Front End of Innovation: Effective Methods, Tools and Techniques Workshop

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An An & Co-Sponsored Best Practice Event
Agenda

- What is the Front End?
  - What’s wrong?
- NCD Model Creation
- NCD Model
  - What it is?
- Most Effective Practices
  - Most important part of Front End – macro perspective
  - Elements of Best Projects
- Disruptive Business Models
- Kitty-Hawk Business Case
What is the “Front End of Innovation?”

“Front End of Innovation” is defined by:

- Activities that come before the “formal and well structured” New Product Development (NPD) Portion

FEI activities are less structured and less predictable

New Product Development Portion

New product development portion includes BOTH new product and process

Structured with a formalized and prescribed set of activities and questions

Commercialization

We prefer NOT use the term “Fuzzy Front End” since it implies that the FEI is mysterious, uncontrollable and cannot be managed.
What is the “Front End of Innovation?”

Highly Innovative and Profitable Platform Strategies Leveraging Core Competencies/Capabilities

Platform Strategies Leveraging Existing Customer Value Chain

Size of Bubble is related to Profit Potential

New Product Development Stage

Commercialization

Traditional Stage Gate

Idea Selection Process for Incremental Products
Breakthrough

**Definition**

Breakthrough products* (i.e. new to the company or new the world) offer a 5-10 times or greater improvement in performance combined with a 30-50% or greater reduction in costs

**Platform**

**Definition**

Platform products* establish a basic architecture for a next generation product or process and are substantially larger in scope and resources than incremental projects.

- New Platform: Kodak’s development of disposable single use 35 mm camera
- Incremental Extension: Addition of flash
- Incremental Extension: Underwater version

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## Why Focus on the Front End?

### Differences

<table>
<thead>
<tr>
<th></th>
<th>Front End Innovation</th>
<th>New Product Development Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work</strong></td>
<td>Experimental, often chaotic. “Eureka” moments. Can schedule work - but not invention</td>
<td>Disciplined and goal oriented with a project plan</td>
</tr>
<tr>
<td><strong>Commercialization Date</strong></td>
<td>Unpredictable</td>
<td>High degree of certainty</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
<td>Depends. In the beginning stages many projects may be “bootlegged”</td>
<td>Budgeted</td>
</tr>
<tr>
<td><strong>Revenue Expectation</strong></td>
<td>Often uncertain with a great deal of speculation</td>
<td>Believable with increasing certainty as the release date gets closer</td>
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<tr>
<td><strong>Activity</strong></td>
<td>Individual or team emphasis in areas to minimize risk</td>
<td>Multi-function product/process development team</td>
</tr>
<tr>
<td><strong>Measure of Progress</strong></td>
<td>Strengthened Concept</td>
<td>Milestone Achievement</td>
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What's Wrong?

Perhaps the front end is the greatest weakness of the innovation process

- **Lack of understanding where high profitable ideas come from**
  - Many anecdotal stories, but few factual case studies
  - Often perceived as coming from one brilliant individual working in an environment free of anxiety

- **Lack of High Profitable Ideas**
  - Need to “feed” the Stage Gate process faster with higher profitable products (Stage Gate has become more efficient)

- **Front End Perceived as Mysterious**
  - No accountability
  - Who is responsible?
  - Know Best Practices only at the end of the front end
**What's Wrong?**

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Why develop a model?

- Will allow for a common set of definitions
  - No common language or definition of the key processes of the front end

“Can’t tame what you can’t name”
Why develop a model?

Secure the building

Attributed to James Schlesinger
Why develop a model?

Secure the building

Marines will form a landing party and assault the building
Why develop a model?

Secure the building

The Army will occupy the building with a troop of infantry
Why develop a model?

Secure the building

The Navy will respond by sending out a yeoman to assure that the building lights are turned off
Why develop a model?

Secure the building

Air Force will develop a contract for a 3 year lease with an option to purchase
Model Creation

Problem Identification → Creation → Improvement
Problem Identification

**Initial Objective: To determine Best Practices in the FEI**
- Presentations by Air Products, Akzo Nobel, BOC, DuPont, Exxon, Henkel, Mobil and Unroyal Chemical

**Tower of Babel**
- No common language or definition of key elements

**Objective of Determining Best Practices Proved Impossible to Accomplish**
Creation

Common Elements

Model Creation

- Many different models proposed

  - Struggle was in letting go of the traditional sequential model

  Moved from a sequential process

  To

  Non-sequential relationship model
Agenda

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  ✔ What’s wrong?
✔ NCD Model Creation
  ▪ NCD Model
    ▪ What it is?
  ▪ Most Effective Practices
    ▪ Most important part of Front End – macro perspective
    ▪ Elements of Best Projects
  ▪ Disruptive Business Models
  ▪ Kitty-Hawk Business Case
New Concept Development Model (NCD)

Provides a common language and terminology necessary to optimize the “Front End of Innovation”


Influencing Factors

- Environmental milieu that consists of things that are relatively **uncontrollable**:
  - Competitive Environment
  - Enabling Sciences
    - Current technology “state-of-the-art”
    - Scientific breakthroughs which occur external to your company
  - Organizational capability
    - Capturing both organizational rigidity (i.e. core rigidity) vs. ability to change (i.e. agility)
  - Outside World
    - Porter Model: Customers, Competitors, New Entrants, Substitutes, Suppliers, Complimentary* and Distribution Chain
    - Society, economics and government regulations
- **Robust NCD can only exist in a healthy environment**
- Controllability of influencing factors depend on the companies agility, assets, ability to execute and modify constraints
Engine

Provides both financial and executive power. Things that are relatively **controllable**

- Leadership, Culture and Business Strategy
  - Role of senior executive
  - Influence of both perceived and real culture on the process
  - Degree of involvement
  - Business Strategy
    - NCD needs to be aligned with the Business Strategy
Examples

**Market Driven**
Non-fat potato chips using a Fat-Substitute Molecule

**Technology Driven**
3M Notepads
Opportunity Identification

Opportunity: A business or technical need that the company or individual realizes by design or default they might want to pursue to capture competitive advantage, respond to a threat or solve a problem.

- Activities and methods that a company uses to identify opportunities to pursue
- Can be a breakthrough opportunity, a problem or a customer need
- Will lead to a new offering, new process, new service, new product platform, new market thrust or new product
- Facilitated or unfacilitated pathways

Food company identifies the need to develop low fat products due to rising consumer trends and/or competitive threats.

Spence Silver creates an oddball glue that is more tacky than adhesive and needs to determine how 3M may utilize.
Opportunity Analysis

- Assessing the opportunity to confirm that it is worth pursing
- Understanding unmet customer needs
- Competitive intelligence and trend analysis would be used extensively
- Business capability and competency would be assessed
- Business and scientific sponsorship would be evaluated
- Despite effort, significant technology and market uncertainty will often remain
Opportunity Analysis

Food Company evaluates market trends in more detail:
- Does the consumer really want low fat?
- How much is the consumer willing to give up on taste?
- Is this a niche or a large market?
- What are the regulatory issues?
- What is the competition doing?
- What products should be low fat? (Potato chips? Cookies? Beer?)
- What is the enabling science? (Is there any?)
- Company decides that initial product offering will be low-fat or not-fat potato chips.

Silver, from 3M, attempts to find an idea for his "not too sticky adhesive."
- Silver visits every division at 3M looking for an application for his technology
Idea Generation and Enrichment

Idea: Most embryonic form of a new product, service or envisioned solution

- Birth, development and maturation of the opportunity into new ideas.
- Translates the opportunity into specific ideas.
- An evolutionary process where ideas are built upon, torn down, combined, reshaped, modified and upgraded.
- May be formal (i.e. idea banks, brainstorming, etc.) or informal (i.e. an experiment goes awry, unusual request from customer, etc.)

Several methods are identified for delivering nonfat potato chips. (Ex: Candidate molecules are envisioned which provide the same flavor, but would not be absorbed by the body. Alternate ingredients may be proposed to give the same taste, but which would contain no fat.)

3M decides on two possible ideas: the sticky bulletin board and note pads.
Idea Selection

- Selection of ideas for allocation of resources
- Selection by individual from self-generated options or a formalized portfolio methodology

Several of the ideas are chosen for continued development.

3M selects the note pad opportunity for continued development.
Concept Definition

- Development of a Business Case
- Assessment of technology and market risks.
- Determination of detailed product specifications. (May only apply to incremental products).

Scientific program would be started and funded to develop specific types of nonfat molecules as determined from the idea selection element.

3M develops business plan for note pads and entirely new manufacturing processes to attach a "non-sticking" adhesive to paper.
Concept Selection and Technology Stage Gate

- Selection of concepts for allocation of resources typically by a formalized portfolio methodology

Technology Stage Gate
- Utilized for managing technical uncertainty
- Depending on company methodology and the level of technical complexity, Technology Stage Gate may be entirely within the NCD, overlapping the NPD, or the link between the two.

Scientific program would be started in Technology Stage Gate and overall and funded to develop specific types of nonfat molecules as determined from the idea selection element.

3M develops business plan for note pads and concept is evaluated in a portfolio with respect to overall value and risk with respect to other projects.
What elements of the NCD Model are highly innovative (i.e. lots of new products every year) companies very proficient in?
Agenda

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✓ NCD Model Creation
✓ NCD Model
  ✓ What it is?

♦ Most Effective Practices
  ♦ Most important part of Front End – macro perspective
  ♦ Elements of Best Projects

♦ Disruptive Business Models
♦ Kitty-Hawk Business Case
Best Practices

Companies Participating

Number of Companies

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Companies</th>
</tr>
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<tbody>
<tr>
<td>High</td>
<td>(Large number of really new products introduced each year)</td>
<td>15</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Low</td>
<td>(Few if any new products introduced each year)</td>
<td>5</td>
</tr>
</tbody>
</table>
Best Practices

Proficiency of NPD vs. FEI

Proficiency Level

NPD Stage

FEI

High Innovation
Med Innovation
Low Innovation

Significance between medium or low innovation companies when compared to high innovation companies (*p<0.05, **p<0.01, ***p<0.005)
**Best Practices**

Significance between medium or low innovation companies when compared to high innovation companies (*p<0.05, **p<0.01, ***p<0.005)
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Elements of Effective Projects

- Early senior management involvement and commitment

Front End Maturity Model
Adopted from PRTM’s model for the entire innovation process

The prime imperative for breakthrough projects in the Front End is NOT picking the winners, but killing the losers early.
World Class Innovation

Breakthrough Maturity Model

**Project Excellence**
Full time attack teams develop actionable plans

**Execution Excellence**
Proficient and quality execution of plan. Team members held accountable and deliver on promises

**Decision Excellence**
Senior management makes timely go/kill decisions which maximizes the options and creates a learning environment for breakthroughs

**Portfolio Excellence**
Breakthrough projects are aligned, selected, killed and balanced with the overall vision and innovation strategy of the division

**Cross-Enterprise Excellence**
Overarching breakthrough vision with projects linked throughout the corporation to achieve maximum leverage of competencies and channels
The prime imperative for breakthrough projects in the Front End is NOT picking the winners, but killing the losers early.

Elements of Effective Projects

- Early involvement of business executive champion
- Collaborative culture which encourages knowledge creation
  - Communities of Practice
  - IT Tools which enable people-to-people contacts
  - Collaborative Work Space
- Constancy of purpose
- Aggressive Goals
Definitions

- **Data**
  - Collection of Facts

- **Information**
  - Collection of organized data
  - May inspire vision, but can’t bring the vision into reality

- **Knowledge**
  - Information combined experience, context and reflections that may be used to make decisions and take actions
  - Is a human act (i.e. a residue of thinking)
  - Created in the present
  - Belongs and circulates between people
  - Breakthrough knowledge occurs at the boundaries of the old
Explicit Knowledge

- Can be put on paper, formulated in sentences and captured in drawings

Explicit knowledge may be transferred through language (word, graphics, etc.)
Tacit Knowledge

- Individual perception, rules of thumb, intuition
  - Examples
    - Learning to ride a bike
    - Putting together a high precision watch
    - Making sense of a seismic readout for identifying a new oil field

Language is NOT the primary mechanism for sharing of Tacit knowledge
Trigger

- Projects typically get started with a trigger (High innovative rents?)
  - New Competitor Movement
  - Fire in Plant
  - CEO initiatives (ex: innovation initiative, fire in plant, lower revenue, holy grails, strategic intent, proposal requests)

- Issue:
  - How to create more opportunities for triggers
Champions

Both Product and Executive Champions are needed

- Product champions are need to move products across valley of death if adequate bootlegged funds are available
- Product champions often champion the wrong project
- Business executive champion needed for almost all projects

Elements of Effective Projects

- Projects get started based on:
  - Customer Trend Analysis (Clear Opportunity)
  - Technology Trend Analysis
  - Technology Road Mapping
  - Competitive Intelligence Analysis
  - Scenario Planning

- These efforts create many triggers
- Need to envision the future
Elements of Effective Projects

- Same tools as in Opportunity Identification, BUT effort is expanded in considerable more detail
- Assignment of 3-5 “full time” multi-function “discovery” team for large breakthrough products
  - “Market Attack Teams”
  - “Technology Attack Teams”
Market Attack Team

A process for rapidly developing actionable plans for large market opportunities

Effort ideally includes 3 - 5 full time people

Preparing to Dive
1st Deep Dive
2nd Deep Dive
Race to the Finish

Phase 1 (Charter)
Phase 2 (Market and Technology Analysis)
Phase 3 (Business Concept Generation)
Phase 4 (Business Case Generation)

3 months
Experts Meeting
Challenge Workshop
TR1 Business Plan

Project Scope
Select broad concepts to focus on
Select best concepts

TR1 business plan
Market Attack Team

Phase 1
(Charter)

- Project Scope

Phase 2
(Market and Technology Analysis)
- Segmentation
- Unmet Customer Needs
- Technology Approaches and Gaps
- Understanding of infringement and freedom to practice
- Generate “rough” business concepts and “win” statement
- Technical Experts meeting?

Phase 3
(Business Concept Generation)
- Clear understanding of unmet customer needs
- Understanding of technology approaches and hurdles
- Continue interview of top experts
- Generate 2-3 business concepts

Phase 4
(Business Case Generation)
- Develop business case
- Challenge concepts in 2 - day work shop

Effort ideally includes 3 - 5 full time people

TR₂

TR₁
Business Plan
Market Attack Team

Why Full Time?

- Average
- Value-Added
- Time on
- Engineering
- Tasks

Source: IBM Development Efficiency Study
Individual creativity occurs when:
- People are on a mission
- Can FOCUS on one activity for a significant part of their day
- Are challenged and involved in their work

Individual creativity does NOT occur when:
- People feel they are on a treadmill
- Experience a highly fragmented day
- Have more group discussions rather than individual meetings
- Have lots of last minute changes in their plans and schedules
- After effects continue onto the 2nd and 3rd day
The Right Mix

Implementer
“Getting things done”

Generator
“Getting things started”

Optimizer
“Turning abstract ideas into practical solutions and plans”

Conceptualize
“Putting ideas together”
The right mix

An example

Creative Problem Solving Profiles
Warwick Manufacturing Group

Implementing

Generating

Conceptualizing

Optimizing
Why Market Attack Team?

Market Attack Team enables World Class Innovation - Wisdom of the “Sages”

- Business-Technology Interspersing
- Based on Market and Technology Trend Analysis
  - Where the future opportunities come from
- Science Based Core Competencies
- Aggressive Goals
- (External) Scientific Peer Review
- Focusing (in contrast to spreading too thin)
  - Constancy of Purpose
- Process Optimization which include:
  - Management Oversight, fact based fast kills and metrics
- Very early prototyping and field trials
- Full time project team populated with inventors with demonstrated track record
Elements of Effective Projects

- Customer
  - Ethnography approaches
  - Lead User Methodology
  - Early involvement of customer champion
  - Discovering the Archetype of your customer

- Business-Technology Interspersing

- Technology
  - Increasing linkages both internal and external (Technology Flow)
  - Partnering

- Web enabled idea bank
- Diversity of cognitive styles on idea enrichment team
- Incentives to stimulate ideas
Customer Knowledge Flow

- Lead User Methodology
- Ethnography Approaches
- Customer Archetypes

Identifying Customer Needs for Real Breakthroughs
Ethnography
Ethnography

Observing

Outside the Fish-Bowl

Story-Telling

Inside the Fish-Bowl
Ethnography

An Example

A new “hunting” boot
Lead User

Tool Box supplied by Company
Lead User

An Example

New methods for controlling sterility and developing new surgical drape products

Market Lead Users
- Surgeons in Malaysia

Analog Lead Users
- Veterinary Surgeon

Technology Lead Users
- Make-up Artist
Customer Archetypes

Dr. G. Coltaire Rapaille
President of Archetype Discoveries
(www.archetypediscoveriesworldwide.com)

“I’m told that this (i.e., PT Cruiser) is as hot a seller as we’ve had since 1984 when minivans came out” sales manager for Mullane Chrysler
Customer Archetypes*

Archetype research identifies the unstated reptilian hot button, the instinctive part of the brain.

*Archetype: An inherited idea or mode of thought that is derived from the experience of the race and is present in the unconscious of the individual.
Customer Archetypes

- Code for the PT-Cruiser Exterior
  - People wanted an SUV
  - They were saying “It’s a jungle out there. People want to kill you. It’s terrible. You don’t know who’s going to attack you. You need to be tough. I feel safe in a big thing.”
  - Same reptilian code for people who purchase four-wheel drive and big SUV’s like Expeditions and Excursions
Customer Archetypes

- Code for the PT-Cruiser Interior
  - People wanted plush interior
  - Inside people wanted the “Ritz Carlton”
    - People want soft and smooth and nice leather, wood and good style
Elements of Effective Projects

- Online Idea Management
- Event Approach
- Formal Idea Selection Process with Prompt Feedback
Elements of Effective Projects

- Quality Business Case
- Early Experimentation
  - Even before project is “completed”
  - Staff up high potential projects while still in Front End of Innovation
- Technology flow tools will speed development
- Partnering outside of areas of core competence
- Focusing (in contrast to spreading too thin)
- Alternative Approaches
Elements of Effective Projects

- Portfolio methodologies based on multiple factors of:
  - Technical Success Probability
  - Commercial Success Probability
  - Reward
  - Strategic Fit
  - Strategic Leverage
    - Using Anchored Scales
- NOT just financial justification
- Use of “Options Theory” to evaluate projects
- Screening methodologies are not used on “breakthrough” projects
  - “Holy Grail”
  - Obvious
- RIGOROUS use of the Technology Stage Gate for high risk projects
Early Experimentation

**Principles**
- Organize for Rapid Experimentation
- Fail Early and Often
  - But do design experiments
- Exploit early information
- Involve the customer

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Disruptive Business Models

What is a Disruptive Business?

Up-Market Migration of Steel Minimills

Disruptive Businesses over time will improve and attack the sustaining business.


Disruptive Business Models

What is a Disruptive Business?

Up-Market Migration of Angioplasty

Procedures (000s)

Bypass

Stents

Balloon Angioplasty
Disruptive Business Models

Sustaining Businesses ALWAYS reject Disruptive Business Models

Why sustaining businesses don’t compete with new business model

<table>
<thead>
<tr>
<th>Initial Customer</th>
<th>Non consumer</th>
<th>Low end low margin</th>
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<tbody>
<tr>
<td>Angioplasty vs. cardiac bypass</td>
<td>Mini-mills vs. Integrated Steel Mills</td>
<td>Discount Retailer vs. Full Scale Merchandiser</td>
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Market segment, from sustaining business, has too low a profit and sustaining business will gladly exit

Why sustaining businesses don’t compete with new business model

Niche is initially too small and takes focus away from mainstream customers

IMPLICATION: Disruptive Business Models need to be separated from sustaining businesses since the disruptive business model is FUNDAMENTALLY different in resource expectations, value and culture
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✓ **Disruptive Business Models**
  ■ **Kitty-Hawk Business Case**
HP Kitty Hawk Synopsis
HP Kitty Hawk Synopsis

- **HP Disk Drive Division**
  - Sustaining Products
    - 5.25 and 3.25 inch disk drives
    - Provided higher storage capacity for high end engineering work stations and network drivers
    - Provided HP with strong profit margin
    - Pioneered 1 and 2 gigabyte drive
HP Kitty Hawk Synopsis

Product Vision
- HP DMD wants to be a major player in the disk drive market
HP Kitty Hawk Synopsis

**Kitty Hawk Project**
- Creates heavyweight project team (Best and the brightest)
  - Co-locate the team in separate facility
- Separates team from the rest of the division
- Product vision: small, dumb and cheap
- Company places “big bet” and heavily resources Kitty Hawk
  - Divisions best engineers taken off of sustaining 5.25 in and 3.25 in projects to work on Kitty Hawk
HP Kitty Hawk Synopsis

Kitty Hawk Charter

- Introduce product in 12 months from start to finish
- Accomplish a break-even-time of less than 36 months
- Achieve a $100 million in revenue 2 years after launch
- To be the 1st to the market with a 1.4 inch drive
- Grow faster than the disk drive market and become a significant growth leader.
  - Revenue growth rate should remain at 35%
HP Kitty Hawk Synopsis

**Kitty Hawk Market**
- Low end game market (ex: Nintendo)
  - Need cheap storage
  - Nintendo during the Christmas season ships 1.5 million/day
- Mobile computing (ex: PDA)
HP Kitty Hawk Synopsis

- **Kitty Hawk Performance**
  - Be able to work after a 3 foot drop
  - Have a storage capacity of 20 MB

- **Manufacturing Capabilities**
  - Outsourced manufacturing to Citizen Watch company and built a capacity of 150,000 units/month

- **OEM Pricing**
  - $250.
HP Kitty Hawk Synopsis

**Outcome**

- Mobile computing
  - Sold 100,000 units instead of plan 700,000
- Could not enter the game market due to the high cost
- Closed Kitty-Hawk in 1994; product removed from the market
- DMD revenue flattened since it lost performance edge at 4 Gigabytes
Conclusions

- Front End of Innovation can be studied, evaluated and managed - BUT only if there exists a common language

- NCD Model Created
  - Engine
  - Five Front End Elements
  - Influencing Factors

- Greatest Weakness of innovation process is Front End of Innovation - NOT NPD

- Greatest weakness of FEI
  - Engine
  - Opportunity Identification
  - Technology Stage Gate
Conclusions

- **“Effective” Practices for FEI are being better understood**
  - Triggers
  - Champions
  - Technology and Market Trend Analysis
  - Providing a collaborative environment for enhancing Knowledge Creation
  - Really understanding unmet customer needs
  - Managing high risk projects

- **Disruptive Businesses**
  - Sustaining Businesses need to embrace the disruptive Business Model
My Touchstones

- **Front End of Innovation**
  - Is NOT “Fuzzy”
  - Should be thought of in a holistic manner
  - Different for incremental, platform and breakthrough

- **Breakthrough Projects**
  - Require senior management involvement, commitment and stomach
  - Expect only 20-25% to be winners
    - The key issue is NOT picking the winners - but killing the losers early
  - Discuss option cost to the next risk reduction milestone - rather than total valuation
  - Expect that the project will morph into something else

- **Disruptive Businesses**
  - Set up a separate business unit to develop
  - Aggressively look for acquisition targets that are potentially disruptive