2.009 Product engineering processes

business case the (very) basics

hand it over. voluntarily please!

A proposition

I will give you $1000 today!

or

I will give you $1200 next year!

factors in making your decision?

current financial/life circumstances

trust in the monetary source

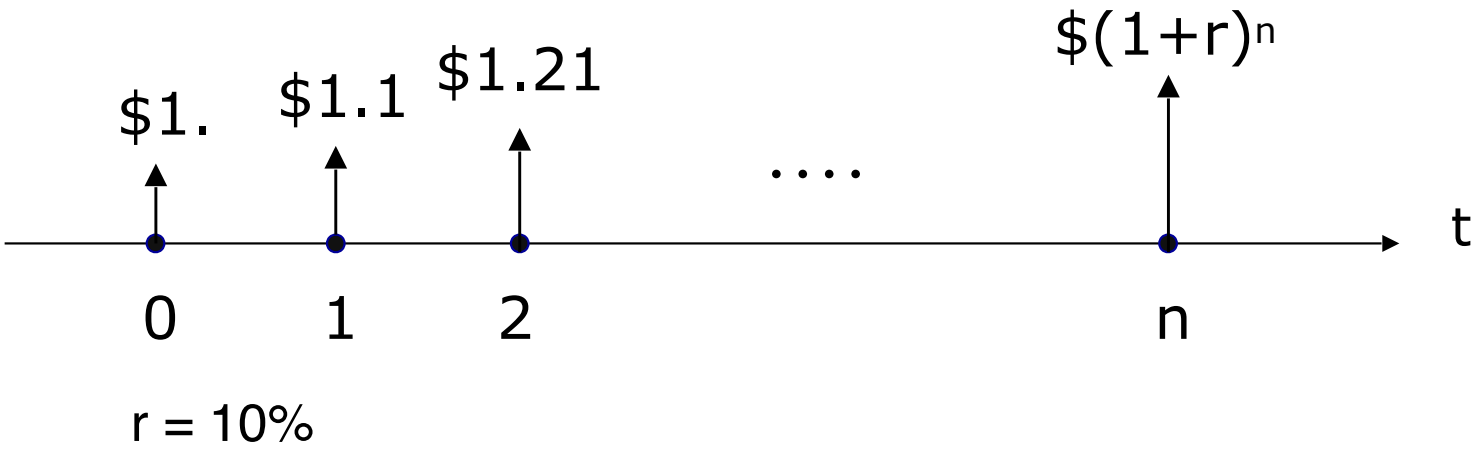
Concept 1

Time value of money

a dollar now is worth more to you than a dollar in the future

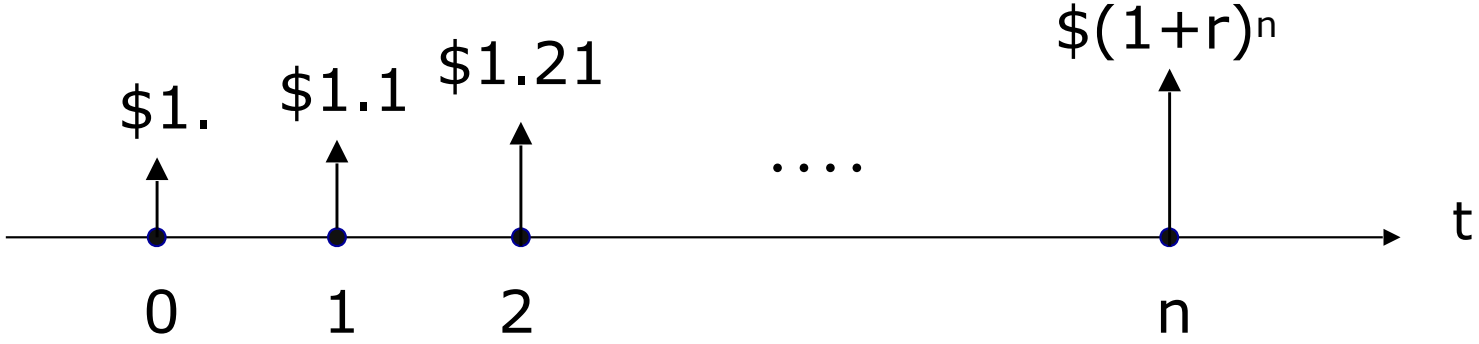
interest rate r = % per period n

future value = present value x $(1+r)^n$



Concept 1

Discount rate



your personal, discount rate ***r*** per period ***n*** is …

$(1+r)^n$ = future value/present value

when you perceive present and future value to be equivalent

so, if you decided to:

take $1000 from me now, your ***r*** per year is > 0.2 (n=1)

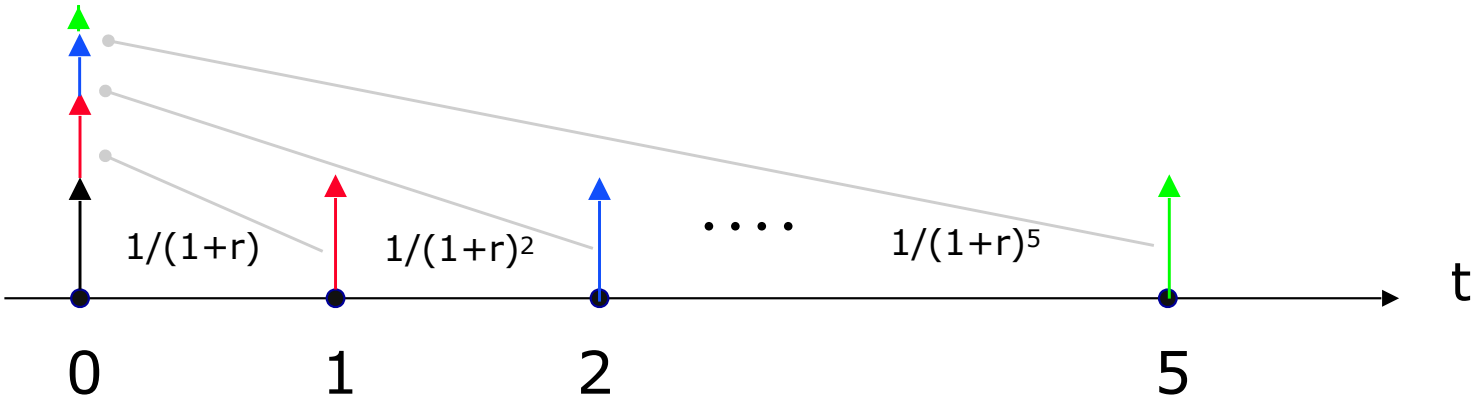
wait for $1200, your ***r*** per year is ≤ 0.2 (n=1)

personal discount rates tend to be high!

Concept 2

Net present value (NPV)

Future cash flows can be converted into a present day value using an appropriate discount rate



c_n is cash flow in period n

r is discount rate per period n

m is total number of periods

(3-5 years typical)

$$NPV = \sum_{n=1}^{m} \frac{c_n}{(1+r)^n}$$

Another proposition

please give me $1000 today

and I promise…

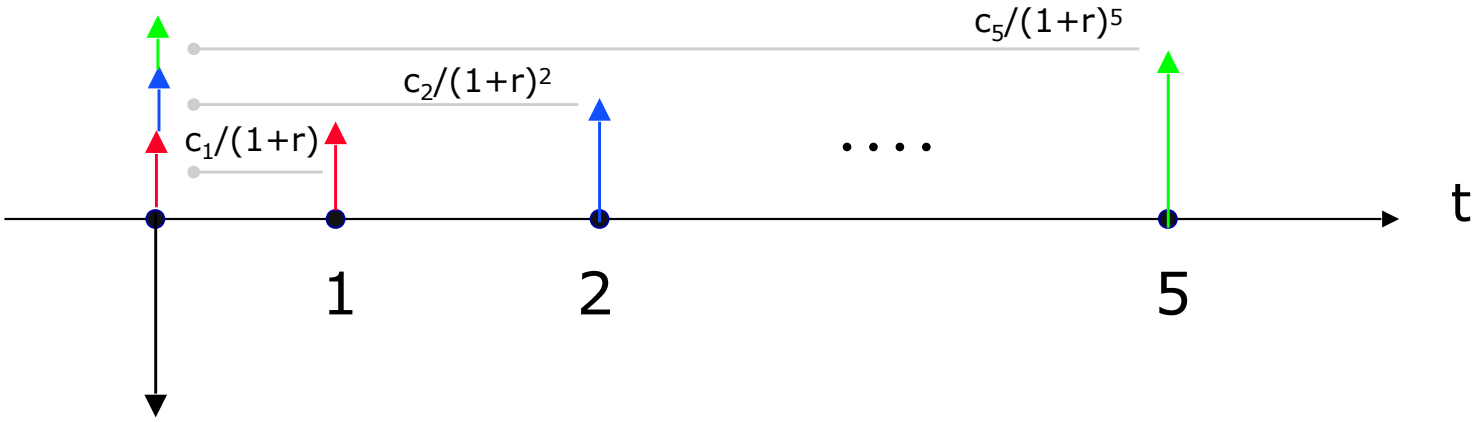
I will give you $1300 next year!

…at least I am quite sure that I will pay you but there is some chance that I might lose it and won't pay you back at all.

Concept 3

Internal rate of return (IRR)
a.k.a. return on investment (ROI)

At what discount rate will future cash flows have the same NPV as your initial investment?



c_n is cash flow in period n

m is total number of periods

r is the IRR

$$i = \sum_{n=1}^{m} \frac{c_n}{(1+r)^n}$$

Concept 3

IRR or ROI

If you gave me $1000 now expecting $1300 next year,
an expected IRR of 30% was enough for you to invest

$$1000 = \frac{1300}{(1+r)^1}$$

If you did not give me $1000 now,
an expected IRR of 30% was not enough

Expectations

IRRs and risk

30++% for risky new ventures
20 % for new products
15 % for extensions/improvements to existing product
10 % for cost improvement to existing product

risk-free rate-of-return

~ 2-3% for short term government bonds

Return expectations

Differ with type of investor

venture investment
strategic partner

angel investment
crowdfunding

question:

How to convince people to give you money?

answer:

Have a credible business proposal

What is a proposal about?

value propositions

getting your product to users

Value proposition(s)

Part 1: product point-of-view

glow is the interactive yoga mat that allows users to practice yoga in their own home as if they were in a studio

not a list of user needs!

what is your product?
who is your user?
how does the user benefit?
where and when would this product be used?
why would someone want this product?

Value proposition(s)

Part 2: business point-of-view

can you deliver?

your product's value proposition
clear target market
know why purchasers will buy/adopt
know why purchasers will not buy – competition
a desirable return (monetary or otherwise)
your confidence, enthusiasm, and trustworthiness

Business Proposal

Important take away messages

product value proposition

We have a desirable, competitive product

what is the product

what are its unique benefits

business value proposition (we can deliver that product)

We have an attractive market

market size $, and 3-year growth rate

profitability and/or other killer benefits

We have a viable business

IRR xx% with initial investment of $ xx

break-even at units in xx months

reach steady state in yy months

Product Value Proposition

A competitive product value proposition

competition can be another product ...
or simply old way of doing things.

killer attributes
attribute 2
attribute k-1

	abc	def	lmn	009
attribute 1	○	○	▨	●
attribute 2	○	●	○	●
attribute 3	●	▨	▨	●
attribute 4	▨	●	●	●
	▨	▨	▨	●
...	●	▨	●	▨
	○	●	●	●
	●	●	○	●
	▨	▨	●	●
	●	○	●	▨
attribute k-1	○	▨	○	●
attribute k	●	●	▨	●

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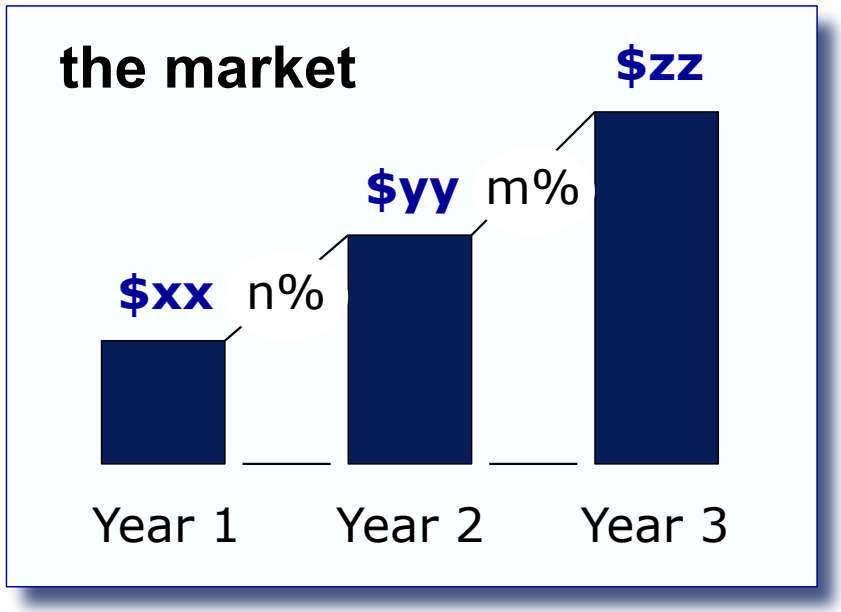
Business Value Proposition

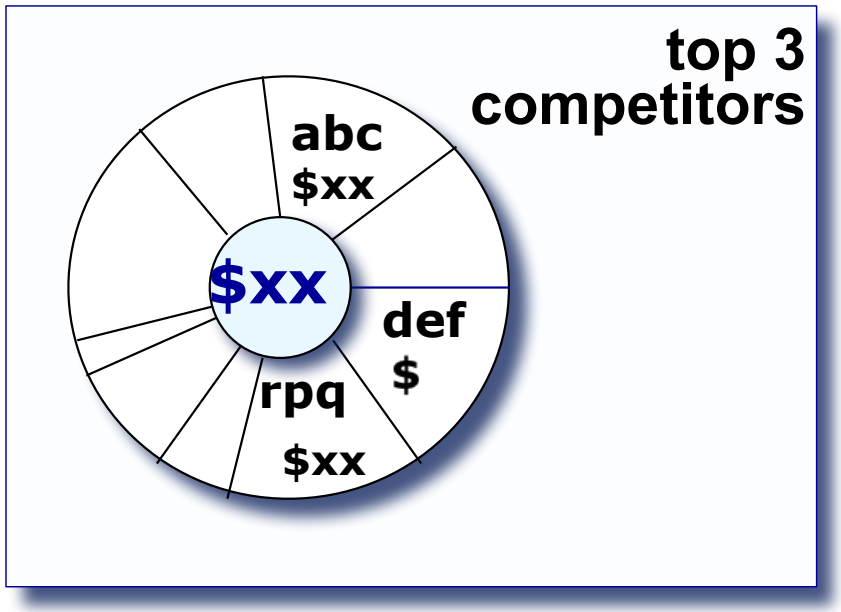
Attractive market

target market

who will buy it and how they relate to product? (< 25 words)

market characteristics





where and how will it be bought: store, sales rep, etc?
how will buyers know about your product?
why is your price attractive?

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Business Value Proposition

A viable business

Getting a handle on your return

but first

Determine your revenue, costs, expenses, and initial investment

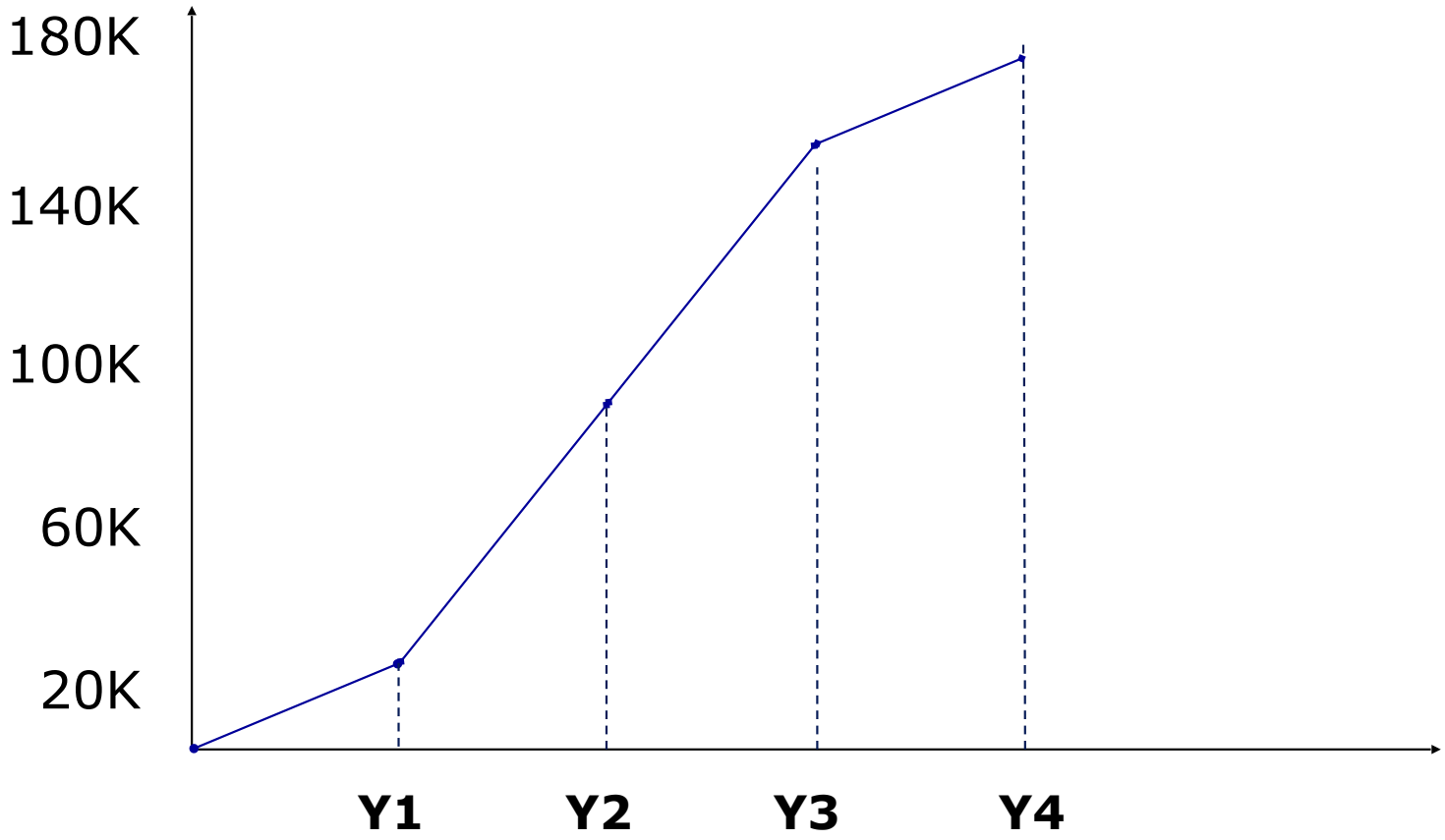
Revenue

i) simplified sales estimation

Assume volume, Q^{max}_{009}=180K

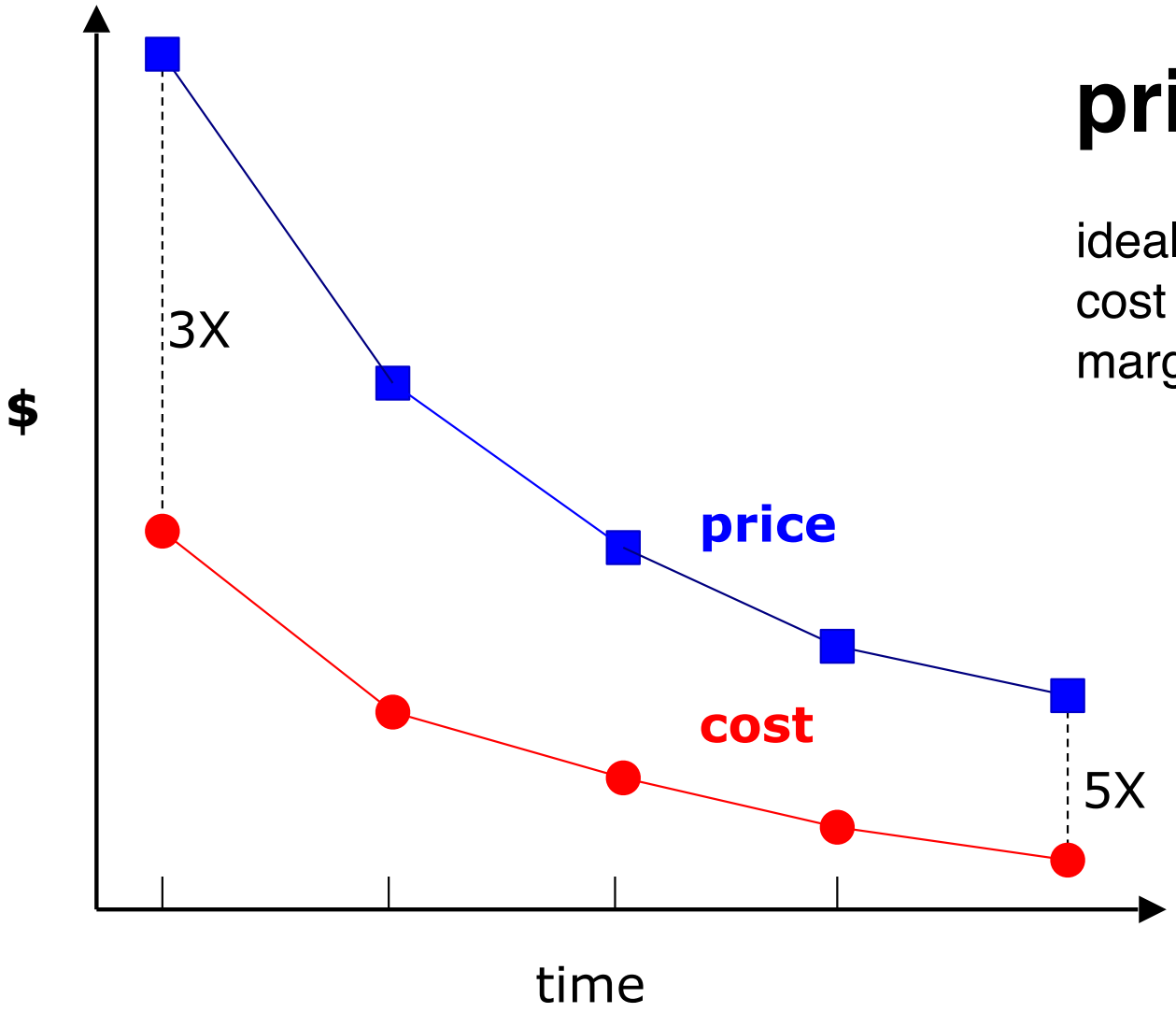
4 years to reach asymptote .... and

guestimate intermediate points



Revenue

ii) develop pricing strategy



price ≠ cost

ideally:
cost and price both decline,
margin increases

Cost

A mini quiz!

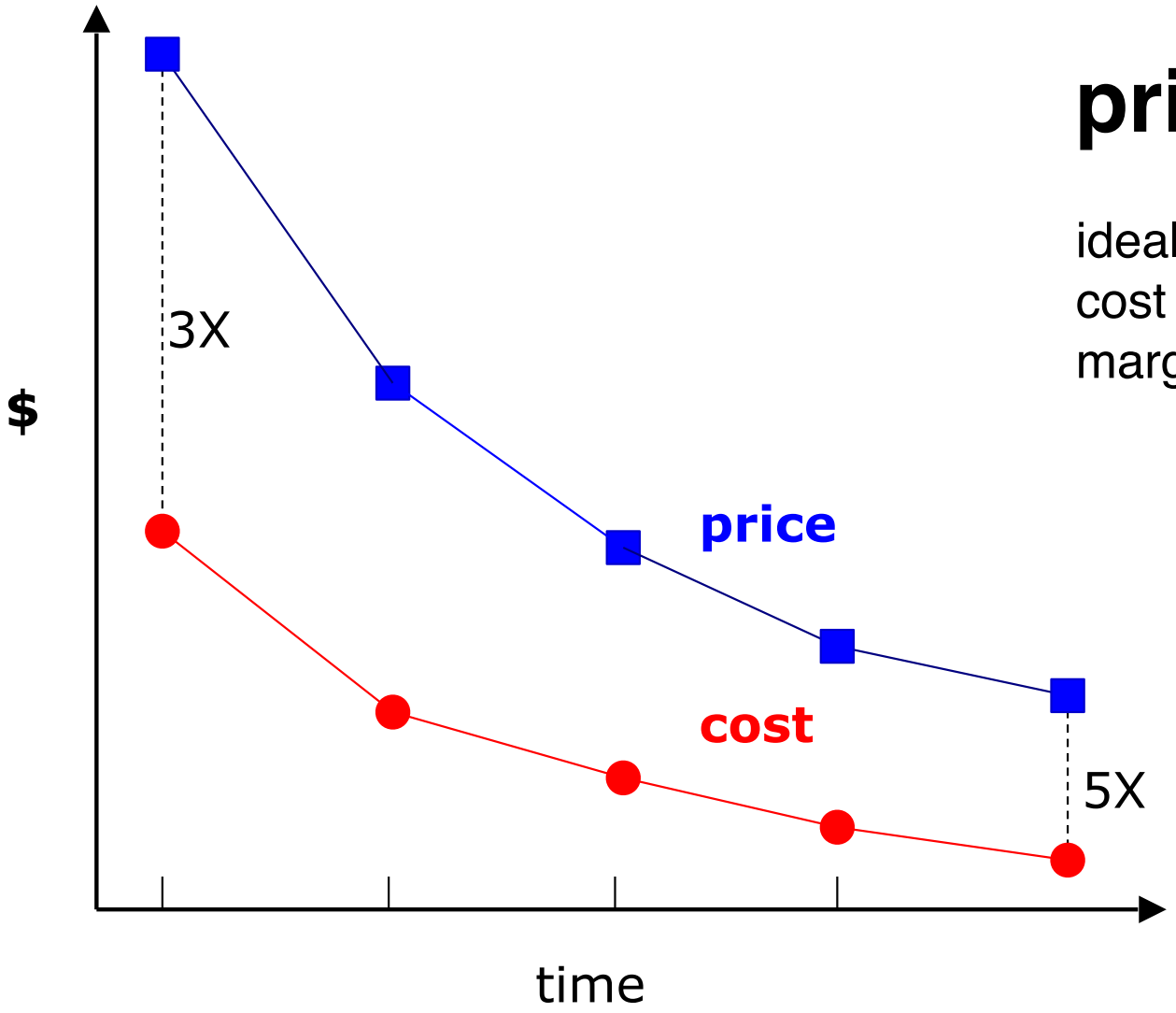
What is the relationship between the cost of an alpha prototype and the product's cost?

answer:

there is no relationship

Revenue

ii) develop pricing strategy



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Revenue

Other possible sources

the value of goodwill?
strategic positioning?

Business Value Propositions

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Revenue, Cost and Expenses

Simplified profit and loss statement

use 4-year time horizon

	T_1 $	T_2 $	…	T_k $	
sales revenues					**Price x quantity**
materials cost					**$ paid for parts**
manufacturing cost					**$ paid for labor, capital**
gross profit					**sales rev.-material cost-manufacturing cost**
R&D expense					**$ paid for engineers and equipment & stuff**
sales expense					**$ paid for sales people, customer lunches, travel ...**
gen. admin. expense					**$ paid for office, insurance**
NEBT (net earnings before tax)					**gross profit - Σexpenses**
interest exp.					
taxes					
NEAT (net earnings after tax)					

should be monotonic increasing

better be monotonic increasing

Costs and Expenses

Examples

income structure

fabricated metal
SIC 3499

(normalized to 100% of revenue)

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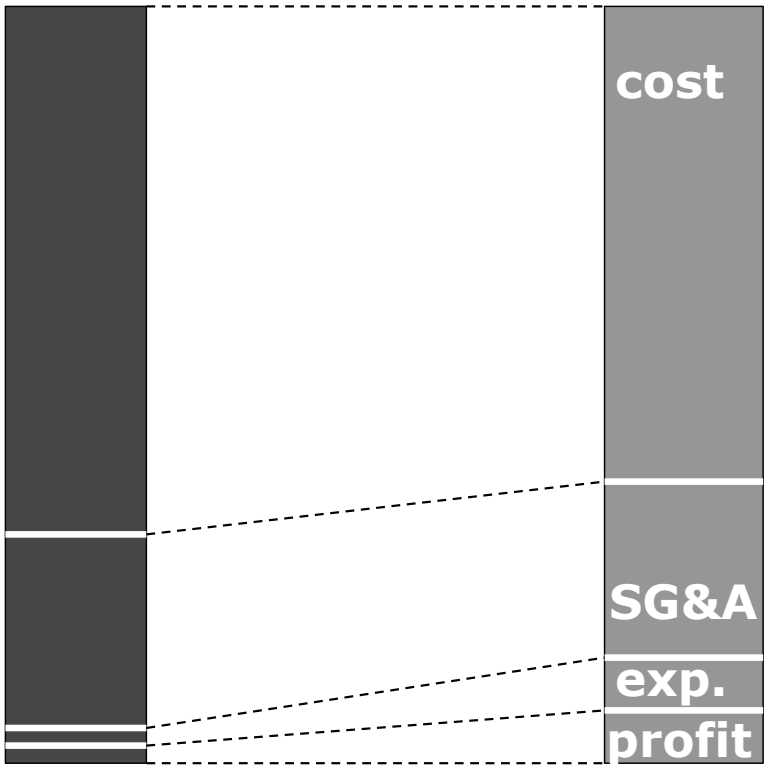

Cost
materials, labor, overhead **69.7%**

Expense SG&A
sales general and administrative **24.3%**

Expense
R&D, interest, taxes **3.6%**

Profit **2.4%**
NEAT: net earnings or profit after taxes

Revenue, Cost and Expenses

Estimate based on ratios

		T_0 %	T_1 $	…	…	T_{k-1} $	T_k $
	units sold	xxx					
a	**sales revenues**	**100%**					
b	returns, etc.	<2%					
c	materials cost	≈17%					
d	manuf. cost	≈17%					
e	depreciation	≈ 5%					
f	**gross profit**	**≈60%**	***f=a-(b+c+d+e)***				
g	R&D	≈10%					
h	sales expense	≈20%					
i	gen admin exp	≈ 5%					
j	**NEBT**	**≈20%**	***j=f-(g+h+i)***				
k	interest exp	≈10%					
l	taxes	≈ 5%					
m	**NEAT**	**≈ 5%**	***m=j-(k+l)***				

Revenue, Cost and Expenses

First order estimation heuristics

manufacturing cost = materials cost (at volume)

tax rate on earnings (NEBT) = 50%

Business Value Proposition

A viable business

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Business Value Proposition

Initial investment

Estimate a base-line for required investments

Target an initial break-even time, T_b (first period in which profit ≥ 0, 1-3 years)

	T_1	T_2	…	T_b	…	T_{k-1}	T_k
	$	$	…	$	…	$	$
Cost+Expenses							
Mat's and mfg.							
SG&A expenses							
R&D, interest, taxes							
Total	$\$CE_0$	$\$CE_1$	…	$\$CE_b$			

Initial investment estimate: $I_0 = [\$CE_1]+[\$CE_2]+\ldots+[\$CE_b]$

Business Value Proposition

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Internal Rate of Return (IRR)

Solve for *r*, ~4 years out

	T_0 $	T_1 $	⋯	T_b $	⋯	T_{k-1} $	$T_k$$
Revenues							
Costs							
SG&A expenses							
R&D, interest, taxes							
Cash Flow	$\$CF_0$	$\$CF_1$	⋯	$\$CF_b$	⋯	$\$CF_{k-1}$	$\$CF_k$

Solve for R:

$$\frac{\$CF_1}{(1+R)^1} + \frac{\$CF_2}{(1+R)^2} + \cdots + \frac{\$CF_k}{(1+R)^k} - I_0 = 0$$

Question!

How do you know when you have the right answer?

Answer:

Fiddle with sales, costs, expenses, investment until business looks reasonable

Or:

Fiddle until you have no belief that your business can credibly look reasonable

But wait…

What about crowdsourced fund raising?

raise directly from your potential customer base

nearly 50% of kickstarter projects get funded

pros: *just do it*

don’t need to fit the pattern of typical venture funding

cons:

don’t need to fit the pattern of typical venture funding

75% of hardware/design projects don’t complete on time

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But wait

There are different types of business proposals!

patent & license (company, NGO)
joint development
toll manufacture (provide materials/components for a fee)
contract manufacture (your label on product someone else makes)

patent & sell (for-profit or not-for-profit)

Developing a business case

Step-by-step

identify product value proposition

identify business value proposition

- create a development and sales timeline
- estimate cost to manufacture
- determine the path for product to reach customers

think about how to communicate the business case!

ROI chart in presentation? likely not

Communicate your story

in 2.009

ROI is analogous to a detailed design calculation
it's not the business case!

a credible path for your product to reach its users!
is 10-15% of your presentation time

it's a product launch, not a business pitch

if you don't understand a question, don't pretend to!

answer informatively and concisely