Project Economics:
Selecting and prioritizing high-value projects
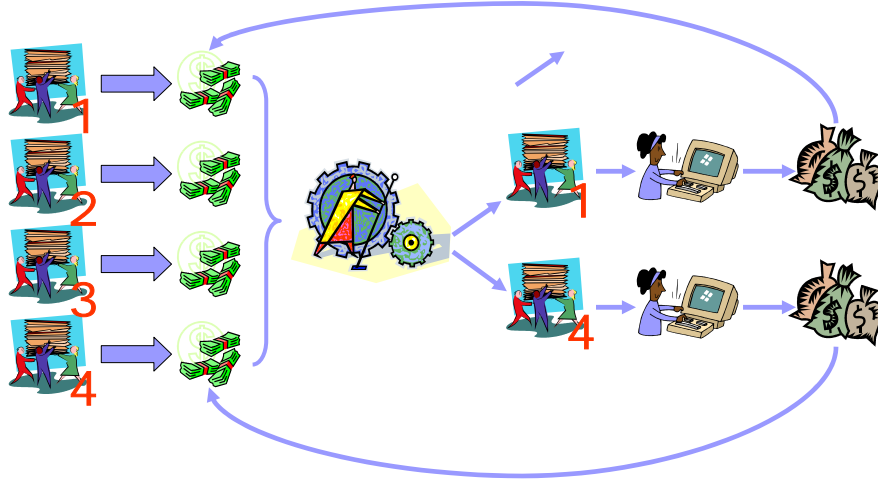
Mike Cohn
September 22, 2004

My background

- Programming for 20 years, managing for 17
  - Author of book on user stories as well as C++ and Java
- Past consulting to Viacom, Fidelity Investments, Procter & Gamble, NBC, United Nations, Citibank, other smaller companies
- Founding member and director of the Agile Alliance

The Addison Wesley Signature Series

USER STORIES APPLIED

FOR AGILE SOFTWARE DEVELOPMENT

MIKE COHN
Foreword by Kent Beck

What we want to do

Today's agenda

- ❑ Return on Investment (ROI)
- ❑ Net Present Value (NPV)
- ❑ Internal Rate of Return (IRR)
- ❑ Modeling return
- ❑ Prioritizing work
- ❑ NPV Decision Trees
- ❑ Economic Value Added (EVA)

Return on investment (ROI)

- Most basic assessment of the reasons to do a project
- Term is often used generically to mean any financial analysis
- Formula:

$$\frac{\text{Total Return} - \text{Total Investment}}{\text{Total Investment}}$$

ROI: an example

Year	Expense	Revenue	Investment	Return
0	$200	$0	$200	
1	$300	$100	$200	
2	$100	$200		$100
3	$100	$300		$200
4	$100	$400		$300
Total	$800	$1,000	$400	$600

When expenses exceed revenue, a net investment is being made

When revenue exceeds expenses, a net return is being earned

$$\frac{600 - 400}{400} = \frac{200}{400} = 0.50 = 50\%$$

3

Which project would you rather do?

Year	Project A		Project B	
	Investment	Return	Investment	Return
0	$1,000		$1,000	
1		$200		$3,000
2		$300		$500
3		$500		$300
4		$3,000		$200
Total	$1,000	$4,000	$1,000	$4,000

$$\frac{4000 - 1000}{1000} = \frac{3000}{1000} = 3.0 = 300\%$$

Usefulness of ROI

- ROI fails to consider the time-value of money
  - A dollar today is worth more than a dollar a year from now

I'll gladly pay you on Tuesday for a hamburger today.
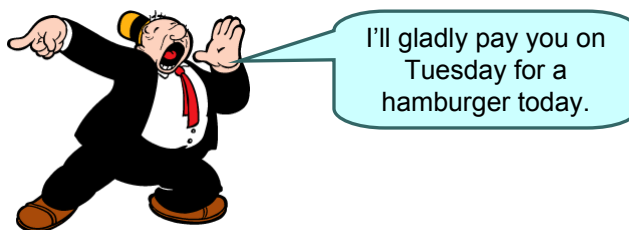
Calculating the value of future dollars

To buy a $5 hamburger next Tuesday…

I probably put $4.99 in the bank today

How much do I put in the bank to buy a $5 hamburger in a year?

$$\frac{\$5.00}{1+0.10} = \frac{\$5.00}{1.10} = \$4.54$$

Assumes 10% interest rate

The present value of $5.00 a year from now.

Present value of one future payment

Present Value

Future Value in period t

$$PV = \frac{I_t}{\left(1 + r_t\right)}$$

Interest rate in period t

Present value of a stream

$$NPV = I_o + \frac{I_1}{1+r} + \frac{I_2}{(1+r)^2} + ... + \frac{I_n}{(1+r)^n}$$

Assumes *r* is the same in each period

Net Present Value (NPV)

- "Fixes" some problems with ROI
  - □ Considers the time-value of money
- Example, assuming 10% discount rate:

Year	Investment	Return	Discounted value
0	200		−200
1	600		−545
2		200	165
3		400	301
4		600	410
Total	800	1,200	131

Discount rate sensitivity

- NPV is highly sensitive to the chosen discount rate:

Year	Net Investment	Discounted value (10%)	Discounted value (20%)
0	–200	–200	–200
1	–600	–545	–500
2	200	165	139
3	400	301	231
4	600	410	289
Total	800	131	–41

Do the project under these conditions

But not under these conditions

Comparing NPVs

- We can compare projects by NPV
- Highest NPV brings the most present-value dollars to the company

Project	NPV
Jabberwock 1.0	$2,100
Boojum 2.0	$1,253
Slithy Toves 3.0	$784
Bandersnatch 1.0	$385
Borogoves 8.0	–$115

Today's agenda

- ❏ Return on Investment (ROI)
- ❏ Net Present Value (NPV)
- ❏ Internal Rate of Return (IRR)
- ❏ Modeling return
- ❏ Prioritizing work
- ❏ NPV Decision Trees
- ❏ Economic Value Added (EVA)

Internal rate of return (IRR)
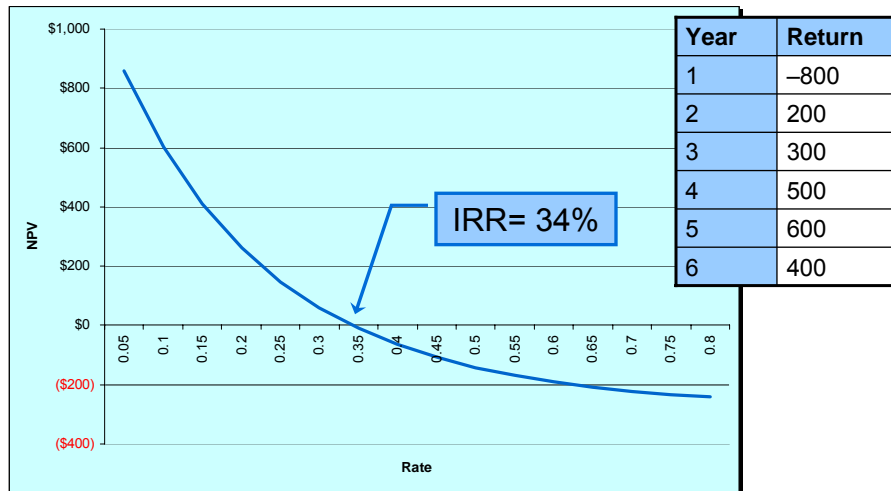
- ■ IRR is the rate at which NPV is 0

$$NPV = I_o + \frac{I_1}{1+r} + \frac{I_2}{(1+r)^2} + ... + \frac{I_n}{(1+r)^n}$$

IRR is where NPV = 0

IRR= 34%

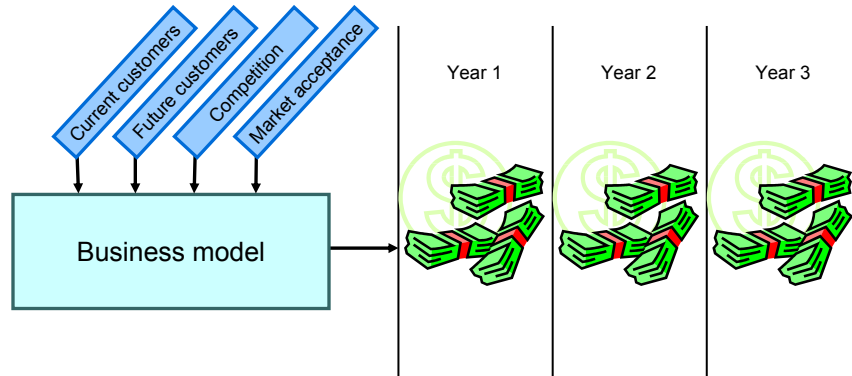| Year	Return
1	–800
2	200
3	300
4	500
5	600
6	400

Today's agenda

- ❑ Return on Investment (ROI)
- ❑ Net Present Value (NPV)
- ❑ Internal Rate of Return (IRR)
- ❑ **Modeling return**
- ❑ Prioritizing work
- ❑ NPV Decision Trees
- ❑ Economic Value Added (EVA)

Need a business model

- These formulas assume you have a model of the returns a project will generate

Current customers · Future customers · Competition · Market acceptance → Business model → Year 1 · Year 2 · Year 3

Sources of return

New revenue

Incremental revenue

Retained revenue

Operational efficiency

New revenue

- Money we'll make selling products or services to new customers
- The first thing most people think of when they think of the return on a project

> - In addition to selling books, Amazon decides to sell music CDs

Incremental revenue

- Sometimes worth distinguishing from new revenue
- Typically comes because new product or service:
  - ☐ Encourages existing customers to buy or license more
  - ☐ Includes optional, add-on modules that are sold separately
  - ☐ Includes features that justify a higher price
  - ☐ Encourages use of consulting services

> - On our eCommerce site we can add gift wrapping and charge $5 per box

Retained revenue

- Revenue you'll lose if the project is not performed
  - Revenue you'll lose is different from revenue you won't get
- Customers who will stay with you who otherwise would leave

> - We're losing customers because our eCommerce site doesn't offer gift wrapping
> - Our competitors have added features we don't have

Operational efficiency

- Most applicable for internally used software
  - But also a factor on commercial products
- Anything that takes a long time
  - Or will take a long time as the company grows
- Anything that improves accuracy or reduces rework

> - An eCommerce site with third-party sellers. It takes 2 hours of manual time to add each seller.
> - Our commercial software has usability issues, we get a lot of tech support calls.
> - We spend 16 hours training new employees how to use our internal software

An example: WebPayroll

- Offers web-based payroll system to small companies
- Calculates payroll taxes, prints checks, etc.
- We tell customers they need to enter payroll data 3 days before they want checks
- Our goal: Next-day service
  - ☐ Enter data by 5pm, we print checks and overnight them to the company

Facts about WebPayroll

- Average customer – pays $400/year in fees
- Lose about 1/3 of all deals because we don't have overnight service

Year	Customers at start	New Customers
1	1,000	1,000
2	2,000	1,000
3	3,000	1,500

13

New revenue

How many new customers?	Revenue per new customer?

Year	Customers at start	New Customers
1	1,000	1,000
2	2,000	1,000
3	3,000	1,500

Incremental revenue

How many current customers want it?	▪ What percentage are late today? ▪ What percentage complain?
What will they pay?	▪ For new customers we already answered this ▪ Use the same number already in our model

Year	Customers at start	New Customers
1	1,000	1,000
2	2,000	1,000
3	3,000	1,500

Retained revenue

| How many customers will we keep who would have left? | How much is each retained customer worth? |

Year	Customers at start	New Customers
1	1,000	1,000
2	2,000	1,000
3	3,000	1,500

Operational efficiency

| We use payroll clerks today. | ▪ With planned growth, we expect to have 3, 4, then 6 full-time employees doing this.
▪ Average salary is $40,000 / year.
▪ Fully-burdened labor cost is $60,000 / year. |

| What new costs will we incur? | ▪ Shipping clerks to print checks, stuff envelopes, mail.
▪ Other? |

Year	Customers at start	New Customers
1	1,000	1,000
2	2,000	1,000
3	3,000	1,500

My numbers for WebPayroll

Year	New revenue	Increased revenue	Retained Revenue	Operational Efficiencies	Operating Cost	Total return
1	150	100	100	60	−70	340
2	225	150	200	120	−140	555
3	338	250	400	180	−210	958

Today's agenda

- ❑ Return on Investment (ROI)
- ❑ Net Present Value (NPV)
- ❑ Internal Rate of Return (IRR)
- ❑ Modeling return
- ❑ **Prioritizing work**
- ❑ NPV Decision Trees
- ❑ Economic Value Added (EVA)

Project (theme) comparison matrix

Theme	Story Points	Cost	3-Year Return	ROI	NPV	IRR
Theme A	25	$150	$1,085	623%	$448	133%
Theme B	32	$192	$2,109	998%	$940	172%
Theme C	90	$540	$2,537	370%	$883	89%
Theme D	48	$288	$1,360	372%	$443	76%
Theme E	55	$330	$900	173%	$191	48%
Theme F	79	$474	$1,365	188%	$331	56%
Theme G	90	$540	$5,964	1004%	$2,519	139%
Theme H	50	$300	$2,415	705%	$1,023	146%
Theme I	15	$90	$1,600	1678%	$747	221%
Theme J	30	$180	$640	256%	$182	65%
Theme K	75	$450	$516	15%	($104)	5%
Theme L	40	$240	$171	-29%	($110)	-12%
Theme M	80	$480	$1,025	114%	$142	36%
Theme N	18	$108	$185	71%	$7	24%
Theme O	35	$210	$423	101%	$50	33%
Theme P	24	$144	$188	31%	($19)	12%
Theme Q	15	$90	$102	13%	($20)	5%
Theme R	6	$36	$155	331%	$53	90%
Theme S	65	$390	$410	5%	($105)	2%
Theme T	12	$72	$1,505	1990%	$748	355%

Today's agenda

❑ Return on Investment (ROI)

❑ Net Present Value (NPV)

❑ Internal Rate of Return (IRR)

❑ Modeling return

❑ Prioritizing Work

❑ NPV Decision Trees
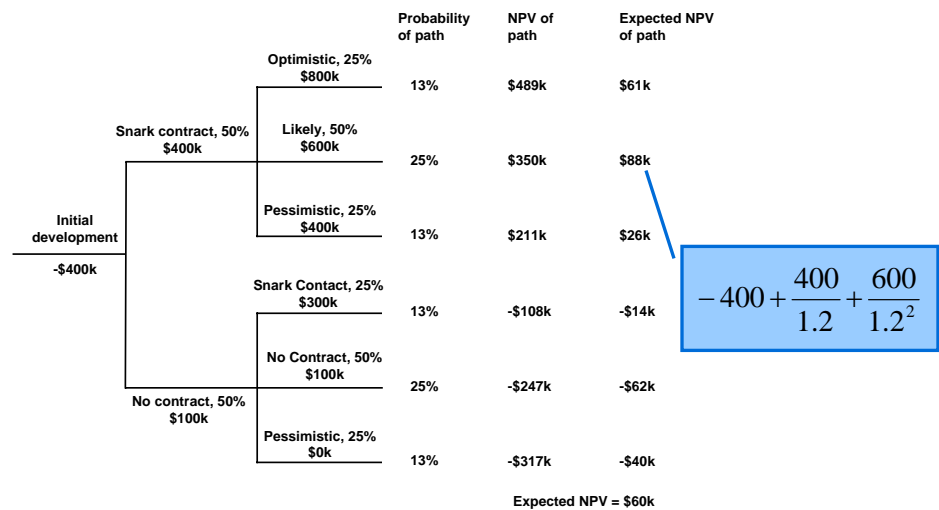
❑ Economic Value Added (EVA)

17

NPV decision trees

- Sometimes we want to work with conditional cases:

> "The Boojum project will make $400,000 next year if we sign the contract with Snark; if not, it will only make $100,000."

Valuing the Boojum project

	Probability of path	NPV of path	Expected NPV of path
Optimistic, 25% $800k	13%	$489k	$61k
Likely, 50% $600k	25%	$350k	$88k
Pessimistic, 25% $400k	13%	$211k	$26k
Snark Contact, 25% $300k	13%	-$108k	-$14k
No Contract, 50% $100k	25%	-$247k	-$62k
Pessimistic, 25% $0k	13%	-$317k	-$40k

Snark contract, 50% $400k

No contract, 50% $100k

Initial development
-$400k

$$-400 + \frac{400}{1.2} + \frac{600}{1.2^2}$$

Expected NPV = $60k

18

Today's agenda

❑ Return on Investment (ROI)

❑ Net Present Value (NPV)

❑ Internal Rate of Return (IRR)

❑ Modeling return

❑ Prioritizing Work

❑ Economic Value Added (EVA)

Which would you prefer?

Year	Investment	Return	Discounted value
0	200		−200
1	600		−545
2		200	165
3		400	301
4		600	410
Total	800	1,200	131

Project A
Revenue $201
Cost $1
Return $200

Project B
Revenue $100,200
Cost $100,000
Return $200

Valuing the capital used

- Other measures don't consider the value of the money used

Year	Investment	Return	Discounted value
0	200		–200
1	600		–545
2		200	165
3		400	301
4		600	410
Total	800	1,200	131

- How much does it cost to run this business?
- Is it shipping a CD or is there a multi-million dollar data center supporting it?

Buying a sandwich shop

- Makes a profit of $5k / month
- Cost is $100k
- **Should you buy it?**

- **What if it cost $1000k?**

20

Economic Value Added (EVA)

- We want a measure that considers the cost of the capital tied up in a project
  - □ Other measures just consider the return
- EVA includes the cost of capital and the amount of capital needed

Calculating EVA

	Y0	Y1	Y2	Y3	Y4
Earnings	0	$300	$600	$500	$500
Cumulative Capital Invested	$1000	$1200	$1400	$1600	$1800
Cost of Capital	15%	15%	15%	15%	15%
Capital Charge	$150	$180	$210	$240	$270
Economic Profit	–$150	$120	$390	$260	$230
PV of EP at 10%	–$150	109	322	195	157
EVA	634				

Determining your cost of capital

| Best approach | ▪ Ask your company or department controller |

| Second best | ▪ Ask your company or department controller |

| Third best | ▪ Capital Asset Pricing Model
  ▪ CAPM |

CAPM

$$\text{Cost of Capital} = r_f + (\beta * (r_m - r_f))$$

- r_f = risk-free rate of return (e.g., government bonds)
- β = How much the company's stock moves relative to the overall stock market; >1 is more volatile
- r_m = overall stock market return

Calculating CAPM, an example

$$\text{Cost of Capital} = r_f + (\beta * (r_m - r_f))$$

- $r_f = 1.7$
- $\beta = 1.5$
- $r_m = 10.5$

1.7 + (1.5 * (10.5 - 1.7))
1.7 + 1.5*8.8
1.7 + 13.2
14.9

Where to go next

The Addison Wesley Signature Series

USER STORIES
APPLIED

FOR AGILE SOFTWARE
DEVELOPMENT

MIKE COHN
Foreword by Kent Beck

- Agile Estimating and Planning
  - groups.yahoo.com/agileplanning
  - www.mountaingoatsoftware.com/agileplanning

- Hakan Erdogmus' publications
  - http://seg.iit.nrc.ca/~erdogmus/Publications.html
- John Favaro's publications
  - http://www.favaro.net/publications
- *Return on Software*
  - Book by Steve Tockey

My contact information

| Email | ▪ mike@userstories.com
▪ mike.cohn@computer.org |

| ▪ www.mountaingoatsoftware.com
▪ www.userstories.com | Websites |