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Why do users innovate for themselves rather than buy?
Low-cost innovation niches

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Essential Definitions (again)

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

- 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.

We will cover two issues today:

Two major factors that affect users' decisions to innovate or buy

- Transaction costs
- The number of users that want the same product

The *kind* of innovations that users develop in their "low cost innovation niches" is affected by:

- Sticky information
- Learning by doing

Transaction costs

- If you have the money to pay for a just-right product made just for you – can you find a manufacturer willing to build it for you?

    - If you want a "just-right" auto, should you call General Motors? What will they say if you do?

    - If you want a "just-right" auto, should you call a custom car builder? Will they be willing to make exactly what you want?

What are agency costs?

Agency costs are:

(1) Costs incurred to monitor the agent to ensure that it follows the interests of the principal,

(2) Cost incurred by the agent to commit itself not to act against the principal's interest (the "bonding cost"),

(3) Costs associated with an outcome that does not fully serve the interests of the principal.

Agency costs induce manufacturers to not quite build what is precisely right for you

- Users want to get their precise need specification met – because that is a lower-cost solution for them.

  – For example, a tennis player wants to get a racket that works better with his or her already-ingrained hitting technique. A precisely-right racket is cheap relative to relearning how to hit.

- Manufacturers want to apply a solution that they "have in stock" and understand well – because that is low cost for them.

  – A metal tennis racket maker will not want to make you a carbon-fiber racket – even if carbon fiber would be a better solution for you as a custom buyer – but they won't tell you that!

  – A disk drive maker will not want to make you a semiconductor memory, even if that solution fits your needs better…

Another agency cost. Manufacturers must invest in quality signals where users don't – Helping users to sometimes make cheaper solutions for themselves

- A user can put a cheap part into an expensive product they own and know the quality is good. "Look, I saved $200! I replaced my BMW's leaking window washer fluid tank in 5 minutes with a recycled plastic milk bottle. It works perfectly!

- A manufacturer can't. "BMW factory special!
    - 7 Series window washer fluid tanks are now made from used plastic milk bottles!
    - Engine electronics are now from Lego Mindstorms kits instead of Bosch!
    - Factory tests show both work perfectly!

Model shows users can always make a unique product more cheaply for themselves than a custom manufacturer can make it for them when there are transaction costs – and there always are!

- Assume both user and manufacturer are hiring from the same pool of designers to design the custom product.
  - V_{ij} is the value of a solution to problem j for user i.
  - N_j is the number of users having problem j.
  - Wh_j be the cost of solving problem j, where W = hourly wage and h_j = hours required to solve it.
  - P_j is the price charged by a manufacturer for a solution to problem j.
  - Let T be fixed or "setup" transaction costs, such as writing a general contract for buyers of a solution to problem j.
  - Let t be variable or "frictional" transaction costs, such as tailoring the general contract to a specific customer.

Portion of Baldwin – von Hippel model of innovate or buy (See Chapter 4 in Democratizing Innovation)

- A user has no transaction costs in dealing with itself, so a user's payoff for solving problem *j* will be *Vij – Whj*. Therefore, a user will buy a solution from an upstream manufacturer rather than develop one for itself if and only if *Pj ≤ Whj*.

- *Assume t* = 0 but *T* > 0. Then, the manufacturer's payoff for solving problem *j* will be *Vij – Whj,* which needs to be positive in order for the manufacturer to find developing the innovation attractive.

- *Nj Pj – Whj – T* > 0. But, as we saw, *Pj ≤ Whj* if the user is to buy, so we may substitute *Whj* for *Pj* in our inequality. Thus we obtain the following inequality as a condition for the user to buy: *Nj*(*Whj*) – *Whj – T* > 0, or *Nj* > (*T / Whj*) + 1.

- In other words, Baldwin and I find that the absolute lower bound on *N* is greater than 1. This means that a single user will always prefer to solve a unique problem *j* for itself (except in Coase's world, where *T* = 0, and the user will be indifferent). If every problem is unique to a single user, users will never choose to call on upstream manufacturers for solutions.

It pays users to innovate rather than buy at the leading edge of markets – where N is small! When N > 1 due to high transaction costs, user communities are the cheapest innovation solution
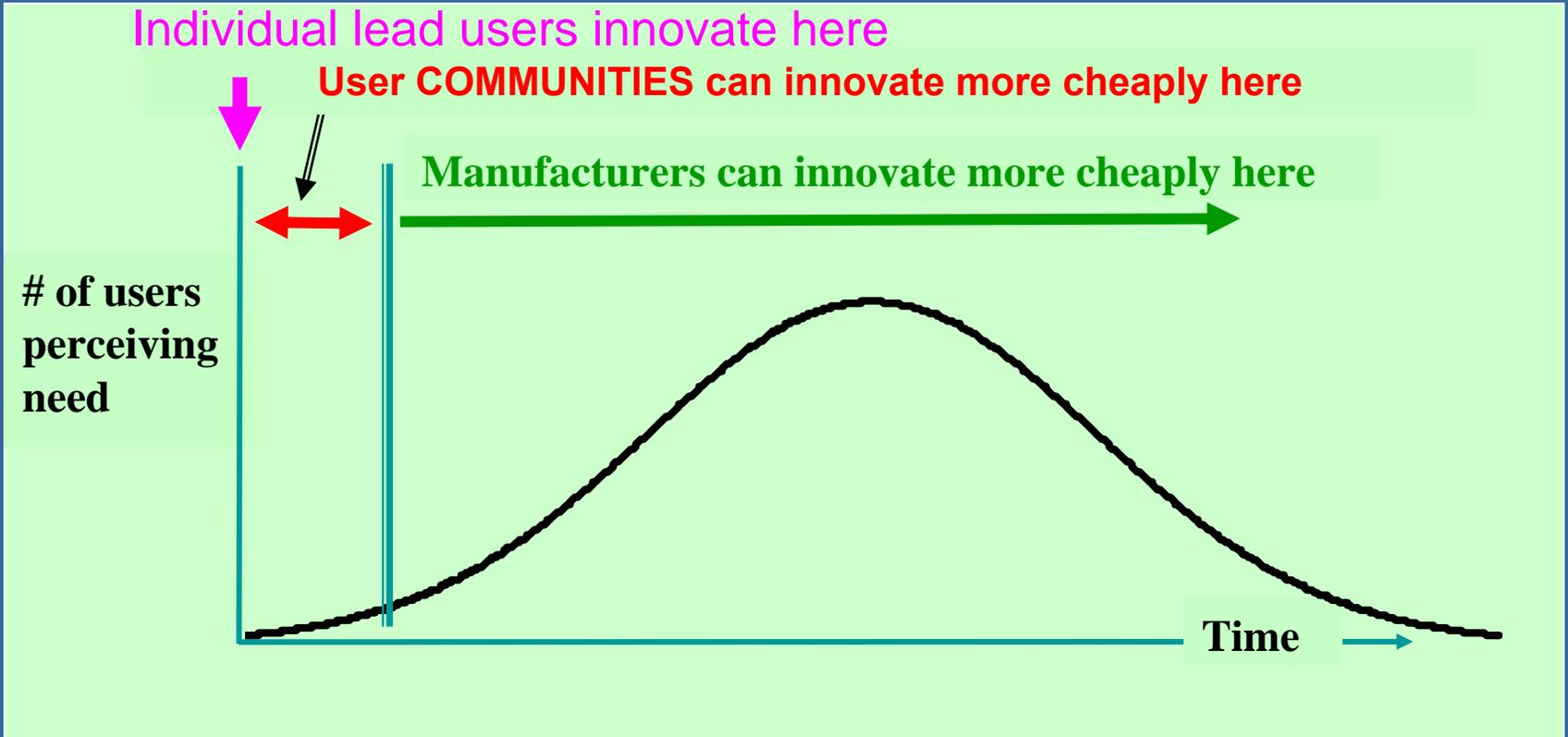
Data supports the model:
Users aren't always the innovators

Innovations Samples:	User	Manufr	Suplr	Other	NA	Total (N)
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

User and Manufacturer Innovations Differ in ways that information asymmetries would predict

Users tend to develop **Functionally Novel** 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

Sticky information leads to information asymmetries and additionally affects who develops what

Information is often very "sticky."

Some reasons:

- Information needed by developers may be *tacit*
  - Can you <u>tell</u> 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.

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

Software Supplier

Solution
Information

Software User

Need
Information

Studies show this effect clearly

Sample of 24 inventory control system innovations by Seven-Eleven Japan and NEC

| Stickiness of Technology Information | **−** → | Amount of Technology Design Done by the User |

| Stickiness of User Need Information | **+** → | Amount of User Need Design Done by the User |
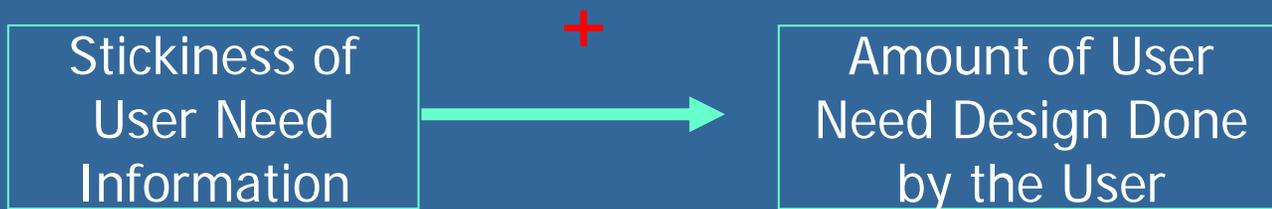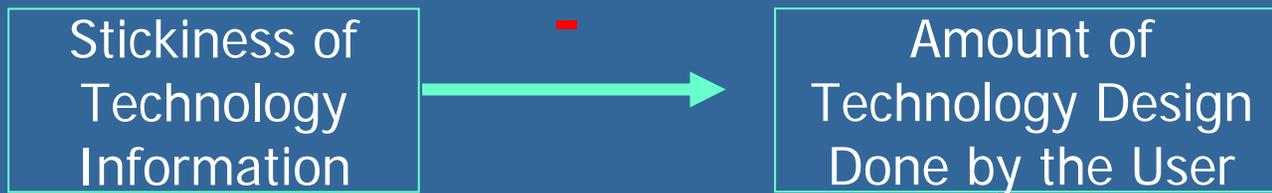
+ = positive influence; - = negative influence

Source: Ogawa, Research Policy 1998

Product or service design tends to move to the site of the crucial sticky information

Manufacturer-Based Design (DOM products)

Manufacturer design tasks

User design task

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

⬅

Need Info
Source
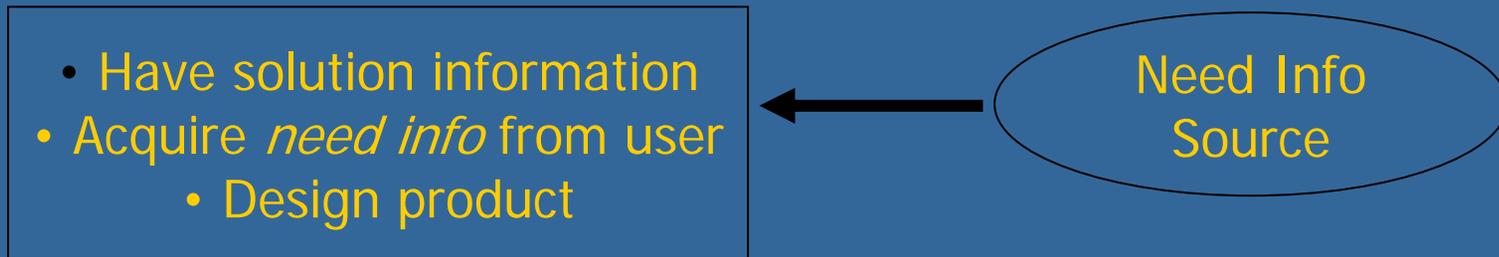
User-Based Design (Functionally novel products)

Manufacturer design task

User design tasks

Solution
Info
Source

➡

- Have need information
- Acquire solution information
- Design product

Example of the impact of sticky information on the locus of innovation:

Fifty percent of all prescriptions written in the U.S. are written for "off-label" uses of prescription drugs

- **New prescription drugs are generally developed in the labs of pharmaceutical firms** – sites where much specialized information about drug development has been build up over the years.

- **Off-label applications are generally found by patients and physicians.** They apply the drugs many times under widely varying field conditions – and discover unanticipated positive (or negative) effects thereby. ("Doctor: this blood pressure medication you gave me is causing my hair to regrow!")

Because information distribution is asymmetric, user innovation is widely distributed – a few "super users" do NOT do all the innovation

Few users developed more than one major commercialized innovation

	Number of users developing this Number of major innovations					
Innovation Type	1	2	3	6	na	(n)
Scientific Instruments*	28	0	1	0	1	32
Scientific Instruments**	20	1	0	1	0	28
Process equipment***	19	1	0	0	8	29
Sports equipment****	7	0	0	0	0	7

* Source, von Hippel 1988, Appendix: GC, TEM, NMR Innovations
** Source, Riggs and von Hippel, Esca and AES
*** Source, von Hippel 1988, Appendix: Semiconductor and pultrusion process equipment innovations.
**** Source, Shah 2000,

Linus' Law

"Given enough eyeballs, all bugs are shallow."
                              - Eric Raymond, 1999

- More users find more bugs - because adding more users adds more ways of stressing the program.

- More users make bugs easier to solve – "shallower"- by increasing the probability that *"someone's* toolkit will be matched to the problem in such a way that the bug is shallow *to that person"*

Learning by doing adds to local information economies to create narrow low-cost innovation niches

Users have the advantage of problem-solving in their *own use environments* as they "do" a desired activity   – they are "learning by doing."

Examples:

- Airlines learn how to maintain their planes more efficiently as they do that work – they "go down the learning curve."

- Skateboarders learn to do new things on their boards *as they skate.* They don't go into the lab and do R&D – they are learning by doing

"Learning by doing" is problem-solving – and so involves trial and error

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          ▼

   ┌──────────────┐
   │   Design     │      • Design a possible solution
   └──────────────┘
          │
          ▼
   ┌──────────────┐
   │   Build      │      • Develop models
   └──────────────┘        prototypes
          │
          ▼
   ┌──────────────┐
   │   Run        │      • Test model/prototype
   └──────────────┘        In real or simulated use
          │                environment
          ▼
   ┌──────────────┐
   │   Analyze    │      • Analyze findings
   └──────────────┘        previous step
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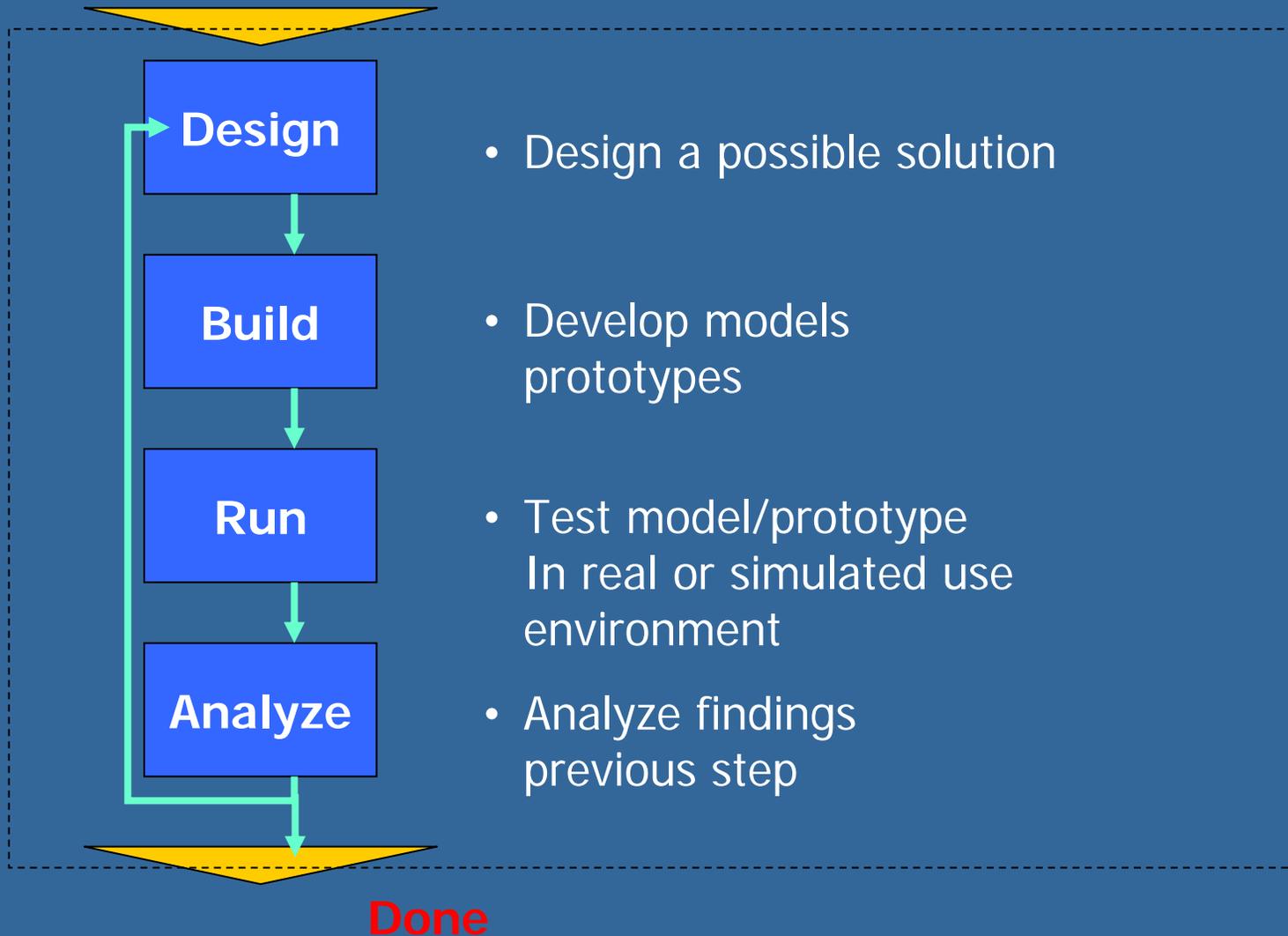
Learning by doing can be incredibly cheap for users *within* their own narrow niche of "doing"

Mountain bike innovation

- "When I do tricks that require me to take my feet off the bike pedals in mid-air, the pedals often spin, making it hard to put my feet back onto them accurately before landing."

  I added a foam ring around the pedal axle near the crank. This adds friction, and prevents the pedals from free-spinning when my feet are off."

Development of instant messaging at MIT

In 1987 MIT Lab for Computer Science had thousands of Athena workstations online and difficulties diffusing system administration information rapidly.

On-site programmers programmed the "Zephyr" instant message system. MIT students quickly begin to use Zephyr for general instant messaging.

Learning by doing can be incredibly cheap for users *within* their narrow niche of "doing"

Example: "I'm a mountain biker and a human movement scientist working in ergonomics and biomechanics. I used my medical experience to improve my mountain bike.

(Consider the cost if that person had not been a biker and had to learn the sport to innovate – or did not have medical training and tools "in stock.")

Table 4.1: Costs of stressed-skin panel innovations developed by users

Function performed		Time	Devel cost	Min
	To devel	cost	to wait for mfr	
solution				
Framing of openings in panels	0.1 day	$20	$1,400	
Structural connection between panels	0.1	30	$1,400	
Ventilation of panels on roof	0.1	32	$28,000	
Insulated connection between panels	0.1	41	$2,800	
Corner connection between panels	0.2	60	$2,800	
Installation of HVAC in panels	0.2	60	$2,800	
Installation of wiring in panels	0.2	79	$2,800	
Connection of panels to roof	0.2	80	$2,800	
Add insect repellency to panels	0.4	123	$70,000	
Connect panels to foundation	0.5	160	$1,400	
Connect panels to frames	1.2	377	$2,800	
Development of curved panels	5.0	1,500	$28,000	
Average time and cost for all innovations:	0.5 day	$153	$12,367	

Exercise: think of your own instance of learning by doing

Example:

I worked out the quickest route from home to school.

1. Think about the process you used to determine the quickest route.

2. Notice the low incremental cost to you of each experiment. For example, since your trip from home to school was a trip you took "anyway" – you were the "user" of the trip - the cost of each experiment was minimal. (It would cost much more to hire someone to do this experiment who did not have to take that trip "anyway.")

To summarize:

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