How Companies Select and Develop Harvesters: the Commercial Perspective

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Strategy for Developing Mechanical Harvesting of Horticultural Crops: Simultaneous Short –, Medium –, and Long – Term Strategies

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Overview of presentation

- NOT a technical talk on machine types
- 8 interviews: 6 companies, 1 economic development entity, 1university ag engineer
- All *passionate* and committed to mechanization of specialty crops
- All with a unique and fascinating story of how they became involved and hope to succeed
- Provided an important personal, and historical, perspective

HAND HARVESTED CROPS – Can it be done?

MAYBE (depends on crop): Difficult, expensive.

Long-term capital cost to grower high, reduces incentive. Need BIG labor cost increase, 3 year ROI to customer. Electronics, software, CAD important ↑

FULL MECHANIZATION? Maybe. Platforms a transition to full? MAYBE

BARRIERS: Selectivity, gentleness, ***grower "paradigms"*** (labor and harvest management/expectations, planting systems)

WHAT IS NEEDED TO SUCCEED?

DEVELOPER: PASSION, PERSISTENCE, SKILL, PATIENCE – AND MONEY!

INDUSTRY: ***long term commitment to crop***
CA – almonds, walnuts, pistachios, wine grapes compete with fresh fruit.

SUCCESSFUL ENTITIES – Serve multiple but related crops: raisins, pomegranates, olives, wine grapes, citrus, pistachios, cherries (tart), apples, nuts, chili peppers, cucumber (pickles), cherry peppers (jalapeno). Enables R&D cost to be spread out, lowers overall cost.

Types of companies (generational) -- ag

- Mechanics/farmers LLCs, family-owned (1st generation)
- Established engineering companies (2nd generation)
- Entrepreneurial 'start-ups" (3rd generation)

LONG TERM, LIMITING FACTOR: STABLE FUNDING (options)

- Days of piecemeal, "do-it-your-self" finance over ("couldn't do it today")
- Investors AND customers desire 3-5 year ROI sought; 20-year timelines less feasible
- Federal grant funds (SCRI, AFRI)
- Commodity groups
- Large (private or cooperative)grower entities
- Venture capital
- **KEEP YOUR DAY JOB !**

Funding Sources

public funds

NATIONAL ROBOTICS INITIATIVE

USDA

NSF

private funds

CHARLES RIVER VENTURES

KPCB | KLEINER PERKINS CAUFIELD BYERS

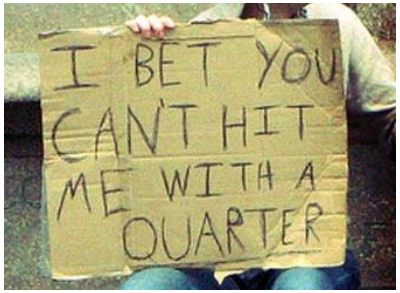
khosla ventures
venture assistance, strategic advice, venture capital

WASHINGTON TREE FRUIT RESEARCH COMMISSION

CITRUS RESEARCH BOARD

California STRAWBERRY COMMISSION

last resort funds



1ST GENERATION
Ag Mechanic/Farmer/Custom Harvester (1960s-1970s)

Field savvy,

"Always tinkering"

Self-taught

Transformed dream to reality

Impetus: Saw need themselves or expressed by *local* grower(s)

Long term, trial and error, stepwise improvement:

"I didn't know enough to give up"

"Pay as you go"

Self or customer-financed, no budgets or business plans

HAVE A DAY JOB!

1ST GENERATION
Ag Mechanic/Farmer/Custom Harvester

Initial success
mechanical skill + persistence + luck + timing: *dream becomes reality*

Continued success
machine payback → new customers → reputation → market widens, new niches

Targets local niche markets initially
Grow, "zeros in" (territory, crop types); parts business important

1ST GENERATION
Ag Mechanic/Farmer/Custom Harvester

Still family – run

mostly <50 employees

10s of units

kids educated (see 3rd generation);

branched out to other businesses

Instrumental in driving industry change

labor management, breeding, planting stand management

2nd GENERATION
Ag Engineering Company
"Mom and Pop" start ups grow up (1980s - 2000s)

Often formed from one or more established "mom and pops"

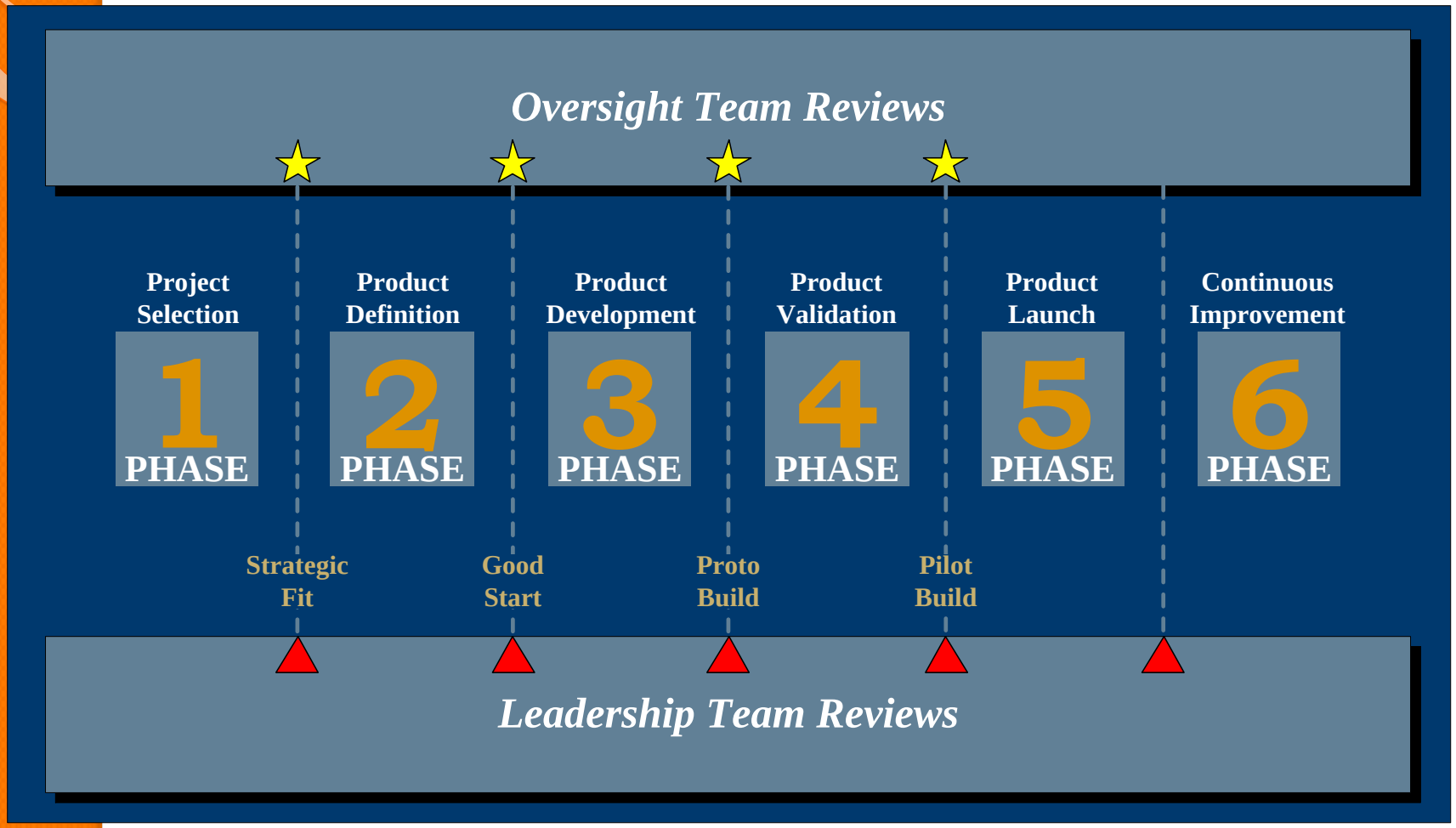
Design engineering, production and marketing staff ⟶

higher overhead

Local ⟶regional ⟶ national ⟶ international growth

Multi-commodity, Multi-operation product line

100's of units


Oversight Team Reviews
Project Selection
1 PHASE
Product Definition
2 PHASE
Product Development
3 PHASE
Product Validation
4 PHASE
Product Launch
5 PHASE
Continuous Improvement
6 PHASE
Strategic Fit
Good Start
Proto Build
Pilot Build
Leadership Team Reviews

2nd GENERATION
Ag Engineering Company

FINANCING

Profits from sales, investor, lender, venture, going public

Rigorous, multi-faceted design →

Implementation

GROWTH

Parallel market studies, acquisition, partnerships. Where the new generation start ups hope to end up!

DEMAND MUST BE ASSURED, CONSISTENT

3rd GENERATION
21st Century Engineering Start Up

Formally and highly educated

May have ag or machine background

Technical skills

Engineering, mechanics,

Computers (multiple aspects), electronics

Material science

Robotics

Emphasis on business skills

Extensive technology market research

Detailed business and product plans

→

Financing (HARD!)

Mainly venture capital

Requires prior reputation or working prototype

A little perspective..

rethink robotics™

Nov 2010	Sep 2009	Nov 2010	Jun 2012	Apr 2013
$5M	$7M	$20M	$30M	Product Launch
BEZOS EXPEDITIONS	CHARLES RIVER VENTURES	HIGHLAND CAPITAL PARTNERS, SIGMA	DFJ	

Rodney Brooks

3rd GENERATION
21st Century Engineering Start Up

Faced with shorter term outlook for success (3-5 years)

HOW? Adapt modern engineering and *electronic* innovations, e.g. aerospace, automotive, defense

Seek consumer-level control simplicity

GOAL: Fill niche market(s), be acquired, or go public

Be a 4th generation ag engineering company

Why now?

Market conditions

- Growers care
- Architectures accommodate it

technological state-of-the-art and

- Vision components have gotten better and cheaper
- Mechanical components have gotten better and cheaper
- Computation has gotten faster and cheaper

What is the Role of Public Research and Extension?

Cooperators with land-grant, USDA-ARS; gained ideas

Often able to persist longer than researchers

Noted downsizing effects, spending priorities (program funding pressures)

Utilized public-developed technology, ex. Force balanced shaker head

Appreciate "3rd party" objective field evaluation, extension involvement

What is the Role of Public Research and Extension?

Should be "cutting edge", then let industry apply the results ex. shaker head; sound waves?

Ideas need to be simplified

What is mechanically harvested today?

Table 3. U.S. Crops That Widely Use Mechanical (M) or Labor-Aid (L) Harvesting Systems

Fresh-Market Crops		Procesing Crops	
Fruits	Vegetables	Vegetables	Fruits
Cranberry M	Above Ground:	Above Ground:	Blackberry M
Date M	Celery M	Brussel Sprout M	Cult. Blueberry M
Fig M	Hd. Lettuce L	Cantaloupe L	Wild Blueberry L
Papaya L	Spinach M	Celery M	Grape M
	Sweet Corn M	Cucumber M	Jojoba M
Nuts		Field Squash M	Papaya M
	Below Ground:	Hd. cabbage M	Pineapple L
Almond M	Carrot M	Honeydew Melon L	Plum M
Chestnut M	Dry Onion M	Hot pepper M	Prune M
Hazelnut M	Garlic M	Lima Bean M	Rasberry M
Peanut M	Horseradish M	Muskmelon L	Sweet Cherry M
Pistacio M	Parsnip M	Mustard Green M	Tart Cherry M
Walnut M	Potato M	Parsley M	
Pecan M	Radish M	Pea M	
	Rutabaga M	Pumpkin M	
	Sweet Potato M	Rhubarb M	
	Turnip M	Snap Bean M	
		Sweet Corn M	
		Tomato M	
		Below Ground:	
		Beet M	
		Carrot M	
		Potato M	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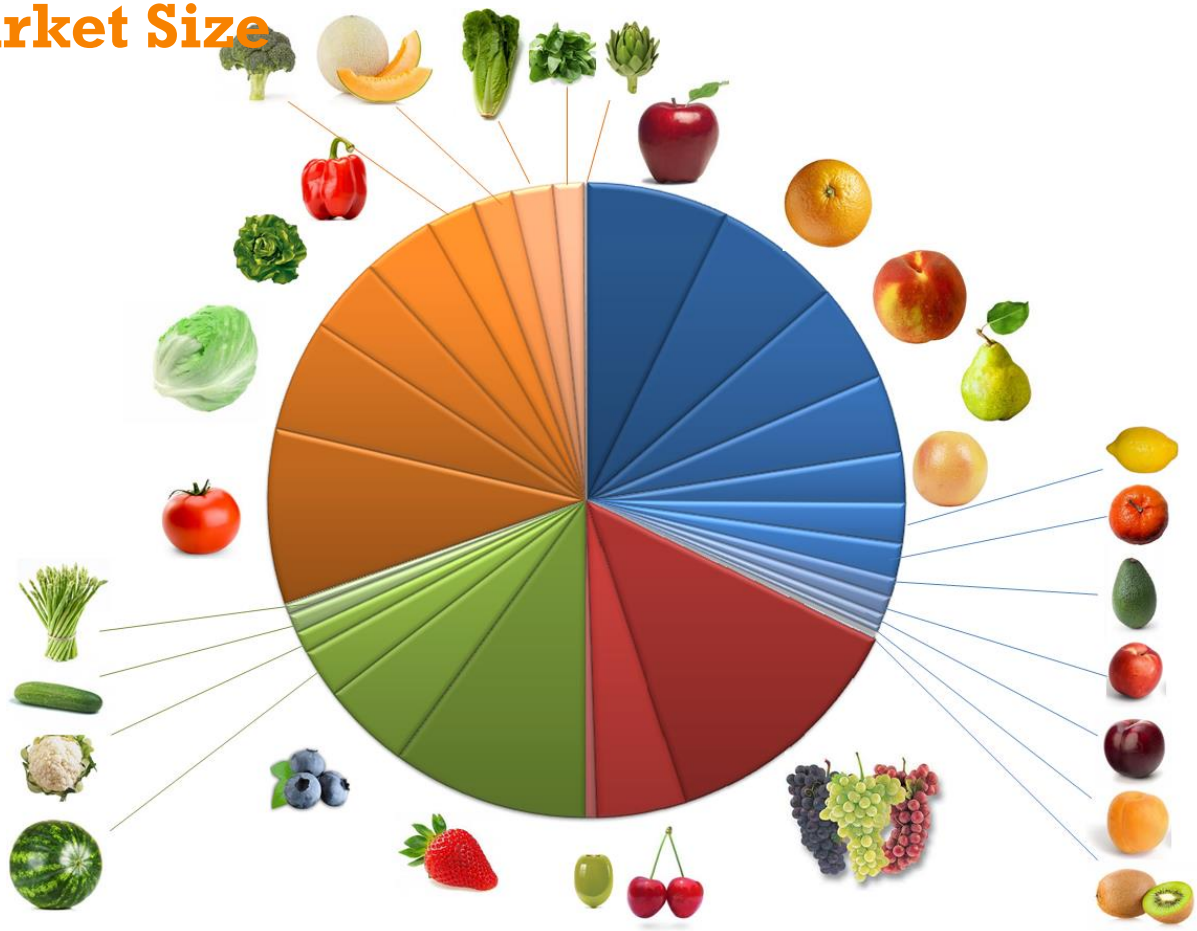
Market Size



	domestic (auto alone)	domestic (auto+dens)	global (auto alone)	global (auto+dens)
apples	$0.8B	$2B	$3B	$8B
top 5 tree fruit	$2B	$5B	$9B	$23B
all crops	$8B	$12B	$26B	**$42B**

TIMING IS EVERYTHING!

"THE STARS MUST LINE UP"

FEW SUCCEED - MANY FAIL

- **Industry**
- **Growers *and* labor force**

- **Engineers and Breeders**
- **Machine Developer**

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THANK YOU!