE objectives
- MS Office adequate for most SE tasks, easier to communicate results to non-SE project participants
- Once SE value is demonstrated, *then* a strong case can be made for improved efficiency

## Seek Strategic Project Situations

- Fight the urge to start small
  - Limited return if successful, but still high risk if not
  - Temptation to cut corners and invalidate SE potential
- Strategic projects often granted immunity from past processes
- You need lead time to plan, execute, and report results
- You want a compelling case for future SE application
- Strong management champion is more likely to exist

# Create Realistic Expectations

- SE projects will look *different*
- At the start
  - More time on planning and set up
  - Significant up-front resource loading
  - No “visible progress” by traditional measures
- At the end
  - Far better match to market and competitive needs
  - Fewer problems and headaches
  - Much greater return on investment

## V. Conclusion

*“All great changes are initially driven by faith, not proof, and commercial acceptance of disciplined SE methods for product design will inevitably test the professional determination and personal courage of INCOSE members!”*