Prior Art Search and Market Research

A Crucial Part of Product Development

Jan 15th, 2020

Who am I?

- Co-founder & CEO of CodeGuard
  - 0 revenue in 2011, ~$4M 2018
  - CodeGuard acquired July 2018
- 5 years at General Electric in Sales, Sourcing, Ops
- BS Mechanical Engineering
- MBA from Harvard Business School

CodeGuard

Prior Art

What is prior art?

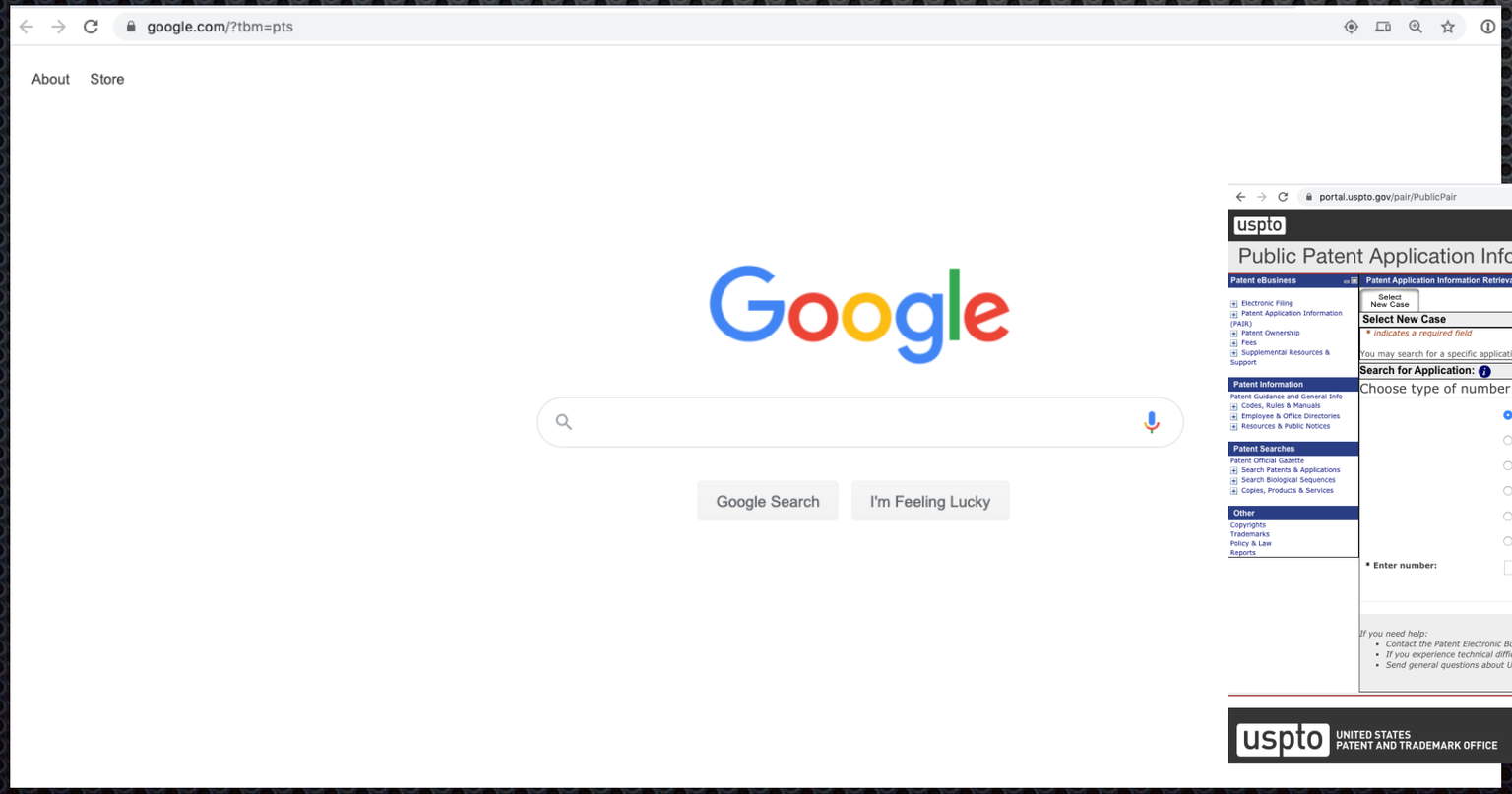
- Prior art is any evidence that your invention is already known.
- Prior art does not need to exist physically or be commercially available.
- It is enough that someone, somewhere, sometime previously has described or shown or made something that contains a use of technology that is very similar to your invention.

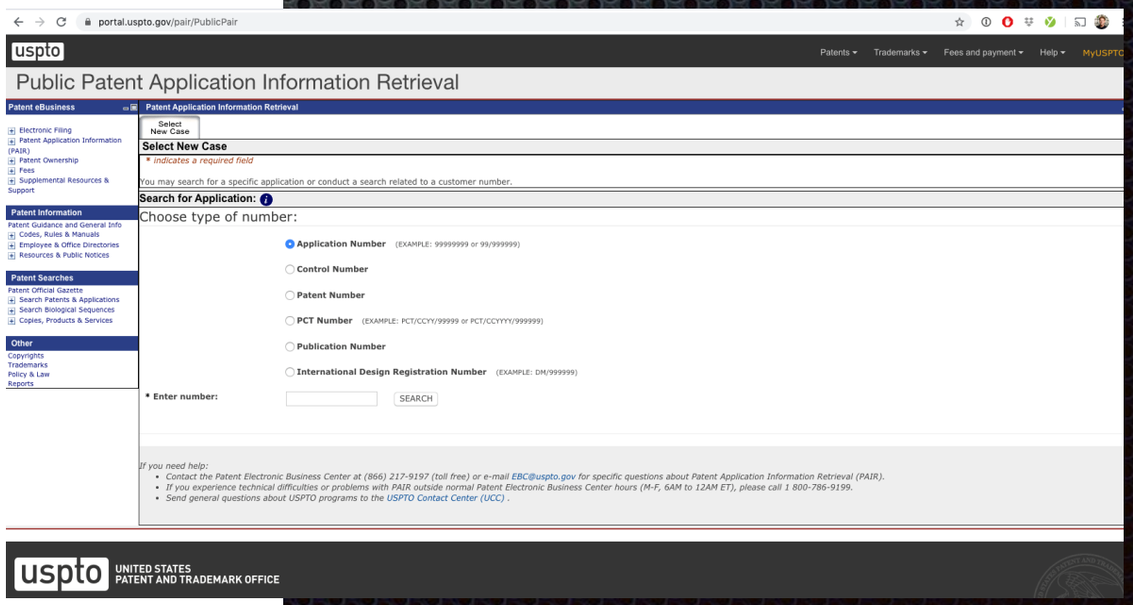
How do you search for it?

- To list some common examples, prior art can include the following:
  - A product that was available for sale
  - Commercial use of the invention
  - Articles, publications, or journals (printed or electronic)
  - Presentation at a public event (a trade show, conference, etc.)
  - Public knowledge or use of the invention (e.g. demonstration)
  - A previously-filed patent application (assuming the previous application eventually becomes a published application or an issued patent)

Patent Searching

- https://www.google.com/?tbm=pts
- https://portal.uspto.gov/pair/PublicPair





Group Activity

3:00

- Use the internet and find competing IP for the following idea:
  - *I want to monitor water quality continuously in my home, perhaps with sensor(s) that connect to the water pipes going to the kitchen sink.*

Prior Art

- It is possible to be your own worse enemy, if you disclose an invention and don’t file a patent!
  - Claw Hanging Systems
- It is possible that someone else has all of the IP around a particular idea, even if it isn’t on the market
  - Water quality technology

reintechinc.com

REIN TECH

WELCOME ABOUT REIN TECH TECHNOLOGY CONTACT

Welcome to Rein Tech Inc.

Rein Tech, Inc. has been securing Intellectual Property for over 12 years now, developing prototype for several markets, and is now beginning to install water conservation products such as its innovative water meter in test home sites and its shower monitoring apparatus in hotels/motels. Rein Tech's bathroom-based products provide comprehensive monitoring of water use to promote water conservation. Rein Tech's intelliger
of Things (IoT) technology that monitors water-event data for real-time download to remote server(s) combined wit
capabilities that either, has the means to remotely control on-site water supply lines via a cell phone, or be programm
minimize water damage to home and corporations due to leak conditions.

The range of technology and products is well suited for residences, corporations, hotels and motels, government hous
colleges, hospitals, exercise gyms and incarceration facilities, each with a mission to promote water conservation. Re
real-time and recorded information concerning water use, water quality and water related energy use. Data is efficier
the home owner, corporate operator or water municipalities.

reintechinc.com/about-rein-tech.html

REIN TECH

WELCOME ABOUT REIN TECH TECHNOLOGY CONTACT

About Rein Tech Inc.

Rein Tech Inc. is a company with innovative technology for water monitoring and conservation. Rein Tech's mission of providing products to monitor water use, water quality and remote water supply control are designed to enable water conservation and minimize damage due to leak conditiona. Rein Tech, Inc. has been securing Intellectual Property for over 12 years, developing prototypes for several markets, and now beginning to install water conservation products in test home sites and hotels/motels. The range of technology and products is well suited for home residences, corporations, hotels and motels, government housing and agencies, high schools and colleges, hospitals, exercise gyms and incarceration facilities, each with a mission to promote water conservation of the limited fresh water resources. These innovative products provide real time and recorded information concerning water use, water quality and water related energy use. Data is efficiently collected and conveniently displayed to the owner/operator, corporations or water municipalities.

Current manufacturers of residential and commercial faucets, shower and bath systems, and water supply systems have focused on products ranging in quality from basic to luxury. However, currently marketed products lack Rein Tech's product capabilities to monitor and display water parameters and to improve water quality or conservation. In addition, government facilities, institutions and municipalities typically use outdated and ineffective water supply products. While government intervention has been attempted to promote water conservation, the field lacks resourceful water devices that complement this effort.

In contrast, Rein Tech products provide comprehensive monitoring of water use, water quality and water related energy use, all of which will enable water conservation. Further, Rein Tech technology provides means to remotely control on-site water supply lines for minimizing water damage due to leak conditions.

My Story

I grew up in Northern California and experienced droughts numerous times during this period. One of the first technological attempts that I recall was to drop a brick in the toilet bowl to reduce its water volume. Water has always been important to California residents, whether they are aware of it or not. Beside the ubiquitous beaches, California has a large central valley and coastal areas that used large amounts of fresh water to produce food for the world. And there is a large canal that transfers fresh water from Northern California to Southern California which has created a regional controversy.

As a patent and corporate attorney, I began thinking of ways to conserve water back in 2001. I documented my ideas and began researching technology and conducting experiments, submitting patent applications and producing prototypes. I have seen California grow from approximately 24 million people in 1980 to almost 40 million residents in 2015, and the demand of individuals and businesses for fresh water has accordingly increase dramatically.

I filed the my first disclosure document in 2006 and first patent application in 2007. Since then, the patent application portfolio has grown to over ten and now issuance of these patents are being achieved. Each patent includes technology that can be used in different market channels.

In 2012, I established Rein Tech, Inc and starting installing test prototypes in real life test sites.

reintechinc.com/patents.html

REIN TECH

WELCOME ABOUT REIN TECH TECHNOLOGY

Patents

Apparatus for Displaying Shower or Bath Water Parameters	Issued Patent 9,254,499
Apparatus for Displaying, Monitoring, and Controlling Shower or Bath Water Parameters	Issued Patent 9,061,307
Apparatus for Displaying, Monitoring and/or Controlling Shower, Bath or Sink Faucet Water Parameters with an Audio or Verbal Annunciations or Control Means	Issued Patent 9,266,136
Water Dispensing Apparatus with Activation and/or Deactivation Means	Issued Patent 8,893,320
Water Use Monitoring Apparatus	Issued Patent 8,347,427
Water Use Monitoring Apparatus	Issued Patent 8,887,324
Water Use Monitoring Apparatus and Water Damage Prevention System	Issued Patent 9,297,150
Water Use Monitoring Apparatus	Issued Patent 9,494,480
Water Use Monitoring Apparatus	Issued Patent 9,749,792

Patentability Search Disclaimer

Note Regarding the Searches:

- When considering this kind of search (patentability), and as we briefly discussed, please keep in mind that any patent search has certain limitations. Searching is more of an art than a science, and no search can be totally relied upon as thoroughly exhaustive. Thus, even after reasonable searching, one cannot state with certainty that there is no patent that will cause a problem unless you specifically and thoroughly review each and every one of millions of patents, which of course is impossible.

- Please note that the accompanying search results were based on a professional search by a professional search firm (Cardinal IP) of issued United States patents and published patent applications maintained on the patent database provided by the U.S. Patent and Trademark Office (USPTO). From time to time in the past, there have been problems with the integrity, accuracy, and completeness of this database, which are beyond the control of this firm and our searchers. Additionally, the search included a search of non-patent literature databases (e.g., academic articles). Please note, however, that we have not made any investigation of what may have been on sale or in public use in this country or internationally. Further still, this search is dependent on the terms selected and the logical operators used. Similar technical subject matter is often expressed in different language and terms, making it difficult to search for similar or related concepts.

- Therefore, results of this search should not be taken as a guarantee that no more pertinent prior art exists than that which has been identified, or that a patent will issue, or if issued, will ultimately prove to be valid. No search can ever give 100% assurance that any item is patentable or a given patent is valid. Further, the results of this search should not be taken as a guarantee that no patent exists that would subject your proposed product to infringement risk.

Marketing

We all have marketing experience with products that:

- No one buys
- I don’t buy
- I do buy

Group Activity

1:00

- 1 product you buy
- 1 product you don’t buy
- 1 product no one buys

Understanding the Customer

- Which products were the easiest to think of?
- Beware when you aren't "eating the dogfood"!

Group Activity

1:00

- Discuss what you think are the two most important functions of a business
- Share the two functions with the class

"Because the purpose of business is to create a customer, the business enterprise has two and only two basic functions:

-Peter Drucker

"Because the purpose of business is to create a customer, the business enterprise has two and only two basic functions:

marketing

and

innovation

-Peter Drucker

What is marketing?

“Marketing is . . . the whole business seen from the point of view of the final result, that is, from the **customer's point of view.**”

Group Activity

1:00

- Describe your Senior Design project in 1 sentences
- What are you working on? For whom? Why?

We are working on a new wing design for Boeing because they want to carry more passengers.

Managing Up

- Be able to articulate the value proposition of what you are doing
- Tell it to everyone you meet – after you get to know them
- Double check when interacting with superiors: “Just so I’m sure, we think we will be done with X by Y date. If we accomplish that, you’ll be happy, right?”

Group Activity

2:00

- Discuss the potential customers for your product/service (end customer)
- Consumers? Businesses?
- Why would a person or business purchase?

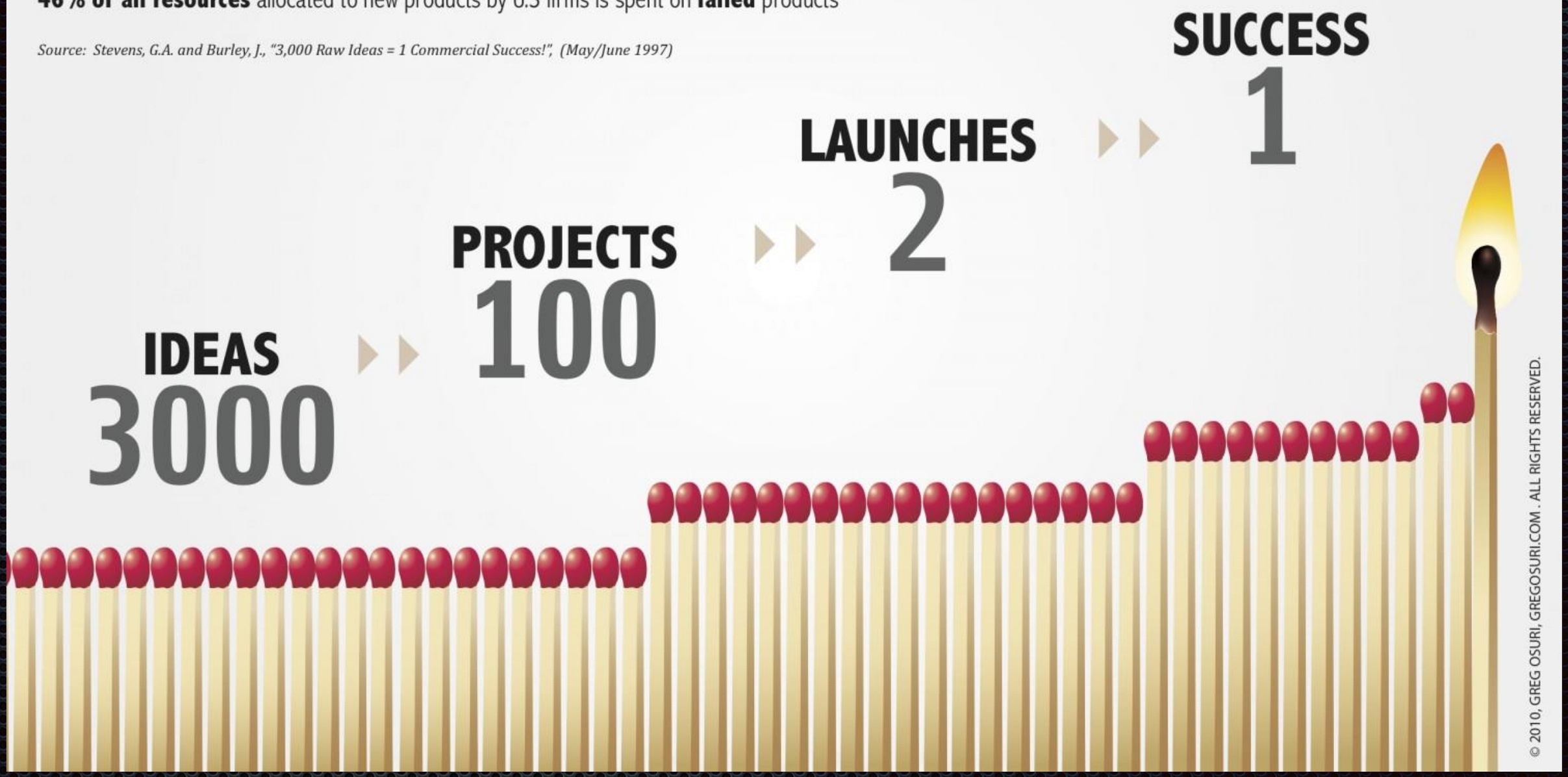
NEW PRODUCT FAILURE RATES

1 of 3 launched products fail despite research and planning

1 out of 4 projects that enter development make it to the market

46% of all resources allocated to new products by U.S firms is spent on **failed** products

Source: Stevens, G.A. and Burley, J., "3,000 Raw Ideas = 1 Commercial Success!", (May/June 1997)



Group Activity 3

1:00

- Why do you think so many new products fail?

Impact on final product

Idea

Technical Feasibility

Design Definition

Development

Ramp Up

Extensions

Deal

ROI

Need

Market

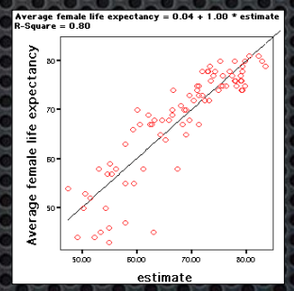
Design Continuum

Customer learning in parallel to product development

Market Research

Market research is used to determine idea viability and create marketing plans

- What?
  - Verify need for product
  - Determine market size: How big is my idea?
  - Choose target customer: Where do we focus first?
  - Understand target customer
- How?
  - Primary
    - Methods: Surveys, Focus groups
    - Risks: Question & facilitator bias
  - Secondary
    - Methods: Reports and studies
    - Risks: Report or study bias



Group Activity 4

2:00

Can primary market research help your team?

Can secondary market research help?

If “yes” to either, how?

The Diffusion of Hybrid Seed Corn In Two Iowa Communities*

By Bryce Ryan and Neal C. Gross†

Abstract

Hybrid seed corn has diffused through the midwest with phenomenal rapidity. In the space of four years, 1936 through 1939, two-thirds of the operators in the two communities studied, changed to the new seed. Relatively few, however, took over hybrid seed for their entire acreage the first year they tried it. This was true even for operators first using the seed at a relatively late date. There appears to be some difference between the diffusion agencies which informed farmers of the new seed and the sources of influence toward adoption. Commercial channels, especially salesmen, were most important as original sources of knowledge, while neighbors were most important as influences leading to acceptance. Although the time pattern of acceptance follows a bell shaped curve, this instance of diffusion cannot be accurately described as following a normal frequency distribution.

Resumen

El maíz de semilla híbrido se ha difundido por el Mediano Oeste con extraordinaria rapidez. En el espacio de 4 años, desde el 1936 hasta el 1939, dos tercios de los agricultores de las dos comunidades estudiadas adoptaron la nueva semilla. Sin embargo, relativamente muy pocos de ellos la cultivaron de lleno en el primero año que la conocieron. Ésto fué cierto también con aquellos que la han usado aún más recientemente. Parece que existe alguna diferencia entre las agencias de difusión que informaron a los agricultores sobre la nueva semilla y las fuentes de influjo que los decidieron a su adopción. Las vías comerciales, particularmente los vendedores, fueron las más importantes fuentes de conocimiento, mientras que los vecinos tuvieron más importancia desde el punto de vista de la aceptación de la simiente. Aunque el modelo del tiempo de adopción conforma con el de una campana, este ejemplo de difusión no puede ser descrito como típico de una perfecta distribución normal de frequencias.

The introduction of hybrid seed corn has been the most striking technical advance in midwestern agriculture during the past decade.[1] Although a few experimenters had been acquainted with this new and sturdier seed for many years, only since 1937 has it become a nationally important production factor. It has been estimated that between 1933 and 1939 acreage in hybrid corn increased from 40,000 to 24 million acres (about one-fourth of the nation's corn acreage). In the North Central region the spread was even more rapid. Although hybrid seed was not available until 1928 or 1929, by 1939, 75 per cent of the corn acreage in Iowa was in hybrid.

The very rapidity of its diffusion makes this trait attractive for study. This is true not only because farmers are usually "conservative," but also because its adoption is well within the memory span of current farm operators, and hence amenable to more intensive study than would

* Journal Paper No. J-1092 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 776.

† Iowa State College, Ames, Iowa.

[1] See *Technology and the Farm*, U.S.D.A., 1940, Chapter 5.

Hear about it, then use it

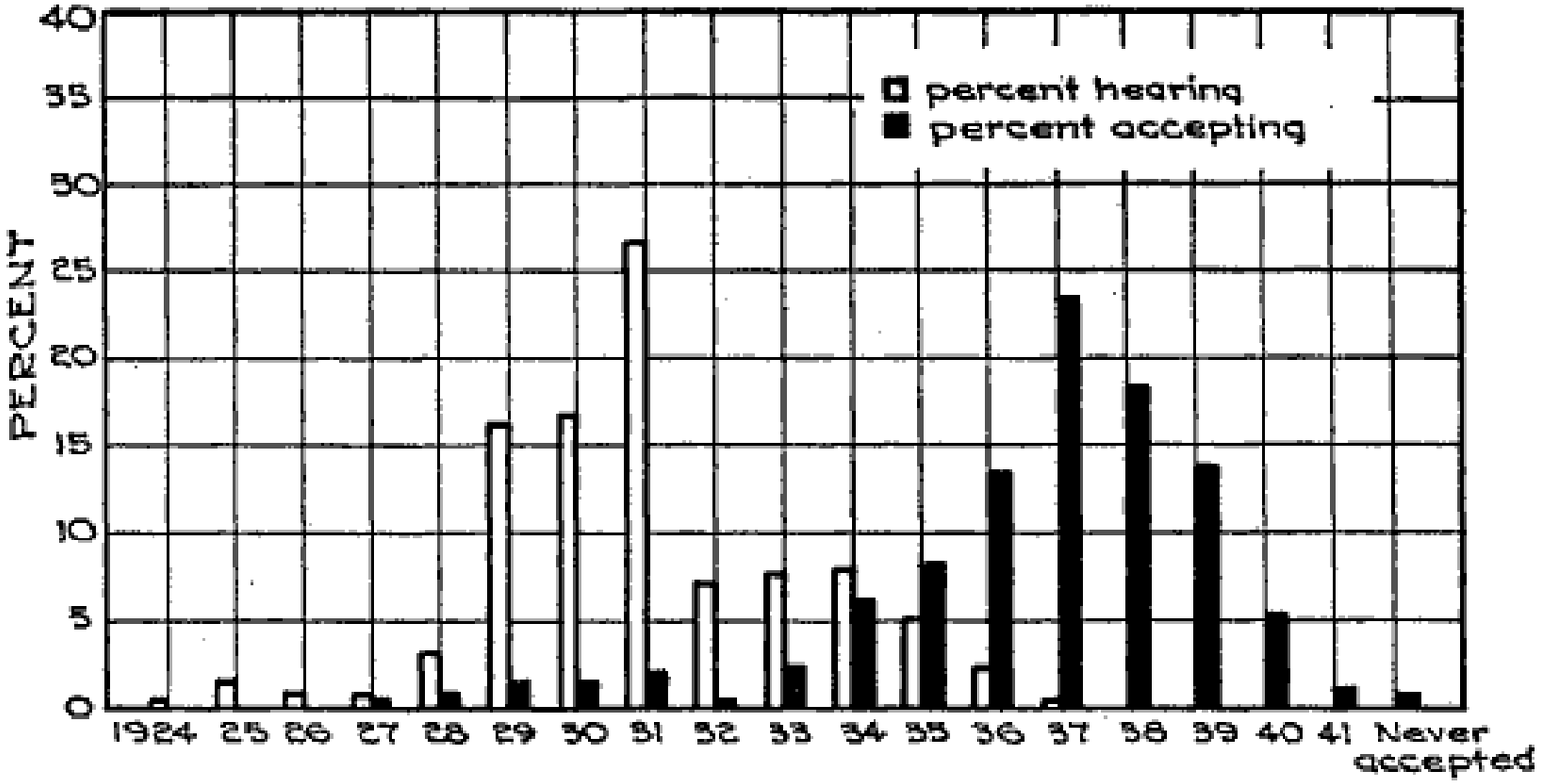


Fig. 1. Percentages of Farm Operators First Hearing of Hybrid Seed Corn and Percentages First Accepting It, by Years.

Use it a little, then a lot

TABLE I. MEDIAN PER CENT OF CORN ACREAGE IN HYBRID FOR INDIVIDUAL YEARS BY YEAR IN WHICH OPERATOR FIRST USED HYBRID SEED

Year first used hybrid	1933	1934	1935	1936	1937	1938	1939	1940	1941	No. of cases
Before 1934	38.0*	50.0	67.0	100.0	100.0	100.0	100.0	100.0	100.0	24
1934		20.0	29.0	42.0	67.0	95.0	100.0	100.0	100.0	16
1935			18.0	44.0	75.0	100.0	100.0	100.0	100.0	21
1936				20.0	41.0	62.5	100.0	100.0	100.0	36
1937					19.0	55.0	100.0	100.0	100.0	61
1938						25.0	79.0	100.0	100.0	46
1939							30.0	91.5	100.0	36
1940								69.5	100.0	14
1941									54.0	3
Total										257
Never accepted										2
Total Sample										259

* The median hybrid planting for this group in first year of acceptance was 12 per cent of total corn acreage.

Awareness vs influence & time

TABLE 2. PERCENTAGES OF ALL OPERATORS CITING SPECIFIC ORIGINAL SOURCES OF KNOWLEDGE OF HYBRID SEED AND MOST INFLUENTIAL SOURCES

Source	Per Cent	
	Original knowledge	Most Influential
Neighbors	14.6	45.5
Salesmen	49.0	32.0
Farm Journal	10.7	2.3
Radio advertising	10.3	. .
Extension Service*	2.8	2.4
Relatives	3.5	4.2
Personal experimentation	.	6.6
All others**	9.1	7.0
Total	100.0	100.0

* Including County Agent, bulletins, etc.
** Including unknown.

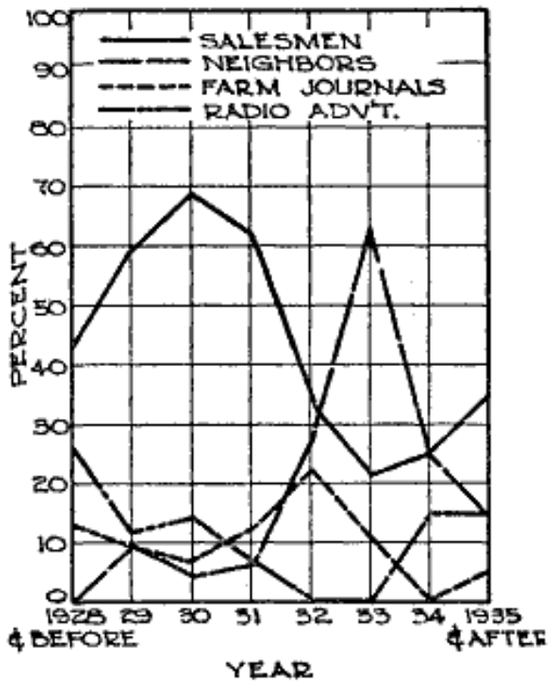


Fig. 2. Percentages of Farm Operators First Hearing of Hybrid Seed Corn Through Various Channels, by Year First Heard.

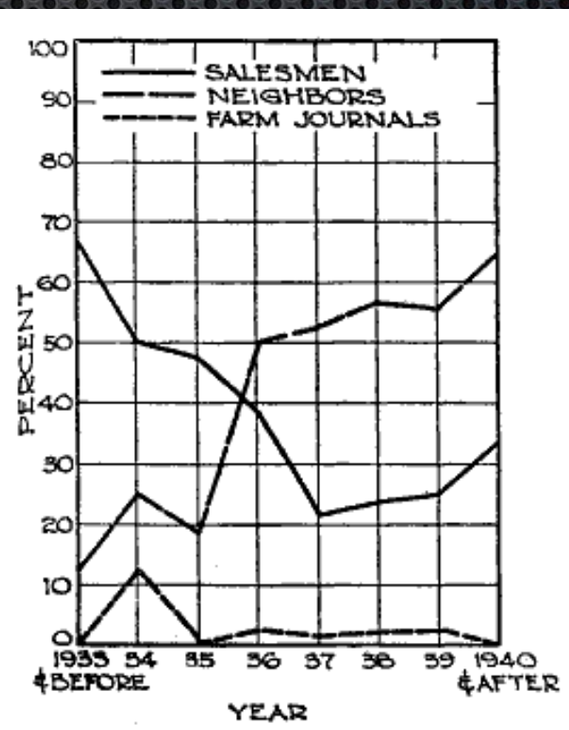


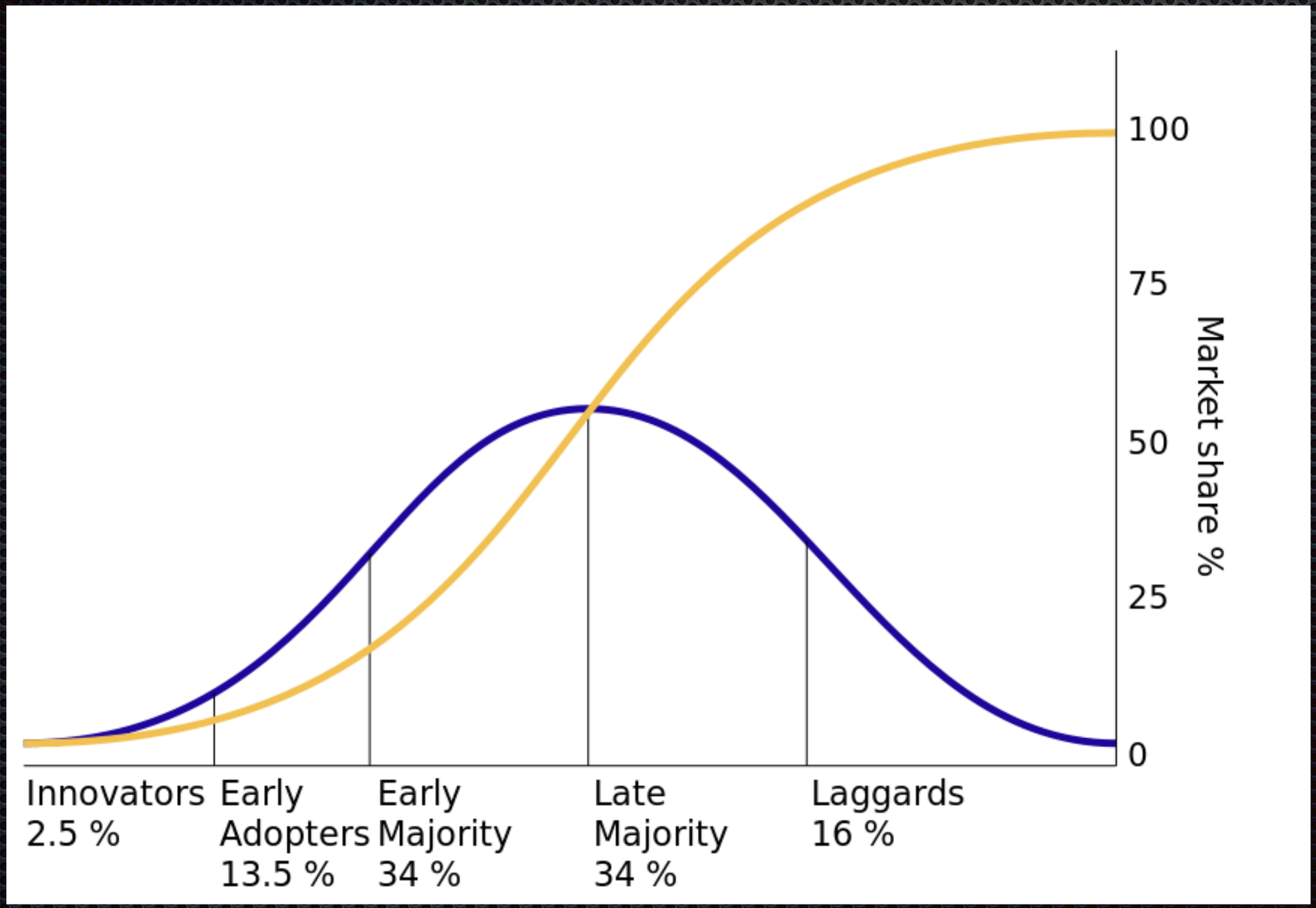
Fig. 3. Percentages of Farm Operators Accepting Hybrid Seed Corn In Different Years Assigning Major Influence to Various Sources.

Group Activity 5

1:00

What could seed manufacturers have done to speed up adoption?

Diffusion of Innovations



Bass Model

Model formulation [edit]

$$\frac{f(t)}{1 - F(t)} = p + qF(t)$$ [2]

Where:

- $f(t)$ is the change of the installed base fraction
- $F(t)$ is the installed base fraction
- p is the coefficient of innovation
- q is the coefficient of imitation

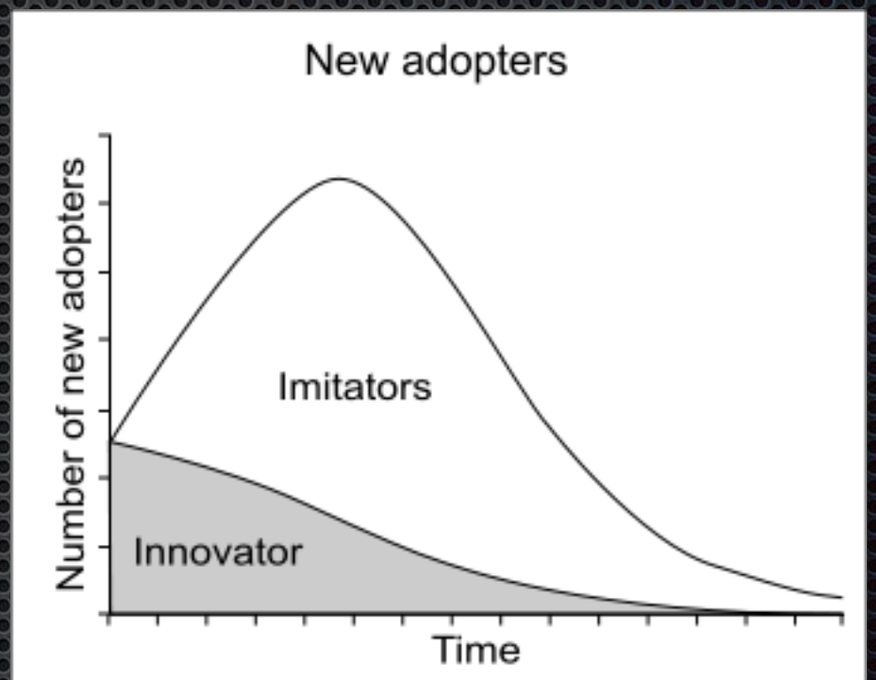
Sales $S(t)$ is the rate of change of installed base (i.e. adoption) $f(t)$ multiplied by the ultimate market potential m:

$$S(t) = mf(t)$$

$$S(t) = m\frac{(p+q)^2}{p}\frac{e^{-(p+q)t}}{(1+\frac{q}{p}e^{-(p+q)t})^2}$$ [2]

The time of peak sales t^*

$$t^* = \frac{\ln q - \ln p}{p+q}$$ [2]



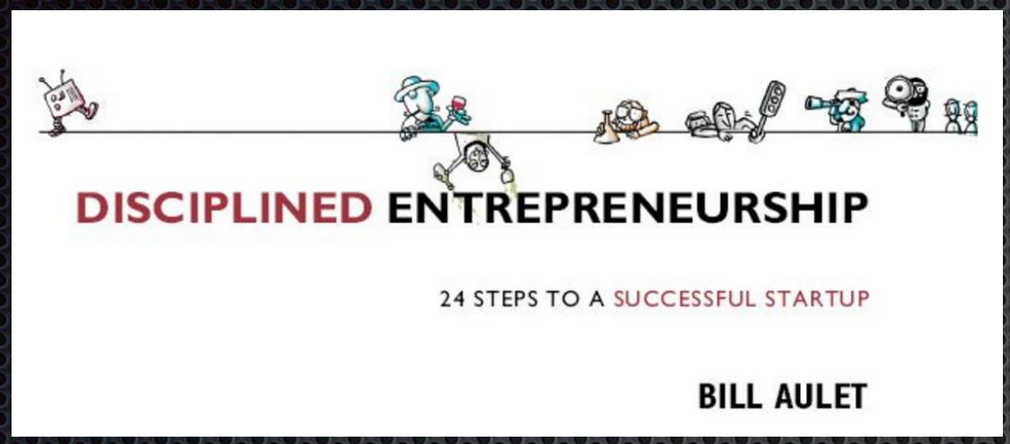
The End

Questions?

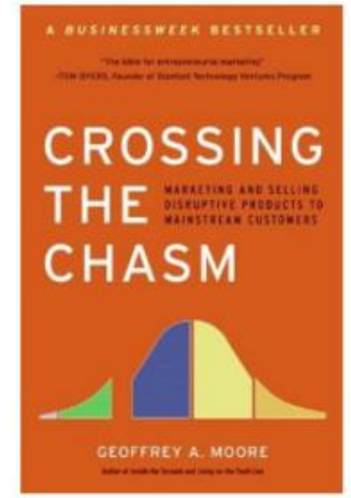
Appendix

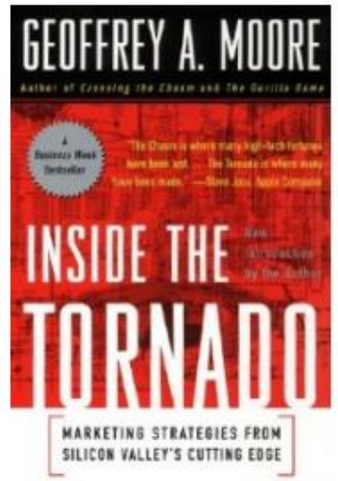
- Resources
- HBS Survey
- Magnus and Corp Survey
- Customer Adoption Curve
- Claw Hanging Systems Channel selection
- Additional files

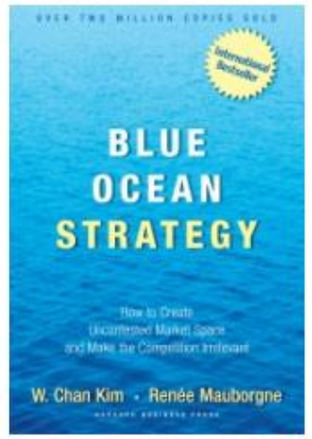
Resources

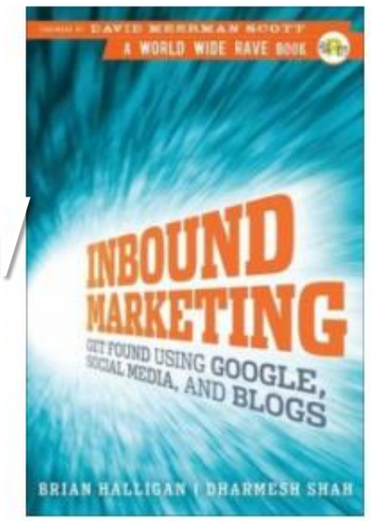


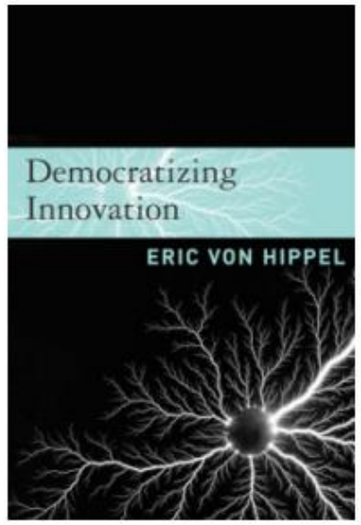
http://www.detoolbox.com/

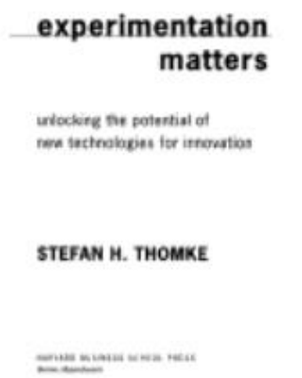


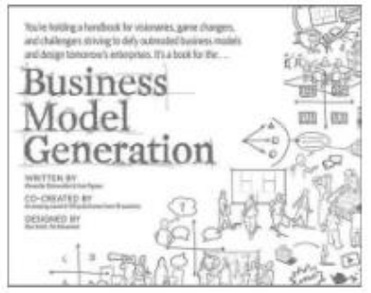


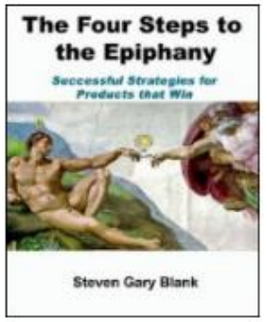












A thorough understanding of your customer will influence every aspect in your product lifecycle

STP

- Segment
- Target
- Position

4 P's

- Product: Features, packaging
- Price
- Place: Channel to market
- Promotion: Branding and message

Case study – Claw Hanging Systems

Bicycle Storage Rack Case Study

Initial questions

- Who is the target consumer?
- Where will they buy it?

CLASS VOTE

- Consumers
  - Enthusiasts: Bike price > $350 and ride often
  - Casual riders: Bike price < $200 and ride occasionally

- Channels
  - Independent Bicycle Dealer
  - Lowes/Home Depot

Case study – Claw Hanging Systems

Utilized secondary market research to determine viability, then primary to create marketing plan and select channels

- **Secondary** market research, conducted by David Moeller from 2004-2006

1. The Australian Bicycle Industry Report 2003
2. U.S. Department of Transportation, Bureau of Transportation Statistics, *Bicycle and Pedestrian Data: Sources, Needs, & Gaps,* BTS00-02,Washington, DC: 2000
3. REGIONAL SPENDING PATTERNS OF HOUSEHOLDS IN THE U.S. AND, METROPOLITAN AREAS IN THE MIDWEST, 2000-2001, Bureau of Labor Statistics
4. US Consumer Product Safety Commission, Office of Hazard Analysis and Reduction, Directorate for Economic Analysis, *Bicycle and Bicycle Helmet Use Patterns in the United States: A Description and Analysis of National Survey Data, 1992*
5. US Consumer Product Safety Commission, Office of Hazard Analysis and Reduction, Directorate for Economic Analysis, *Characteristics of Adult Bicyclists in the United States: Selected Results from a National Survey, April 1993*
6. The National Bicycle Dealers Association – *Industry Overview*- from web page www.nbda.com, 2004
7. Copyright © 1999 Bicycling Life Website., *Bicycle Vs Auto Production*, Riley Geary
8. *Transportation Alternatives- GIANT bicycle presentation, 1999*
9. *Bicycle/Pedestrian Federation of America, Bicycle Facts and Trends, 1992*
10. Omnibus Transportation Survey by Bureau of Transportation Statistics, July 2001

- **Primary** market research - fall of 2006: 156 respondents
  - Goals
    - General Demand: Does anyone want it? And what will they pay?
    - Competitive Intel: What rack are people using now?
    - Demographics: Who will buy it? And who will pay the most? Correlating receptivity to current bike price or other demographic variables
- **Primary** market research conducted by Magnus & Co.during July 2007: 256 respondents
  - Goals
    - Obtain data to create realistic market segmentation
    - Use pictures of final prototype to hone pricing

HBS Survey

Harvard Business School Student Survey

- Initial perceptions
  - Tell me about the item. What are your thoughts?
  - What do you think this does? What would you use it for?
  - Do you value it?
  - What are five key words that describe the invention?
  - What else would you use this for?
- Additional Information
  - Do you store bikes at your house?
  - If yes, where do you store them?
  - If yes, how do you store them and why?*
  - Do you own any current bike racks?
  - If yes, which ones?
  - Based on what you have seen today, would you consider buying the Claw? Why or why not?
  - What price level seems reasonable for the Claw?

HBS Survey

Business Idea Survey - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites

Address http://www.surveymonkey.com/Users/34695199/Surveys/709952539451/A40094B8-014F-4676-9ED2-155B44D84E62.asp?U=709952539451&DO_NOT_COPY_THIS_LINK Go

Exit this survey >>

THE Claw

Business Idea Survey

1. Section I

Please first go to the Claw Survey Video and Pictures Page and view the two short video clips. After watching the videos, please take the survey, answering the questions as if you were in your last job and residence prior to starting business school.

Technical info on Claw: housing made of durable ABS plastic; arms and base made of steel

1. How new and different do you think this is (unique)?

- Extremely
- Somewhat
- Marginally
- Not very
- Not at all

2. On a scale of 1-10 how would you rate "The Claw" on (10 indicating strongly like and 1 not like at all):

	Ratings
Expected ease of use	
Look	
Flexibility of use (attach to wall or ceiling)	
Expected durability	
Brand	

3. Is there anything that could be improved on "The Claw"?

4. Knowing what you know about "The Claw", how likely would you be to buy it for a price of $59.99?

- Definitely would buy
- Probably would buy
- Might or might not buy
- Probably would not buy
- Definitely would not buy

5. Why or why not? (Referring to previous question)

6. How many "Claws" would you consider buying within the next 12 months at each price point listed below?

	Price
$29.99	
$39.99	
$49.99	
$59.99	
$69.99	

7. Which of the following best describes your need for this product?

- I really need this product because nothing else can solve this problem
- This is a minor improvement over what I currently use
- Looks okay but is about the same as what I'm using now
- My current product would serve me better

- My current product would serve me better
- I am not at all interested in this product

Pictures for question 6

Hook	Arm Rack	Standing Bike Rack	Pulley System	"The Claw"
				

8. Please rank the following types of racks in order of preference (1 being most desirable, 5 being least desirable):

	1	2	3	4	5
Hook	○	○	○	○	○
Arm Rack	○	○	○	○	○
Standing Bike Rack	○	○	○	○	○
Pulley System	○	○	○	○	○
"The Claw"	○	○	○	○	○

Next >>

2. Section II

9. Which best describes your wall or ceiling bicycle rack ownership level?

Do not own (Skip to Section III)	Considering one	Own one	Own more than one	Owned one or more in the past
○	○	○	○	○

10. If you own a rack or plan on purchasing one, what was (or is) your reason?

11. How often do you use your bicycle rack?

- ○ Once a week or more often
- ○ 2-3 times a month
- ○ Once a month
- ○ 2-3 times a year
- ○ Once a year
- ○ Do not use

12. What type of rack do you own (select all that apply)?

- ☐ Hook
- ☐ Arm Rack
- ☐ Standing Bike Rack
- ☐ Pulley System
- ☐ Cannot recall which type I own

13. What brand is (are) your rack(s)?

<< Prev Next >>

HBS Survey

Business Idea Survey

3. Section III

14. How often do you ride your bike? (If you do not own a bike, please skip to question 20)

- More than once per week
- Once per week
- Once per month
- Once per year
- Less than once per year

15. Why do you ride?

16. What did you spend on your last bike?

- Below $100
- $100-$200
- $200-$300
- $300-$400
- $400-$500
- $500+

17. How much have you spent on bike accessories in the last 12 months?

- Below $100
- $100-$200
- $200-$300
- $300+

18. If you had a house with a garage, how would you store your bicycles?

- Lean them against the garage wall
- Hang them on the wall
- Use a standing rack
- Other (please specify)

19. If you owned a Claw and your friends did not, would you show it off to them?

- Yes
- No
- Would not purchase Claw
- Other (please specify)

20. Which best describes you?

- Own or buying a house or condo
- Rent
- Live with a relative
- Other

21. You are:

Male Female

22. You are:

Married Not married

23. Would you like for me to send you more information if "The Claw" is released? If yes, please enter your email address:

Sample respondent data

How new and different do you think this is (unique)? Response	On a scale of 1-10 how would you rate 'The Claw' on (10 indicating strongly like and 1 not like at all): Expected ease of us	Look - Ra	Flexibility (	Expected (	Brand - Ra	Is there anything that could be improved on 'The Open-End	Knowing what you know about 'The Claw', how likely would you be to buy it for a price of $59.99? Response	Why or why not? (Referring to previous question) Open-Ended Response	How many 'Claws' would you consider buying within the next 12 months at each price $29.99 - Price	$39.99 - P	$49.99 - P	$59.99 - P
Extremely	2	9	10	10	6		Definitely would not buy		3	2	1	
Somewhat	10	5	7	7	7		Probably would not buy	Too Expensive -- a 'C' hook in a wall/ceiling stud	1			
Marginally						If I had to r	Definitely would not buy	I'm a biker who has stuggled with this problem. I				
Somewhat	9	4	7	5	2		Definitely would not buy	$59.99...for a hook? are you kidding?				
Not very	2	2	1	2	1	I don't see	Definitely would not buy	I don't see why it is superior to a basic screw in				
Extremely	8	9	3		9	I am conc	Definitely would not buy	Concerned about the 4 factors in #3				
Marginally	5	4	7	6	5		Definitely would not buy	I think it damages the wheel of the bycicle	1			
Extremely	10	6	6	7	5	Yes, thing:	Probably would not buy	Not because - too expensive - need to mount on	2	1		
Somewhat	8	5	6	7	8		Might or might not buy	not sure how exactly it differs from a regular				
Somewhat	6	4	3	2	1	don't see .	Definitely would not buy	see above.				
Marginally	7	2	5	2	2		Probably would not buy	I'm unclear what functions this serves that could				
Marginally	6	5	5	4	5		Probably would not buy	I'm not sure the claw has many advantages over a	1			
Marginally	9	7	9	9	5		Probably would buy	I have seen many products for hanging bikes up				
Somewhat	8	2	3	7	3		Definitely would not buy	I can achieve the same goal with some simple	1			
Marginally	9	7	9	8	1		Definitely would not buy	looks like something walmart might carry for $15	1			
Marginally	5	6	5	6	5		Probably would not buy	Unsure of the benfits as opposed to existing				
Extremely	9	9	9	7	8	I would wa	Might or might not buy	Price seems a little high for me personally, but I'm	1	1	1	
Somewhat	8	5	2	7	7		Might or might not buy	Already have an existing wall mount for my bike.	2	1		
Somewhat	8	8	4	6	5		Might or might not buy		2	1	1	
Marginally	8	7	8				Probably would not buy	Many other simpler products on the market that	1			
Somewhat	7	7	8	8	8		Probably would not buy	29.99	2			
Extremely	3	3	4	8	4		Definitely would not buy	Can not see what the benefit of this vs normal	1	1	1	1
Extremely	9	8	8	5			Definitely would not buy	That price is too high, considering I could just buy	4			
Somewhat	8	5	6	10	6		Probably would not buy	Too expensive. I can get a hook from Home				
Somewhat	8	3	6	4	1		Definitely would not buy	too expensive	2			
Somewhat	5	4	7	7	3		Definitely would not buy	I do not see significant value over just buying a				
Marginally	6	5	6	2	5	Neat engir	Definitely would not buy	I'd buy a $1.30 bike hook from Home Depot that				

Analysis

A. Bicycle Price

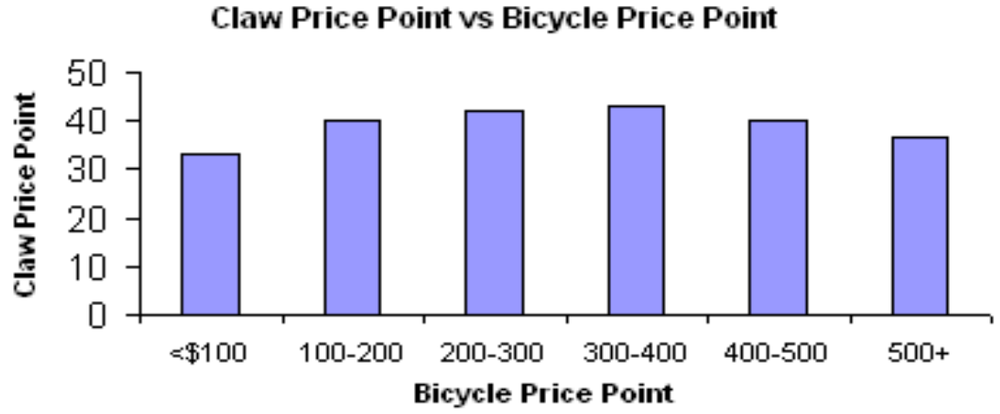
Null hypothesis: Those who paid more for their bike will be willing to pay more for their bike rack

Steps

1. Using the response data from question 6, "Knowing what you know about the 'Claw', how many are you likely to purchase in the next 12 mos?", I extracted the maximum price each respondent would be willing to pay
2. Converted price ranges into definite values, i.e. Bike price point levels of 300-400 became $350.
3. Performed a regression analysis, with Claw price point as the independent variable, and Bike price points as the dependent variables

Data

Avg Price	Price Point Group	# of respondents
$ 33	<$100	6
$ 40	100-200	8
$ 42	200-300	9
$ 43	300-400	7
$ 40	400-500	4
$ 36	500+	14



Results

As can be seen clearly from the data above (and verified with a p-value >.05), higher bicycle price point is not predictive of a willingness to pay a premium for the Claw.

B. Importance of features

Steps

Utilize question 2, focused on claw features. On a scale of 1-10 how would you rate 'The Claw' on (10 indicating strongly like and 1 not like at all): Expected ease of use, Look, Flexibility of use (attach to wall or ceiling), Expected durability, Brand

Results

At a 95% confidence level, durability has a 0.055 p-value, indicating it is an influencing factor on price.
Look and expected ease of use are close behind, with p-values of .07 and .11, respectively.
Flexibility of use and current brand had no impact on pricing level

C. Impact of design uniqueness

Uniqueness - Question 1

Uniqueness perception resulted in a p-value of .005 in relation to Claw price point.

D. Impact of current storage solution

Rack Ownership - Question 20

P-value = .018; rack owners were willing pay $7.5 more than non-owners

When market research is utilized correctly to determine the target customer (STP), it should drive channel selection

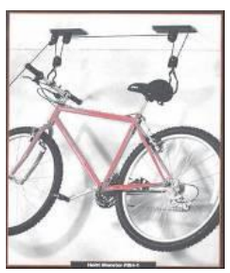
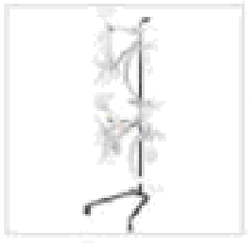
Executive Summary

156 HBS first-year students were interviewed via surveymonkey.com from 9/16/06 to 9/18/06; 66 of the respondents stated they would consider purchasing a Claw during the next 12 mos for an average price of **$38.32**

The most startling result was the lack of correlation between the price the respondent paid for their last bike and the price they would be willing to pay for the Claw. Also, the expected durability and the perception of uniqueness were significant factors that influenced the customer's perceived value premium. Consumers were willing to pay roughly $6 more for each level of uniqueness (range from "not at all" to "very").

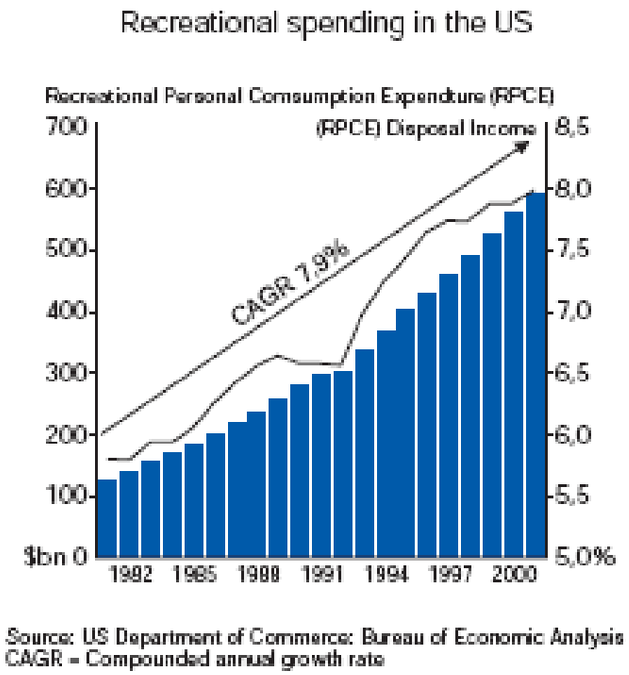
As a result of this analysis it has been determined the target market is not the "enthusiast" bikers who paid >$500 for their last bike purchase, but rather those bikers with a need for space, who currently own hooks.

Hook & arm racks are the primary competition

Type of Rack (Options for Garage Storage)	Cable & Pulley Ceiling Suspenders ($35-$50)	Standing Bike Rack ($80-$240)	Leaning Racks ($40-$75)	Hook racks ($2-$30)	Arm racks ($20-$30)
Pro	Effective	Easy to use	Easy to use	Cheap	Moderate Price, Ease of use
Con	Difficult to install, ease of use, time to raise & lower the bike	Takes up space	Could fall over, takes up space	Ease of use	Uses horizontal wall space
Pictures	  	 	 	  	  

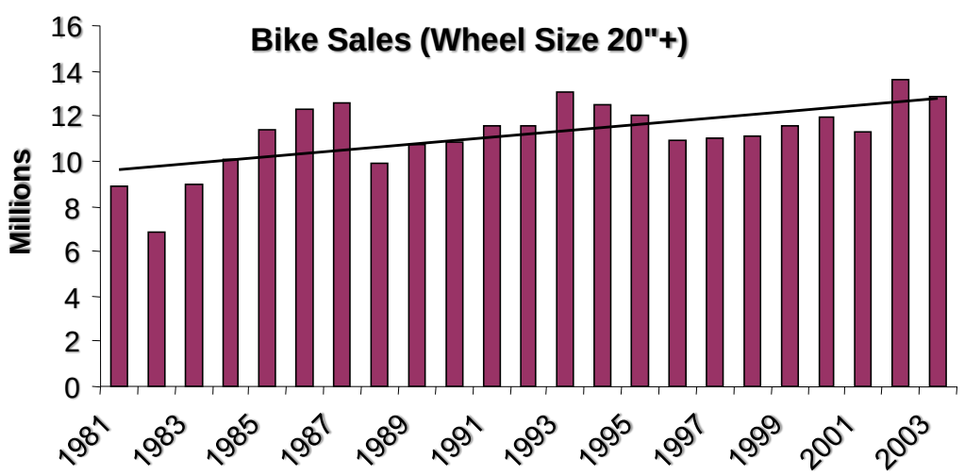
Recreational spending and new bike sales are increasing

Recreational spending in US increasing at a CAGR of 7.9%



Source: US Department of Commerce: Bureau of Economic Analysis
CAGR = Compounded annual growth rate

Average 11.2M new bikes purchased yearly



Magnus Survey

Hi! My name is_____. I work for an independent research firm. We're testing a new bike storage invention. And, as an avid cyclist, your opinion is very important to us. Just need a minute or two of your time to answer a few quick questions. ***Can you help us out?*** Great!

How do you now store your bike?

___Hang from a hook in garage
___Use a free-standing rack or stand
___Use a hoist or lifter
___Rest against a wall
___Other_____

Are you pleased with this approach?

☐ Don't care ☐ No ☐ Yes

Let me tell you about a new invention for bicycle storage on the ceiling or wall of a garage. Look at these pictures. In the invention, there are two opposing hooks with a giant click pen mechanism between them. The arms open and close when a bike tire touches the pen button. Only vertical motion is required.

Magnus Survey

If we could offer you a such an easy-to-use, secure, simple, space-saving solution that's affordable, would you buy it or convert to it?

☐ Absolutely ☐ Probably ☐ No

Would you want to use it on your ceiling or wall?

What would this solution be worth to you?

___ More than $ 40 ___ $ 30 to $ 40 ___ Less than $ 30

May we ask your age?

___Under 30 ___30 – 45 ___45 +

May we ask your homeownership level?

___Apt – Rent ___Apt – Own
___Home – Rent ___Home – Own
___Other

If respondent is willing to talk further, go ahead and ask:

How often do you replace your bike?

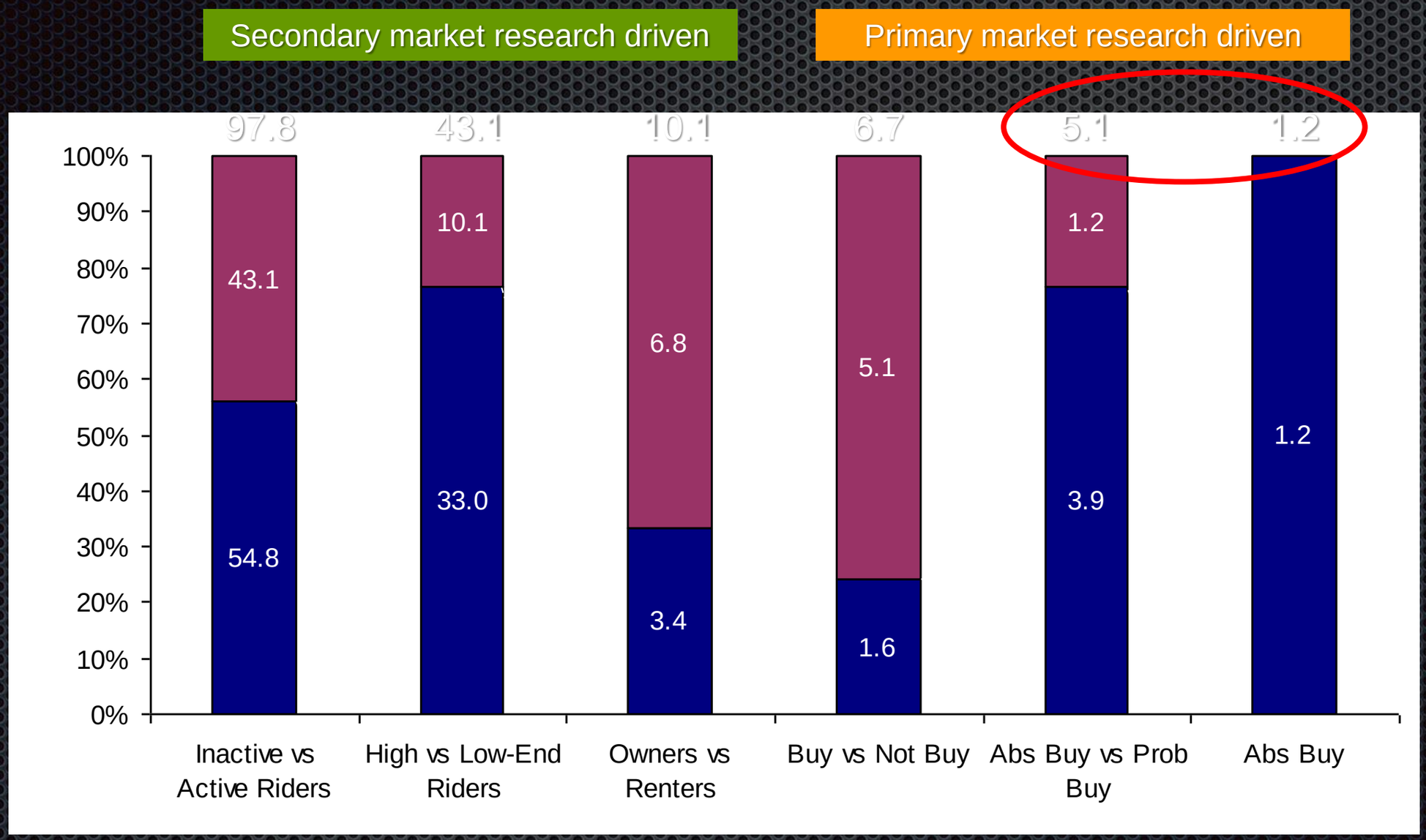
___every yr ___every 3 yrs ___once in 5 yrs

Storage Rack Market Overview

Use	User	Dist Channel	Size
Bike	Active	IBD	10M
Bike	Active	Mass merchants/DIY	33M
Bike	Inactive	Mass merchants/DIY	55M
Non-bike	-	DIY	30M

High-end consumer (>$213 on last bike); visits independent retailer 1+ times/yr
Mid-level consumer (<$213 on last bike, but buys bikes new); purchases bicycle from mass merchant

Size of IBD channel (high-end) is 1.2M to 5.1M consumers



Assumptions and Sources

1.US Bike Riders – Mintel/Simmons NSC 2001/US Census 2000

2.Active Riders – Magnus Corporation 2007/US Sporting Goods Association

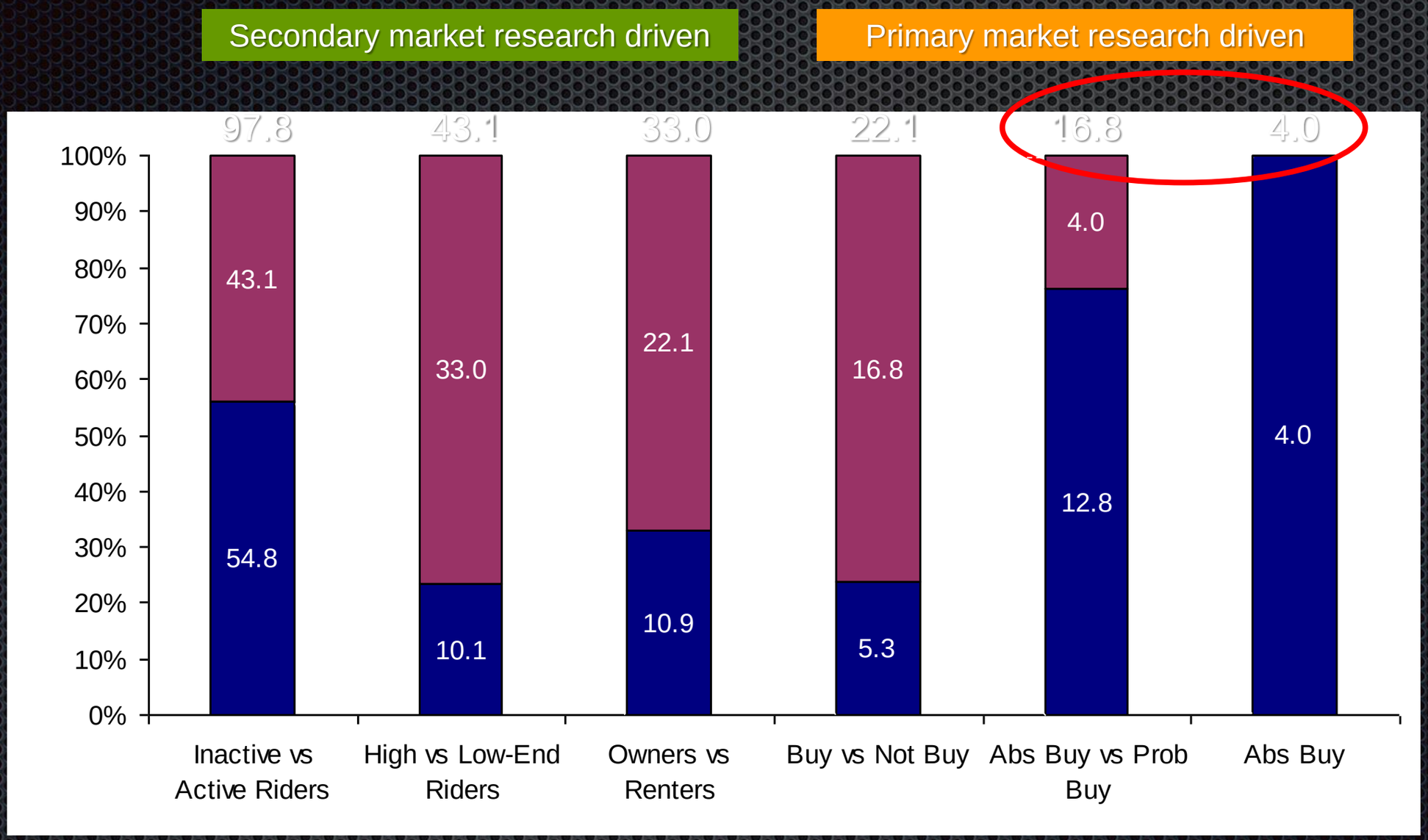
3.High-end – 10.1mm riders, composed of 0.9 mm enthusiasts, 2.4 mm moving-up, and 6.8 mm casual riders - Rodale Press, The Cycling Consumer of the 90's, A Comprehensive Report on the U.S. Adult Cycling Market, Emmaus, PA: Author; 1991

4.Home or Apt Owner – 67% of riders live in their own home or apt- Rodale Press, The Cycling Consumer of the 90's, A Comprehensive Report on the U.S. Adult Cycling Market, Emmaus, PA: Author; 1991

5.Probably or Absolutely Buy – 76% of all riders would consider purchase – Magnus and Company, Primary Market Research, 2007

6.Absolutely Buy Claw – 18% of all adult riders would absolutely buy **–** Magnus and Company, Primary Market Research, 2007

Size of DIY channel (non high-end) is 4.0M to 16.8M consumers



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5.Probably or Absolutely Buy – 76% of all riders would consider purchase – Magnus and Company, Primary Market Research, 2007

6.Absolutely Buy Claw – 18% of all adult riders would absolutely buy **–** Magnus and Company, Primary Market Research, 2007

Independent retailer should be first channel due to higher likelihood of early adopters

Channels to market

- Independent Retailers (Neighborhood Bike Shop)
- Mass Merchants (Wal-Mart, Toys R Us)
- Full-line Sporting Goods Stores (Dicks, Sports Authority)
- Other (Internet, Container Store)

"Specialty bike dealers commanded the vast majority of parts and accessories sales . . .They dominate the market in bicycles selling for $250 and up."

2002 Bicycle Sales

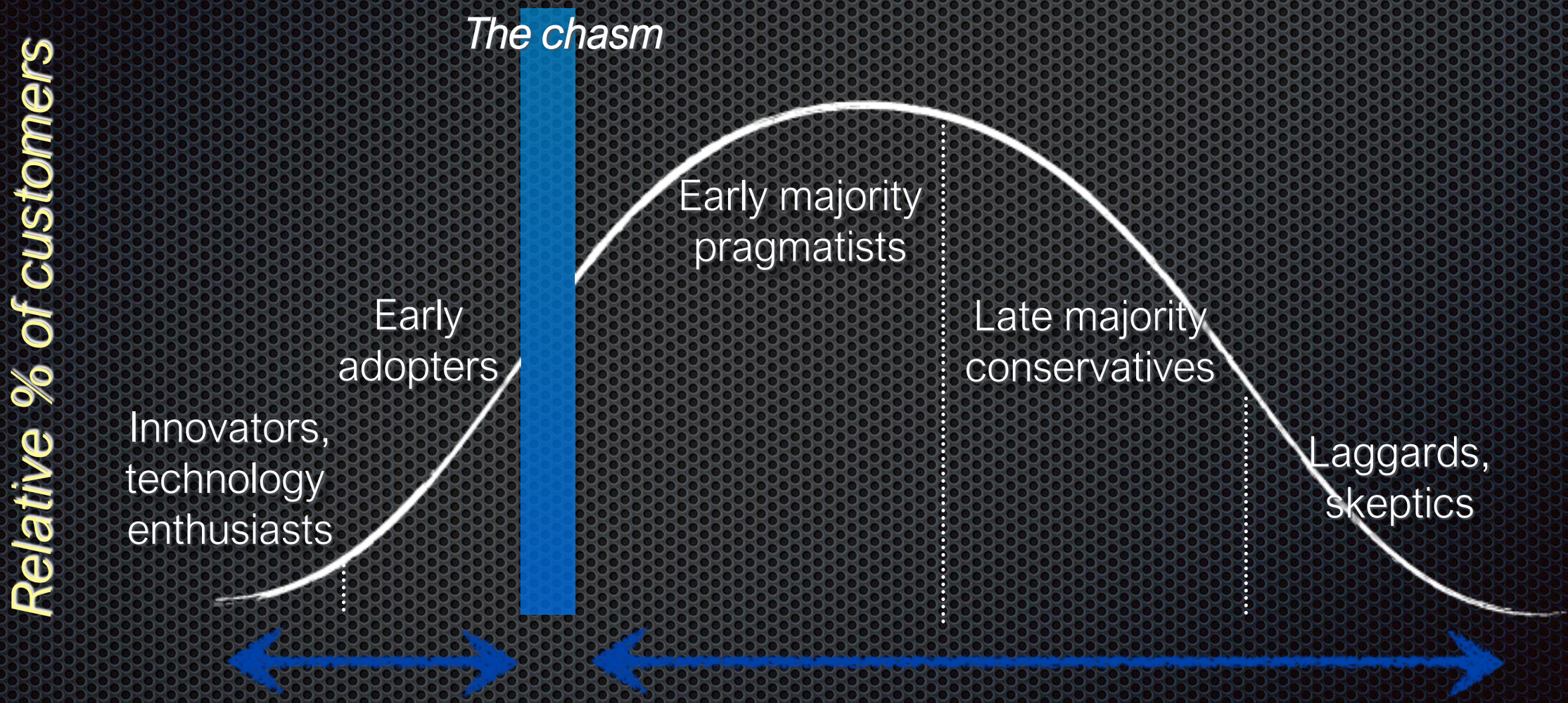
	% of 2002 units	% of dollars	avg bike cost	Mkt Size (M $s)
Mass Merchant	74	35.8	65	892
Ind Retailer	16.2	46.6	387	1,161
Full-Line Sporting	2.5	2.9	157	72
Other	7.3	14.7	270	366
				2,491

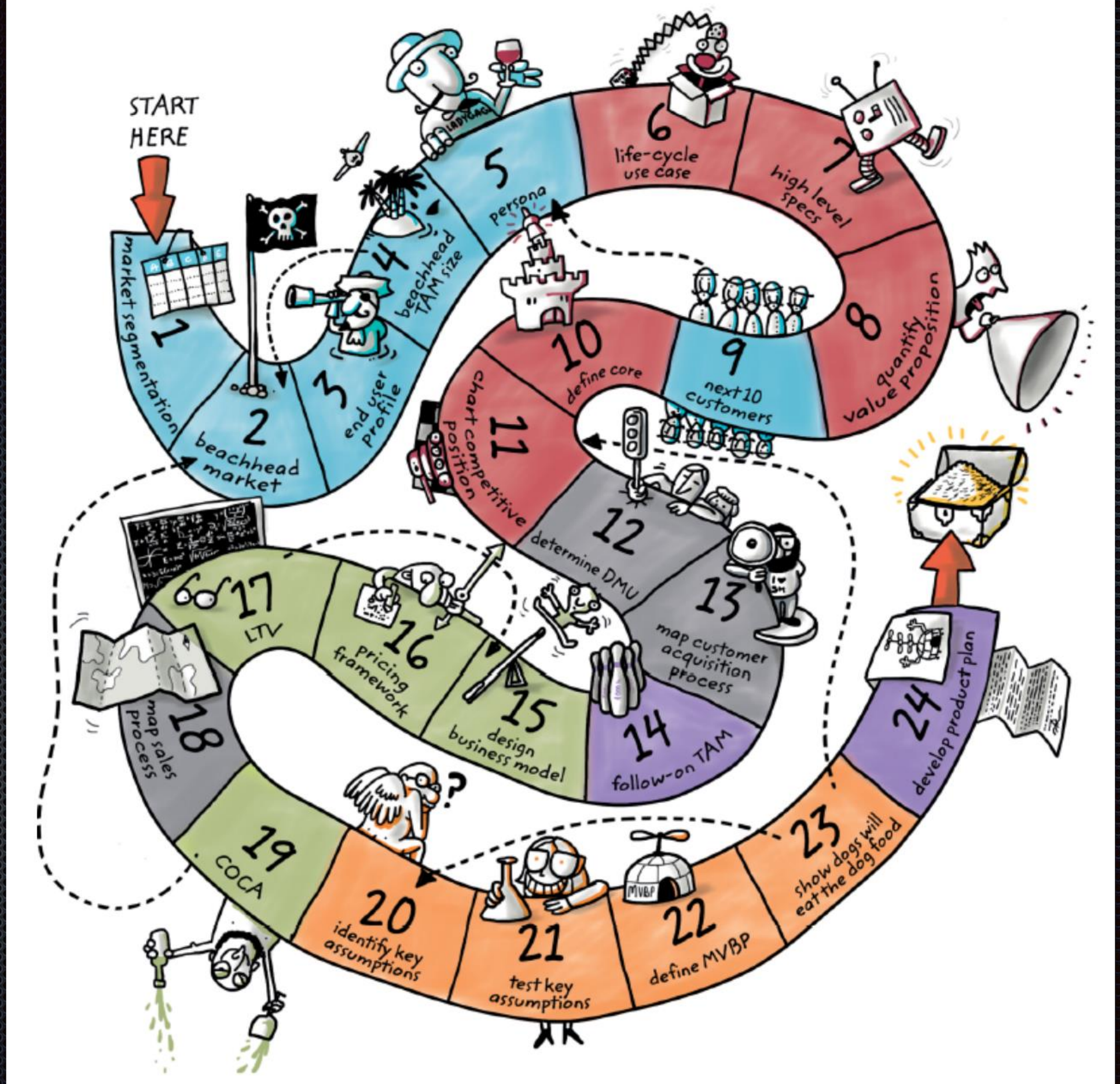
Ind Retailers

Bike Sales Revenue	Parts and Accessories Revenue
$1,160,806,000	$ 913,826,000

From The National Bicycle Dealers Association – *Industry Overview*- web page www.nbda.com, 2004

Technology Adoption Lifecycle




START HERE
1 market segmentation
2 beachhead market
3 end user profile
4 beachhead TAM size
5 persona
6 life-cycle use case
7 high level specs
8 quantify value proposition
9 next 10 customers
10 define core
11 chart competitive position
12 determine DMU
13 map customer acquisition process
14 follow-on TAM
15 design business model
16 pricing framework
17 LTV
18 map sales process
19 COCA
20 identify key assumptions
21 test key assumptions
22 define MVBP
23 show dogs will eat the dog food
24 develop product plan

WHO IS YOUR CUSTOMER?

1. Market Segmentation
2. Select a Beachhead Market
3. Build an End User Profile
4. Calculate the TAM Size for the Beachhead Market
5. Profile the Persona for the Beachhead Market
9. Identify Your Next 10 Customers

WHAT CAN YOU DO FOR YOUR CUSTOMER?

6. Full Life Cycle Use Case
7. High-Level Product Specification
8. Quantify the Value Proposition
10. Define Your Core
11. Chart Your Competitive Position

HOW DOES YOUR CUSTOMER ACQUIRE YOUR PRODUCT?

12. Determine the Customer's Decision-Making Unit (DMU)
13. Map The Process to Acquire a Paying Customer
18. Map the Sales Process to Acquire a Customer

HOW DO YOU MAKE MONEY OFF YOUR PRODUCT?

15. Design a Business Model
16. Set Your Pricing Framework
17. Calculate the Lifetime Value (LTV) of an Acquired Customer
19. Calculate the Cost of Customer Acquisition (COCA)

HOW DO YOU DESIGN & BUILD YOUR PRODUCT?

20. Identify Key Assumptions
21. Test Key Assumptions
22. Define the Minimum Viable Business Product (MVBP)
23. Show That "The Dogs Will Eat the Dog Food"

HOW DO YOU SCALE YOUR BUSINESS?

14. Calculate the TAM Size for Follow-on Markets
24. Develop a Product Plan

The Diffusion of Hybrid Seed Corn In Two Iowa Communities*

By Bryce Ryan and Neal C. Gross†

Abstract

Hybrid seed corn has diffused through the midwest with phenomenal rapidity. In the space of four years, 1936 through 1939, two-thirds of the operators in the two communities studied, changed to the new seed. Relatively few, however, took over hybrid seed for their entire acreage the first year they tried it. This was true even for operators first using the seed at a relatively late date. There appears to be some difference between the diffusion agencies which informed farmers of the new seed and the sources of influence toward adoption. Commercial channels, especially salesmen, were most important as original sources of knowledge, while neighbors were most important as influences leading to acceptance. Although the time pattern of acceptance follows a bell shaped curve, this instance of diffusion cannot be accurately described as following a normal frequency distribution.

Resumen

El maíz de semilla híbrido se ha difundido por el Mediano Oeste con extraordinaria rapidez. En el espacio de 4 años, desde el 1936 hasta el 1939, dos tercios de los agricultores de las dos comunidades estudiadas adoptaron la nueva semilla. Sin embargo, relativamente muy pocos de ellos la cultivaron de lleno en el primero año que la conocieron. Ésto fué cierto también con aquellos que la han usado aún más recientemente. Parece que existe alguna diferencia entre las agencias de difusión que informaron a los agricultores sobre la nueva semilla y las fuentes de influjo que los decidieron a su adopción. Las vías comerciales, particularmente los vendedores, fueron las más importantes fuentes de conocimiento, mientras que los vecinos tuvieron más importancia desde el punto de vista de la aceptación de la simiente. Aunque el modelo del tiempo de adopción conforma con el de una campana, este ejemplo de difusión no puede ser descrito como típico de una perfecta distribución normal de frequencias.

The introduction of hybrid seed corn has been the most striking technical advance in midwestern agriculture during the past decade.[1] Although a few experimenters had been acquainted with this new and sturdier seed for many years, only since 1937 has it become a nationally important production factor. It has been estimated that between 1933 and 1939 acreage in hybrid corn increased from 40,000 to 24 million acres (about one-fourth of the nation's corn acreage). In the North Central region the spread was even more rapid. Although hybrid seed was not available until 1928 or 1929, by 1939, 75 per cent of the corn acreage in Iowa was in hybrid.

The very rapidity of its diffusion makes this trait attractive for study. This is true not only because farmers are usually "conservative," but also because its adoption is well within the memory span of current farm operators, and hence amenable to more intensive study than would

* Journal Paper No. J-1092 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 776.

† Iowa State College, Ames, Iowa.

[1] See *Technology and the Farm*, U.S.D.A., 1940, Chapter 5.

otherwise be possible. Analysis of this diffusion has a special significance in that it represents a farm trait which can almost unqualifiedly be termed a "good (economic) farm practice." The study of its spread may offer some factual knowledge of conditions attendant to the eminently successful diffusion of a rational technique.[2]

The 1930's provide a curiously complex background to the diffusion of a new, hardier, and more productive breed of corn. On the whole the peculiar circumstances of this decade should have favored the more rapid spread of the trait rather than its retardation, but this assumption cannot be accepted unequivocally. From a rational standpoint the period of economic distress should have given added incentive to the acceptance of a more efficient practice, but the new seed demanded cash outlay at a time when farmers were loath to use either cash or credit. Although none of the farmers studied attributed delay in adoption to lack of credit, the general restriction of cash expenditures in the depths of depression was undoubtedly a limiting factor.[3] Balanced against the negative effects of depression were two conditions stimulating adoption. The first of these was the AAA starting in 1933, and the second was the severe droughts especially in 1934 and 1936. The reduction of corn acreage associated with a "pegged price" was certainly favorable to the more productive type of seed and the superior performance of hybrid corn under drought conditions offered objective demonstrations of its hardiness.

Even with this conspiracy of circumstances, it still might be wondered that hybrid spread so rapidly, in view of the slowness with which many sound economic practices are accepted.[4] Aside from the obvious superiority of the new breed (except where improper seed was used in a particular locality) it was a trait which could be and was promoted profitably by lively commercial interests. Further, its advantages were visible not only in account books; they showed up tangibly to every drought-wearied farmer who passed by. In Iowa, at least, the Extension Service aided the movement in a number of ways, but notably through the publication of comparative corn yield tests, and the certification of commercial seeds. Also of importance was the very ease by which the new practice could be adopted. Its use required few changes in routine or equipment.

To ascertain the process through which hybrid seed was absorbed into the technicways of the Corn Belt, two communities in central Iowa were selected for study in the summer of 1941.[5] Practically all of the farm operators dependent upon the two town centers of Grand Junction and Scranton were included, totalling 323 farmers. Since 64 of these had started farming since hybrid corn began its spread, they have been excluded from the analysis. The age bias resulting from this is not as serious as would have been the inclusion of operators having unequal opportunity of adopting the trait in any given year.

[2]This paper represents a part of a longer study now in progress in which factors affecting rapidity of spread are also being analyzed.

[3]Too much emphasis should not be placed on this essentially psychological assumption. The use of hybrid seed would have been profitable in every separate year of the depression. See Neal C. Gross, "The Diffusion of a Culture Trait in Two Iowa Townships," M.S. Thesis, Iowa State College, 1942 (unpublished).

[4]For example: hog sanitation, liming, systematic accounts, and many more which have been promoted by the Extension Service for years.

Diffusion of Knowledge and Practice

Figure 1 shows the comparative percentages of all operators first hearing of hybrid corn in specified years, and the percentages first adopting it. While the curves are generally similar, allowing for a time lag of roughly five years between first knowledge and first adoption, some differences are worth noting. Whereas the modal frequency in knowledge came 7 years after the first operator heard of the seed, the modal frequency in adoption occurred 10 years after the trait was first accepted. The preliminary stages of diffusion were somewhat slower in terms of adoption than in knowledge; once the wave of adoption

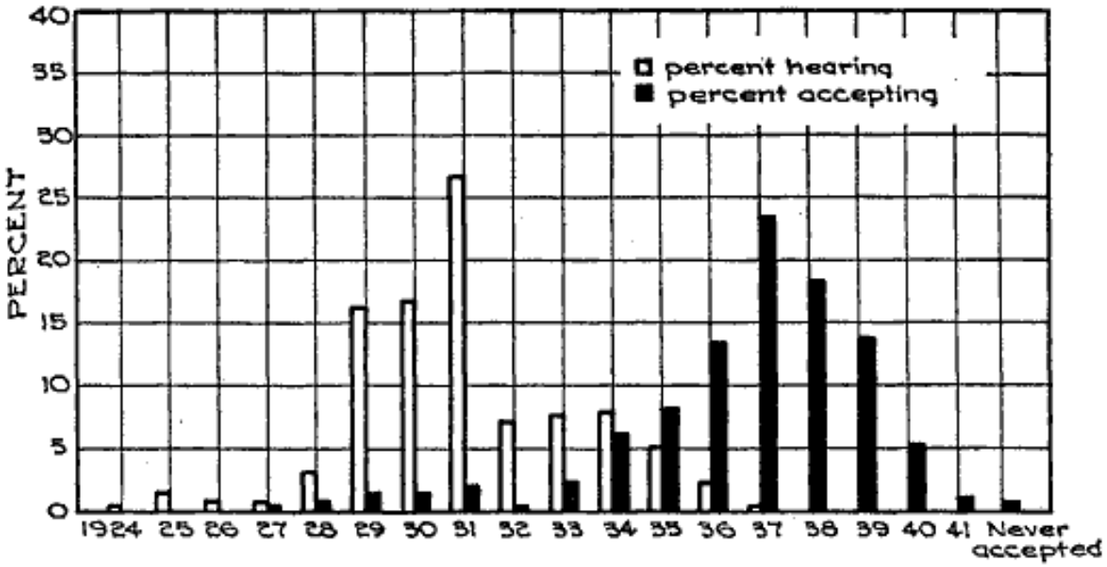


Fig. 1. Percentages of Farm Operators First Hearing of Hybrid Seed Corn and Percentages First Accepting It, by Years.

[5]These communities are situated in Greene County 15 miles apart, equidistant from urban centers and on a main east-west highway. They are not typical of Iowa but probably are typical of the intensive grain producing, high income, and highly commercialized central area of the state. They are typically rurban; practically all operators have radios, newspapers, farm journals, and telephones. It should be recognized that some of the operators were not members of these communities at the time they adopted hybrid seed, but there is no reason to believe that this offers any serious bias for the present problem.

swelled, hybrid practically "took the field" in the space of four years (1936-1939 inclusive). Almost all had heard of the new trait before more than a handful were planting it.[6]

Increasing Acceptance

As might be expected, few operators turned their corn acreage completely to hybrid seed in the early years (See table I). In fact, this tentative pattern of acceptance characterized the majority who began using the seed even in 1940 and 1941. While the very late operators generally took up the new seed immediately for a larger share of their acreage, the median planting for those first using hybrid in 1939 amounted to only 30 per cent of their total corn acreage for that year. More surprising than the increase in the size of first plantings as time went on is the fact that the more conservative operators, with several years of community experience to guide them, were so "experimental" in their acceptance.

Although the size of first plantings increased very little with the passing years, until about 1939, the later acceptors took a shorter time to reach practically complete adoption of the new seed. Thus, for example, the operators starting to plant hybrid in the respective years, 1934, 1936, and 1937, all reached a 100 per cent median planting for the first time in 1939.[7] However, in most years prior to 1939 the earlier the operators had started using hybrid, the larger was the percentage of crop in the new seed. Although some exceptions to this arise, notably among operators starting in 1935, in general, the later acceptors did not "catch up with" the earlier ones until the point of practically complete adoption had been reached.

In a sense the early acceptors provided a community laboratory from which neighbors could gain some vicarious experience with the new seed over a period of some years. The importance of this local laboratory has been attested by the weight given "neighbors" as influences toward acceptance.[8] But at the same time it is evident that the more conservative operators would not accept other farmers' experience at full face value. This offers a suggestive slant on the learning process in farm practice. It would seem that whatever the advantages demonstrated by community experience in hybrid, the bulk of the operators insisted upon personal experimentation before complete acceptance. As we have seen, the experimentation period was shortened for the late ones, but very few were willing to start at the point already reached by earlier adoptors. The acceptance of hybrid was far from a conversion; individual and

[6]This would be much more striking if adoption of the trait meant 100 per cent of corn acreage in hybrid. Here we have considered acceptance of the seed in any degree as adoption.

[7]The mean percentages of corn land in hybrid for each of these groups in 1939 were: 1934—97.2; 1936—82.1; 1937—86.6. Means have not been used generally because of the skewed distributions especially in early and late phases of the acceptance process.

[8]See below.

TABLE I. MEDIAN PER CENT OF CORN ACREAGE IN HYBRID FOR INDIVIDUAL YEARS BY YEAR IN WHICH OPERATOR FIRST USED HYBRID SEED

Year first used hybrid	1933	1934	1935	1936	1937	1938	1939	1940	1941	No. of cases
Before 1934	38.0*	50.0	67.0	100.0	100.0	100.0	100.0	100.0	100.0	24
1934		20.0	29.0	42.0	67.0	95.0	100.0	100.0	100.0	16
1935			18.0	44.0	75.0	100.0	100.0	100.0	100.0	21
1936				20.0	41.0	62.5	100.0	100.0	100.0	36
1937					19.0	55.0	100.0	100.0	100.0	61
1938						25.0	79.0	100.0	100.0	46
1939							30.0	91.5	100.0	36
1940								69.5	100.0	14
1941									54.0	3
Total										257
Never accepted										2
Total Sample										259

* The median hybrid planting for this group in first year of acceptance was 12 per cent of total corn acreage.

time-consuming self-demonstration was required even after visible evidence and objective comparisons were readily available to all.[9]

Original Source of Knowledge[10]

Almost one-half of the farmers cited personal contact with salesmen as their earliest source of information on hybrid seed, while an additional tenth named radio sales talks (See table 2). Only 14.6 per cent named neighbors as original informants and 10.7 per cent "farm journals." All other sources were of minor importance. Figure 2 illustrates the sharp fluctuations in the importance assigned these various media, depending upon the year in which the trait was first made known to the farmer. Thus, salesmen were of major significance before 1933. Nearly 70 per cent of the operators learning of hybrid in the

TABLE 2. PERCENTAGES OF ALL OPERATORS CITING SPECIFIC ORIGINAL SOURCES OF KNOWLEDGE OF HYBRID SEED AND MOST INFLUENTIAL SOURCES

Source	Per Cent	
	Original knowledge	Most influential
Neighbors	14.6	45.5
Salesmen	49.0	32.0
Farm Journal	10.7	2.3
Radio advertising	10.3	..
Extension Service*	2.8	2.4
Relatives	3.5	4.2
Personal experimentation	.	6.6
All others**	9.1	7.0
Total	100.0	100.0

* Including County Agent, bulletins, etc.
** Including unknown.

[9]Iowa State College began publishing and distributing its reports on comparative corn yields in 1921.

[10]The study of diffusion sources is of course based upon highly subjective data, i.e., dependent upon the farmer's recall and evaluation. However, the most feasible way of approaching the problem is on the question-answer basis, and in the comparison of early and late acceptors at least there is no reason for the existence of great differences in sources on the strength of recall bias.

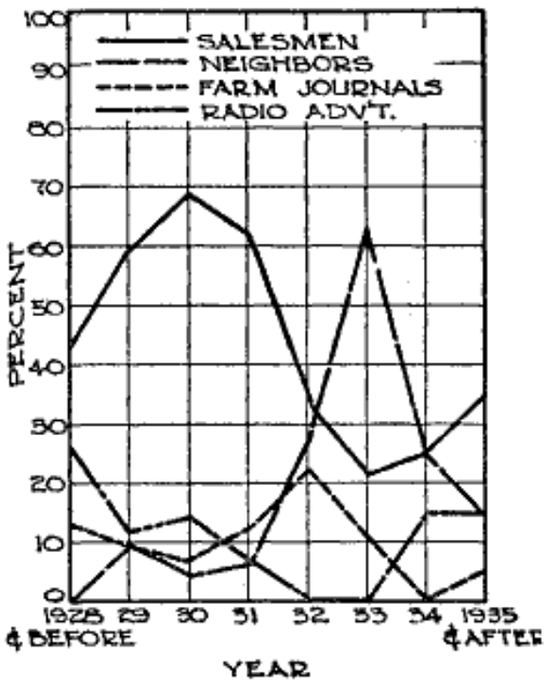


Fig. 2. Percentages of Farm Operators First Hearing of Hybrid Seed Corn Through Various Channels, by Year First Heard.

year 1930 named salesmen as their initial source; three years later only 21 per cent learned of the trait through salesmen. On the other hand, as salesmen declined in importance "neighbors" notably increased. In 1931 only 6 per cent named neighbors, but in 1933 more than 60 per cent named them. In the final years during which the most isolated operators were being reached, these two sources were about equal. There are sharp fluctuations also for the minor sources of diffusion. Farm journals were of significance mainly in 1932 while radio advertising was of some importance for the very early and the very late operators.

It is evident that some of these observations have been based on very few cases, since about two-thirds of the operators heard of hybrid seed in 1929, 1930, and 1931. All of these were years in which salesmen were important. Hence, it was mainly a group of stragglers who were reached through other farmers. The speed with which knowledge of the new trait spread through the communities is probably in fact, as well as in farmer opinion, a tribute to the initiative of hybrid seed dealers. The unimportance of neighbors prior to 1932 is consistent with the earlier finding that only 5 per cent of the operators were using the seed prior to that date. Observation of neighboring fields would probably not have become important until after that time.

Most Influential Sources of Knowledge

When the farmers were asked to evaluate their various sources of information on hybrid as to relative influence in leading them to take up the practice, neighbors were cited more frequently than any other medium (by 45.5%). While salesmen were also accorded considerable importance as influences, as well as original informants, only 32.0 per cent felt that their judgment was influenced most significantly by such commercial representatives. Nearly 7 per cent believed that their personal experience was the only strong motivator.[11]

In analyzing the time pattern in

[11]This was an evasion of the real issue since the desired information was as to influence leading to personal use of the seed.

the comparative influences of neighbors and salesmen, it is more reasonable to use a time scale by year of adoption of the trait, rather than by year of first information. Two-thirds of the early adoptors credited salesmen with influencing them most, while two-thirds of the latest adoptors credited their neighbors as being primary motivators (figure 3).

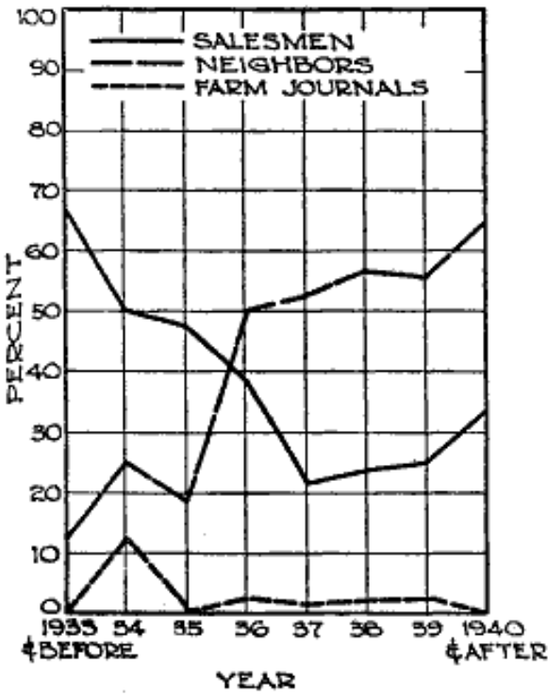


Fig. 3. Percentages of Farm Operators Accepting Hybrid Seed Corn In Different Years Assigning Major Influence to Various Sources.

With the passing years neighbors gained almost consistently in importance and salesmen lost. The bulk of the operators fall in the later years—hence, the much greater neighbor influence in the total sample.

Insofar as the farmers' evaluations are accurate, it may be suggested that the diffusion agencies are divisible into two moderately distinct types, namely, those important as introductory mechanisms and those important as activating agents. Thus salesmen were credited with informing the majority of the operators but neighbors were credited with convincing them. This is consistent with the earlier observation regarding the extreme caution with which individual farmers took up the new trait. Salesmen no doubt were in fact the major sources of introductory knowledge, but experience within the community counted for more in terms of action. This stands out also in the almost complete lack of influence assigned to other impersonal agencies. While this hypothesis demands further testing, the functional distinction between diffusion agencies is a problem warranting much greater attention both from scholars and from extension service administrators. The spread of knowledge and the spread of "conviction" are, analytically at least, distinct processes, and in this case have appeared to operate in part through different although complementary channels.

Diffusion and the Normal Frequency Curve

It has been evident that the acceptance sequence of hybrid seed in these communities has followed a bell shaped pattern. Certainly the cumulated frequency curve of acceptance would appear similar to the S curve familiar to students of growth phenomena.[12] Pemberton has attempted to give a precise mathematical statement of this, arguing that diffusion

may be expected to follow a normal frequency distribution unless upset by crisis conditions. It seems worth while to test the applicability of a normal frequency hypothesis to the present data.[13]

Figure 4 demonstrates wide differences between our data and their

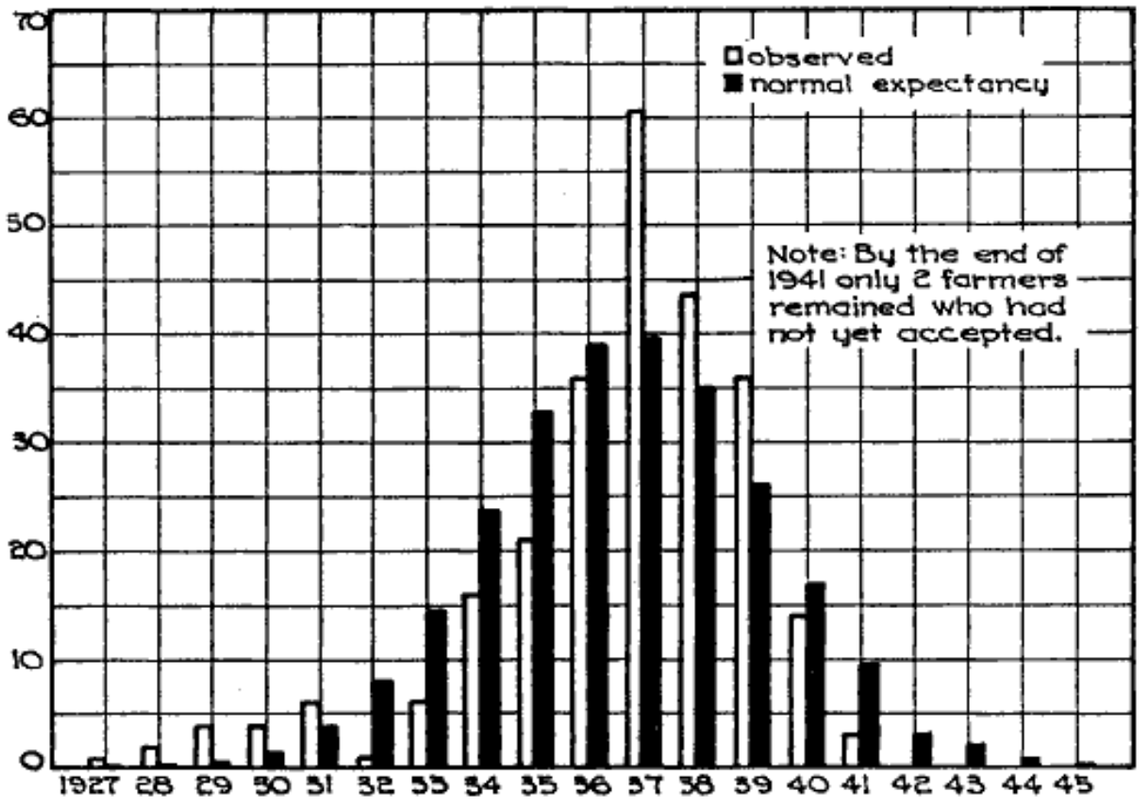


Fig. 4. Observed and Expected (normal) Distributions of Farm Operators According to Year Hybrid Seed Corn Was Accepted for Planting.

computed values in a normal frequency distribution. This deviation from the normal frequency is statistically highly significant. (Chi square =21.67, d.f. 9.) Specifically, the observed frequencies differ from the normal curve fitted to them in the following ways:

1. The total time span was four years less than expected, although only two operators remained without hybrid corn at the time of study.
2. The expected frequencies are greater than the observed in the final years of acceptance and less in the very early years.
3. The observed cases are greatly concentrated at the mode and in the two years following it.

Obviously any reference to the observed distribution as a normal one would be quite misleading, and attributing deviations from normal to "crisis" is to explain away rather than to explain.[14] This failure to conform to a popular hypothesis leads to the consideration of the theoretic applicability of the normal curve to such diffusion data.

It is perhaps true that a normal frequency distribution would describe our sample in reference to some general measure of degree of resistance to change. Granting such an assumption, it would not necessarily postulate a normal frequency distribution in terms of actual trait adoption. There is no doubt but that the behavior of one individual in an interacting population affects the behavior of his fellows. Thus the demonstrated success of hybrid seed on a few farms offers a changed situation to those who have not been so experimental. The very fact of acceptance by one or more farmers offers new stimulus to the remaining ones.[15] The decision to adopt the new practice is a product not only of the operator's position in respect to some pre-existing conditions, but also of the influences and incentives brought to bear. The intensity of the latter is affected by knowledge of previous acceptances, especially when the various acceptors are competitors and the trait raises the general productivity level.

This situation is quite different from that presented by the measurement of heights in a population. Normal frequency does not appear to be a concept closely adapted to this condition where pressures, or reasons, for adoption become increasingly acute with passing time. If we would find mathematical expressions of diffusion, or diffusion rates, it seems reasonable that they be sought in formulae resting upon adequate processual assumptions. Consequently the acceptance pattern demonstrated by these data might with greater methodological exactitude be expressed as a logistic curve. However, it is difficult to see anything beyond an interesting analogy even if we should find a close fit to a logistic curve computed from the data. We see no reason for assuming that a formula developed mainly within the framework of population analysis should conform to diffusion data. The twisting of sociological phenomena into the analytical frameworks of other fields is not only sterile but may actually retard the development of useful sociological tools. If there is indeed an expected diffusion curve, its contours must be derived from comparative inductive researches.[16]

As yet there is no justification for identifying any mathematical formu-

[13]The application of the S curve to diffusion was popularized by F. Stuart Chapin in *Cultural Change*, published in 1928. This obvious result of cumulating frequencies in a bell-shaped distribution has been refined by later students, notably Earl Pemberton whose hypotheses will be discussed in the light of our data. See Earl Pemberton, "The Curve of Culture Diffusion Rate," *Am. Soc. Rev.* (Aug. 1936), and "The Effect of a Social Crisis on the Curve of Diffusion," *ibid* (Feb. 1937).

[14]Pemberton, *op. cit.* (Aug. 1936), states that "the time of trait acceptance in any given case is determined by the chance combination of factors for and against adoption." This he believes is analogous to the distribution of heights in a population, *i.e.*, where the probability of predominance of plus or of minus determinants is less than the probability of mixed determinants.

[15]See Pemberton, *op. cit.* (Feb. 1937).

[16]Obviously there must be a decline in frequency of acceptance after the modal year, *simulating* a normal curve, since fewer operators remain who may yet accept the trait.

la with the diffusion process *per se* but this is a challenge rather than a confession of defeat. It may indeed be that for some classes of diffusion the normal frequency or logistic may be found to be more than interesting analogies, but at best this could be true only of limited types of diffusion, *i.e.*, where the methodical assumptions underlying those curves are identical with conditions of social interaction basic to the trait's spread. It is quite possible that different types of diffusion occur with different temporal patterns. The "tidal wave" process we have noted may indeed be typical of intra-community diffusion, or further research may show it to be a product of special circumstances, *i.e.*, commercial incentives, competition, etc. Surely there is neither empirical nor theoretical foundation for identifying the diffusion curves of fads and fashions with those of postage stamps, bath tubs, or hybrid seed corn. The formulation of ideal diffusion curves must wait upon analysis of vastly more material than has yet been done, but it seems doubtful if any theoretic pattern can adequately conform to situations involving all degrees of interaction and isolation; to economic practices as well as styles; to intra- as well as to inter-societal diffusion.

[10]There is no implication here that fitting mathematical curves to sociological data is entirely useless. Mathematical curves may be extremely useful for comparative analysis at least. Raymond Jessen, of the Iowa State College Statistical Laboratory, suggests that the Orthogonal Polynomial may have possibilities in the comparative analysis of diffusion data. For a provocative utilization of logistic and Gompertz curves in diffusion research, see Alice Davis, "Technicways in American Civilization," *Social Forces* (March, 1940).