Successful Entrepreneurship for Microsystems

Rakesh Kumar, *Ph.D., Life Fellow IEEE*

May 28, 2015

rakeshk@eng.ucsd.edu

rakesh@tcxinc.com

858.945.3758

Teaching assistant – **Sneha Venkatesh Yelimeli ("Sneha VY")**

svyelime@eng.ucsd.edu

Tutor – **Ashwin Raman**

asraman@ucsd.edu

Course presented at UCSD CSE 190, Spring Quarter 2015

Final Presentation

Friday, June 5, 2015

EBU3B – 1202

530 pm – 9 pm (Pizza ~630)

Each TEAM - **7 minute presentations**, plus 3 minutes of Q&A

Presentations due to Sneha by 4pm on Friday, June 5th

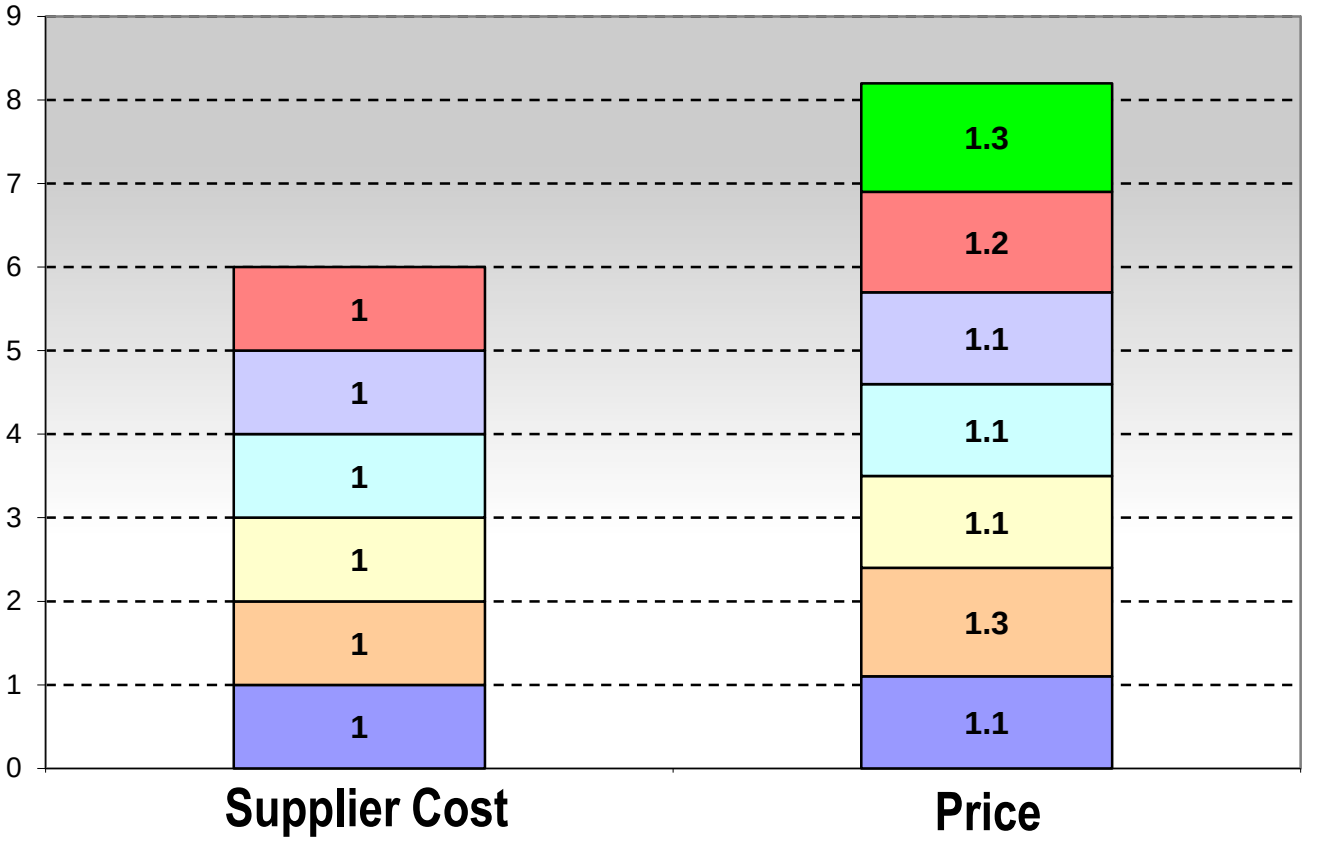
Final Report

Due **- Sunday, June 7, 2015** ***no later than midnight***

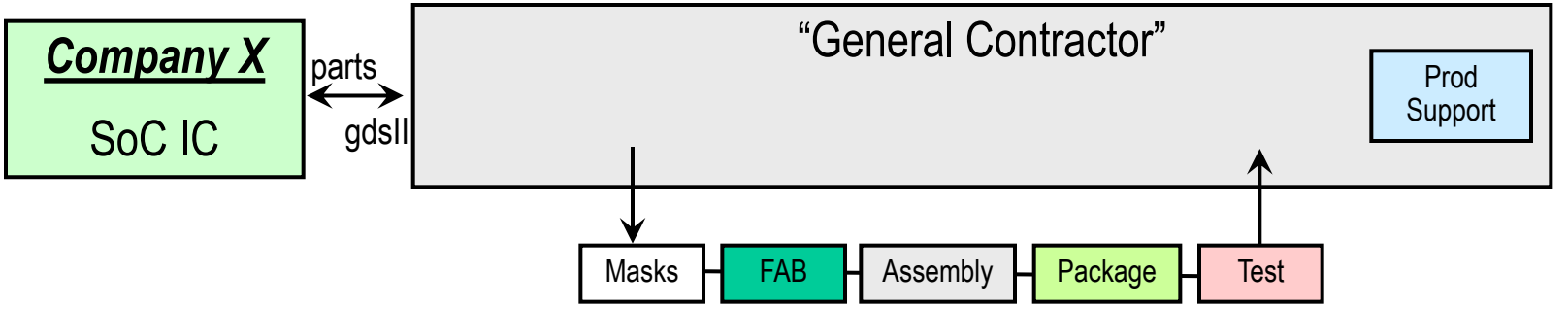
OUTSOURCING

- **When to use**
  - Not your core-competency
  - Need quick entry/service
  - Conserve capital
  - Does not compromise your IP
- **Some 'watchouts'**
  - "Make" vs "Buy"
  - Margin stacking
  - Supplier Management
    - Meet your goals for Schedule, Performance, Quality, Reliability,…

Margin Stacking



COT Outsourced Margin Stacking – SoC GDSII Handoff



Supplier Cost :		**1 m**	**1 d**	**1 a**	**1 p**	**1 t**	**1 s**
Marked-up Cost (typ) :		**1.1 m**	**1.3 d**	**1.1 a**	**1.1 p**	**1.1 t**	**1 s**
Price for Company X :	**1.3[a] x**	**[1.1 m**	**1.3 d**	**1.1 a**	**1.1 p**	**1.1 t**	**1 s]**

Notes:

[a] this markup could vary (1.0 - 1.3), depending on price negotiation

m mask cost, could be amortized over unit volume

d die cost

a assembly cost

p package cost

t test cost

s product and other support cost

Mark-up vs Margin

MARKUP = [P-C] / C

or, P = [1 + MU] * C

MARGIN = [P-C] / P

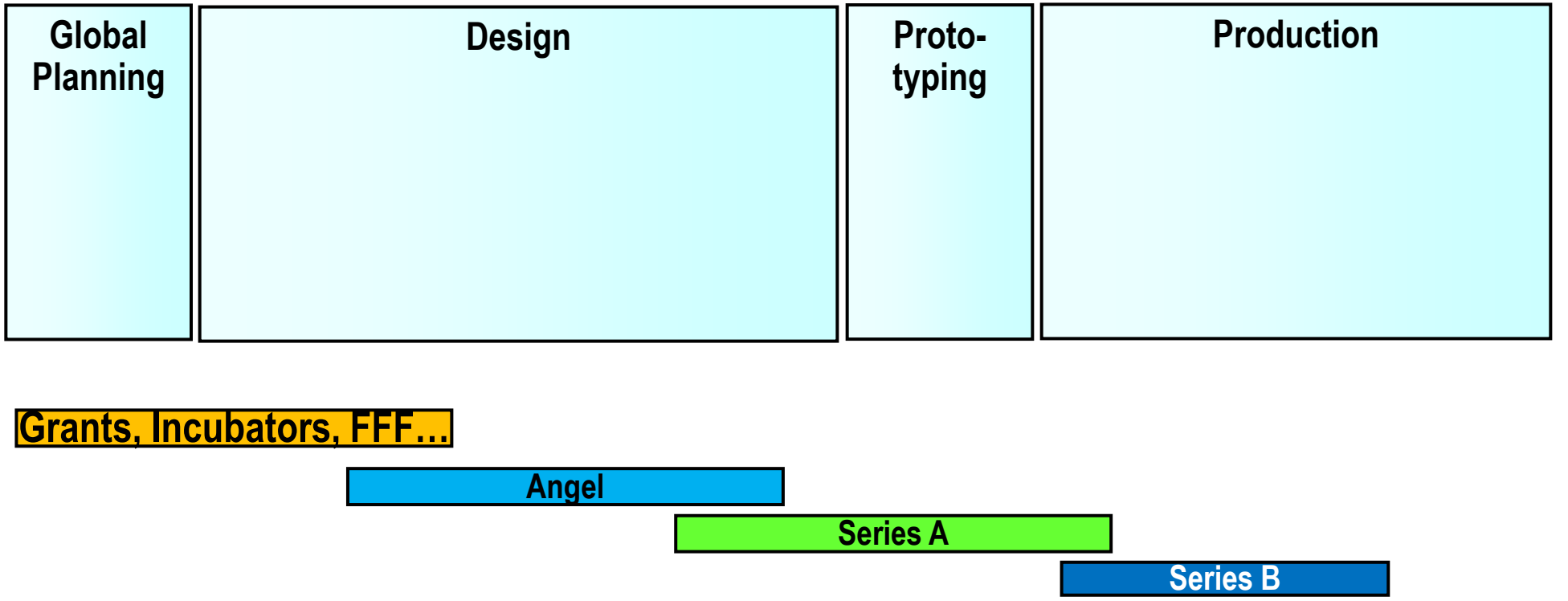
or, P = C / [1 - GM]

aka Gross Profit Margin

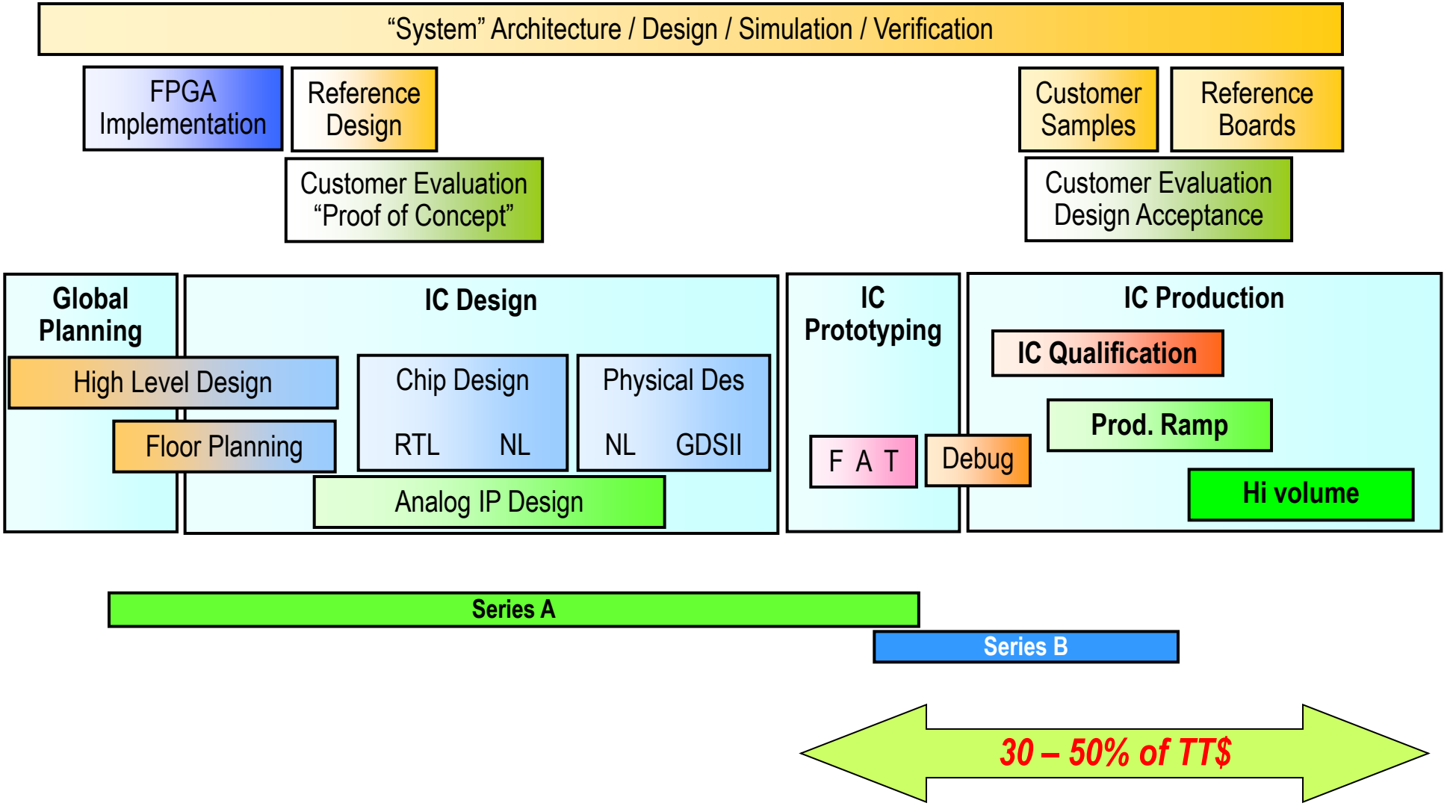
Example:
C= $10
MU = 30%
P = $13

Margin = ?

Lifecycle of a Startup development – the 4 phases

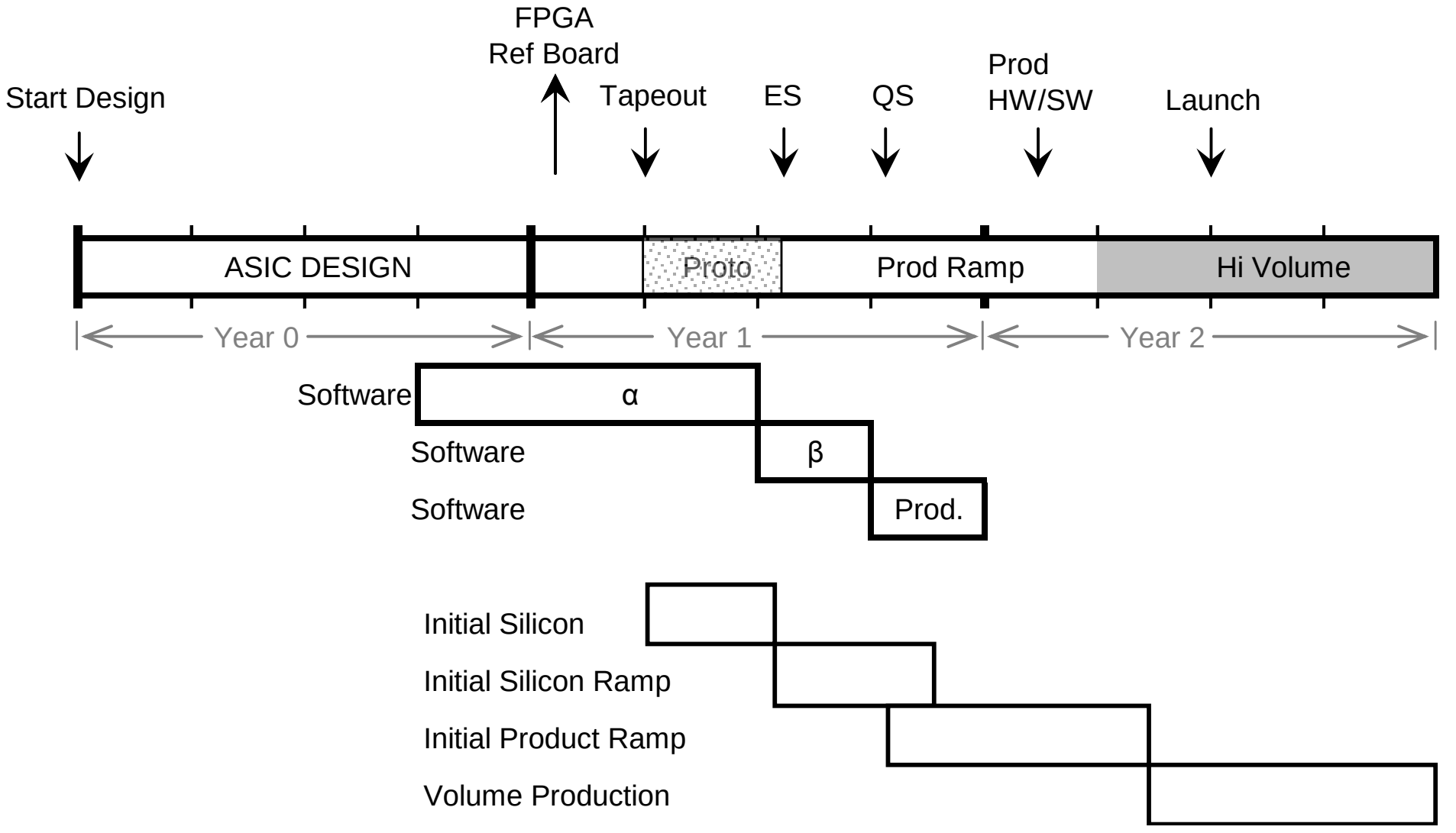


Lifecycle of a Fabless IC development – activity highlites



Manage your Internal Development Schedule

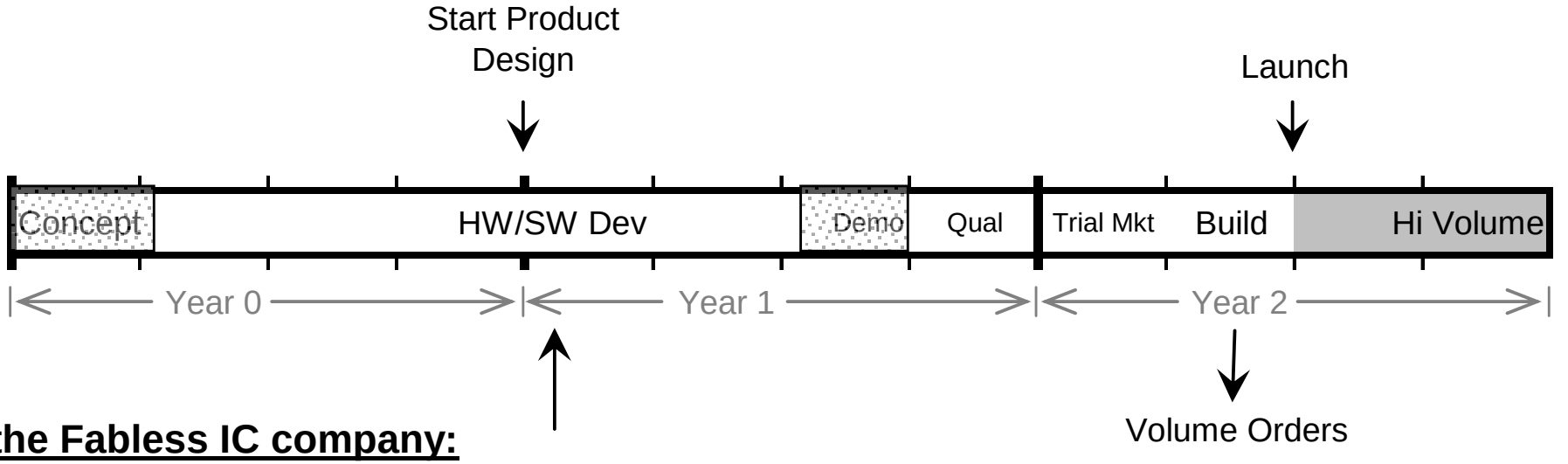
Typical ASIC Development Cycle



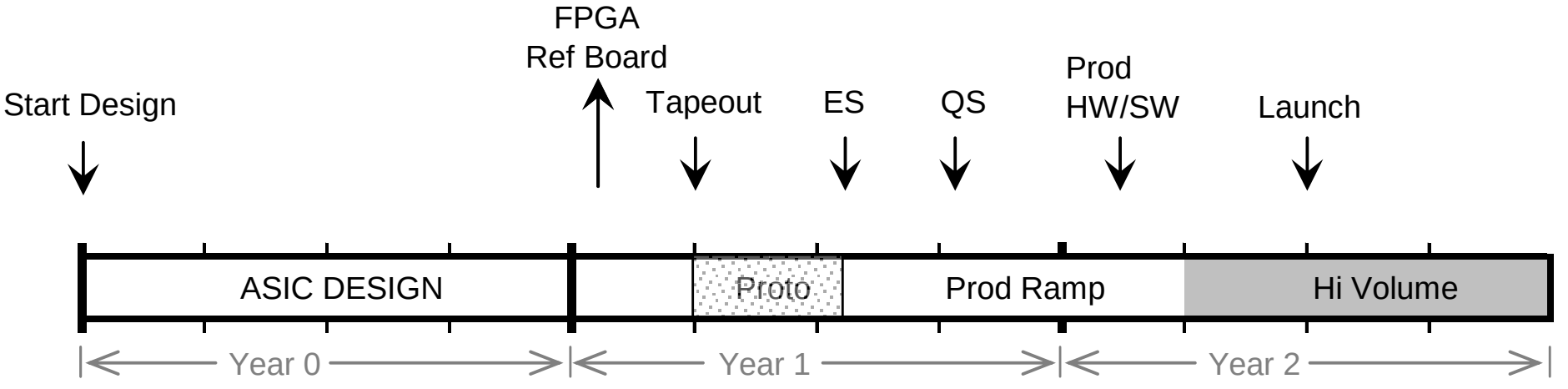
Manage Development Schedules – Internal and Customer's

System vs. IC Development Cycle

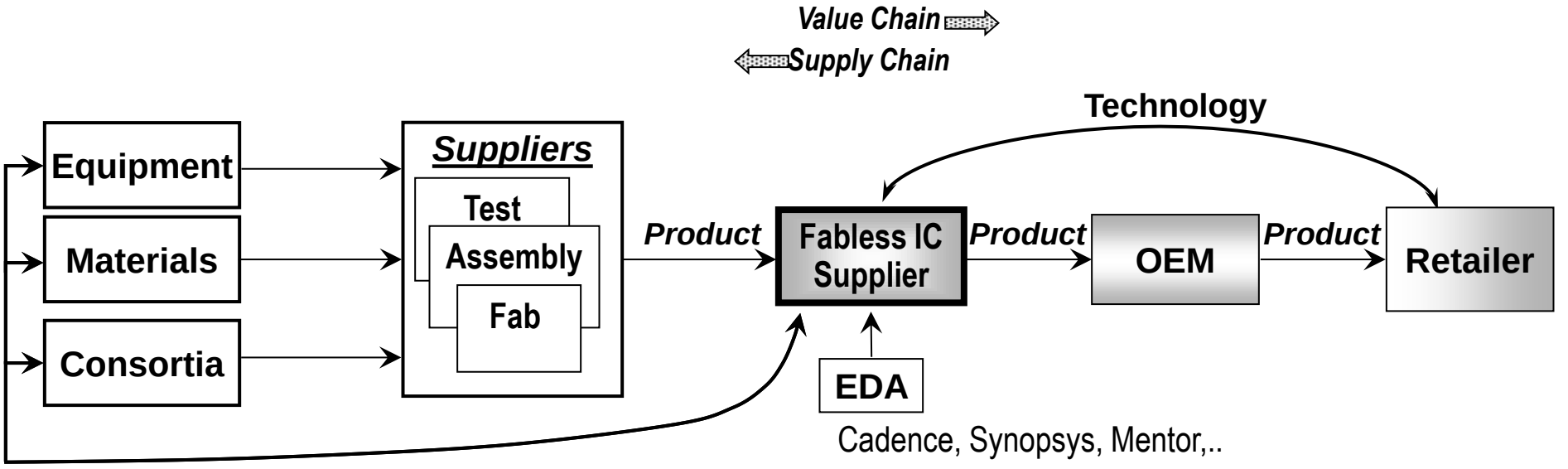
a. At the System company:



b. At the Fabless IC company:



Value Chain using “Strategic”/”Partnership” approach

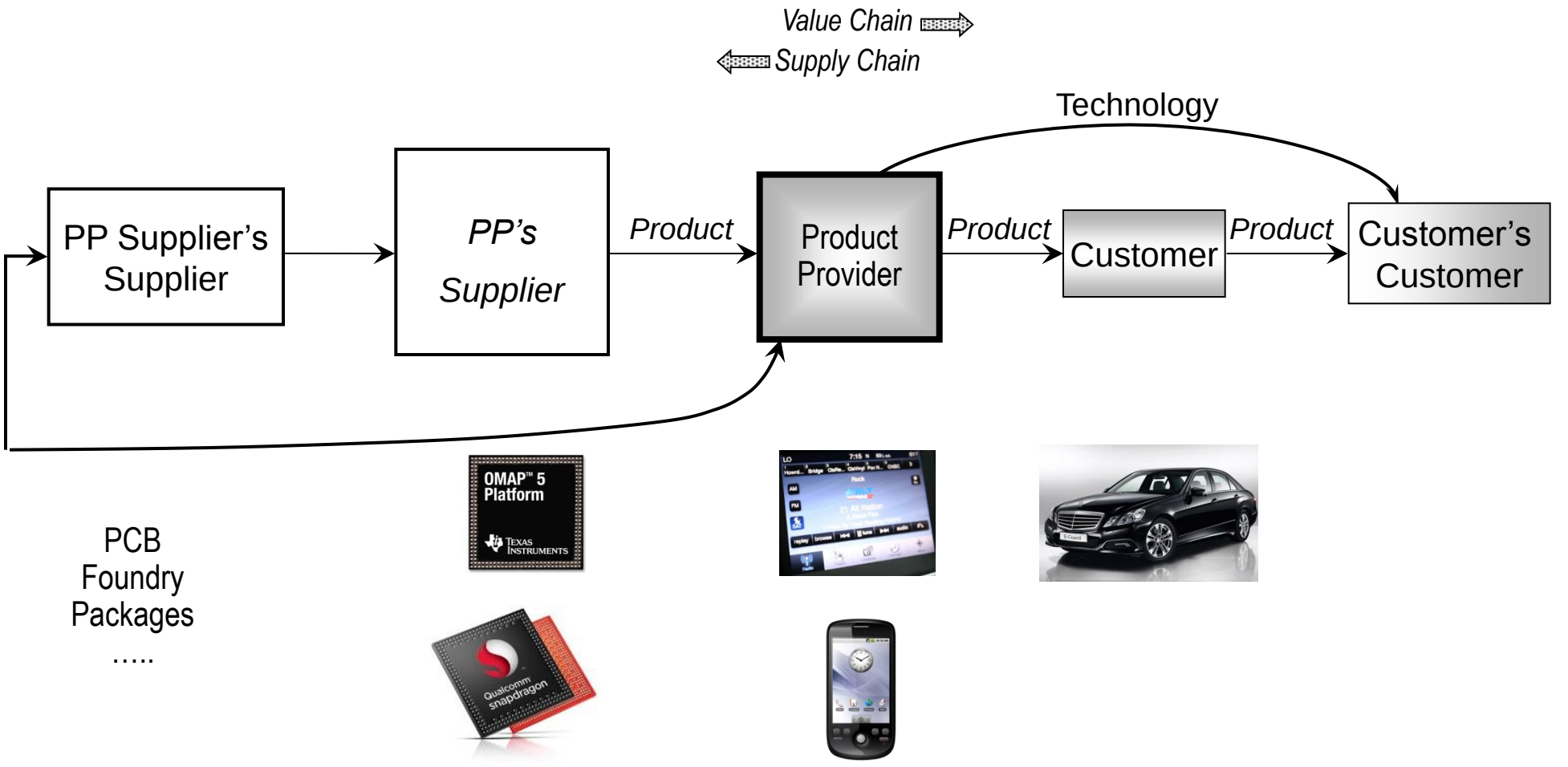


Applied Materials
ASML
Nikon
…
Rogers
…

TSMC
Global Foundries
Samsung
IBM
…
Amkor
ASE
StatsChipPac
…

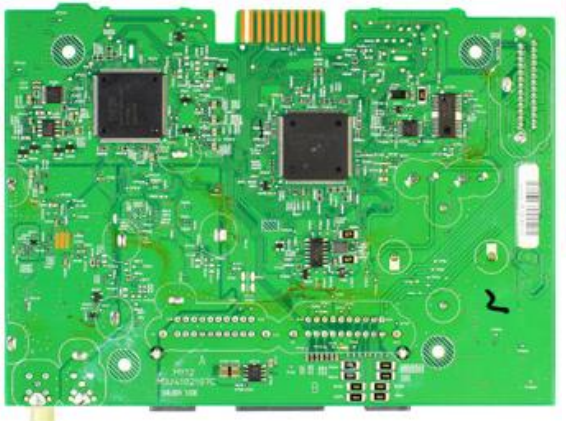
Fabless success depends on a strong Eco-system of suppliers and partners

Multi-Tiers of Value Chain and Ecosystems



MANY Opportunities for Innovation & Electronics Development

Electronics Value Chain…Auto Nav System



Display
Touchscreen Overlay
MCU 32 bit 32 MHz 1 MB Flash64 KB RAM
16-Channel 10-bit ADC
Regulator DC_DC converter
Power Management IC

Chrysler 300
Hyundai Sonata
Source: IHI Electronics360 130813

OMAP Processor, ARM11
Dual core 400 MHz
MCU 32-bit 32 MHz 128 I/Os
MCU 32-bit 400 MHz
Gyroscope
GPS Receiver
Flash 8GB MLC
Flash 4GB
CD/DVD Drive

Smartphones – Looking Inside

Soure: iFixit iPhone5

Electronics Value Chain …Smartphones BoM (Bill of Materials)…iPhone5 S

Table 1: Preliminary Teardown Bill of Materials and Manufacturing Cost Estimate for the Apple iPhone 5s (Cost in US Dollars)

Components / Hardware Elements	Details	16GB	32GB	64GB
	Pricing without contract	**$649.00**	**$749.00**	**$849.00**
Implied Margin		**69%**	**72%**	**74%**
Total BOM Cost		**$190.70**	**$200.10**	**$210.30**
Manufacturing Cost		**$8.00**	**$8.00**	**$8.00**
BOM + Manufacturing		**$198.70**	**$208.10**	**$218.30**
Major Cost Drivers				
Memory				
NAND Flash		$9.40	$18.80	$29.00
DRAM	1GB LPDDR3	$11.00	$11.00	$11.00
Display & Touch Sreen	4" Retina Display w/ Touch	$41.00	$41.00	$41.00
Processor	64-Bit A7 Processor + M7 Co-Processor	$19.00	$19.00	$19.00
Camera(s)	8MP (1.5-micron) + 1.2MP	$13.00	$13.00	$13.00
Wireless Section - BB/RF/PA	Qualcomm MDM9615M+WTR1605L+Front End	$32.00	$32.00	$32.00
User Interface & Sensors	Includes fingerprint sensor assembly	$15.00	$15.00	$15.00
WLAN / BT / FM / GPS	Murata Dual-Band Wireless-N Module	$4.20	$4.20	$4.20
Power Management	Dialog + Qualcomm	$7.50	$7.50	$7.50
Battery	3.8V~1560mAh	$3.60	$3.60	$3.60
Mechanical / Electro-Mechanical		$28.00	$28.00	$28.00
Box Contents		$7.00	$7.00	$7.00

Source: IHS, September 2013

Electronics Value Chain …Smartphones BoM (Bill of Materials)…iPhone5

(Costs in U.S. Dollars)

Components / Hardware Elements	iPhone 5 Hardware Comments	iPhone 5 Model		
		16GByte	32GByte	64GByte
Pricing without Contract		**$649**	**$749**	**$849**
Total BOM Cost		**$199**	**$209**	**$230**
Manufacturing Cost		**$8.00**	**$8.00**	**$8.00**
BOM + Manufacturing		**$207**	**$217**	**$238**
Major Cost Drivers				
Memory				
NAND Flash		$10.40	$20.80	$41.60
DRAM	1GByte LPDDR2	$10.45	$10.45	$10.45
Display & Touchscreen		$44.00	$44.00	$44.00
Processor	A6 Processor	$17.50	$17.50	$17.50
Camera(s)	8 Megapixel + 1. 2 Megapixel	$18.00	$18.00	$18.00
Wireless Section - BB/RF/PA	Qualcomm MDM9615+RTR8600+Front End*	$34.00	$34.00	$34.00
User Interface & Sensors		$6.50	$6.50	$6.50
BT / WLAN	BTv4.0 + Dual-Band Wireless-N	$5.00	$5.00	$5.00
Power Management		$8.50	$8.50	$8.50
Battery	Assumed 1800mAh	$4.50	$4.50	$4.50
Mechanical / Electro-Mechanical		$33.00	$33.00	$33.00
Box Contents		$7.00	$7.00	$7.00

* - Assumed

Source: IHS iSuppli Research, September 2012

iPhone5 vs, iPhone4 Bill of Materials ("BoM")

IHS iSuppli Table: Preliminary iPhone 5 vs. iPhone 4S Cost Estimates

	Apple iPhone 5 (Pricing as of Sept, 2012)				Apple iPhone 4S (Pricing as of Oct, 2011)			
Components / Hardware Elements	iPhone 5 Hardware Comments	16GB3	32GB4	64GB5	iPhone 4S Hardware Comments	16GB32	32GB43	64GB54
Pricing without Contract		$649	$749	$849		$649	$749	$849
Implied Margin		68%	71%	72%		70%	71%	70%
Total BOM Cost		$199	$209	$230		$188	$207	$245
Manufacturing Cost		$8.00	$8.00	$8.00		$8.00	$8.00	$8.00
BOM + Manufacturing		$207	$217	$238		$196	$215	$253
Major Cost Drivers								
Memory								
NAND Flash		$10.40	$20.80	$41.60		$19.20	$38.40	$76.80
DRAM	1GB LPDDR2	$10.45	$10.45	$10.45	512MB LPDDR2	$9.10	$9.10	$9.10
Display & Touchscreen	4" Retina Display w/ In-Cell Touch	$44.00	$44.00	$44.00	3.5" Retina Display w/ Touch	$37.00	$37.00	$37.00
Processor	A6 Processor	$17.50	$17.50	$17.50	A5 Processor	$15.00	$15.00	$15.00
Camera(s)	8MP + 1.2MP	$18.00	$18.00	$18.00	8MP + VGA	$17.60	$17.60	$17.60
Wireless Section - BB/RF/PA	Qualcomm MDM9615M+RTR8600 +Front End	$34.00	$34.00	$34.00	Qualcomm MDM6610+RTR8605 +Front End	$23.50	$23.50	$23.50
User Interface & Sensors		$6.50	$6.50	$6.50		$6.85	$6.85	$6.85
WLAN / BT / FM / GPS	Murata Dual-Band Wireless-N Module	$5.00	$5.00	$5.00	Murata Single-Band Wireless-N Module	$6.50	$6.50	$6.50
Power Management	Dialog + Qualcomm	$8.50	$8.50	$8.50	Dialog + Qualcomm	$7.20	$7.20	$7.20
Battery	3.8V ~1400mAh	$4.50	$4.50	$4.50	3.7V ~1400mAh	$5.90	$5.90	$5.90
Mechanical / Electro-Mechanical		$33.00	$33.00	$33.00		$33.00	$33.00	$33.00
Box Contents		$7.00	$7.00	$7.00		$7.00	$7.00	$7.00

Source: IHS iSuppli Research, September 2012

Samsung Galaxy S4/S3 Bill of Materials ("BoM")

Preliminary Samsung Galaxy S4 Virtual Teardown BOM Estimates (Pricing in U.S. Dollars)

	Samsung Galaxy S4 (HSPA Version)		Samsung Galaxy S4 (LTE Version)		Samsung Galaxy S3 (HSPA Version)	
Total BOM Cost	**$236**		**$233**		**$205**	
Manufacturing Cost	**$8.50**		**$8.50**		**$8.00**	
BOM + Manufacturing	**$244**		**$241**		**$213**	
Major Cost Drivers						
Memory (NAND Flash + DRAM)	16GB eMMC + 2GB LPDDR3	$28.00	16GB eMMC + 2GB LPDDR3	$28.00	16GB eMMC + 1GB LPDDR2	$29.00
Display & Touchscreen	5" 1920x1080 Super AMOLED (441ppi), w/ Gorilla®Glass3 by Corning	$75.00	5" 1920x1080 Super AMOLED (441ppi), w/ Gorilla®Glass3 by Corning	$75.00	4.8" 1280x720 Super AMOLED, w/ Gorilla®Glass2 by Corning	$65.00
Processor	Samsung Exynos 5 Octa (5410)	$30.00	Qualcomm Snapdragon 600 (APQ8064T) - Quad-Core	$20.00	Samsung Exynos 4 Quad	$17.50
Camera(s)	13MP + 2MP	$20.00	13MP + 2MP	$20.00	8MP + 1.9MP	$19.00
Wireless Section - BB/RF/PA	Possibly contains Intel PMB9820 + PMB5745 + Front End	$16.00	Possibly contains MDM9615 + WTR1605L + Front End	$25.00	Contains Intel PMB9811 + PMB5712 + Front End	$14.50
User Interface & Sensors	Contains accelerometer, RGB Light, e-compass, Gyro, Barometer, Temperature & Humidity, IR Gesture	$16.00	Contains accelerometer, RGB Light, e-compass, Gyro, Barometer, Temperature & Humidity, IR Gesture	$16.00	Contains Capella CM3663 ALS / Proximity, ST LSM330DLC Accelerometer / Gyro, AKM AK8975C e-Compass, & ST LP331AP Barometer Sensors	$12.70
WLAN / BT / FM / GPS	Possibly contains Broadcom BCM4335 + BCM47521	$9.00	Possibly contains Qualcomm Atheros WCN3680	$5.75	Contains Broadcom BCM4334 + BCM47511	$8.20
Power Management	Samsung PMIC (TBD)	$8.00	Qualcomm PMICs	$9.50	Contains Maxim PMIC	$7.00
Battery	3.8V, 2600mAh w/ NFC Antenna (TBD)	$5.60	3.8V, 2600mAh w/ NFC Antenna (TBD)	$5.60	3.8V, 2100mAh w/ NFC Antenna	$4.90
Mechanical / Electro-Mechanical		$22.00		$22.00		$21.40
Box Contents		$6.00		$6.00		$6.00

Source: IHS iSuppli Research, March 2013

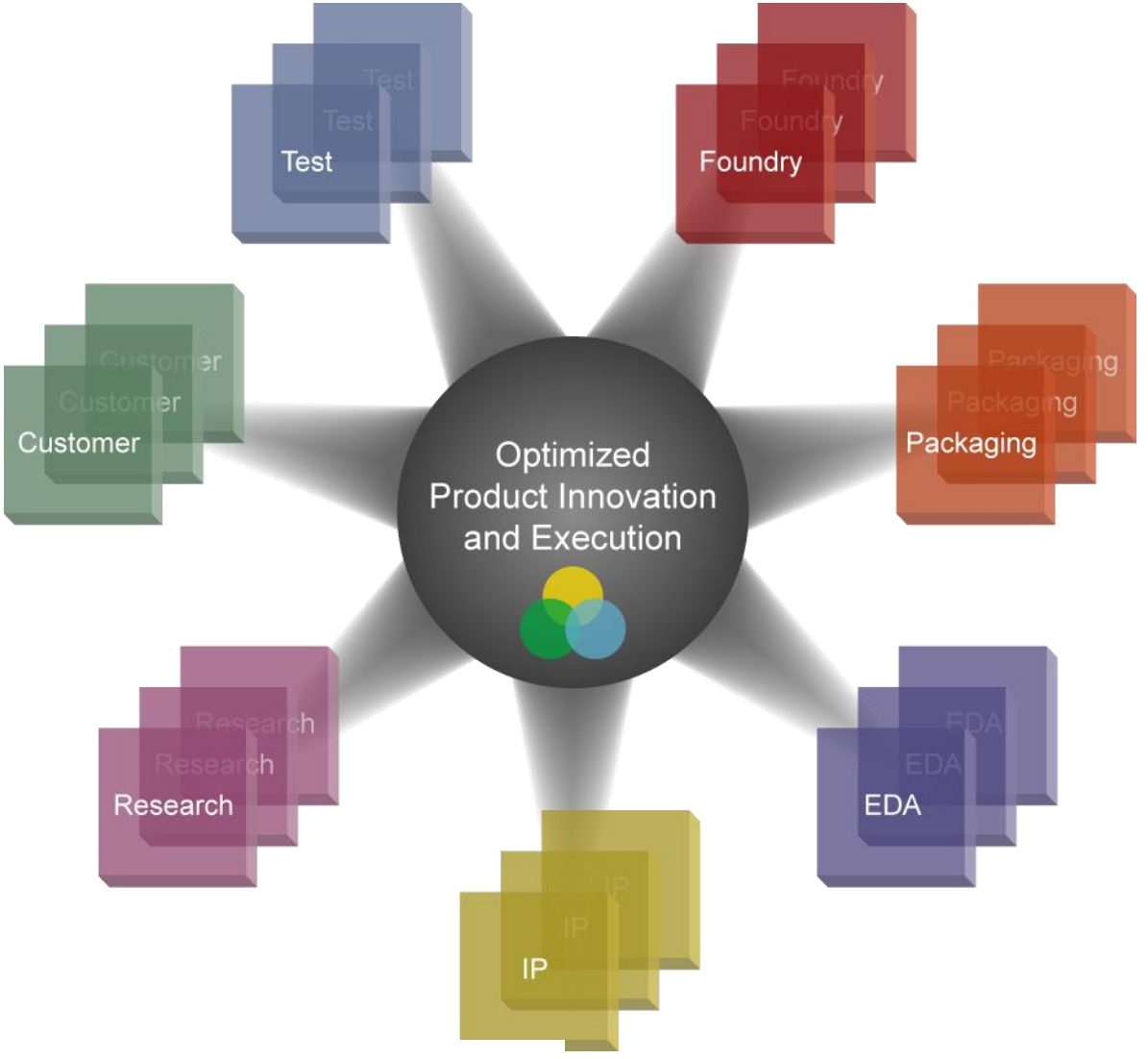
iPhone5 vs, iPhone4 Bill of Materials ("BoM")

IHS iSuppli Table: Preliminary iPhone 5 vs. iPhone 4S Cost Estimates

	Apple iPhone 5 (Pricing as of Sept, 2012)				Apple iPhone 4S (Pricing as of Oct, 2011)			
Components / Hardware Elements	iPhone 5 Hardware Comments	16GB3	32GB4	64GB5	iPhone 4S Hardware Comments	16GB32	32GB43	64GB54
Pricing without Contract		$649	$749	$849		$649	$749	$849
Implied Margin		68%	71%	72%		70%	71%	70%
Total BOM Cost		$199	$209	$230		$188	$207	$245
Manufacturing Cost		$8.00	$8.00	$8.00		$8.00	$8.00	$8.00
BOM + Manufacturing		$207	$217	$238		$196	$215	$253
Major Cost Drivers								
Memory								
NAND Flash		$10.40	$20.80	$41.60		$19.20	$38.40	$76.80
DRAM	1GB LPDDR2	$10.45	$10.45	$10.45	512MB LPDDR2	$9.10	$9.10	$9.10
Display & Touchscreen	4" Retina Display w/ In-Cell Touch	$44.00	$44.00	$44.00	3.5" Retina Display w/ Touch	$37.00	$37.00	$37.00
Processor	A6 Processor	$17.50	$17.50	$17.50	A5 Processor	$15.00	$15.00	$15.00
Camera(s)	8MP + 1.2MP	$18.00	$18.00	$18.00	8MP + VGA	$17.60	$17.60	$17.60
Wireless Section - BB/RF/PA	Qualcomm MDM9615M+RTR8600 +Front End	$34.00	$34.00	$34.00	Qualcomm MDM6610+RTR8605 +Front End	$23.50	$23.50	$23.50
User Interface & Sensors		$6.50	$6.50	$6.50		$6.85	$6.85	$6.85
WLAN / BT / FM / GPS	Murata Dual-Band Wireless-N Module	$5.00	$5.00	$5.00	Murata Single-Band Wireless-N Module	$6.50	$6.50	$6.50
Power Management	Dialog + Qualcomm	$8.50	$8.50	$8.50	Dialog + Qualcomm	$7.20	$7.20	$7.20
Battery	3.8V ~1400mAh	$4.50	$4.50	$4.50	3.7V ~1400mAh	$5.90	$5.90	$5.90
Mechanical / Electro-Mechanical		$33.00	$33.00	$33.00		$33.00	$33.00	$33.00
Box Contents		$7.00	$7.00	$7.00		$7.00	$7.00	$7.00

Source: IHS iSuppli Research, September 2012

Fabless Eco-system Alignment Across Entire Value Chain is Required



Dev LC →

HW 8 – Value Chain

…Due Thursday, June 4th

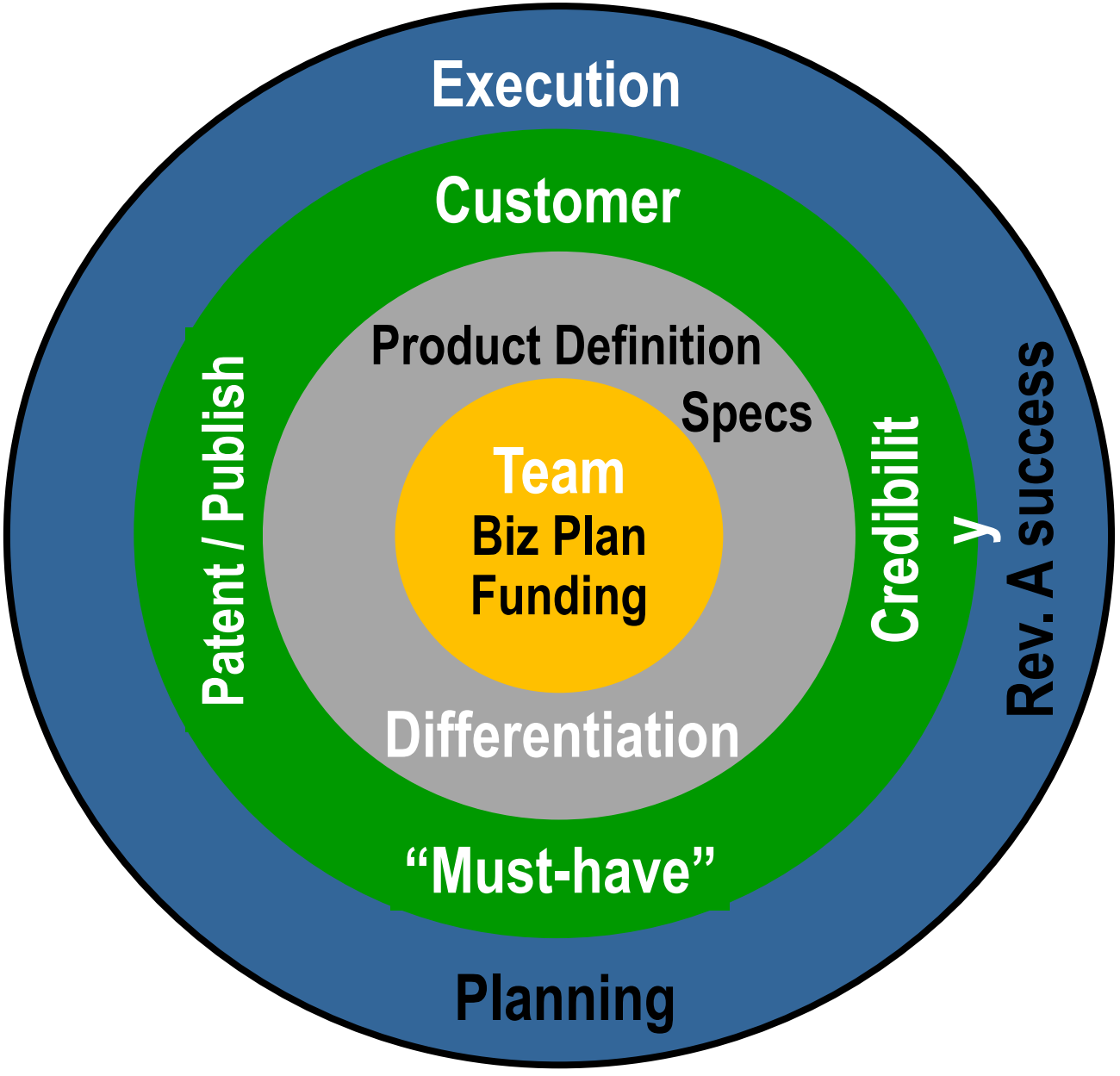
…This is a TEAM project. Only one submission per team is required.

- Create a Value Chain for your Project
  - Identify the suppliers including any "sub-contracting" work
  - What do you consider as the top 3 Risk areas?

CSE 190 - What we covered…

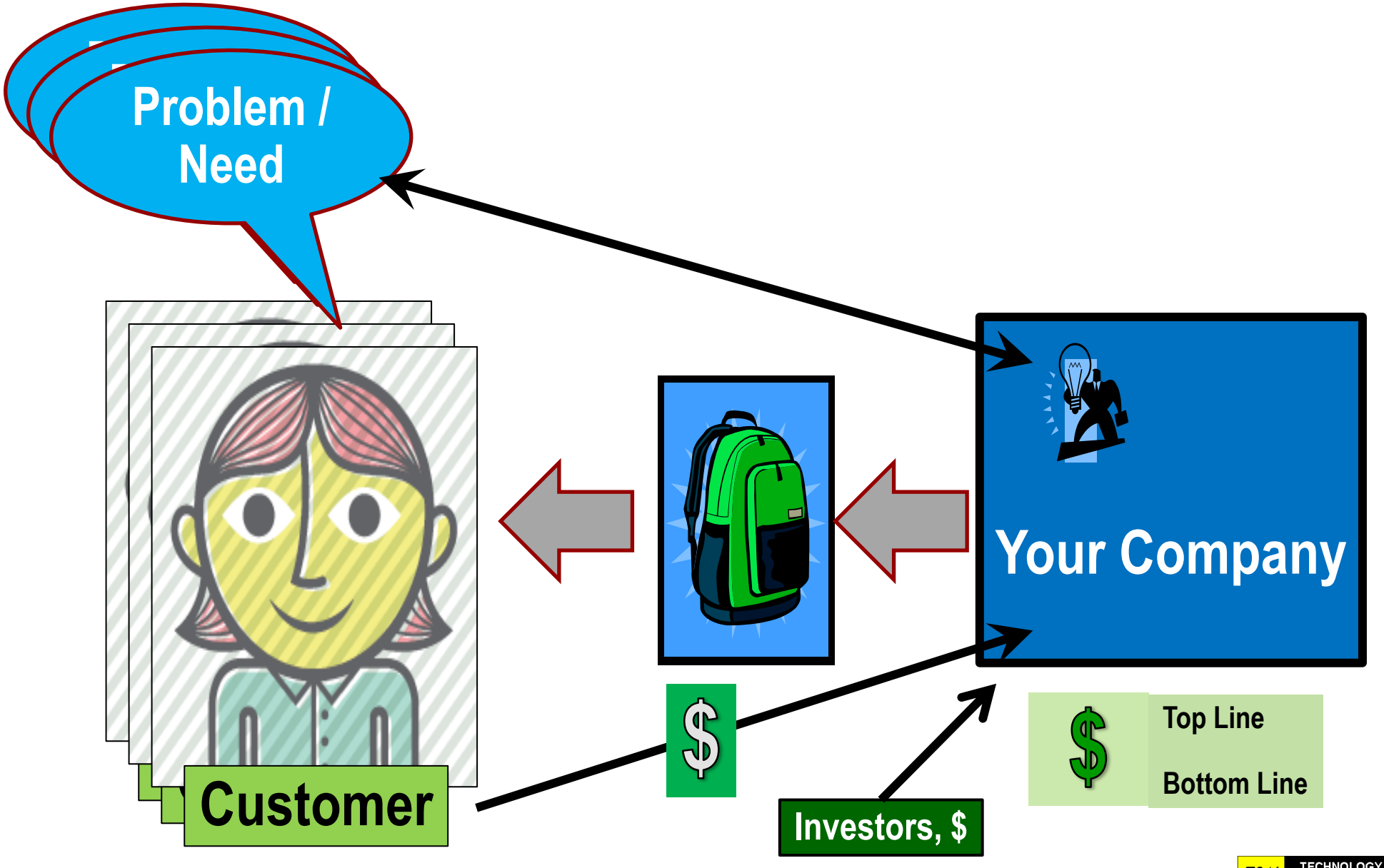
- Entrepreneurship Overview
- Projects and Projects selected, Round 1 presentation
- Microsystem – History, Market Drivers, Lifecycle
- Mobile Apps opportunities - Dr. Greg Hoovers's session
- Intro to Business Plan, Business Model Canvas
- Presentation template, Sample Presentations
- Success Stories – Yapert (Mike Young), Nate Delson
- Microsystem Development Lifecycle , Roadmaps, and Schedules
- Lean Canvas, Business Plan, Product Positioning
- Financials – Income Statements, Balance Sheets, Dilution, Case studies
- Company Lifecycles
- Outsourcing, Value/Supply Chain
- Business Structure, Legal Considerations
- Presentations

Entrepreneurial Checklist



Towards a Successful Startup

…"Plan A" – an iterative process



CSE 190 – KEY Takeaways for Entrepreneurial Success

- **TEAM**
- ID the **CUSTOMER** and their **PROBLEM**
- Map your **SOLUTION** to the Customer Problem
  - **PIVOT**
- **EXECUTE**
  - **Develop a Business CANVAS and a PLAN**
    - Funding
    - Product Development
    - Product "Manufacturing"
    - Sales and Marketing
    - ….

TEAM Formation

- You
- Team of Founders *…remember Financial implications*
- Hiring additional resources:
  - Start small
  - Use outsourcing where possible
  - Fill “gaps” in expertise and “disciplines”
- Look for “team-players”
  - flexible individuals
  - “can-do” attitude
  - Hard workers
  - Share your personal and company vision/passion
  - …
- Avoid “crony-ism”

Talking to CUSTOMERS

- Walking in the Customer's shoes
  - Pretend you were the customer
- Observe the Customer behavior, actions, reactions
- Regroup to review initial Observations
- Make first pass Assumptions – validate and Challenge them with "field data"

Ref: Giff Constable, "Talking to Humans", 2014

CUSTOMER Discovery

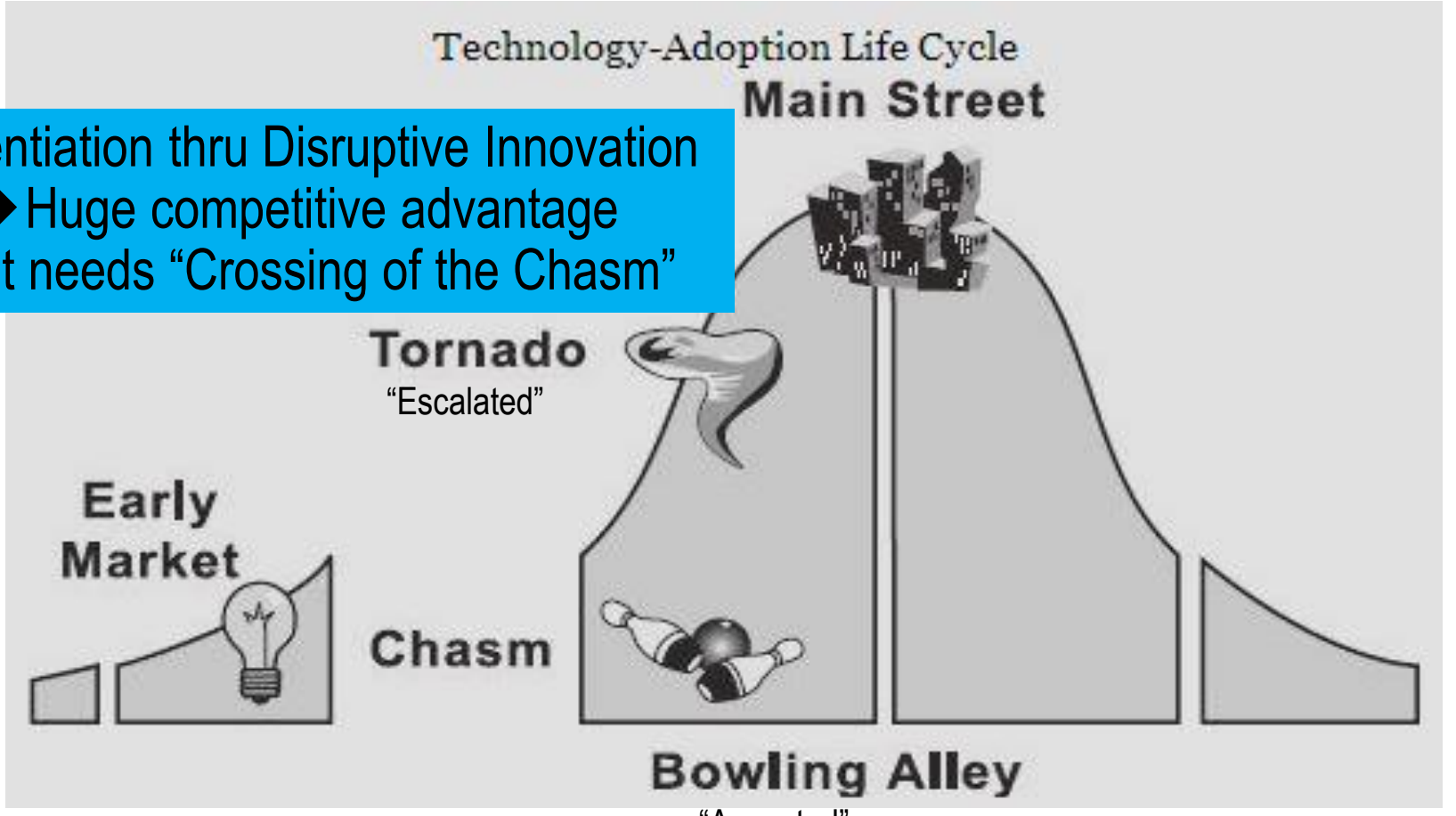
1. Customer discovery is about gaining much deeper insight into your customer, or your partners, or your market
2. Being told your idea is cool is not useful; seeing behavior that validates your customer's willingness to buy is very useful
3. Prepare an interview guide before you get out of the building
4. To ask the right questions, you need to understand your risks and assumptions
5. Get creative when trying to recruit people — if at first you don't succeed, try something new
6. Sometimes observation is as powerful as interviews
7. Take good notes, especially on your key risks, so that you can calculate metrics later. Even better, set your target goals ahead of time!
8. Bring learning back and analyze your patterns as a team
9. Never stop asking hard questions about your business

Ref: Giff Constable, "Talking to Humans", 2014

Customer Discovery – WHO to Learn from?
Target Early Adopters

…from Geoffrey Moore, "Crossing the Chasm", "Dealing with Darwin"

Differentiation thru Disruptive Innovation
➔Huge competitive advantage
…but needs "Crossing of the Chasm"



Pragmatist(s)
Niche
Few adopters

CUSTOMER Discovery – What to Learn?

- My target customer will be?
- The problem my customer wants to solve is?
- My customer's need can be solved with?
- Why can't my customer solve this today?
- The measurable outcome my customer wants to achieve is?
- My primary customer acquisition tactic will be?
- My earliest adopter will be?
- I will make money (revenue) by?
- My primary competition will be?
- I will beat my competitors primarily because of?
- My biggest risk to financial viability is?
- My biggest technical or engineering risk is?
- What assumptions do we have that, if proven wrong, would cause this business to fail? (*Tip: include market size in this list*)

Ref: Giff Constable, "Talking to Humans", 2014

CUSTOMER Discovery – What to Learn?

- Get Stories, Not speculation
- Ask Open-ended Questions
- Test for Price
- Get feedback on a Prototype
- The “magic wand” Question

- Design Quantitative measures
- A Guide, not a Script
- Observation can be as powerful as Q&A

Ref: Giff Constable, “Talking to Humans”, 2014

CUSTOMER Discovery – Effective Interviewing

- In-person
- One person at a time, add a note taker if possible
- Start with a “warm up” and keep it Human
- Disarm your own biases
- GET THEM TO TELL A STORY
- LISTEN, DON’T TALK
- Understand Priority
- Drill down with follow up Questions
- PARROT BACK to confirm
  - Impress if you got it right, or be corrected!
- Do a Dry Run

Ref: Giff Constable, “Talking to Humans”, 2014

Exit Strategies

- Stay private
  - scale up company at least for some years, especially if profitable
- IPO (Initial Public Offering) - go public
- M&A (Merger and Acquisition) – merge with or get acquired by a larger company

CSE 190 – Quick survey

		High				Low
1	Rate your ENTREPRENEURIAL KNOWLEDGE now relative to the beginning of this class	5	4	3	2	1
2	Rate your LEVEL OF INTEREST in being an Entrepreneur	5	4	3	2	1
3	How HELPFUL was this class if you were to pursue a STARTUP idea?	5	4	3	2	1
4	Rate your satisfaction with this COURSE	5	4	3	2	1
5	Rate your satisfaction with the Professor	5	4	3	2	1
6	Rate your satisfaction with the TA's	5	4	3	2	1
7	How likely are you to RECOMMEND this course to others?	5	4	3	2	1
8	Suggestions to improve the class					

Final Report – Business Plan

…1 per Team, 2000 words max
…due on Sunday, June 7th…no later than midnight..
…use example Table of Contents from Class 8-2, content must include the following

1. Your Entrepreneurial IDEA?
2. What Customer problem does your idea solve?
3. Who are the potential Customers? A summary of your Customer Discovery to date.
4. Who is your Competition? How will you DIFFERENTIATE your product?
5. Who will make it?
6. How big a company do you want to build?
7. Income Statement - Revenue, Expenses, # Units sold, # people
8. Business Model Canvas
9. Introduce your Team

Final Report – Individual Summary….Optional, for extra credit

…1 per Individual, 1 page max

1. Your contributions to your team
2. Your top 3 learnings from the class and team?

Business Plan example Table of Contents

- Executive Summary
  - Objectives
  - Mission
  - Key to Success
- Company Summary
  - Startup Summary
  - Management Team
  - Technical Team
  - Company Locations and Facilities
- Market Analysis
  - Industry Overview
  - Market Size
  - Market Opportunities
  - Competition
- Product Summary
  - Product Description
  - Sourcing and Technologies
  - Product Development Schedules
  - Competitive Analysis
  - Product Advantages
  - Product Roadmaps
- Marketing and Sales Strategy
  - Targeted Markets
  - Customers
  - Strategic Alliances
  - Advertising and Promotion
  - Selling Tactics
- Manufacturing and Operations Plan
  - Wafer Sourcing
  - Backend Manufacturing Plan
- Organization and Personnel Plan
  - Organization
  - Personnel Plan
- Financial Plan

Final Report Example ToC

DASH_CSE190
FA14

Final Report Example ToC

DASH_CSE190
FA14