Enterprise Design for Dynamic Complexity: Enterprise Product Strategy

Ted Piepenbrock
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Research Partnership Structure

Industry Sponsor

Intermediary Research Vehicles

Academic Partners

MIT Sloan School of Engineering

LAI LEAN AEROSPACE INITIATIVE

BOEING

MIT’s Research on Lean 3-Dimensional Concurrent Engineering
World Class Lean Enterprises

Manufacturing Example:

Service Example:

Market Capitalization 1998-2001

Market Capitalization 2002

Toyota

Chrysler Ford GM

American Delta All Others Southwest

GM

Toyota

Ford Chrysler
Corporate “Eating Disorders”
(data from The Machine That Changed the World)
“The World’s Worst Industry”

“There is no worse business of size that I can think of than the airline business. Since it began in 1903, the industry has had an overall net loss... If there was a capitalist on Kitty Hawk, he would have shot the plane down.”

Warren Buffet
“World’s Most Successful Investor”
“The World’s Worst Industry”

Total Airline Profits (1970-2002)

- $20 b
- $15 b
- $10 b
- $5 b
- $0 b
- $5 b
- $10 b
- $15 b
- $20 b


“Higher, Faster, Farther”
Network Carriers
Hub & Spoke Networks
Wide Body Planes

“Better, Faster, Cheaper”
Low-Fare Carriers
Point-to-Point Networks
Narrow Body Planes

American
Delta
Southwest
All Others

Market Capitalization 2002
Commercial Aircraft

% Market Share in Commercial Airplane Deliveries

100%

50%


Time


US

EU

B.F.C. Enterprise

H.F.F. Corporation

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Agenda

- Product Development & the “Lean Heavyweights”
- Enterprise Design for *Dynamic Complexity*
- Technology & Industry Roadmapping
- “Lean” Revisited
Product Development & the “Lean Heavyweights”
Aerospace Industrial Evolution

Higher, Faster, Farther
(Integral Product & Supply Chain Architecture)

Better, Faster, Cheaper
(Modular Product & Supply Chain Architecture)

Product Innovation

Process Innovation

Boeing

Airbus

Number of Firms

Time

Fluid Phase (1900-1950)

Transitional Phase (1950-1980)

Specific Phase (1980-2020)
Organizational Re-Architecture

Product Innovation
Process Innovation

Domiant Design

Number of Firms

Time

Fluid Phase (1900-1950)
Transitional Phase (1950-1980)
Specific Phase (1980-2020)

Marketing
Define (Engineering)
Produce (Manufacturing & Supplier Mgmt.)

Better, Faster, Cheaper Products
Horizontal Customer Focus

Programs
Customers

Higher, Faster, Farther
Vertical Functional Focus

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The “\textit{Lean Heavyweight}”

Higher, Faster, Farther

- Marketing
- Product Development
- Manufacturing

\textbf{Lightweight Project Manager}

Better, Faster, Cheaper

- Customer Demands
  \hspace{1cm}
  \textbf{Marketing}
  \hspace{1cm}
  \textbf{Product Development}
  \hspace{1cm}
  \textbf{Manufacturing}
  \hspace{1cm}
  \textbf{Customer Deliveries}

\textbf{Heavyweight Project Manager (\textquotedblleft Shusa	extquotedblright)}

\textbf{External Integration (Strong Concept Champion)}

\textbf{Internal Integration (Strong Project Coordinator)}
Enterprise Development is Large-Scale Product Development

The family is a happy, efficient unit. Be sure your family, for instance. The high operational efficiency of the Airbus aircraft allows pilots to prepare quickly and safely for their next flight. More time saving for all. Airbus is setting the standards. For more information about the Airbus family, visit our website at http://www.airbususa.com.
Mastery of Dynamic Complexity

- Tame Problems
  - Product Design
  - Platform Design
- Negotiated Problems
- Messy Problems
  - Corporation Design
- Wicked Problems
  - Enterprise Design
Enterprise *Dynamics*
Airline Profitability Dynamics

Deregulation

Airline Profitability

Year

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Airline Profitability Dynamics

Total Airline Profits (1970-2002)

- $20 b
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- $10 b
- $5 b
- $0 b
- -$5 b
- -$10 b
- -$15 b
- -$20 b

10-year Period of Oscillation (like Juglar waves of machine-investment cycles)

- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015

- A380 Delivery
- 7E7 Delivery
- Begin Placing New Orders
- Stop Placing New Orders

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Closing the Business Case

NPV

$11.6 billion

> 15 years

Year

$ million

Base Case

Best Case Scenario

Worst Case Scenario
Lean Segmentation of Market
(Notional)

Total Airline Profits

- $20 b
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- $0 b
- $5 b
- $10 b
- $15 b
- $20 b


“Better, Faster, Cheaper”
Low-Fare Carriers
Point-to-Point Networks
Narrow Body Planes

“Higher, Faster, Farther”
Network Carriers
Hub & Spoke Networks
Wide Body Planes

Network Strategy:
10 year, $10 b batched launches

Low Fare Strategy:
3 year, $3 b continuous flow launches

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Enterprise Complexity
Commercial Airplane Enterprise

$200 billion in Sales
(spread over 20 years)

Reliable Transport Network
(STRATEGIC ECONOMIC ENGINE)

Airlines
(e.g. JAL & ANA)

Government
(e.g. Japanese)

$10 billion in N.R. Costs
(investment risk)

$200 billion in Sales
(spread over 20 years)

Boeing

Suppliers
(e.g. Mitsubishi,
Kawasaki, Fuji)

Transportation Network

$10 billion in N.R. Costs
(investment risk)

Risk-Sharing
Skilled Work Placement

Sales Revenues

Tax Breaks, Bailouts

NPV

$10 billion in N.R. Costs
(investment risk)

Taxes, Votes

Offset Agreements

Components & Sub-Assemblies

Government
(e.g. Japanese)

$10 billion in N.R. Costs
(investment risk)

Reliable Transport Network
(STRATEGIC ECONOMIC ENGINE)

Airlines
(e.g. JAL & ANA)

Government
(e.g. Japanese)

$200 billion in Sales
(spread over 20 years)
Enterprise Boundaries

World-Class Aerospace Company

BCA

Gov’t
Unions
Suppliers

Airbus

Gov’t
Unions
Suppliers

World-Class Aerospace Enterprise
Strategic Architecture

The Realm of “Public Goods” and “Protected Commodities”

Government / Regulatory Policy Dynamics

Business Cycle Dynamics

Industry Structure Dynamics

Corporate Strategy Dynamics

Product/Technology Dynamics

Airbus

The Realm of “Private Goods” and “Differentiated Products”

Boeing
Technology & Industry Roadmapping
Industrial Dynamics

- Government / Regulatory Policy Dynamics
- Business Cycle Dynamics
- Industry Structure Dynamics
- Corporate Strategy Dynamics
- Product / Technology Dynamics
Disruptive & Sustaining Technologies

Performance Trajectory of Sustaining Technologies:
- **Over-served** Middle of the Market
- **Under-served** Middle of the Market

Performance Trajectory of Disruptive Technologies:
- Performance Trajectory that Customers Demand or can Absorb

Upper End of the Market (Demanding, Profitable Customers)
- Companies with integral architectures beat competitors with Functionality

Middle of the Market (Today’s Customers)
- Companies with modular architectures beat competitors with Speed & Customization

Lower End of the Market (Undemanding, Unprofitable Customers)
- Performance Trajectory that Customers Demand or can Absorb
Products for “Unprofitable” Customers

Targeting “Profitable” Customers

Concorde

Targeting “Unprofitable” Customers

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The Disruptor and the Disrupted
The Evolution of Disruption

- 500 seat **Wide Body** Commercial Jet
- 100 seat **Narrow Body** Commercial Jet
- 50 seat Regional Jet
- 5 seat **Eclipse** Air Taxi
- 1 seat **Aeromobile**
The Evolution of Disruption

- Both are normalized to 1.0
- Air Travel Growth
  - 1.5
- Fractional Aircraft Ownership
  - 37
Lean Revisited
Capturing Value

Traditional “Mass” Enterprise:

- In a rapidly growing homogenous market, with large customer in-flows...
- Construct a large, expensive, inflexible monument to capture value, but...
- Poor integration creates holes through which value leaks out (waste!)

Integrated “Lean” Enterprise:

- In mature/saturated markets, with reduced/variable customer in-flows...
- Construct a right-sized, integrated, flexible enterprise to capture value so that...
- Waste is eliminated and flexibility is maximized.
Architecture of a Lean Enterprise

1. Remove **Waste** (Muda)

2. Make Enterprise **Flexible** (Muri)

3. Control **Variability** of Input (Mura)

Is there something you don’t know about your enterprise?