New Product Design

New Product Development

Definition

New Product Development is a process which starts from a motivating goal, moves through an idea conception phase, is reduced to practice in its implementation phase, and is completed in a transitional phase, during which time the product becomes established.

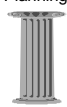I.S Servi, New Product Development & Marketing Preager, 1990

Good Product Ideas

- Most hi-tech product ideas for new start-up companies come from positions held with previous employers. Most entrepreneurs get product ideas from their current employment (E. Roberts, *Lessons from MIT and Beyond*, Oxford U. Press, 1991)

- Other sources of product ideas: customers, customer sponsored R&D, technical conferences and trade shows, technical and business periodicals, newspaper.
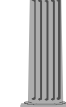

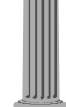## New Product Development Depends on Three Pillars

Planning

Technology
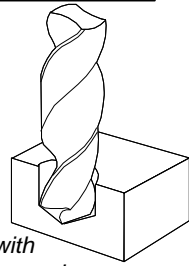
Marketing

"*A hardware store owner does not sell drill bits, he/she sells holes*"

- Drill bit (means) - holes (ends)

- Develop product that delivers a benefit to your customers.

- One does not sell technology, one sells benefits !

First find the holes that need filling with your technology, then you can design and develop your product.

New Product

- **Entrepreneur / Employee of Company**

  ⇒ *Very different perspective!*

- **Products or Services ? Is a Service a Product?**

  ⇒ *A service can be replicated and marketed just like a product - a service can represent a high growth, high profit margin opportunity.*

- **High technology**

  ⇒ *Converting great devices into products - not easy! When a device is properly augmented [with service] so that it can be easily sold and used by customers it becomes a product.*

Can a New Product be an Application of an Old Material ?

Sure !
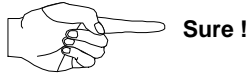
Can a New Product Have Absolutely No Applications ?

Why Not ?

No Practical Application Whatsoever!

SILLY PUTTY

- General Electric Laboratory - 1943 - New Haven, CT
- Scientist working on rubber substitute - combined boric acid with silicone oil in a beaker.
- A polymer 'gooey' substance was formed with unique properties.
- Sent out samples to the scientific community to find application - their response;

"*This is an interesting material, but we are unable to find even one functional use for it.*"

Clever Product Ideas

Not everything is Third Wave!

Product ideas come from many places. Here a few from *Why Didn't I Think of That?,* by Freeman and Golden (both Brown alumni)

⇒ New application of existing material

⇒ Product from a waste material

⇒ Combine 2 existing materials

⇒ Health benefit

⇒ Personal experience

⇒ By accident

Liquid Paper

- **Bette Nesmith, a secretary, was frustrated with the mistakes she was making on an electric typewriter.**

- **She put waterbase white paint into a nail polish bottle to paint over her mistakes … this later became known as liquid paper.**

    New application of existing material

*Why didn't I think of that,*Freeman and Golden

Kitty Litter

- **A sawdust business owner was looking for a better way to soak up oil and grease spills, instead of sawdust (flammable).**

- **Developed clay granules that did the job and suggested to a customer one day to try it for her cat instead of sand.**

    New application of existing material

*Why didn't I think of that,*Freeman and Golden

Lego
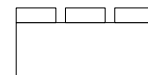
A carpenter, who enjoyed carving wooden toys for children, was one of the first to use plastic to make toys … he developed plastic parts that were interlocking.

- **Unique and creative application of plastic**

*Why didn't I think of that,*Freeman and Golden

Vaseline

A chemist in 1859 converted black residue from an oil-drilling-rig and converted it into a safe white jelly that could be applied to dry skin, and a number of other applications.

• Turned a seemingly worthless byproduct into a useful product.

*Why didn't I think of that,*Freeman and Golden

**Behind Every Man is a Woman …..**
With a Better Idea
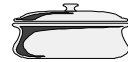
Tupperware - Earl Tupper (1939) convinced Du Pont to sell him a polyethylene waste product. He developed a new refining process to turn the waste slag into a purified plastic that was:

• Clear, Flexible, unbreakable, nontoxic, light-weight, and very easy to clean.

• A Florida distributor, named Brownie Wise, started the Tupperware parties to sell the product !

Make a new product out of waste material from other process

*Why didn't I think of that,*Freeman and Golden

Band-Aid
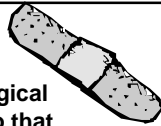
Earle Dickson began integrating surgical tape onto surgical gauze (in 1920) so that his accident prone wife (who always cut and burned her hands in the kitchen) could apply the bandage to herself when he was not home.

• Integrated two materials to form a new product.

*Why didn't I think of that,*Freeman and Golden

Excellent Laxative (Ex-Lax)

Max Kiss, a druggist in NY, recognized the future of over-the-counter medications and mixed a known laxative into chocolate that tasted good even to children (1905).

• Combined two existing materials to make a new product.

• Insight into future of over-the-counter remedies and market.

*Why didn't I think of that,*Freeman and Golden

Swiss Army Knife

A master craftsman in Switzerland who organized the Associated of Swiss Cutlers in 1890 develop the Swiss Army Knife for Swiss soldiers.

The knife needed to perform multiple tasks so they integrated into the knife scissors, cork screw, can opener, etc., the multi-purpose knife is used all around the world today. It was originally painted red so it could be easily spotted if dropped in the snow.

*Why didn't I think of that,*Freeman and Golden

Nordictrack

A series cross-country skier developed the Nordictrack ski machine because he began to wonder why he endured the agonizing freezing rain and miserable slush during training.

• Developed a new product based that benefited him and shortly thereafter revolutionized the indoor exercise industry.

*Why didn't I think of that,*Freeman and Golden

Slinky

A mechanical engineer who worked in a ship yard dropped a torsion spring on the floor, which subsequently fell off the table and traveled end over end on the floor .. he thought what a nice toy. He later perfected it.

Came up with an idea by accident….using a well-known device - a spring.

*Why didn't I think of that,*Freeman and Golden

Post-It Notes

A 3M scientist and church choir singer didn't like to loose his place in the hymn book during service so he inserted scraps of paper between the pages….he was continually annoyed by the paper always falling out.

He recalled an adhesive developed at 3M by a co-worker ('unglue') that was strong enough to grip yet could be easily removed. He developed a very practical use of the 'unglue - the post-it notes.

*Why didn't I think of that,*Freeman and Golden

S.O.S. Pad

In 1908 an aluminum cookware salesman was having difficulty selling his product. Although his Al product was lighter weight and less expensive than copper and iron, former customers had a horrible time cleaning the Al cookware.

He impregnated steel wool pads with soap to solve the cleaning problem of his product … His wife came up with the catchy name SOS
SAVE OUR SAUCEPANS

*Why didn't I think of that,*Freeman and Golden

The Club

After thieves eluded a GM anti-theft device and car alarm and stole Jim Winner's new Cadillac sedan in 1985, he came up with the idea of 'the Club'.

He got the idea from his days in the Army when he prevented other soldiers from driving off with his jeep by winding a metal chain around the steering wheel.

He worked with a auto mechanic to build a prototype … he interviewed both car thieves and cops to perfect his device .. making it the ultimate barrier.

*Why didn't I think of that,*Freeman and Golden

A Quick Introduction to New Product Issues

- Market Driven - Technology Fueled
- Avoid Playing the Marketing Game
- Identify Real Customer
- Collateral Revenue
- Clear Distribution Channels
- Product Positioning / Competition
- Intellectual Property
- Product / Service
- Ergonomic / Human Factors
- Identify Resources / Infrastructure
- Time-to-Market

The Five Questions of New Product Development

In a new product stage, always ask basic questions

Why ? Define business strategies and consider how you will evaluate success and failure.

What ? Define products you want to develop and the market needs they are expecting to satisfy.

How ? Define the implementation modes from both technical and commercial view points.

Who ? Define who is accountable for what and never lose sight of the interfunctional nature of new product development.

When ? Be sensitive to timing in all product development endeavors

Baird's Rule of Thumb

Engineering Your Start-Up: A Guide for Hi-Tech Entrepreneurs

Your new product should have 3-10 times the advantage in terms of price and/or performance of an existing product for a customer to switch.

'Company should be market and customer driven and technology fueled'

Technology Fueled

No matter how clever your technology is, there must be a market need.
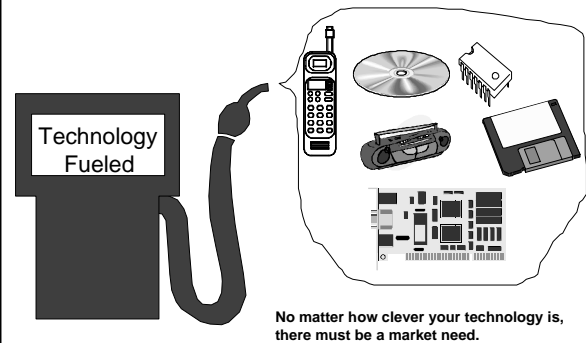
Play in a Large Enough Market

• Many engineers make the mistake of developing a specialized product with a small world-wide market potential.
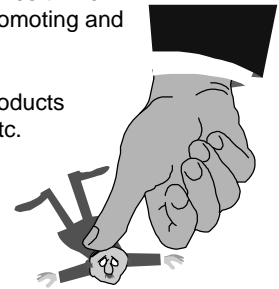
• Your product should target a large enough market segment, as well as a market that is healthy and growing.

Avoid Playing in a Marketing Market

• Marketing driven companies thrive on unique methods of promoting and selling their product

- cigarettes, liquor, food products perfume, razor blades, etc.

Identify Real Customers

• Who are your customers ?

• Some customers are good candidates for seed funding !

• Speak with potential customers ! Find out their needs.

• What is the buying cycle of your customers ?

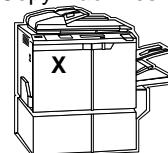## Substantial Collateral Revenue

A good product generates revenue from collateral items such as service and maintenance contracts, accessories, updates, consumable supplies, etc. , essentially another business. Keep the customers coming back.

Example: **Xerox**

Copy Machines

Largest revenue from paper

X

Clear Distribution Channels

Visualize how product will be marketed and sold.

Products >$50K are typically sold by direct sales representatives - expensive sales staff, highly trained, need to cover salaries and commissions for the sales force.

Products <$5K are typically sold through distribution. Hire independent distributors or sales reps that promote your product. Can give up 40% of sale price for their efforts …. usually a proven distribution channel will accelerate the time to market.

Product Positioning and Your Competition

Competing on the basis of cost alone
- Computer memory modules often gain market share primarily on the basis of price.
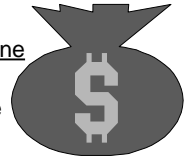
Cost advantage alone does not guarantee success
- for example, you develop a new word processing and spreadsheet program equivalent to *Word* and *Excel* and sell it for one-half the price - customers recognize Microsoft, and perceive better customer service, product life, and future product upgrades.

Product Positioning and Your Competition

Competing on the basis of product differentiation alone
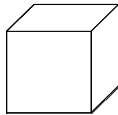
- Adding three dimensional data representation and charting capabilities to a 2D spreadsheet.

- Less tangible features - company's reputation, service delivery, training, or product support
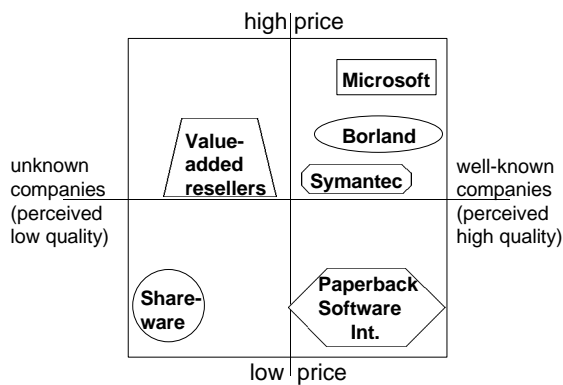

Paperback Software International
(Adam Osborne's low cost computer programs offered by PSI)
- PSI was unique - product clearly differentiated by cost, and functionality was perceived to be nearly as good as the more expensive giants.

- Name well-known, Osborne Computer was the first to sell a personal computer w/ software for < $2,000.

- Company did not succeed because it lost a copyright infringement suit.

**Before you launch your new product, know positioning w.r.t. competitors, and know what will be the perceived benefits in cost and functionality.**

Positioning of a Software Product

high price

Microsoft

Borland

Value-added resellers

Symantec

unknown companies (perceived low quality)

well-known companies (perceived high quality)
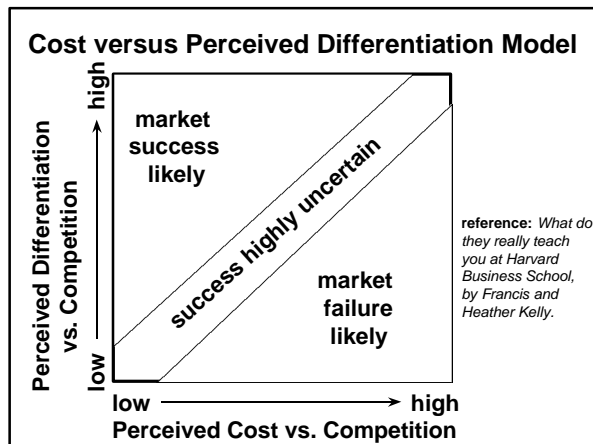
Share-ware

Paperback Software Int.

low price

Callaway Golf Company

The Callaway club is more than double the price as a normal driver, but has a much sought-after larger sweet spot due to its revolutionary design - larger head and superior weight distribution.
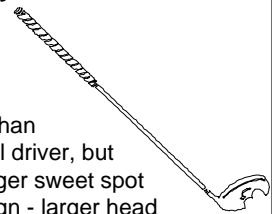
Take an objective look at your product, and the value and benefits it will deliver to the market place.

Cost versus Perceived Differentiation Model

Perceived Differentiation vs. Competition

high

market success likely

success highly uncertain

market failure likely

low

reference: *What do they really teach you at Harvard Business School, by Francis and Heather Kelly.*

low → high

Perceived Cost vs. Competition

Product Positioning and Your Competition

Significant product differentiation alone does not guarantee success.

Example

3-D information displays - expensive - no real benefit to user (except limited high end applications, e.g. simulators)

It has been a disaster for many companies who have tried to sell 3-D technology.

Is your product novel ?
Maintain Proprietary Advantage
Patent Protection
Intellectual Property (IP)

Patent - Grant of right to exclude others from the making and selling of an invention during a specified period of time (a legitimate monopoly for the owner of the patent).

Maintain Proprietary Advantage
Patent Protections
Intellectual Property (IP)

• Investors and employers like to hear the technical reasons why their products can deliver better benefits and performance to customers and that those advantages can legally protected.

• While under patent protection, you can often charge aggressive prices for products in demand.

Balancing Product with Service

Never overlook the importance of product service / support.

Good Products

Good Service-Support

Successful companies, such as IBM, have knowingly sacrificed technology leadership in order to provide a high level of service!

A Warning to Engineers:

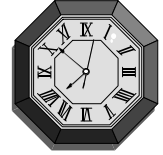**DO NOT overlook human factors or ergonomic issues.**

- these can be show-stoppers

Accurately Identify Needed Infrastructure for Development

Two Extreme Examples

	Software	Laptop FP Display
Capital Investment	$ 5-10 K	>$0.5B
Space	Basement / Garage	50,000 ft^2

Time to Market

- Time to market is crucial in this day of time based competition. You need to develop your product in a relatively short time to compete

Factors that Lead to New Product Success

- Align Core Competencies / Identify Weaknesses
- Capitalize on Business Environment
- Pursuing Market Acceptance
- Motivating the Organization
- Creating New Product Ideas
- Designing New Products from Concepts
- Refining New Product
- Tracking New Product

Aligning Core Competencies & Identify Weakness

- **Identify your strengths**
- **Identify weaknesses**
  - **-hire expertise**
  - **-hire consultant**
  - **-strategic partnership**

Capitalize on Business Environment

- **Very complicated and tend to be global**
- **Out of your control (natural resources, population, cultural values, technology, economy, laws & regulations)**

Two Schools of Thought:

- **Accept environmental trends and develop products around them**

- **Proactive, mediate & manipulate those individuals and organizations who can affect them**

Forces:
- **-politicians**
- **-regulatory agencies**
- **-media**
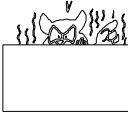- **-financial institutions**

Pursuing Market Acceptance

- **Many factors in the human equation that are hard to gauge**
- **Understanding the market is interactive**

Motivating the Organization

Paradox:
new products are a means of survival
yet
companies resist innovation many times

Explanation:
companies and organization are formed to
create stability
and
new product teams often envisioned as
renegades and redefine product line, and
perhaps basic philosophy

New Product Ideas - Ways to Generate Them

Organization needs to develop new products for its future livelihood

Ideas come from internal & external sources:

Internal: engineers
scientists
marketing, etc.
employees

External: customers
competitors
revival of obsolete products
new products by acquisition

Designing New Products from Concepts

Develop written specification, statement of requirements, that is in a common language for R & D, marketing, accounting, sales can all understand.

The document should contain illustrations, models, simulations that integrate a multidisciplinary team's thoughts.

New product idea → Statement of requirements → Marketing need

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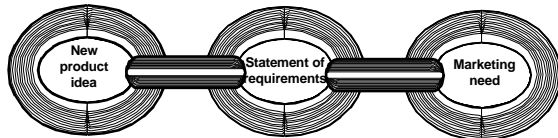
Refining Your New Product

As you mold your new product idea into a prototype, many problems will arise.

Refine is triggered by testing:

α **Alpha - testing with the organization**

β **Beta - primary user base**

γ **Gamma - those who might construct barriers or facilitate sales (regulatory agencies, media, politicians)**

δ **Delta - testing after product launch**

Tracking Your New Product

Tracking product after launch is essential - first real test in customer hands in real situation.

Marketing should also be tracked

- business environment can be changed

- advertising may not be effective

Make sure you have contingency plans!

Make Your Product Clearly Understandable

This may be hard for an engineer, often concoct elaborate product ideas.

My novel LC display is based on thin-film-transistor technology that has a uniquely patterned alignment layer providing four-domain orientation on the pixel level for expanded viewing angle in four viewing quadrants. In addition we have implemented addressing schemes so we can drive a 40-diagonal display with 300 pixels/inch resolution…with a discrimination ratio exceeding 1000:1.

Engineer

Make Your Product Clearly Understandable

Describe your product and its benefits with utmost clarity.

Venture Capitalist

When you tell me your what your product does and why someone needs it, I want to hear an answer that's clear as if you were describing the function of a parking lot; everyone knows the function of a parking lot and why it is needed. If you cannot describe your product in simple terms, it is unlikely that your potential customers will even know that they need your product.

From Baird, Engineering Your Start Up

## You have targeted in on a good product idea !

- You have approached potential customers
- You have confirmed a large and growing market
- You have identified a number of obvious benefits
- Compared to competition, you are well positioned and protected
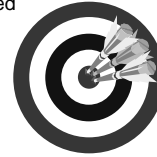
Time to lay the groundwork for actually producing your product.

Philips: The Compact Disc

New technology; digitally coded disk < 5 inches diameter. Surface is read by a laser beam for accurate reproduction of the digital encoding of sound. Plastic coating protects the encoded surface.
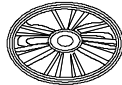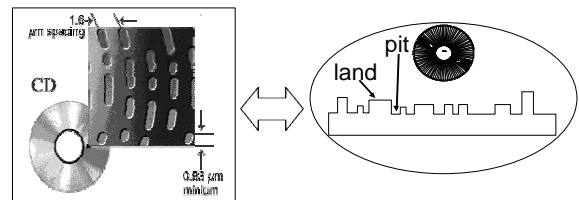
Replace: recording media- records, tapes, magnetic disks

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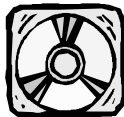
How Does a CD Work?

The CD player compares the amount of light diffracted back from that slit and converts this to a 0 or a 1 (bits). This digital language is converted into music.
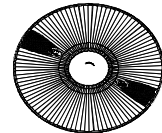
land pit

CD

How Does a CD Work?

The length of the 'pits' on the surface of the disk represents bits (0's and 1's)

- label
- lacquer
- aluminium
- polycarbonate
- objective lens
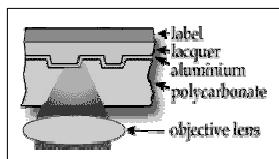
The player rotates >500 rev/minute. The code lies on a spiral trail ~3miles in length and is read by a laser beam. The higher parts of the disk (land) diffracts light differently than the lower parts (pit).
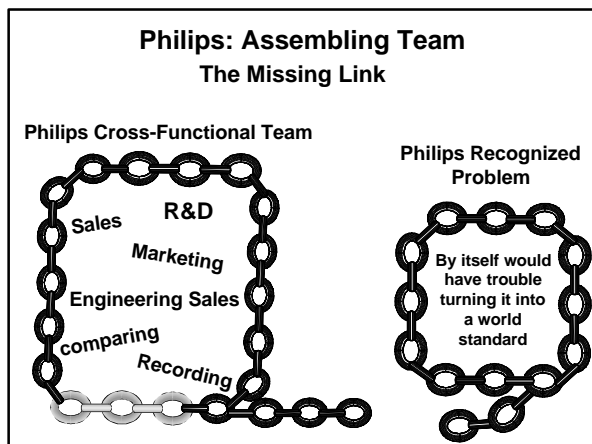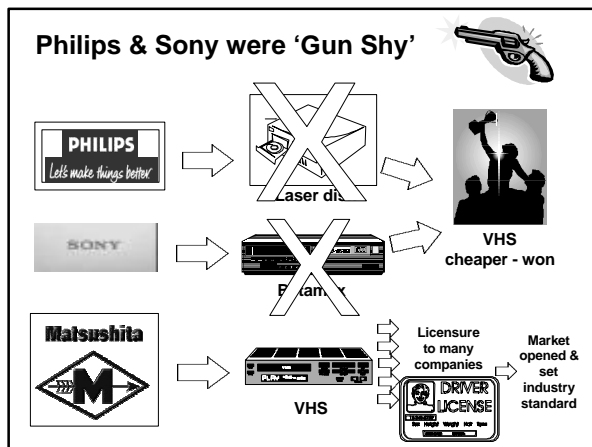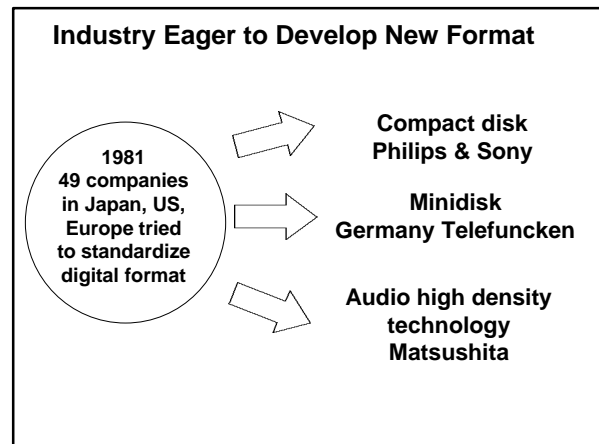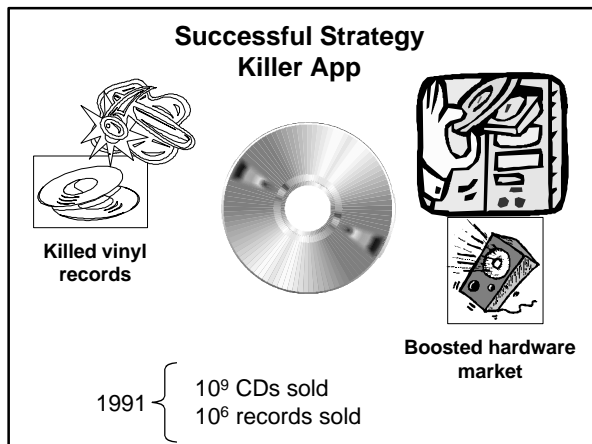

Why CD?

Compact disk process around since the 1950's.

- market ready for innovation

- alliance of key industrial leaders

- superior product

Successful Strategy
Killer App

Killed vinyl records

Boosted hardware market

1991 { 10^9 CDs sold
10^6 records sold

Industry Eager to Develop New Format

**1981
49 companies in Japan, US, Europe tried to standardize digital format**

→ **Compact disk Philips & Sony**

→ **Minidisk Germany Telefuncken**

→ **Audio high density technology Matsushita**

Philips & Sony were 'Gun Shy'

PHILIPS
Let's make things better

→ Laser disc ✗

→ **VHS cheaper - won**

SONY →

Betamax ✗

Matsushita
M →

VHS → Licensure to many companies → DRIVER LICENSE → **Market opened & set industry standard**

Building Strategic Alliance

- Combine expertise

- Share market risk

- Facilitate establishment of standards

- Integrated organization response to innovation; marketing just as important as R&D

Philips: Assembling Team
The Missing Link

Philips Cross-Functional Team

Sales
R&D
Marketing
Engineering Sales
comparing
Recording

Philips Recognized Problem

By itself would have trouble turning it into a world standard

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Philips / Sony Partnership
Philips recognized Sony

- Sony was a progressive audio equipment manufacturer

- A powerful marketing tool (successful at Walkman)

- Provides access to Japanese market

- Philips President (van der Klugt) and Sony CEO (Morita) were buddies.

Establishing CD Standards

Philips and Sony merged to establish a common format.

- Electronic Industry Association (EIA) of Japan

- Digital Audio Disc Council

- Two competing corporations (Telefunken and Matsushita) withdrew their technology and bought a license

- Record industry reluctant, but creative and powerful marketing overcame resistance because of strong customer and trade interest

- 3 cent royalty on each CD sold

Lessons for Success

Philips technology — new product — Sony marketing
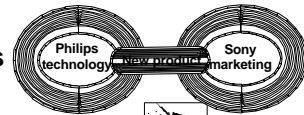
- Record industry needed new product - new customer who appreciated sound quality and would pay for it

- Union of strong technology (Philips) and aggressive marketing (Sony)

Philips — Sony

- The Union ultimately convinced industry to standardize CD

- Superior Technology

- Path to other markets - the portable one

Risks of Alliances / Partnerships

- Philips developed original technology, but CD became synonymous with Sony

- Sony gained tremendous market share in Japan and US due to aggressive marketing

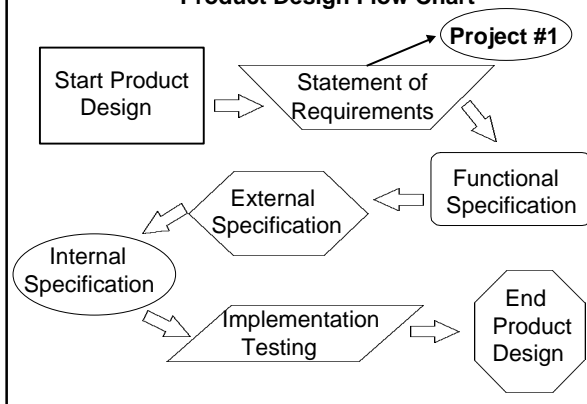**- Philips had trouble marketing it under its name, so marketed under Magnavox**

Strategic Partnership

risks   benefits

Timeline of CD New Product Development

Year	Event
1972	Philips invents initial idea for CD system
1973	
1974	
1975	
1976	
1977	
1978	Prototype is accepted by the Philips board of directors
1979	CD is presented to press; strategic alliance with Sony announced
1980	Japanese DAD Council accepts CD as industry standard
1981	October: first public prototype presented at Japanese Audio Fair
1982	November: CD introduced into Japanese market
1983	February: CD introduced to European and U.S. markets
1984	
1985	3 million CD players sold worldwide
1986	9 million CD players sold worldwide
1987	
1988	
1989	
1990	
1991	Over 1 billion CD players sold worldwide
1992	

Product Design Flow Chart

Start Product Design → Statement of Requirements → **Project #1**

Statement of Requirements → Functional Specification

Functional Specification → External Specification

External Specification → Internal Specification

Internal Specification → Implementation Testing → End Product Design

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Preparing a Development Plan

Statement of Requirements

- well-written document that describes the requirements of your product to be used by engineering, marketing, sales, and management. Intended to maintain focus and cohesiveness between technical and non-technical players. More marketing less engineering.

Functional Specification

- An engineering document that defines the detailed requirements of the product. Can be highly technical and intended to be specification intensive.

Statement of Requirements
(may or may not be applicable to your product)

What is your product ?
• Features
• Applications and uses
• Benefits delivered
• Needs met

Market Analysis and Requirements
• Competition
• Estimate riding
• Who is the user?
• What are the sales/distribution channels

Statement of Requirements (Cont.)
(may or may not be applicable to your product)

Product Requirements
• Competitive Positioning
• Target production costs
• Who installs the product
• Training and field support
• Customer support requirements
• Warranty policy
• User and reference manuals
• Product packaging
• Maintenance considerations
• Product life
• Testing schedule

Statement of Requirements (Cont.)
(may or may not be applicable to your product)

Functional Requirements
• Performance requirements
• Systems requirements
• Human factors

External Requirements
• Environmental requirements
• Space requirements, infrastructure

Other Requirements
• Regulatory requirements
• International and export requirements

Functional Specification
(may or may not be applicable to your product)

• Technical terminology   • Program inputs/outputs
• Hardware platform   • Operating environment
• Operating system   • Reliability
• User-interface standards
• Help system
• Input devices supported
• Copy protection
• Product features
• Documentation
• Debugging support
• Limitations and restrictions

Your Product Design Will Only Incorporate:

External Specification: Translate the 'whats' in the functional design into 'hows' - states everything about the product that can be seen, felt, measured or touched by the customer.

Internal Specification: How you will accomplish the external spec., e.g. software, what language or data structures to be used, for hardware, define actual components down to the component level (part #).

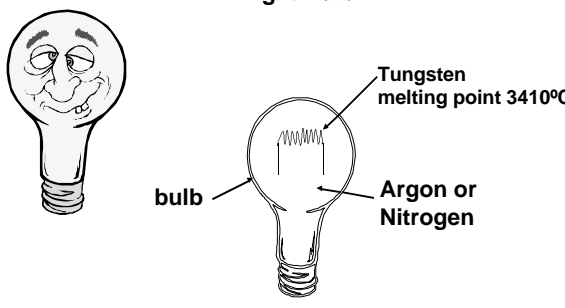**Implementation and Testing**

No more questions on how well the product will operate, with what parts, and how everything interconnects.

Test final product design - performance, reliability, highly product dependent.

Beyond the scope of this class!

Product Examples

Light Bulb

Tungsten
melting point 3410ºC

bulb

Argon or
Nitrogen

Light Bulbs

General Electric

-Soft White Light
-Life 1200 hours
-50 Watts / 580 Lumens
-3 way bulb

Philips

-Soft White, pleasant light
-Longer Life, 900 hours
-Puts 35% more light where
you need it
-Lasts up to seven years
-Last 10-13 times longer
than standard incandescent
-75 Watts / 1150 Lumens

These are some phrases that you might see in your state-
ment of requirements - more qualitative (features, uses,
benefits, needs met, etc.)
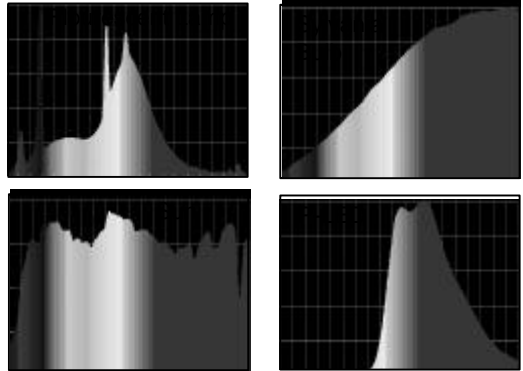
Light Bulbs

Statement of Requirements

Features - robust, bright, long life, good efficiency, direction
Applications/Uses - indoor / outdoor lighting
Benefits - highly efficient coupled with low cost
Competition - GE, Philips
Estimate Pricing - cheap ($)
Who is the user - everyone needs lightbulbs
Sales - hardware stores, dept. stores, etc.
Performance Requirements - bright, long life, efficient,
        operate inside and outside
System Requirements - conventional 120 V electrical conduit
Human Factors - pleasant, soft light
Environmental - any concerns to the environment if it breaks

Is a lightbulb a lightbulb ?

Light Bulbs

Functional Specification - translating the state-
ment of requirements into a functional specification

Soft White Light - white pt. measured with spect spectro-
        radiometer (see color chromaticity diagram).

Lifetime - turn lightbulb on and see how long it takes to
        degrade to inferior performance (8760 hrs/year).

Direction of light - monitor the brightness (lumens) of
        light as a function of angle.

Efficiency = brightness / power [lumens / watt]
        General Electric 11.6 Lumans / Watt [@50 Watts]
        Philips 15.3 Lumans / Watt [@75 Watts]

Temperature - operate at different tempertures for limits

Smaller Niche Markets
For Light Bulbs

Garage Door Opener Light Bulbs

**More Efficient and longer life in cold operating
environments (Temperature testing)**

**Anti-Vibrations, more robust filament (vibration
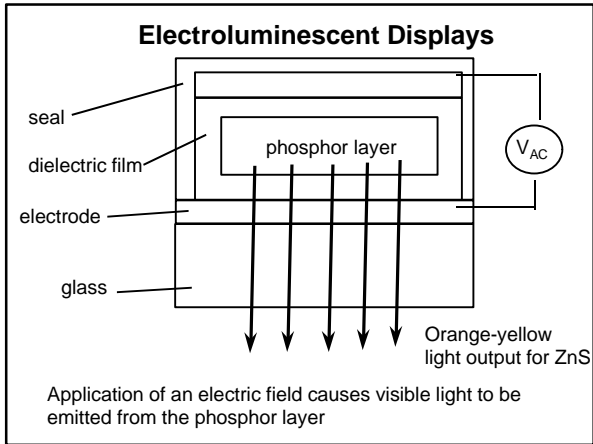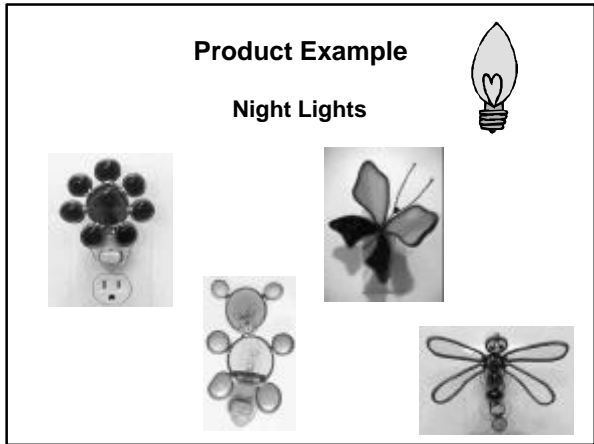testing)**

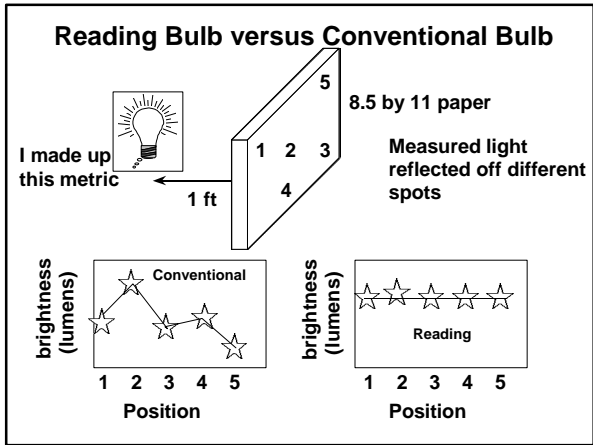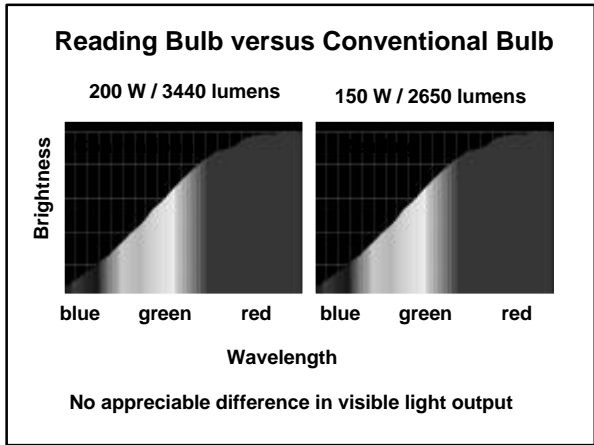**10. 5 lumens / watt (lower efficiency)**

**Smaller Niche Markets
For Light Bulbs**

Soft White Reading Lamp

Frosted diffusion
glass

high voltage filament
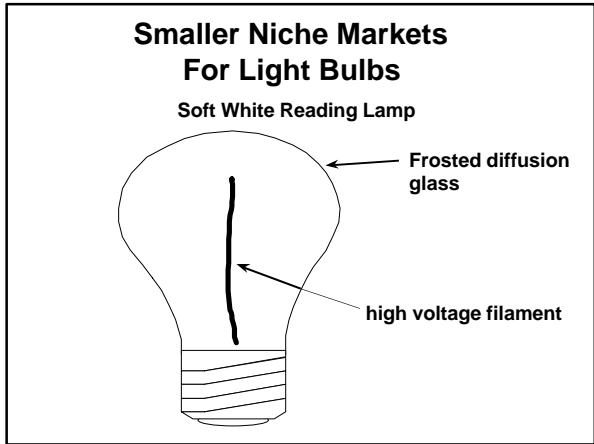
**Smaller Niche Markets
For Light Bulbs**

Soft White Reading Lamp

- **Ideal for reading, 2650 lumens at 150 Watts**

- **17.6 lumens / watt**

- **Lifetime is at 750 hours**

Reading Bulb versus Conventional Bulb

200 W / 3440 lumens   **150 W / 2650 lumens**

Brightness

blue   green   red   blue   green   red

Wavelength

No appreciable difference in visible light output

Reading Bulb versus Conventional Bulb

5

8.5 by 11 paper

1 2 3

**I made up
this metric**

4

1 ft

**Measured light
reflected off different
spots**

brightness
(lumens)   Conventional

1 2 3 4 5

Position

brightness
(lumens)

Reading

1 2 3 4 5

Position

Product Example

Night Lights

Electroluminescent Displays

seal

dielectric film

electrode

glass

phosphor layer

V_{AC}

Orange-yellow
light output for ZnS

Application of an electric field causes visible light to be
emitted from the phosphor layer

Indiglo / Limelite Nightlight Technology

Some Statement of Requirements

Cool to the touch - does not generate a lot of heat
Save electricity - 2 cents per year continual operation
A calming glow - blue or green
Lightweight - packs easily for travel
Lifetime Guarantee - send it back and pay postage to
get money back
Applications - cheap nightlight technology
Pricing - a few dollars
Sales - department stores
System - needs to operate off conventional 120 V
Export Requirements - will it work in Europe ?


Indiglo / Limelite Nightlight Technology
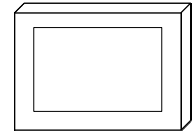
Functional Requirements

Brightness - > 200 lumens
Color - What is the color the material emits (wavelength)
Power - Needs to cost less than 2 cents per year to run
Cool to touch - can not be too hot for a child to touch it
(35 C)
Operating Environment - indoor, room temperature
Reliability - super, needs lifetime gaurantee

Human Factors / Nightlight
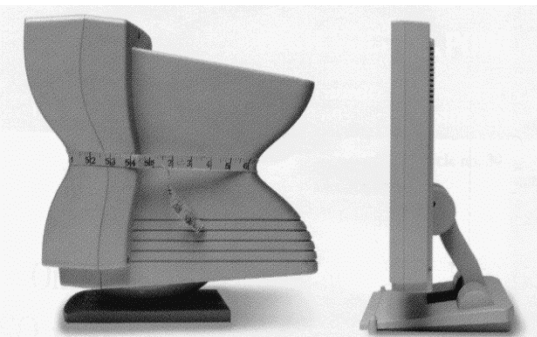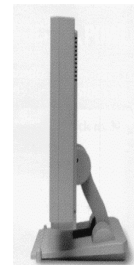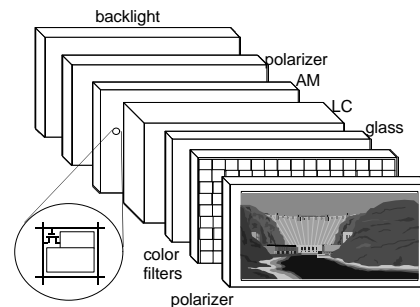**Both nightlights put out the same brightness**

Sensitivity of Human Eye
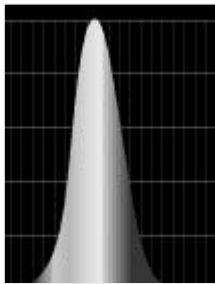
Wavelength

Product Example

Flat Panel Displays

Liquid Crystal Display - lots of components

backlight
polarizer
AM
LC
glass
color
filters
polarizer

Twisted Nematic
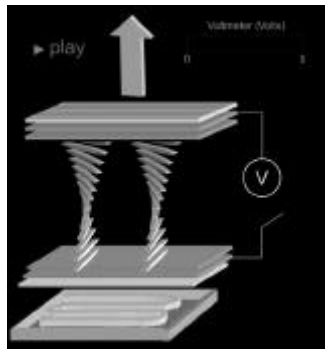
Flat Panel Displays (Laptop Screen)

Statement of Requirements

Thin, lightweight
Good color purity
High Resolution
High Brightness
Low Power
15.1 Inch diagonal
Sell directly to integrators (Gateway)
Operate on battery pack
Operates for 6 hours
Portable Market

What are the human factors issues

Flat Panel Displays (Laptop Screen)

Functional Specification

Thin, lightweight - 2 mm thick, <1 lb
Good color purity - saturated colors for RGB
High Resolution - >120 pixels / inch
High Brightness - 250 lumens
Low Power - <0.5 Watt
15.1 Inch diagonal - Is bigger better ?
Sell directly to integrators (Gateway)
Operate on battery pack - (weight)
Operates for 6 hours - Coast to coast flight

What are the human factors issues ?

New Product Example
Electronic Newspaper

Let's make up an example product

Electronic Newspaper

- **Revolutionary electro-optic material sandwiched between thin mylar sheets - 200 μm thick**
- **Download newspaper from computer**
- **Interactive advertisement capability**
- **Material reflects ambient lighting for low power operation - no illumination source needed.**
- **mW operation - battery life approaches 16 hours**
- **Light weight, under 2 pounds**
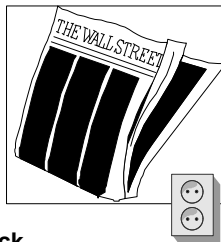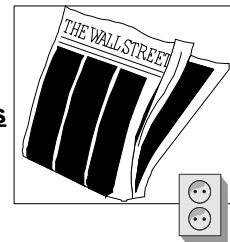

Electronic Newspaper (Cont)

Statement of Requirements

Features:

Applications:

Benefits:

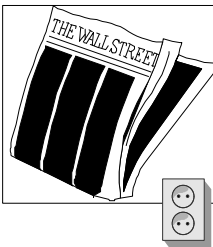**Needs Met:**

Electronic Newspaper (Cont)

Statement of Requirements

Competition:

Estimate Pricing:

Who is the User:

Sales / Distribution:

THE WALL STREET

Electronic Newspaper (Cont)
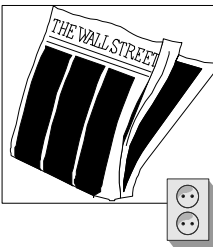
Statement of Requirements

Performance Req.:

System Req.:

Human Factors:

Environmental, Safety, etc.:

THE WALL STREET

Electronic Newspaper (Cont)
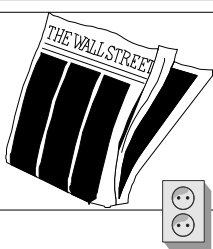
Functional Specification

Technical Terminology:

Hardware:

Operating System:

Display Standards:

THE WALL STREET

Electronic Newspaper (Cont)

Functional Specification

Copy Protection:

Product Features:

Debugging Support:

Operating Environment:

Reliability:

THE WALL STREET

Photopic Reflectance

$$\% R_P = \frac{\int_{380}^{780} SPD\,(\,l\,)\,R(\,l\,)\,\overline{y}(\,l\,)\,d\,l}{\int_{380}^{780} SPD\,(\,l\,)\,\overline{y}(\,l\,)\,d\,l}$$

Flourescent Lamp   CLC Theory   Color Matching

Should I be the service provider for electronic newspaper or should I manufacture the electronic newspaper device ?
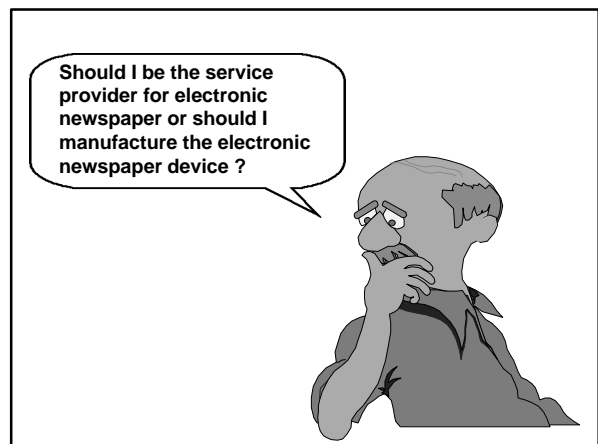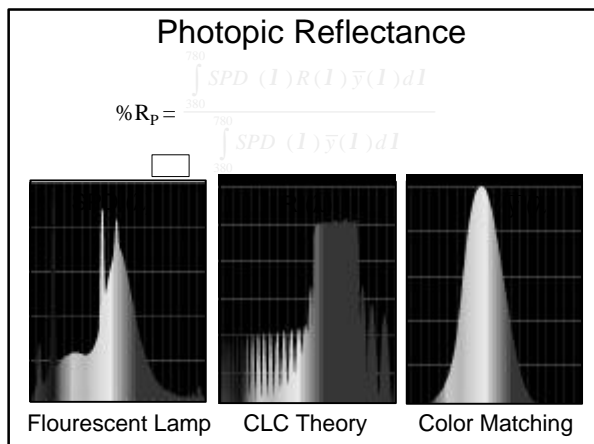
5 Events & 4 Intervals of the
New Product Development Cycle

Five New Product Events:

Detect an opportunity	Define a goal	Start product shipment	Achieve profit objective	End of life

	Front End	Stages and Gates	Pre-profit Sales	Continued Sales
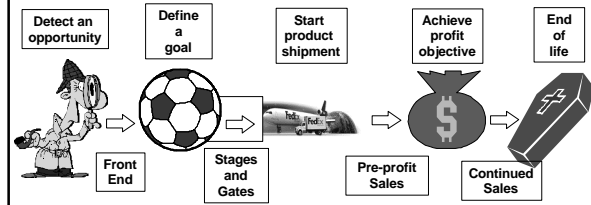
Four new Product Intervals

min*imize*   *ma*xi**mize**

Time Evolution