



**School of Business
Yonsei University**

Product Innovation

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Operations and Technology Management

Recent Changes in Korea

- Development Focus

Engineering oriented → Design Oriented → Integrated Thinking

- Product Focus

Function → Aesthetics (Form) → Concepts (e.g. eco-)

- Product Strategy

Single product → Product groups → Platform (ecosystem)

Design

Use Environment

User

Form

Function

Concept

- philosophical
- ethical
- emotional







Freshman Zack Anderson can check the weather at the monitor by the sink in his fully automated dorm room.

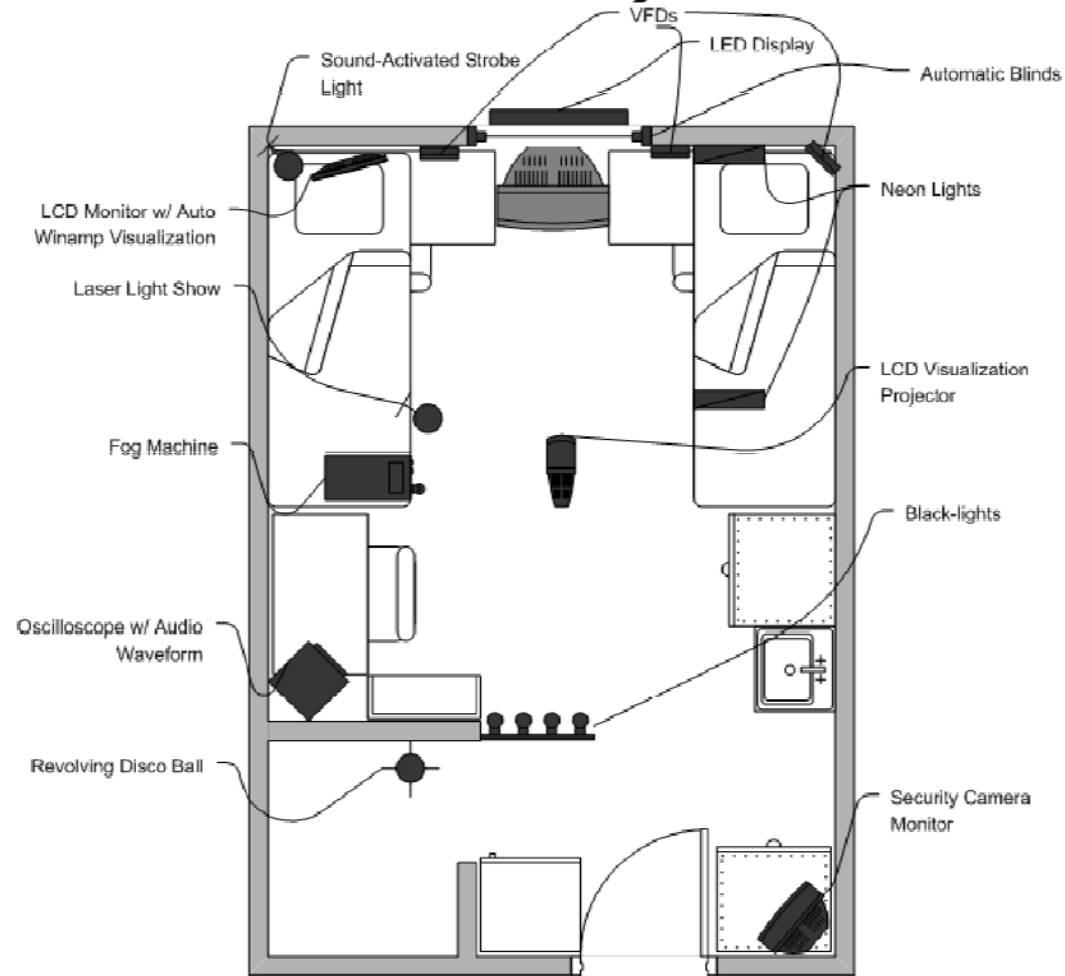
Credits - Photo / Donna Coveney



"Multifunction In-Dorm Automation System" (MIDAS)

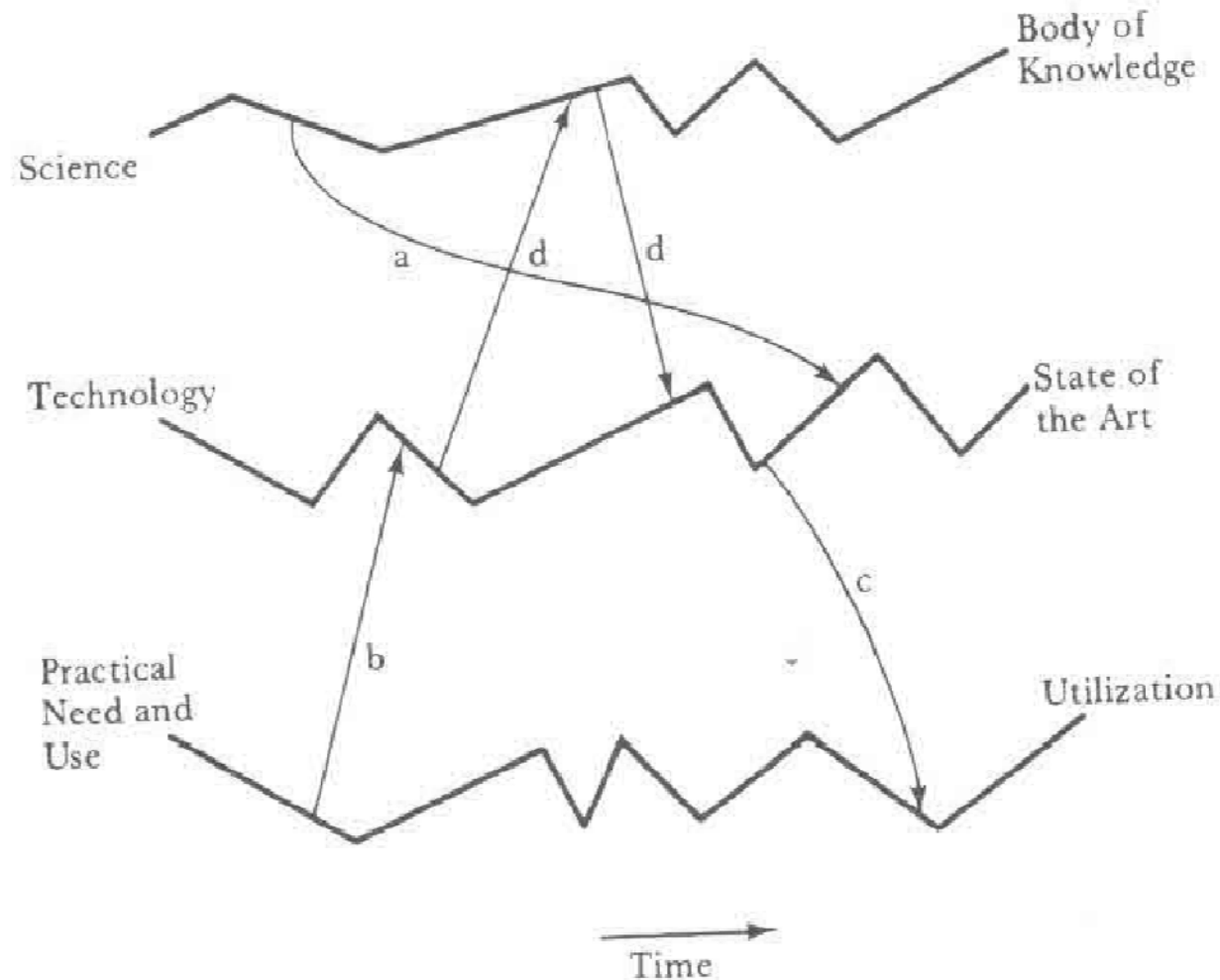
Freshman R.J. Ryan hits the 'emergency' button in his automatic dorm room on East Campus. The button activates 'party mode.' (relax mode, sleep mode also possible)

MIDAS Party Mode



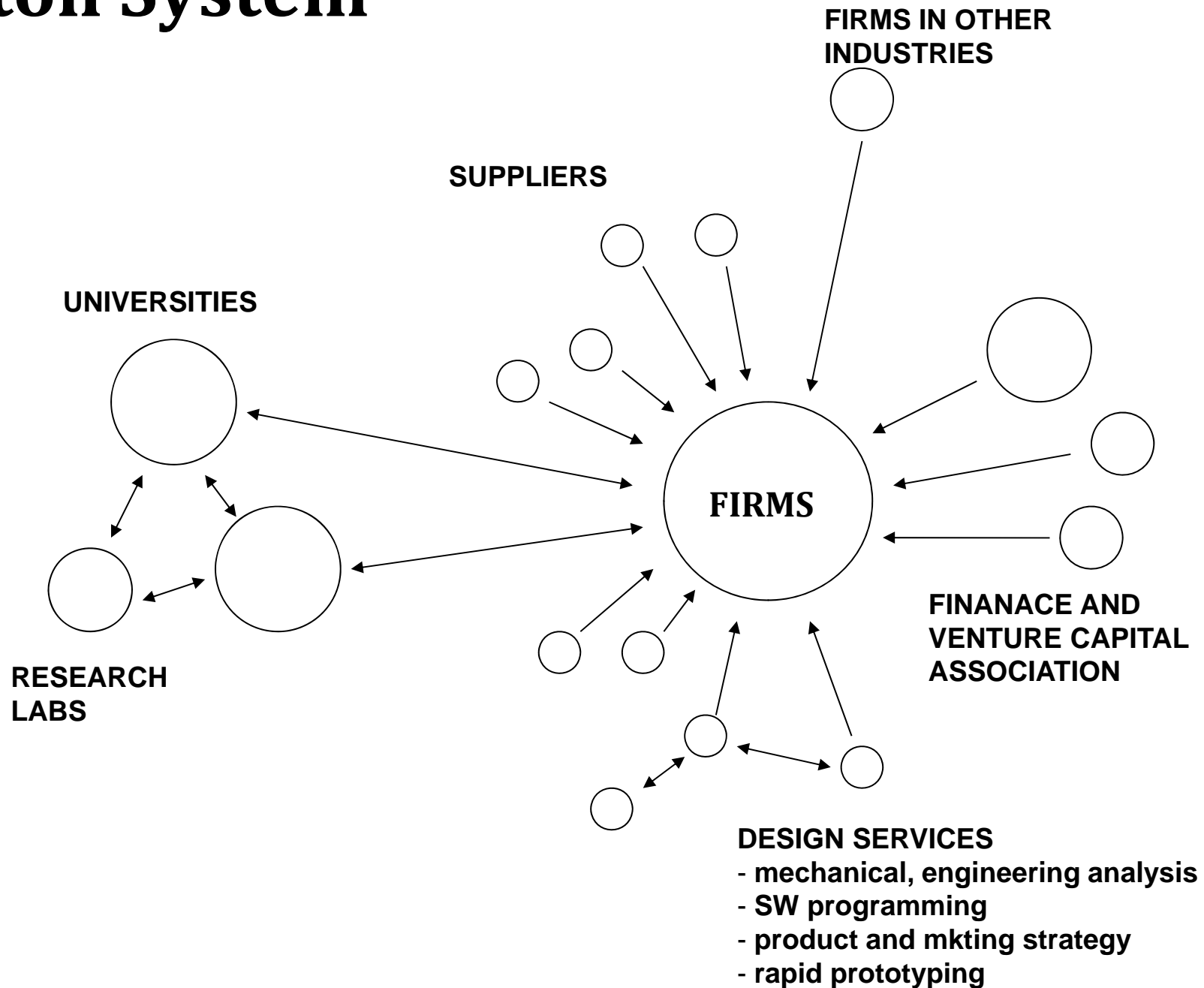
VIDEO: MIDAS at work

The Relationship between Science & Technology



- a. Assimilation of scientific results into technology**
- b. Recognized need for a device, technique, or scientific understanding**
- c. Technology adoption for use**
- d. Technological need for understanding of physical phenomena**

Boston System



Attributes of Five Development Projects



	Stanley Tools Jobmaster Screwdriver	Rollerblade In- line Skate	HP Deskjet Printer	Volkswagen New Beetle Automobile	Boeing 777 Airplane
Annual production volume (units/year)	100,000	100,000	4 million	100,000	50
Sales lifetime (years)	40	3	2	6	30
Price (US\$/unit)	3	200	300	17,000	130M
Part numbers (parts)	3	35	200	10,000	130,000
Development time (years)	1	2	1.5	3.5	4.5
Internal development team (peak size)	3	5	100	800	6,800
External development team (peak size)	3	10	75	800	10,000
Development cost (US\$)	150,000	750,000	50M	400M	3B
Production investment	150,000	1M	25M	500M	3B

(Source: Ulrich & Eppinger)

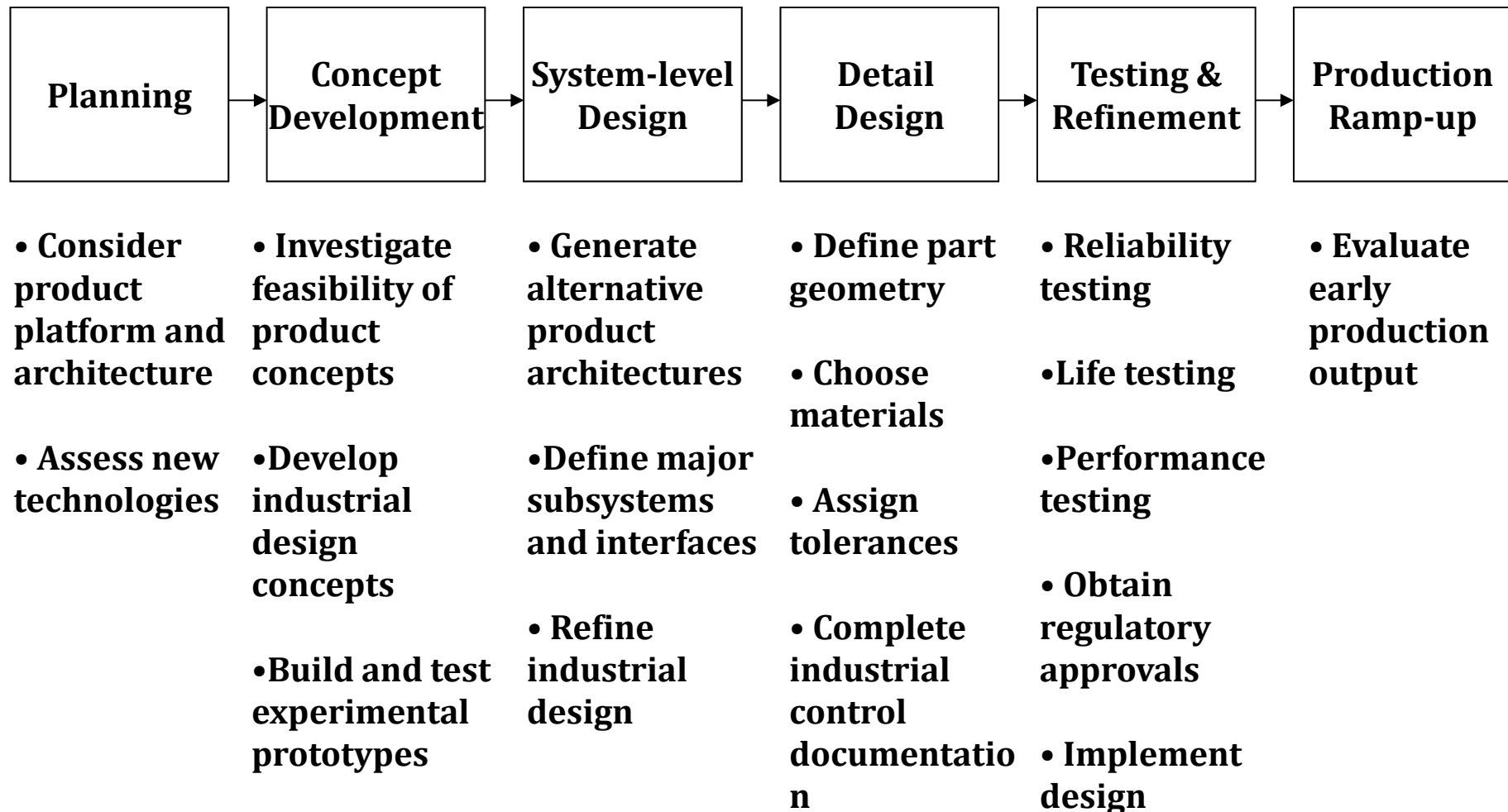
New Product Success Factors

- Product differentiation with unique value to customers
- Strong market orientation throughout the development process
- Speed to market
- Top management: specifying new product strategy and providing needed resources
- Sharp project selection decisions
- Early product definition before development begins
- Quality execution (completeness, consistency, and proficiency) of activities in the development process
- Organizational structure (multifunctional, empowered teams)

(Cooper, 1996)

New Product Development Process

Design Activities:



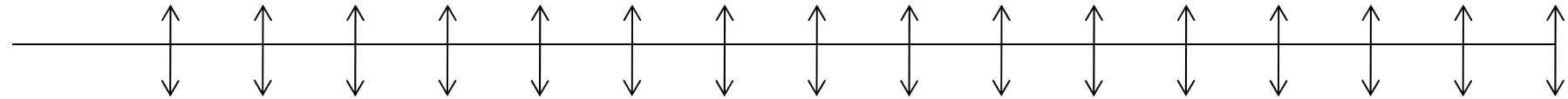
Alessi & Lombardy Design Discourse



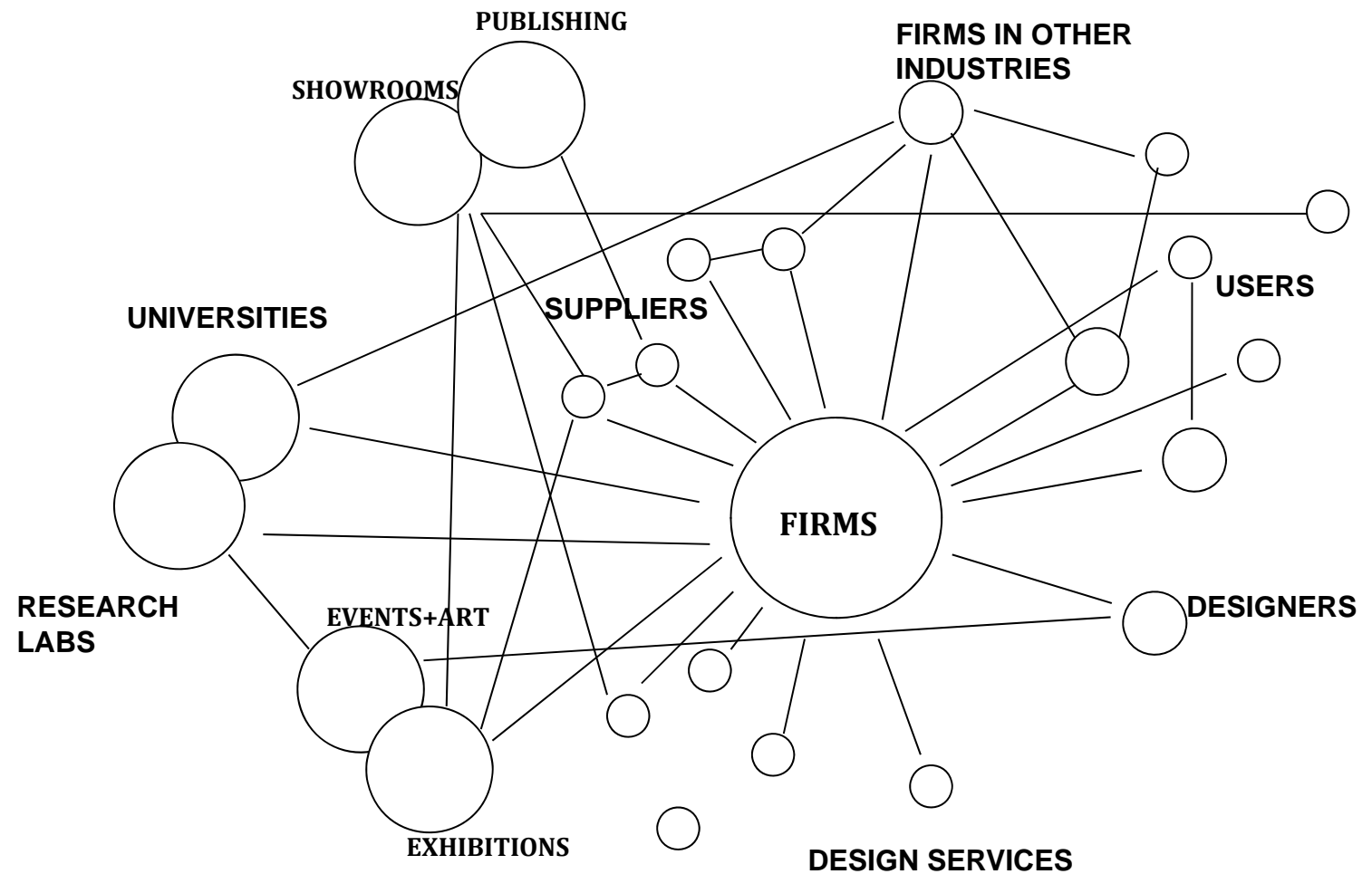
- Free-floating community of architects, suppliers, photographers, critics, curators, publishers, and craftsmen
- Initially utilitarian (Form follows function) → Importance of form increased
- Combination of “local” and “global”
- Change of product meaning → Change in design (iMac: office product → home appliance) Other examples?
- Absorb → Interpret → Address
- Links of the components of the design system (schools, studios, mfr., etc.) made Lombardy special

Actors in Lombardy System

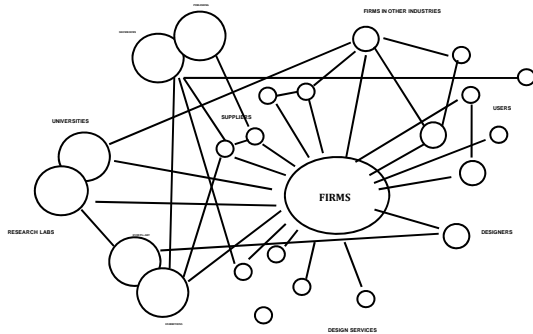
Global
Discourse



Local
Discourse
談論



Actors in Lombardy System



actor	characteristics
Mfrs.	<ul style="list-style-type: none"> • Italy is the largest world exporter(16%) • Lombardy accounts for 23% of Italian furniture manufacturer (High-end)
Design Firms	<ul style="list-style-type: none"> • +700 design firms (60% of Italian total) • Mainly small studios with less than 4 employees
Users	<p>Italians spend 10% of their non-food budget on furniture</p> <p>Local users are immersed in the design discourse</p>
OEM in other industry	Most advanced industrial setting
Suppliers	Geographically concentrated and highly specialized
Universities & Research Labs	Milan is the center for architecture and design education – Politecnico di Milano and other universities in the region
Fairs, exhibitions and Publishers	<ul style="list-style-type: none"> • The most important international furniture fair: the Salone del Mobile • Triennale di Milano since 1920 / Experimentation at the show rooms • 454 design related publishers, 16 design magazines

Bang & Olufsen's Design Oriented Product Development Process



Bang & Olufsen

Product Characteristics	Details
Design philosophy/Process	
Mode/Speed of innovation	
Product strategy	
Customers	
Manufacturing process	

Bang & Olufsen

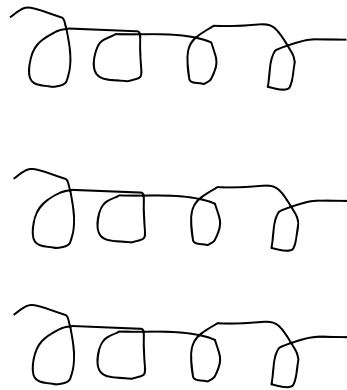
Product Characteristics	Details
Design philosophy/Process	<ul style="list-style-type: none"> • Home electronics + luxury category product characteristics • External design first → internal delivery • Importance of substance • Designers have “near-absolute” control over product
Mode/Speed of innovation	<ul style="list-style-type: none"> • 1 year ~ 3-5 years • Iterate until you get what you like • R&D partnership
Product strategy	<ul style="list-style-type: none"> • Special products • Fanatical acclaim • Fabulous profit margin
Customers	<ul style="list-style-type: none"> • Loyal, repetitive • Small number of exclusive customers • Distribution channel specifically designed
Manufacturing process	<ul style="list-style-type: none"> • Small autonomous production groups

Bang & Olufsen

75% from Designers

IDEAS

25% fill
holes in
catalog



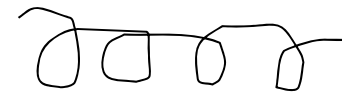
2 or 3 ideas,
model
iterations

Designer-driven
No market researchy

Concept
With
Substance



Thesis Thesis



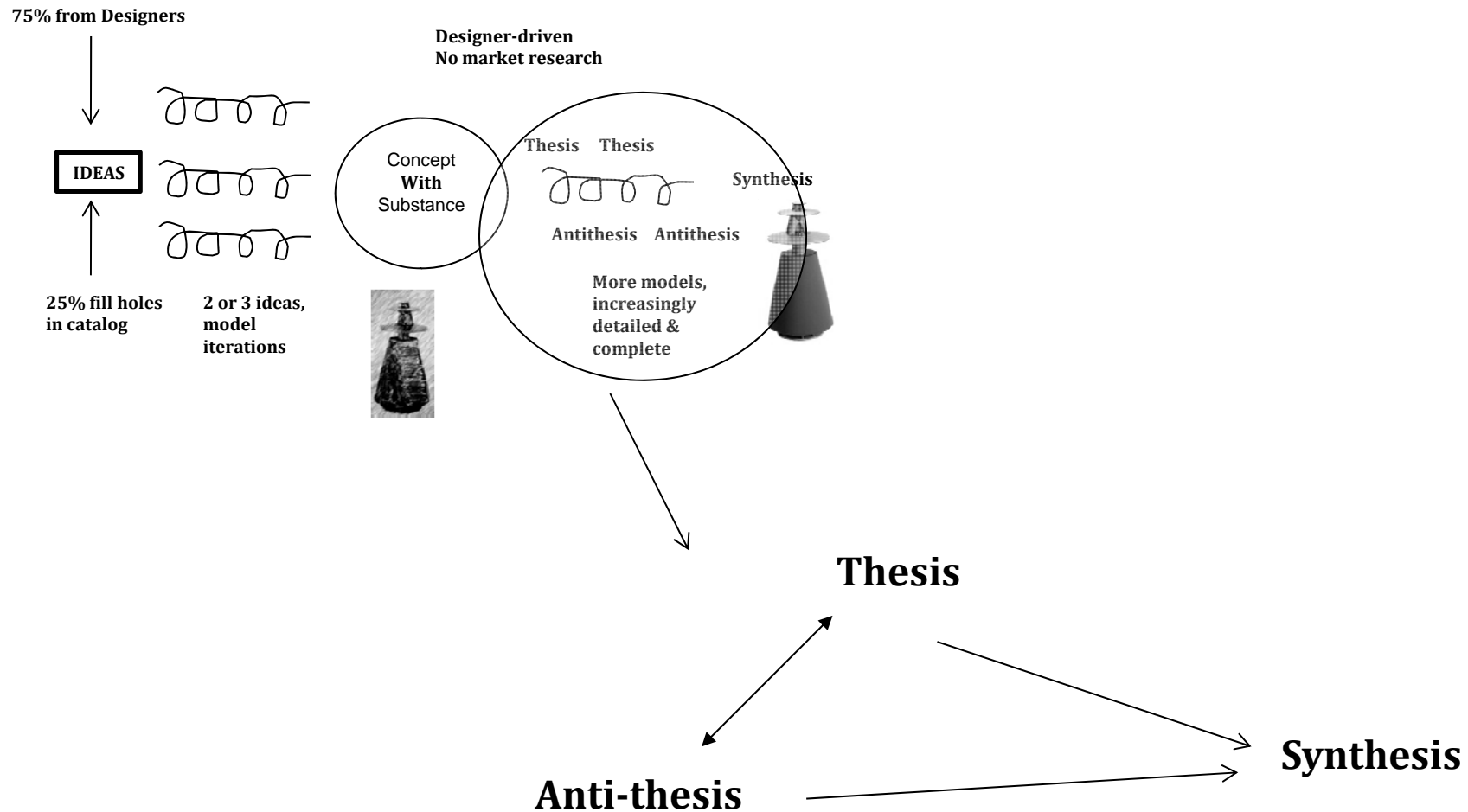
Antithesis Antithesis

More models,
increasingly
detailed &
complete

Synthesis

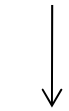


Bang & Olufsen



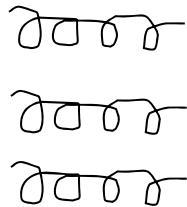
Bang & Olufsen

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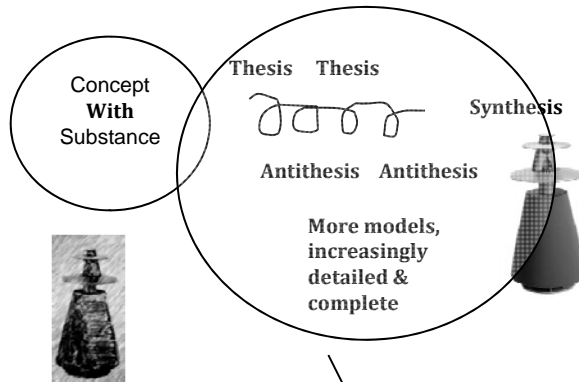
IDEAS

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2 or 3 ideas,
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Designer-driven
No market research



David Lewis

Form

Design

Thesis

Anti-thesis

Engineering

Function

**Synthesis
Product**

Torben Ballegard Soresen

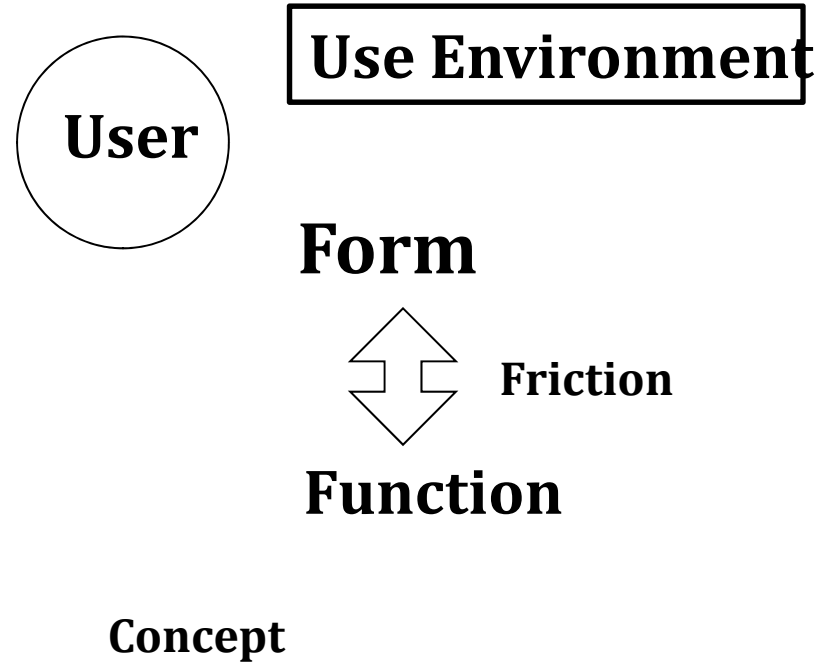
Christopher Sorensen

Design-oriented product development at B&O

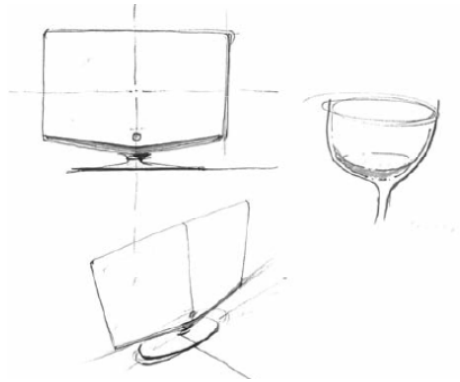
- Pros
 - Much more design-focused product development approach
 - Priorities given to the aesthetic appeal
- Cons
 - Difficult to cope with the digital change (e.g. iPod and related services) → Functional sacrifices?
 - Designers having too much inputs in the product (sometimes dominating the discourse)

Christopher Sorensen's IdeaLab efforts → failed

Design



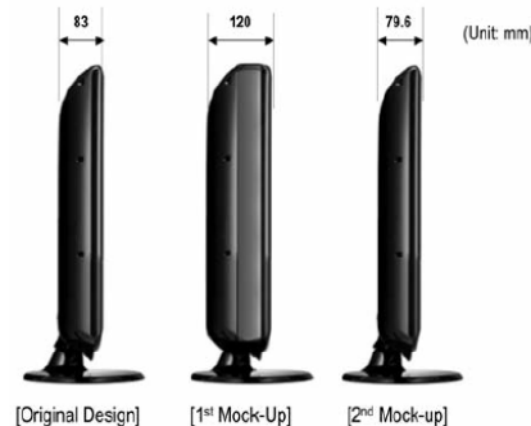
Design Oriented Product Development



Design concept: “thin” and “glossy” in an organic design that made the TV seem to be of one piece – front, back and stand

VIP Center: Developed the product concept

- Emotion and lifestyle
- Room decoration
- Picture & Sound etc. (functional)



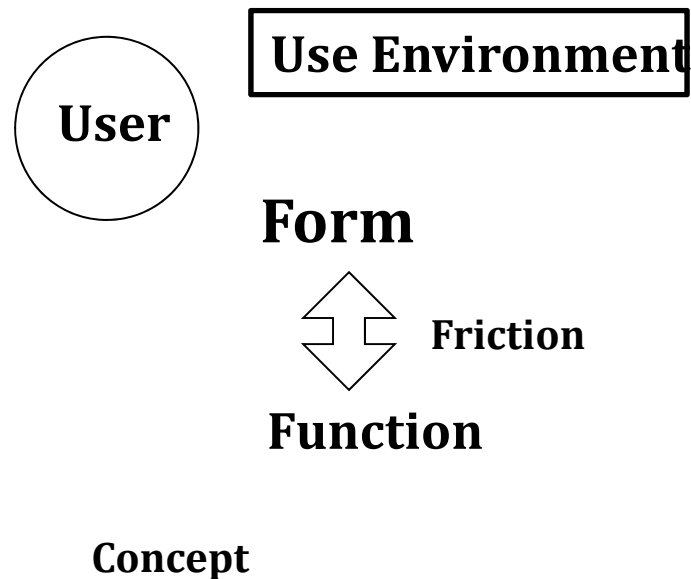
Engineering Challenges

1. Slimmer, Glossy throughout
2. Speaker holes
3. High glossy finish

Solution:

- Reducing the size of printed circuit board
- Integrated frame (speaker holes into the frame)
- New injection molding technique

Integration of form and function in the organization



- **Integration is like a seeding process**

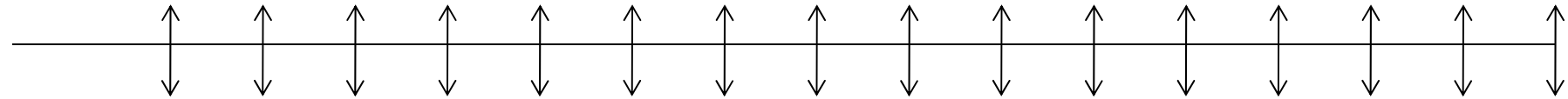
- Seed it and let it grow
- Rather than design and implement the perfect system

- **Seed What?**

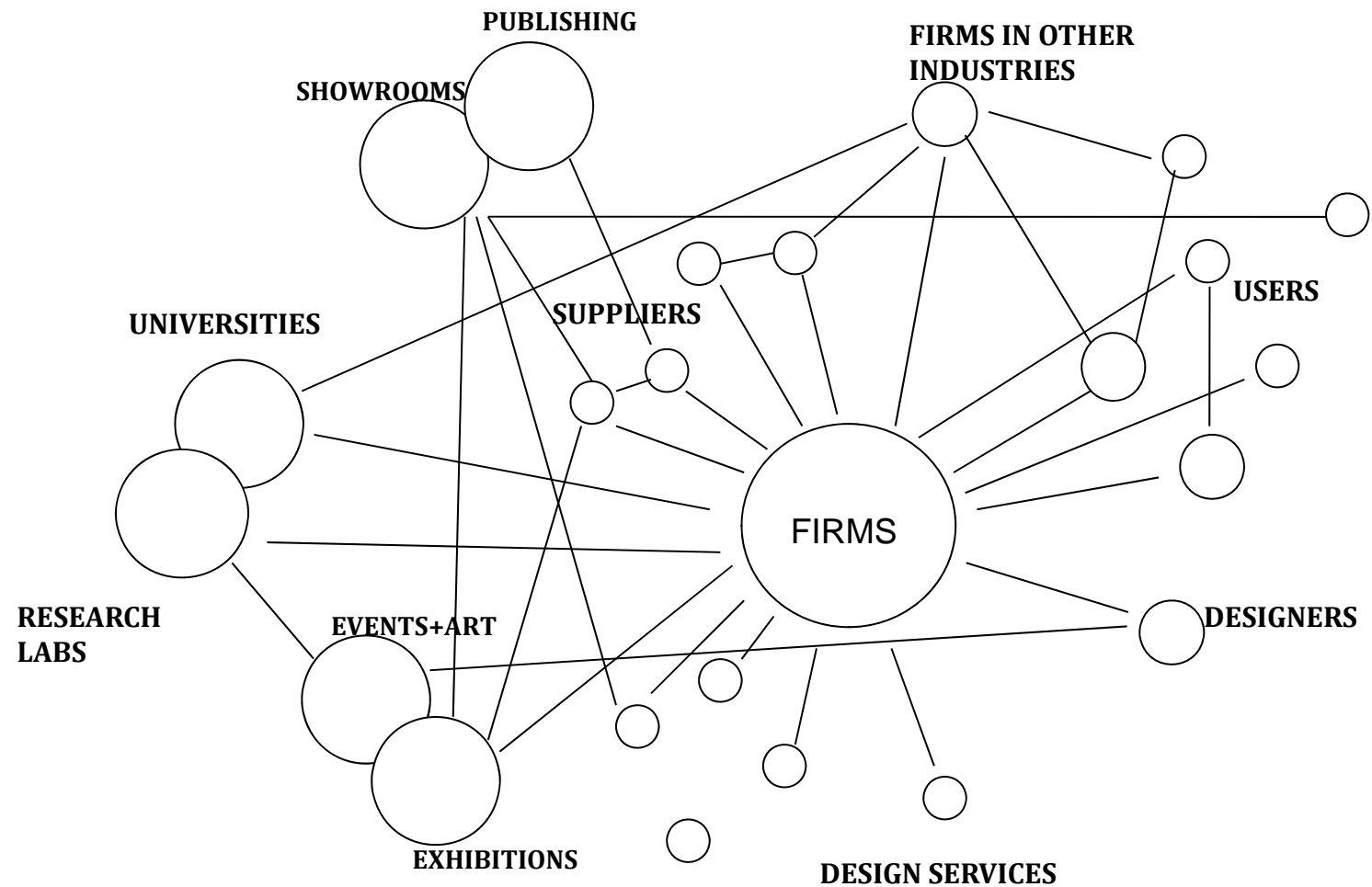
- Principles
- Consensus (people)
- Leadership
- Incentive system (rewards)

Actors in Lombardy System

Global
Discourse



Local
Discourse
談論

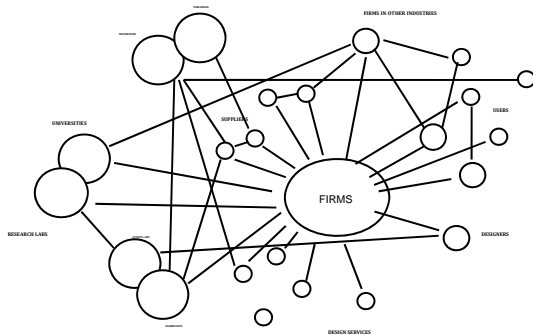


Alessi & Lombardy Design Discourse



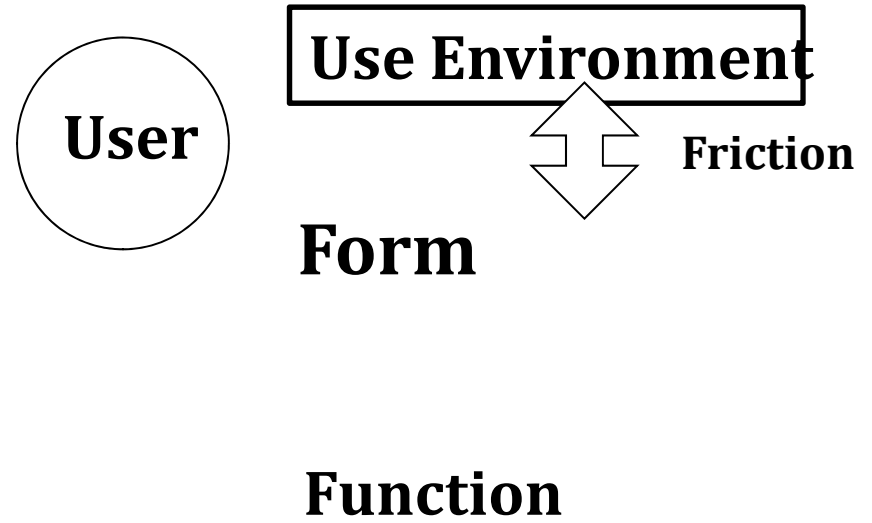
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Design



Internal vs. External Sources

Of the 157 cases studied by Myers and Marquis, how many innovations are evoked by information from sources outside the firm?

98 = 62%

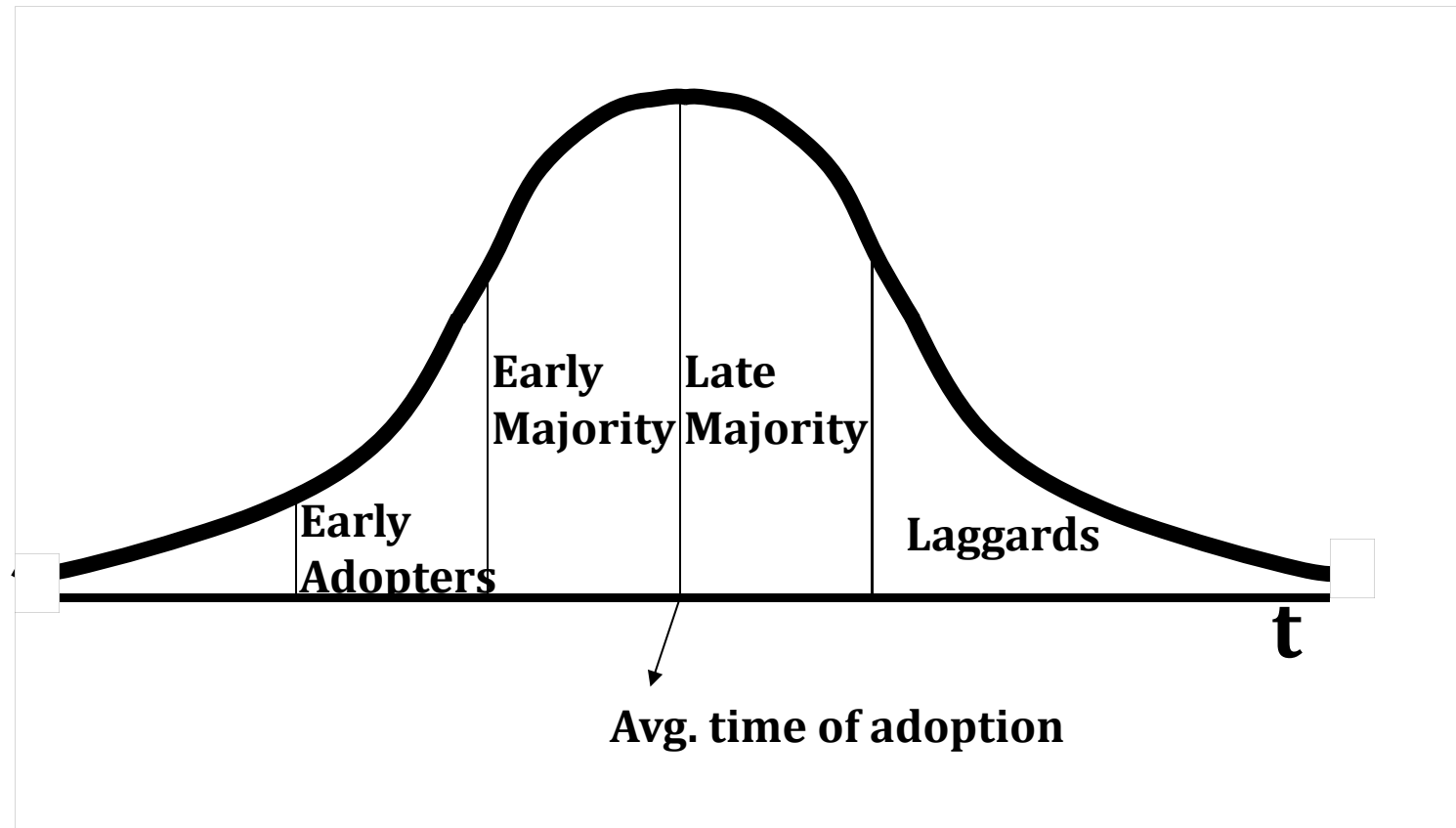
How about in the case of new scientific and measuring instruments?

39/59 ideas = 66%

Case of DuPont's major product and process innovations?

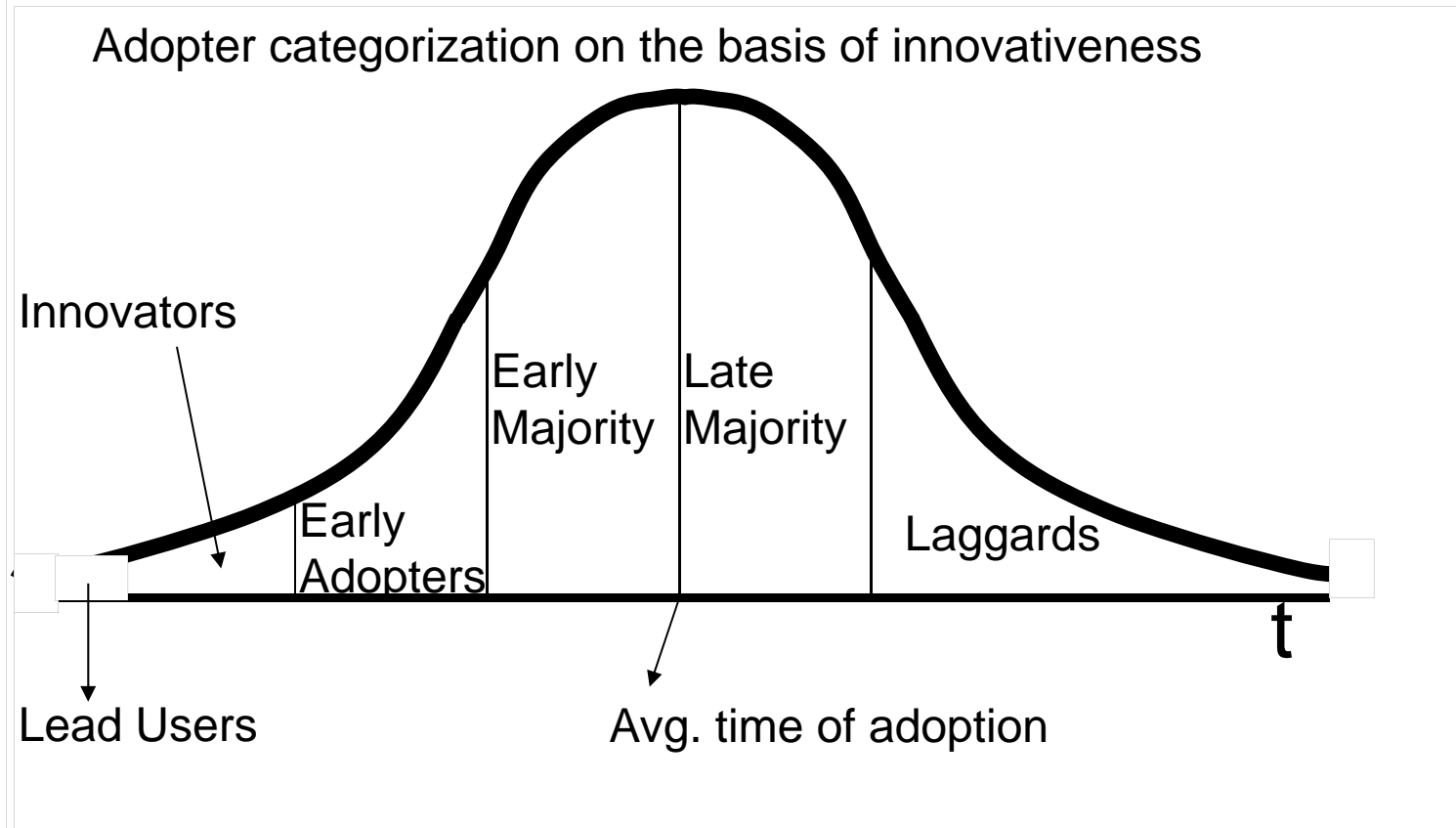
14/25 = 56%

Diffusion – An important part of the technological innovation



Source: Rogers (Diffusion of Innovation)

User Innovation - Another Important Factor



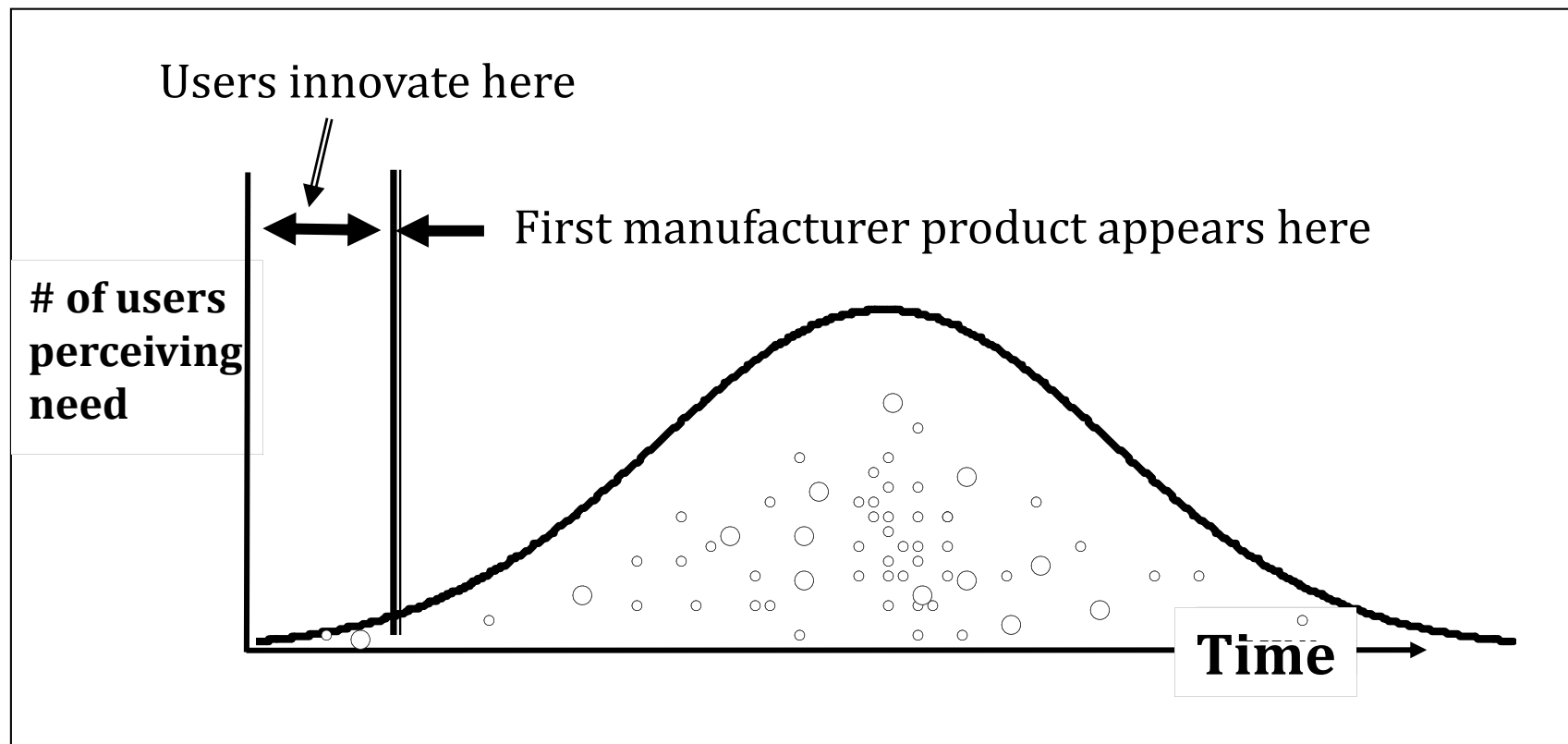
Source: Rogers (Diffusion of Innovation - modified)

Traditional, Manufacturer-Centered Innovation Paradigm

Manufacturers identify user needs, develop products at private expense,
And profit by protecting and selling what they have developed.

User-Centered (Democratized) Innovation Paradigm

Lead Users innovate to solve their own needs at private expense
- and then freely reveal their innovations



Source: Eric von Hippel's class – "How to create breakthrough products and services"

What is meant by “Innovation is becoming democratized?”

- **Increasing numbers of users are able to develop innovations *for themselves* at a steadily more professional level.**

Why?

- **Improvements in design tools via computing (like simulation)**
- **Improvements in communication (like the Internet)**
- **All being provided at lower costs**

Users at the leading edge are termed “lead users:” They (1) lead the market and (2) have a strong need

**John Heysham Gibbon – physician, USER -
inventor of the heart-lung
machine (Cardiopulmonary bypass
(CPB)).**

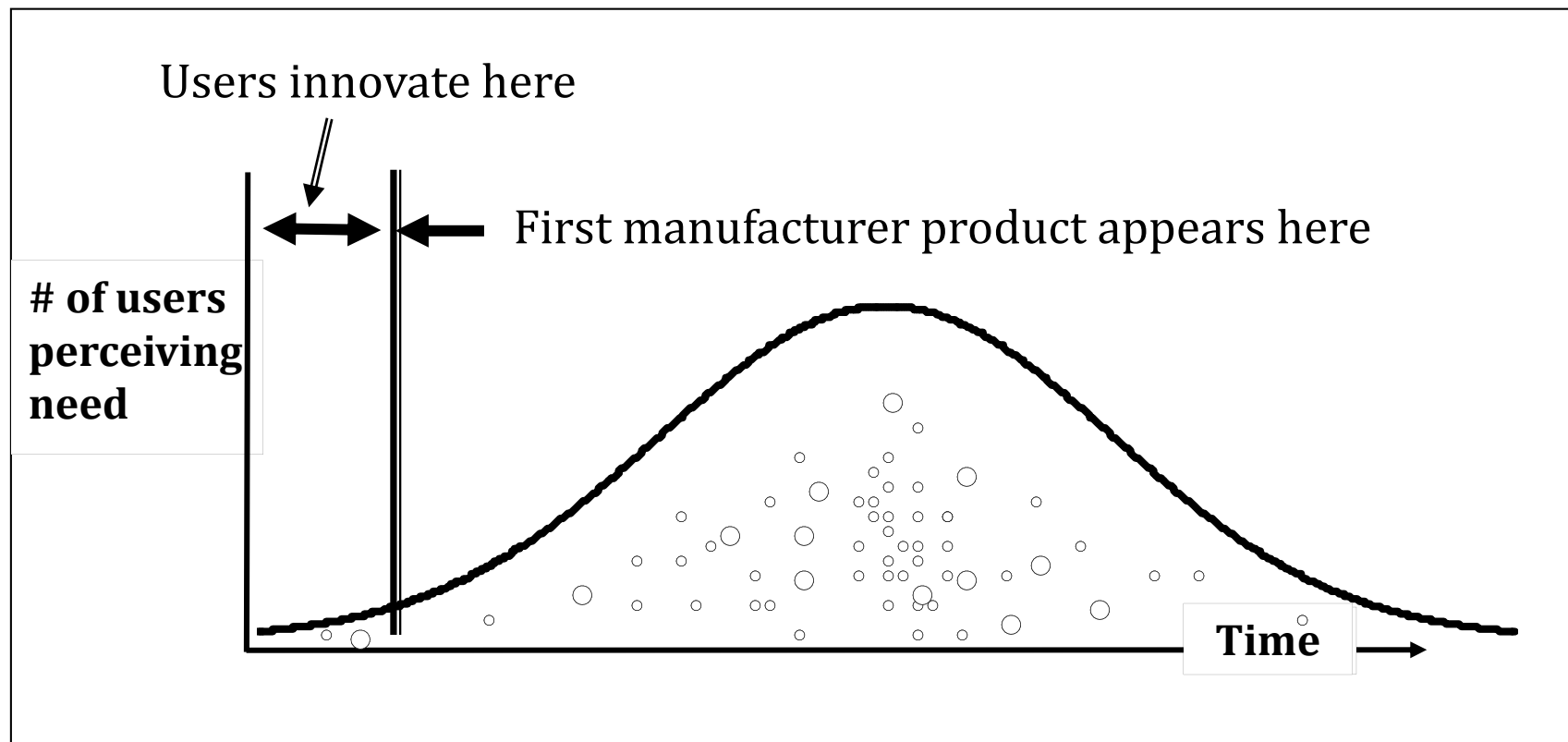
- **“The death of a young patient in 1931 motivated Dr. Gibbon to develop the first heart-lung machine, enabling more effective heart surgery techniques.**
- **Gibbon was dissuaded by all with whom he broached the subject, but he continued his experiments.**
- **In 1935 he successfully used a prototype heart-lung bypass machine to keep a cat alive for 26 minutes.... In 1953 first used a heart-lung machine on a human patient...**
- **Why did a *USER* have to develop the first heart-lung machine?**

**At the start of something really
new *there is no “proven” market!***



Users tend to innovate at the leading edge of markets where demand is both small and uncertain.

Manufacturers find this pioneering arena NOT attractive
– but later do adopt lead user innovations as a
feedstock for their commercial product developments

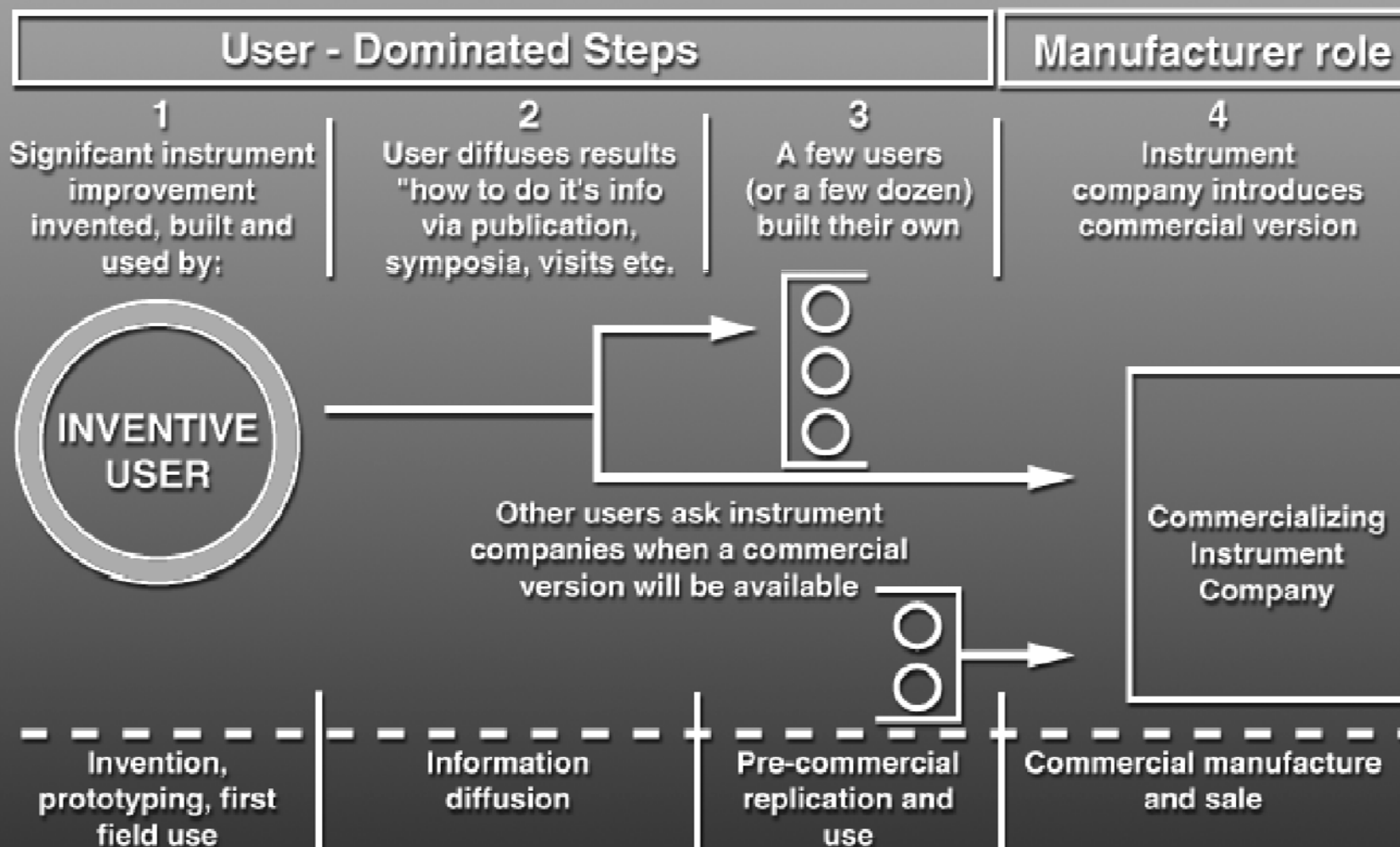


Source: Eric von Hippel's class – "How to create breakthrough products and services"

Essential Definitions

The “functional” source of innovation depends upon the *functional* relationship between innovator and innovation:

- An **INNOVATION** is anything new that is actually used (“enters the marketplace”) – whether major or minor.
- An innovation is a **USER innovation** when the developer expects to benefit by USING it;
- An innovation is a **MANUFACTURER innovation** when the developer expects to benefit by SELLING it.



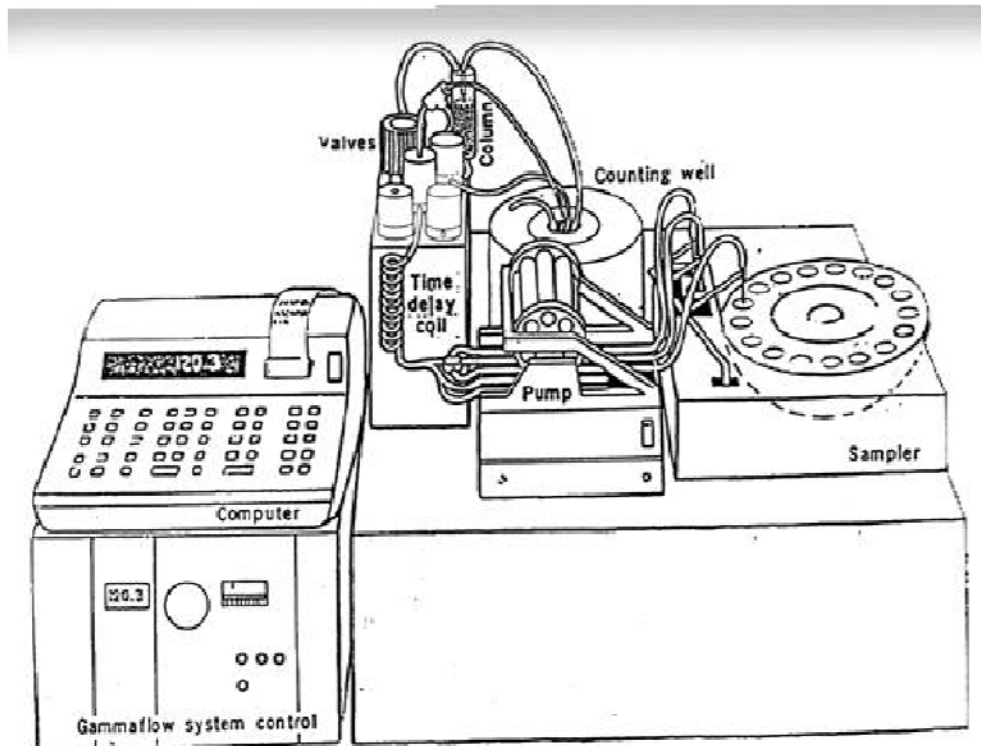
First device used in field developed and built by:

<i>Innovations Affecting</i>	% User	User	Mfg.
Gas Chromatography	83%	10	2
Nuclear Magnetic Resonance Spectrometry	80%	12	3
Ultraviolet Spectrophotometry	100%	6	0
Transmission Electron Microscopy	72%	44	17
Total	77%	72	22

User innovations don't look like “products” to manufacturers

Example: First completely automated radioimmunoassay system

First User-Developed Equipment



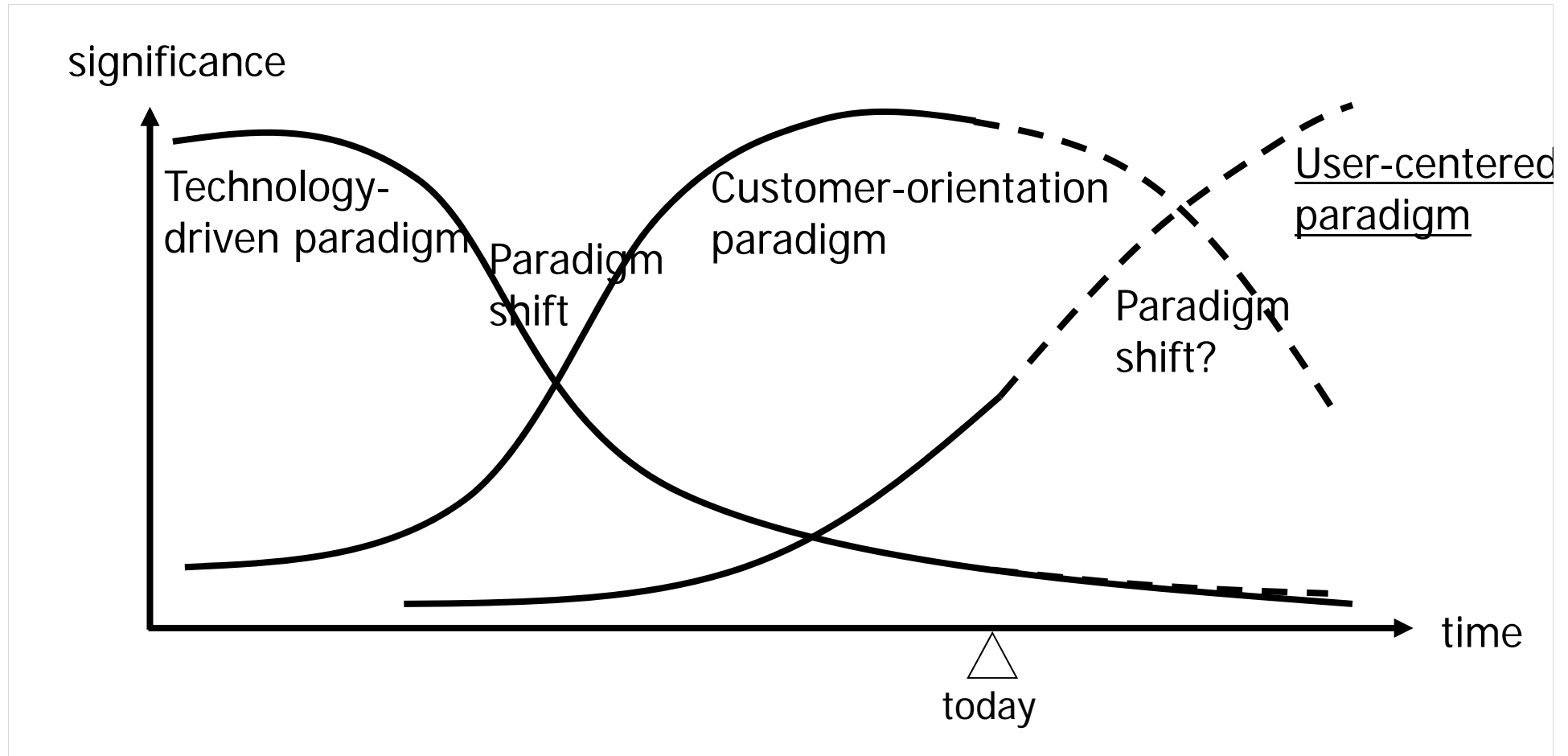
A Manufacturer's Product



Radioimmunoassay is a very sensitive technique used to measure concentrations of antigens (for example, hormone levels in the blood) without the need to use a bioassay. (source: wikipedia)

Paradigms in new product development

Past decades have seen different paradigms in new product development.



Source: Franke 2007

Source: Eric von Hippel's class – "How to create breakthrough products and services"

Consider Center-Pivot Irrigation – A major agriculture innovation

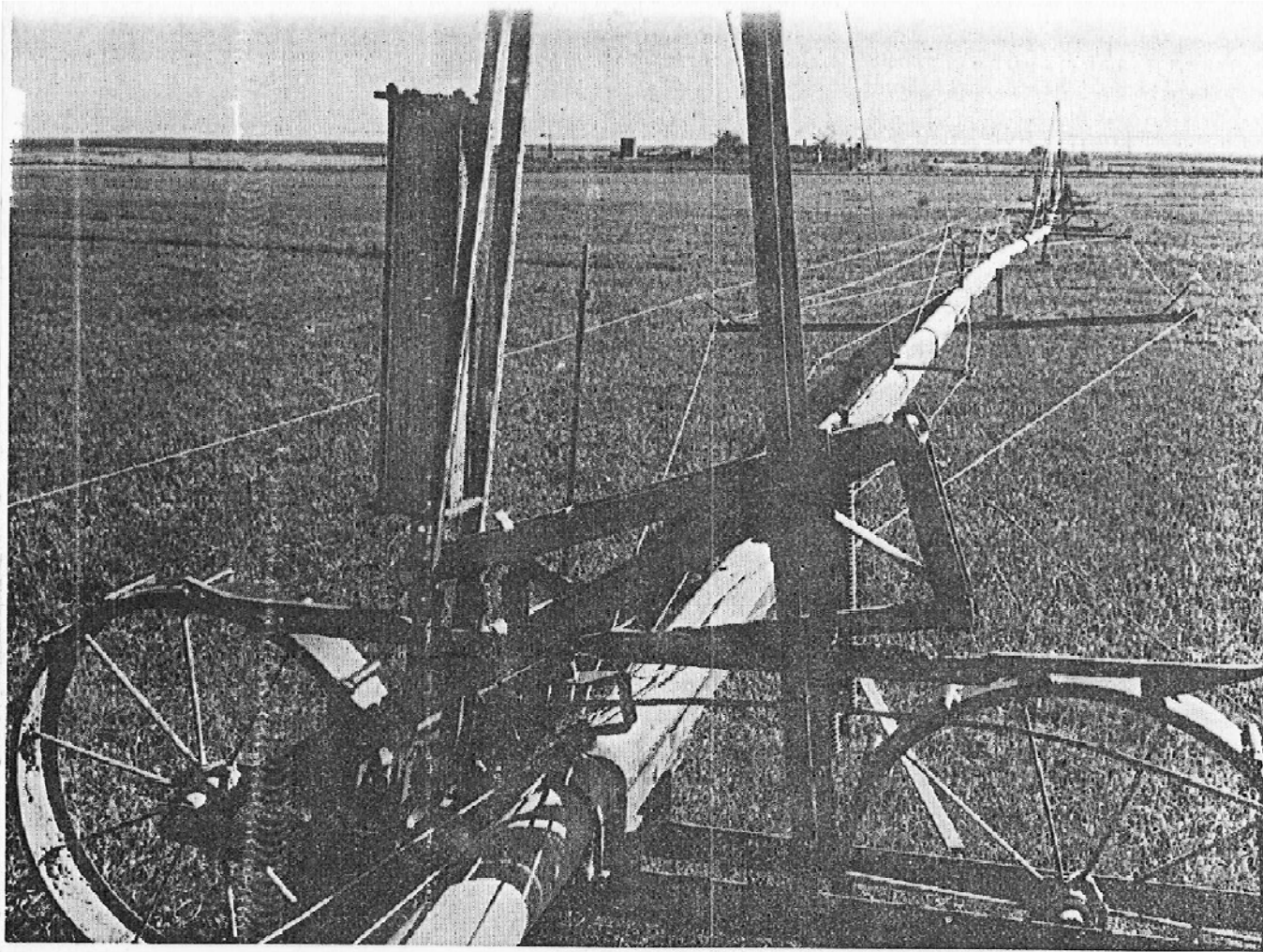


ANOTHER PERSPECTIVE on the complex of center-pivot systems at Kufra is provided by this oblique aerial photograph. Irrigated

fields here, supplied with water from a vast underground reservoir, are somewhat larger than usual, measuring almost a mile in diameter.

08

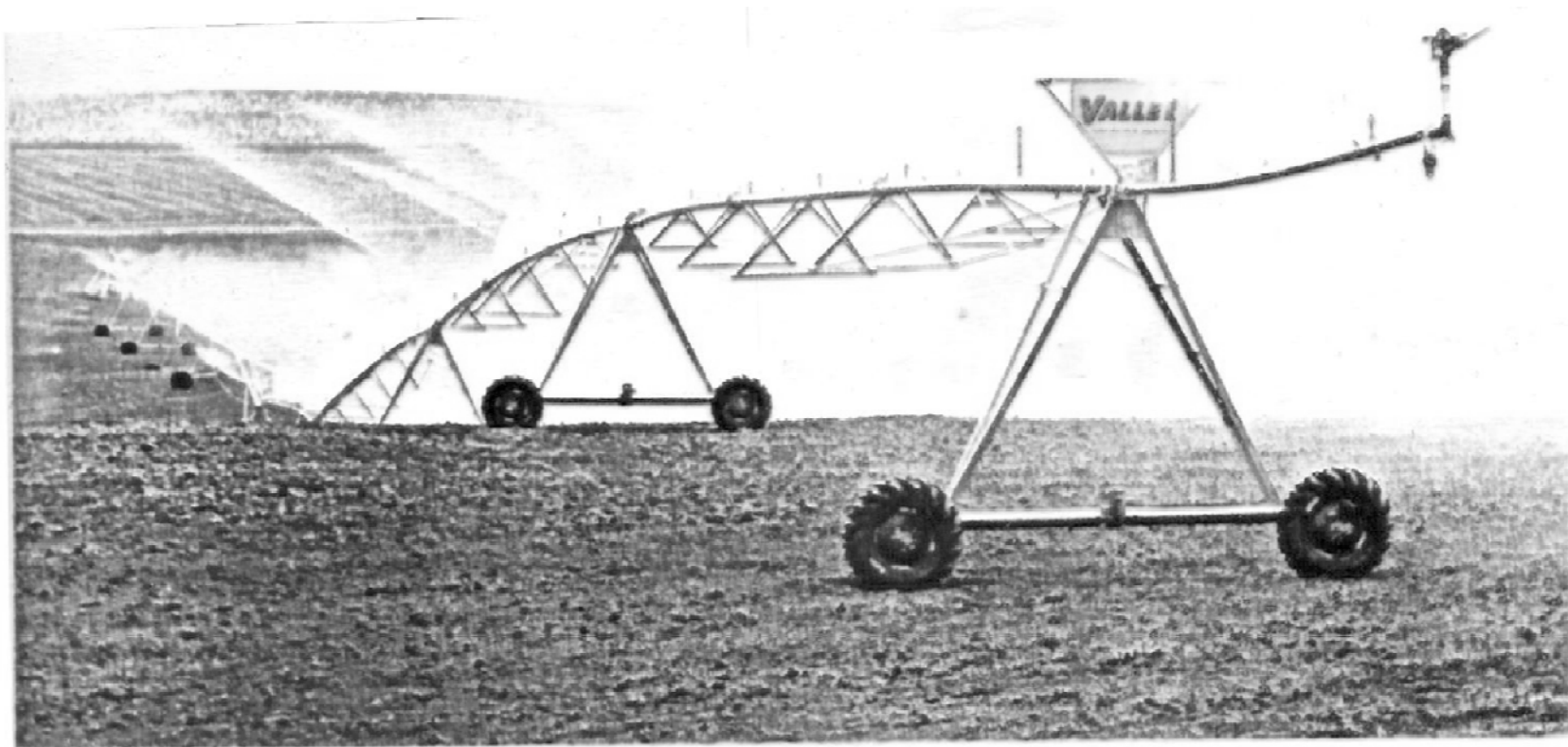
The original user innovation by a farmer



CLOSE-UP of one of the mobile towers of the original center-pivot machine shows the parts of the system with greater clarity. Water taken under pressure from the supply line powers a piston, which

ratchets the tower ahead by means of a mechanical device called a Trojan bar that engages lugs on both support wheels. The rate of advance is set by the flow of water into the piston at outermost tower.

The product-engineered commercial version



GROUND-LEVEL VIEW of a recently installed center-pivot system demonstrates its ability to accommodate to rolling terrain. The

wheeled towers in this example are driven by electric power. The photograph was supplied by Valmont Industries, Inc., of Valley, Neb.

The World Wide Web – A Lead User Innovation

“Berners-Lee did not set out to invent a contemporary cultural phenomenon; rather, he says, “it was something I needed in my work.” He wanted to simply to solve a problem that was hindering his efforts as a consulting software engineer at CERN.

Berners-Lee’s innovation was to apply hypertext to the growing reality of networked computers. He expanded the idea he had developed at CERN and made it available on the Internet in the summer of 1991.

Technology Review, July 1996, p.34

Source: Eric von Hippel’s class – “How to create breakthrough products and services”

Examples of Important Consumer Product Innovations

Category	Example
Health Products	Gatorade
Personal Care	Protein-base Shampoo Feminine Hygiene
Sports Equipment	Mountain Bike Mountain Climbing-Piton
Apparel	Sports Bra
Food	Chocolate Milk Graham Cracker Crust
Office	White-out Liquid
Computer Application Software	Electronic Mail Desk Top Publishing

Source: Eric von Hippel's class – "How to create breakthrough products and services"

Users aren't always the innovators

<u>Innovations Samples:</u>	<u>User</u>	<u>Manufr</u>	<u>Suplr</u>	<u>Other</u>	<u>NA</u>	<u>Total (N)</u>
Scientific Instruments	77%	23%	-	-	17	111
Semicon & PC Crd Process	67%	21%	-	12%	6	49
Pultrusion Process	90%	10%	-	-	-	10
Tractor Shovel Related	6%	94%	-	-	-	11
Engineering Plastics	10%	90%	-	-	-	5
Plastics Additives	8%	92%	-	-	4	16
Industrial Gas-Using	42%	17%	33%	8%	-	12
Thermoplastic-Using	43%	14%	36%	7%	-	14
Wire Stripping Equip	25%	75%	-	-	2	8
Connector Attaching Equip	4%	13%	83%	-	-	12
Sports Equipment	58%	27%	-	15%	-	48

Source: Eric von Hippel's class – "How to create breakthrough products and services"

User and manufacturer innovations *differ*

Users tend to develop Novel Functional Capability innovations:

- **The first sports-nutrition bar**
- **The first scientific instrument of a new type**

Manufacturers tend to develop Dimension of Merit Improvements:

- **A better-tasting sports-nutrition bar**
- **Improvements to an existing type of scientific instrument**

Example – Study of Scientific Instrument Innovations

New functional capability	82% user-developed
DOM improvements	87% mfr-developed

Total innovation sample size: $n = 64$

Source Riggs & von Hippel (1994)

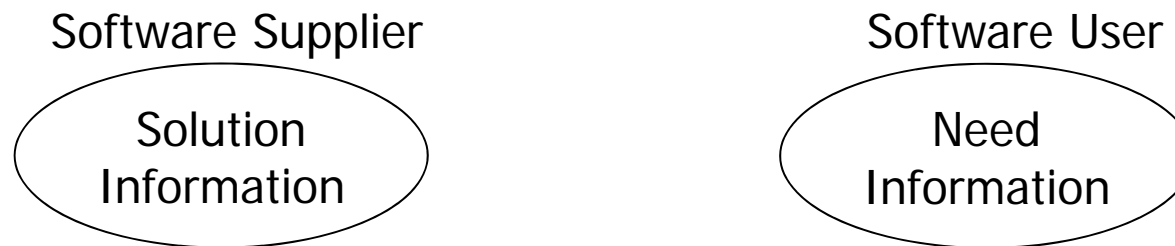
Sticky information affects who develops what

Information is often very “sticky.”

Some reasons:

- Information needed by developers may be *tacit*
 - Can you tell your child how to ride a bike?
- A *lot* of information is often needed by developers
 - “You didn’t tell me you were going to use the product *that* way!”

To develop a product or service, information about needs and about solutions must be brought together at a single site.



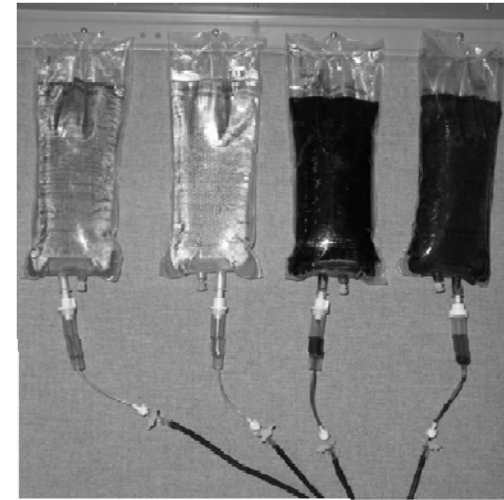
Because of information is sticky, each user responds to local needs using local solution information

**U.S. Troops Make Use
of Water Gear**
The New York Times
July, 2003

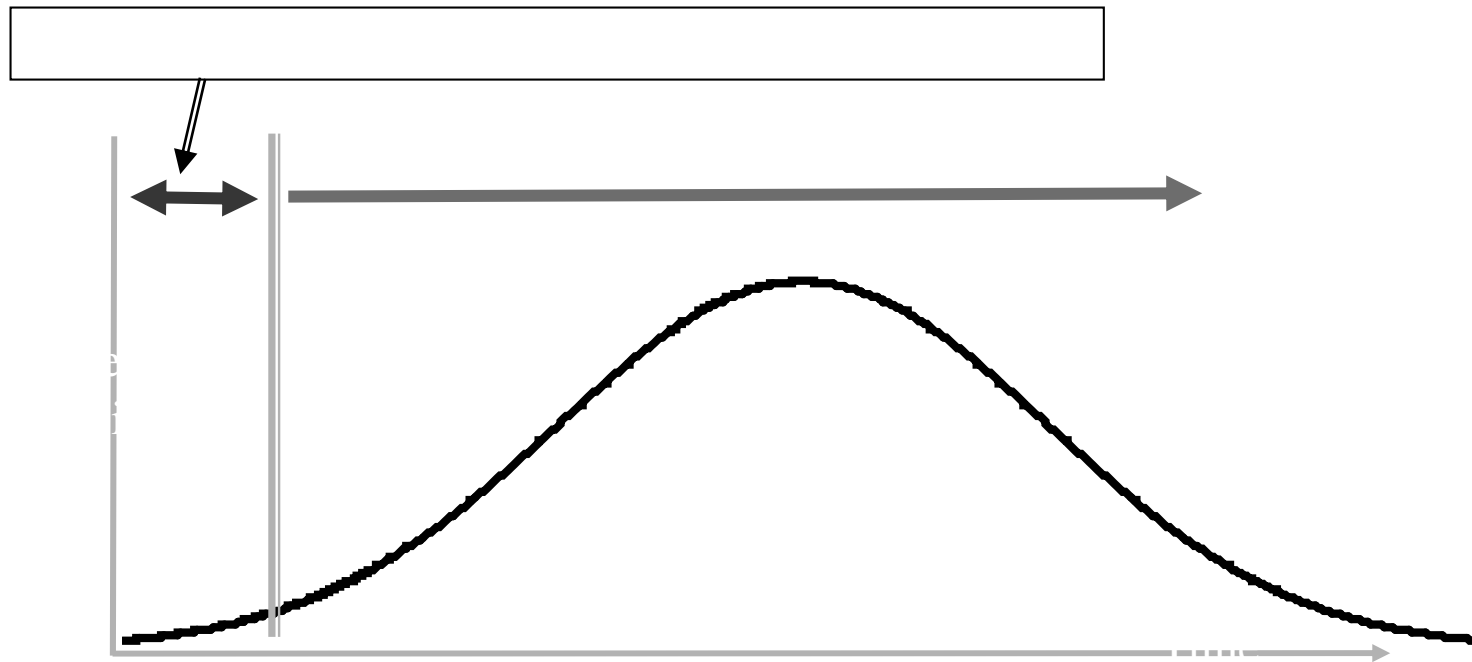
Many troops have custom
backpacks that serve as
personal water-carrying and
drinking systems.

Camelbak's patented
"personal hydration system"
was invented in 1988 by a
Texas paramedic, Michael
Edison.

To prevent dehydration during
a summer bike race, he
fashioned a drinking system
from surgical tubing and an IV
bag that he sewed to his shirt.



Lead users are *now* facing “emerging needs”



**NOT all user innovations are LEAD user innovations –
It is the MANUFACTURER’S job to figure out which ones are
at the leading edge of an important market trend**



User Conversion of a Model T Ford into a snowmobile



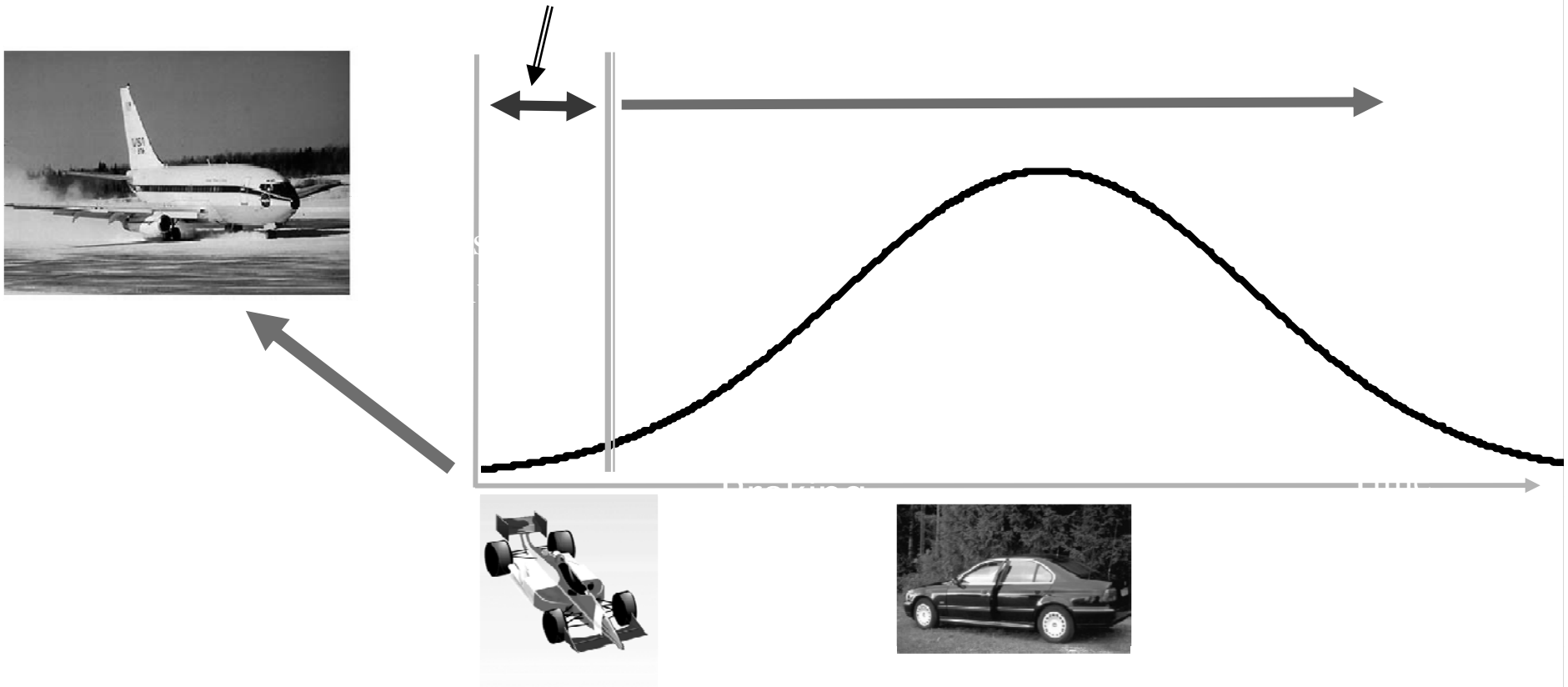
Source: Eric von Hippel's class – "How to create breakthrough products and services"

User Conversion of a Model T Ford into a traveling chapel



Source: Eric von Hippel's class – "How to create breakthrough products and services"

Breakthrough solutions are often found in “advanced analog” applications and markets



Source: Eric von Hippel's class – "How to create breakthrough products and services"

Harnessing the Capability of Users

threadless

tVPeTEs

Select

KIDS!

Login

JOIN NOW!

threadless
Nude No More

Guys

Girls

Participate

Info

0 Items in your cart!
CHECKOUT


ORDER STATUS | SERVICE & HELP

Google Custom Search

Search


Search options

New tees for THURSDAY, OCTOBER 1




\$18 Reprint

NOT
Aled Lewis




\$18 Reprint

The Gaming Revolution
by Robert Muri




\$18 Reprint

Let It Grow by Florence



\$18 Classic



Rock Out
by Simon Massey Di
Vallanza



\$18 Classic

Pandemonium by Ross
Zietz

New tees for MONDAY, SEPTEMBER 28



\$2,500+ Fame.

Design the next 'POP' masterpiece
for the Tate Modern! ▶

Submit ideas now - October 29th

HUH? THREADLESS?

Threadless is a community based tee
shirt company with an ongoing, open
call for design submissions.

IF YOUR DESIGN IS CHOSEN
FOR PRINT, GET PAID UP TO

\$2,500+

\$500 PER REPRINT

With a chance to win over \$22,500 in
our Annual Bestee awards!

→ LEARN HOW TO GET STARTED!

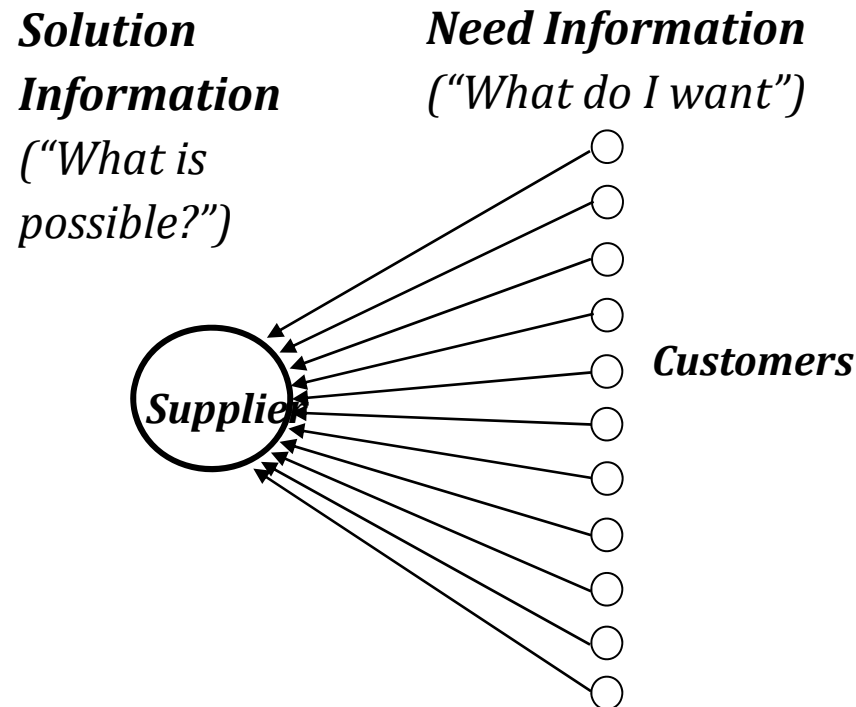
New tees and prints
EVERY MONDAY!

Join the newsletter to stay in the loop!

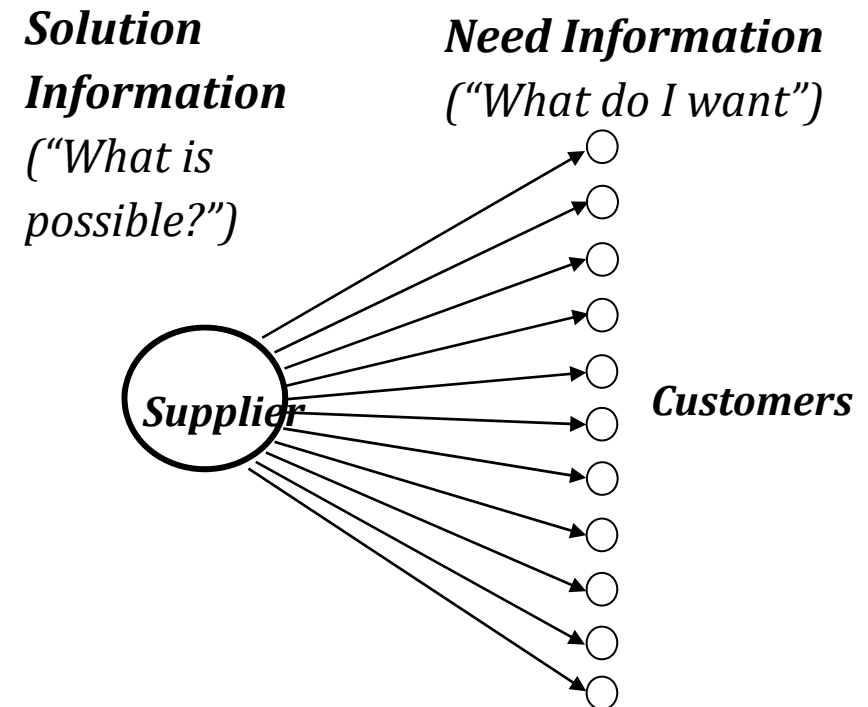
Enter your email address... Join

Toolkits – the basic idea

The standard, “find a need and fill it” product development model



The toolkits development model



Toolkits make sense because collecting accurate Information about customers needs is costly

The “sticky information” story

To develop a product or service, information about needs and about solutions must be brought together at a single site.

- **Need** information is usually found at user sites.
- **Solution** information is usually found at manufacturer sites.



Manufacturer-Based Design

Manufacturer design tasks

- Have solution information
- Acquire *need info* from user
 - Design product

User design task

Need Info
Source



User-Based Design

Manufacturer design task

Solution
Info
Source



User design tasks

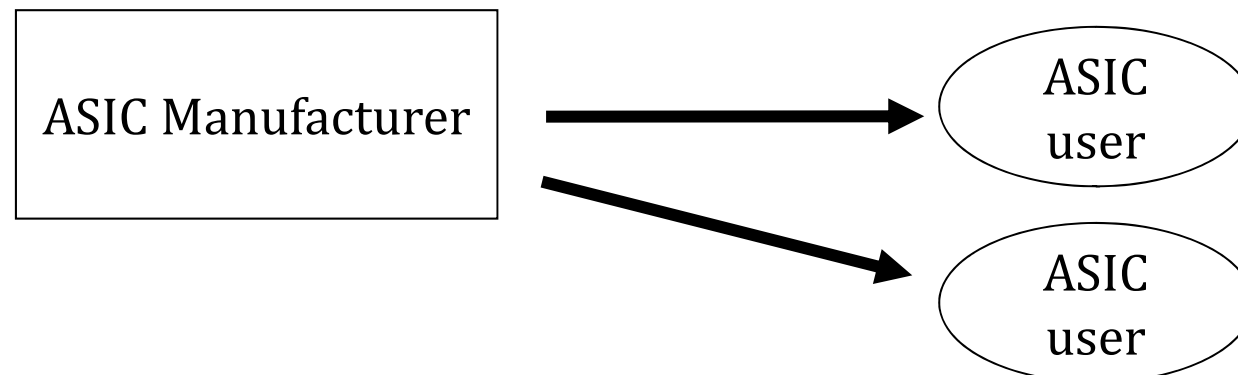
- Have need information
- Acquire solution information
- Design product

Why sticky information means manufacturers should transfer toolkits to users

Economics of sticky information tends to shift the locus of problem-solving to users. For custom design projects, manufacturer information is standard from project to project but user need differs

Example:

Each ASIC design tends to require the same information from the ASIC manufacturer, but unique information from the ASIC user.



How do you design a toolkit?

There are two major tasks

A. Separate out development tasks that are custom “need-information –intensive” and assign those to users.

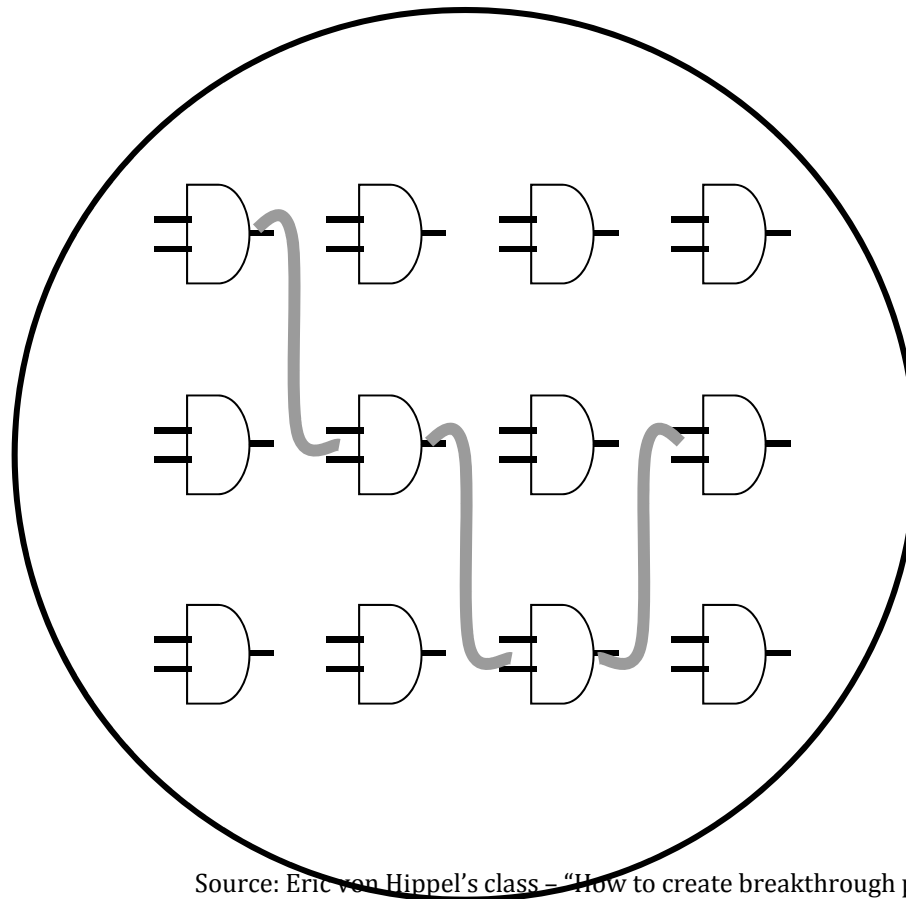
Impact on Product architecture can be major

- Custom cake vs custom pizza;
- “Full-custom” IC vs custom ASIC

B. Develop the tools users need to carry out the need-intensive tasks assigned to them.

You might have to change the basic design of your product to enable toolkits your customers can easily use

“Full-custom” IC Design vs “Gate Array IC Designs”



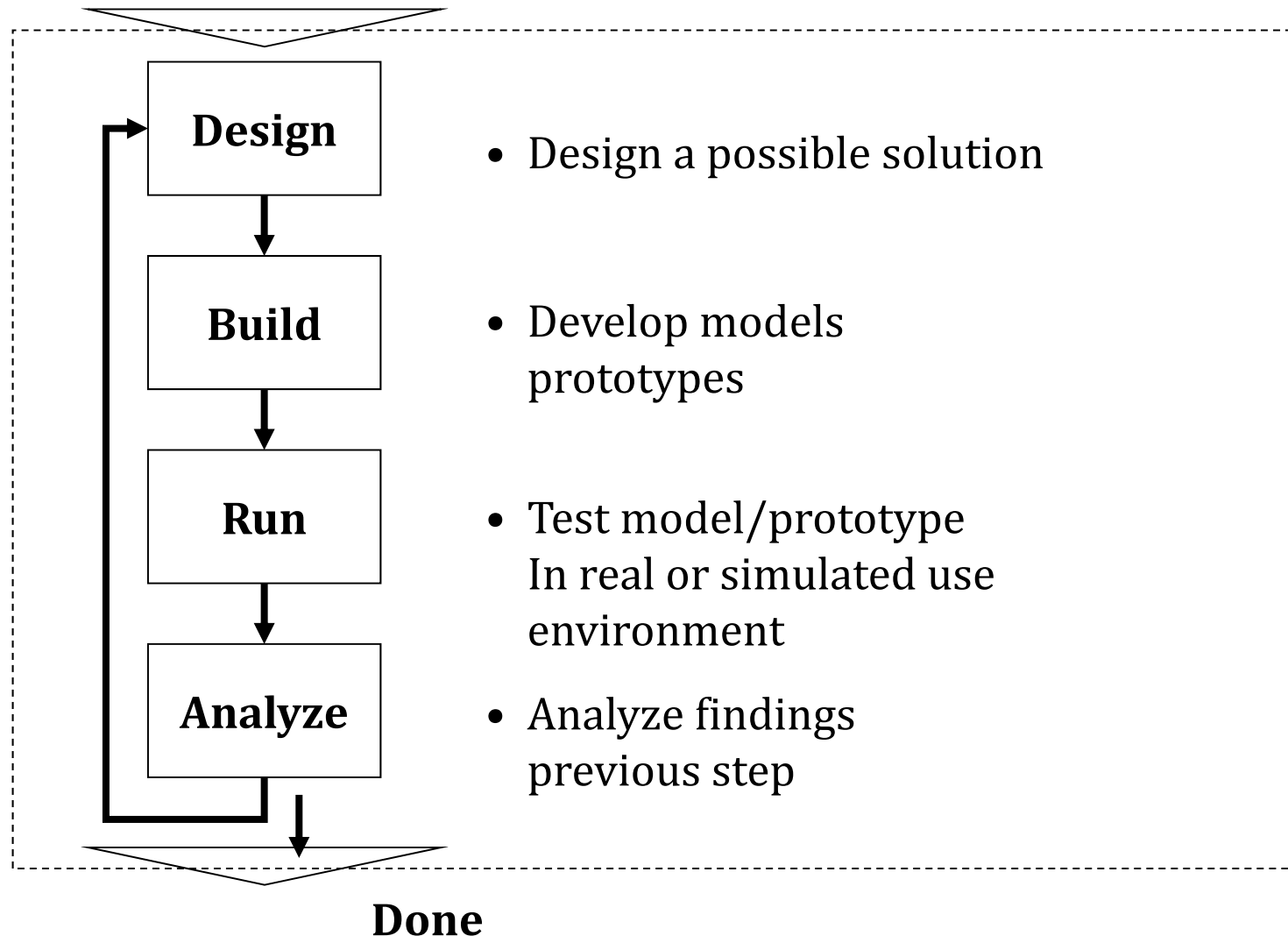
Source: Eric von Hippel's class – "How to create breakthrough products and services"

(B) Toolkits for users contain:

Tools to carry out trial-and-error design:

1. That are “user-friendly”
2. That offer the right “solution space”
3. That offer libraries of pre-designed modules
4. That can translate from user-language to producer language without error

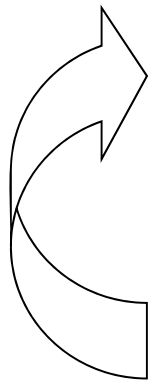
Toolkits should help users to do the trial-and-error work of problem-solving in design



Source: Eric von Hippel's class – "How to create breakthrough products and services"

Tools to enable user to carry out design by trial-and-error

Four steps in trial-and-error-process:



Design

Build

Test

Analyze

ASICs example

Design custom circuit

Create functioning prototype

Take prototype for a “test drive”

Compare expected and actual results. If needed, do trial-and-error cycle again. (“Iterate”)