

Project Economics: Selecting and Prioritizing High Value Projects

Mike Cohn

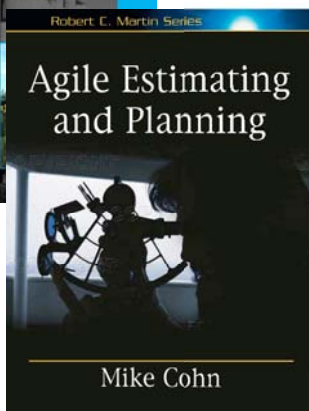
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Mike Cohn - background



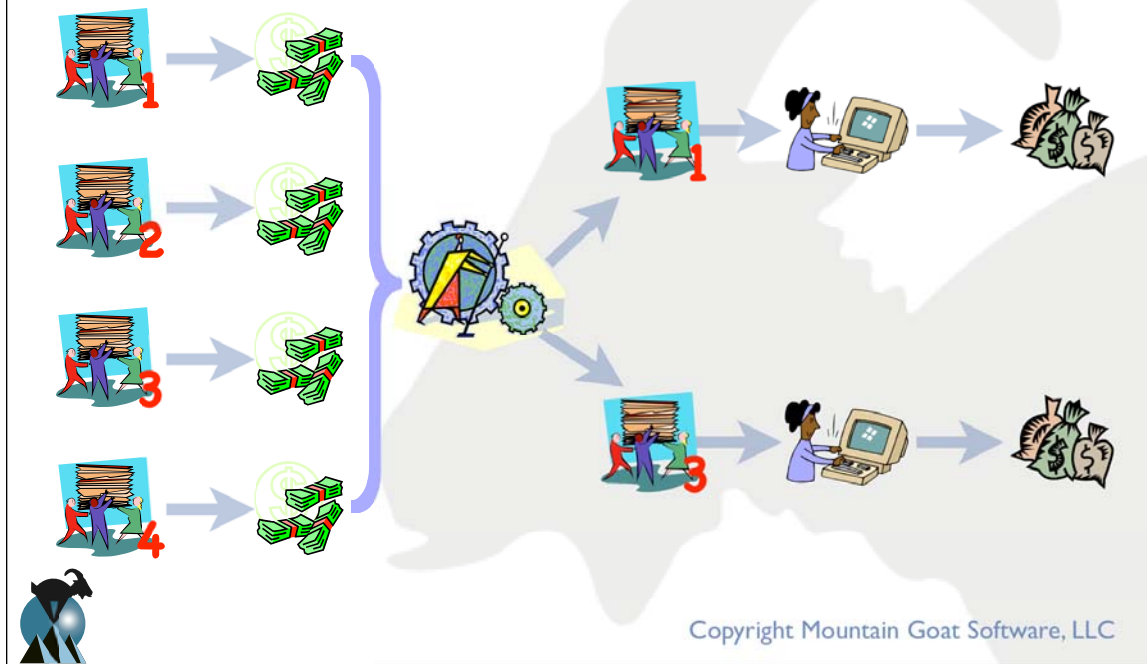
Consultant, author,
and speaker

- Founding member and director of Agile Alliance, Scrum Alliance, and Agile Project Leadership Network
- Founder of Mountain Goat Software



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What we want to do



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Today's agenda



- Net Present Value (NPV)
- Internal Rate of Return (IRR) and ROI
- Payback Period
- Modeling Return
- Prioritizing
- Non-financial approaches



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Which project would you prefer?

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

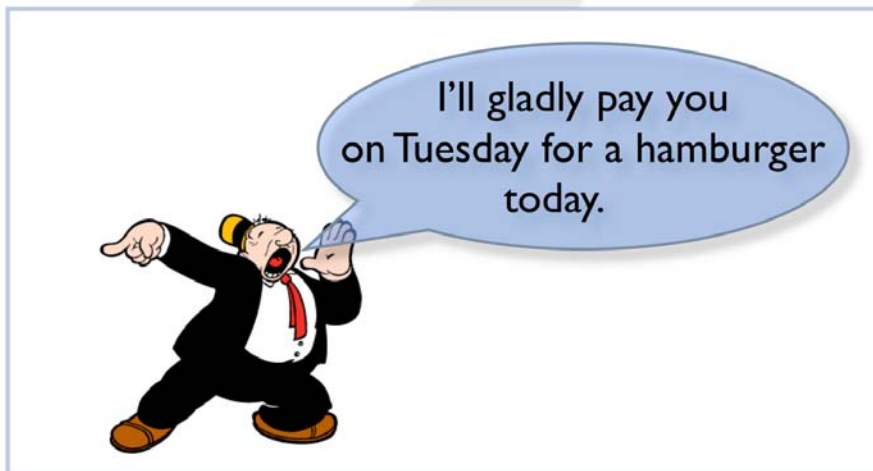


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The time-value of money

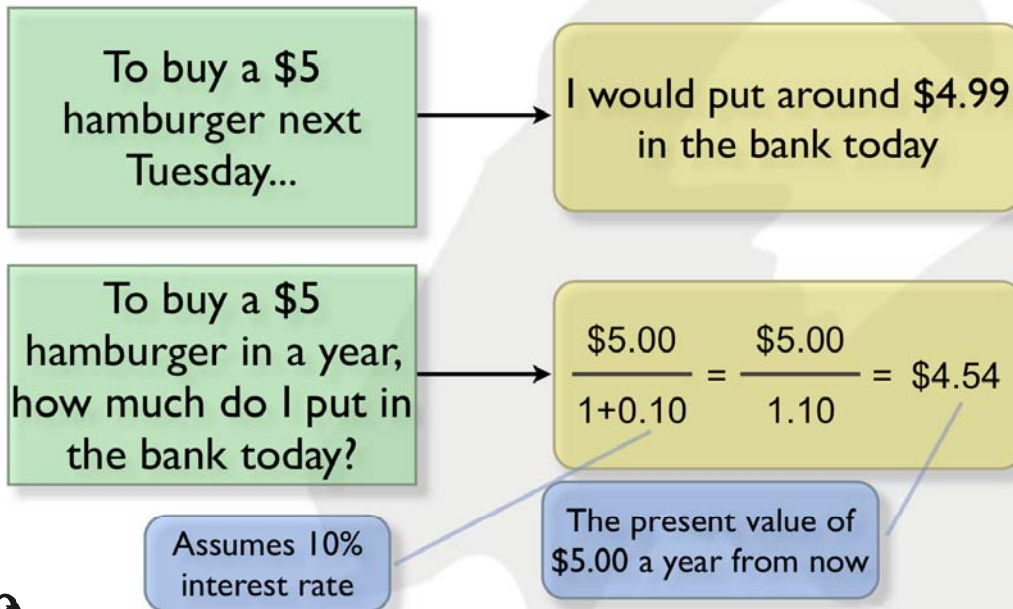
- A dollar today is worth more than a dollar a year from now



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Calculating the value of future dollars



Present value of one future amount

$$\text{Present Value} = \frac{\text{Future Value}}{1 + \text{interest rate}}$$

An example: $\frac{\$5.00}{1+0.10} = \4.54

Generalizing

$$PV = \frac{FV}{(1+i)^t}$$

Simplifying

$$PV = FV(1+i)^{-t}$$



Net present value (NPV)

- The present value of a stream of cash flows
- Measures the return on a theme or project as an amount of money

$$NPV(i) = \sum_{t=0}^n F_t(1+i)^{-t}$$



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NPV example

- Assuming 12% annual discount rate (3% / quarter)

Quarter	Cash flow	$(1+i)^{-t}$	Discounted Cash Flow	Running Total
0	-200	1.000	-200	-200
1	-600	0.971	-583	-783
2	100	0.943	94	-689
3	300	0.915	275	-414
4	500	0.888	444	30



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Discount rate sensitivity

- NPV is highly sensitive to the chosen discount rate

Quarter	Cash flow	Discounted Cash Flow (3%)	Discounted Cash Flow (6%)
0	-200	-200	-200
1	-600	-583	-783
2	100	94	-689
3	300	275	-414
4	500	444	30
Total	100	30	-29

Do the project under these conditions

But not under these



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Comparing NPVs

- Highest NPV brings the most present-value dollars to the company

Theme	NPV
Scalability	\$2,100
Gift registry	\$1,253
Ad hoc reporting	\$784
Pay by invoice	\$385

Comparing NPVs can be misleading. What if:

- "Pay by invoice" requires a \$5 investment
- "Scalability" requires \$50,000?



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Return as a percentage

- Rather than expressing returns in dollars, we'd like to express return as a percentage
 - Allows for direct comparisons
- NPV = how much money a project will return
- ROI = how quickly an investment will grow



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Internal rate of return (IRR) and ROI

- IRR = Internal Rate of Return
 - Often called Return On Investment (ROI)
- The interest rate at which NPV is 0

$$0 = PV(i^*) = \sum_{t=0}^n F_t (1+i)^{-t}$$



Remember this table?

Quarter	Cash flow	Discounted Cash Flow (3%)	Discounted Cash Flow (6%)
0	-200	-200	-200
1	-600	-583	-783
2	100	94	-689
3	300	275	-414
4	500	444	30
Total	100	30	-29

- IRR gives us the discount rate at which we don't care whether or not we do the project
 - We don't make \$30; we don't lose \$29; we break even



How to calculate ROI or IRR

- Use Excel's irr function

+irr({-200, -600, 100, 300, 500})

An investment
made on the first
day of the project

Cash flows for
remainder of
project
(4 quarters)



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Advantages and disadvantages

- Advantages
 - You don't need to guess at a discount rate like with NPV
 - Can be used to directly compare projects
- Disadvantages
 - Calculation is hard to do by hand (but easy in Excel); may lead to numbers being distrusted
 - Cannot use in all circumstances
 - e.g., once cash flow turns positive, it stays positive



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Payback period

- The amount of time before an initial investment is paid back
- I loan you \$5. You pay me back \$1/week. The payback period is 5 weeks.

Quarter	Cash Flow	Running Total
0	-200	-200
1	-200	-400
2	100	-300
3	300	0
4	500	500

Payback period is 3 quarters.



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Advantages and disadvantages

- Advantages
 - Calculation is very easy
 - Measures the duration of financial risk
 - Longer payback period = greater risk
- Disadvantages
 - Doesn't consider the time-value of money
 - Doesn't measure profitability at all



Discounted payback period

- Discount future cash flows and determine when the investment is paid back

Quarter	Cash Flow	$(1+i)^{-t}$ $i=3\%$	Discounted Cash Flow	Running Total
0	-200	1.000	-200	-200
1	-200	0.971	-194	-394
2	100	0.943	94	-300
3	300	0.915	275	-25
4	500	0.888	444	419

Discounted payback period = 4 quarters



Financial analysis recap

- Net Present Value (NPV)
 - Sum of discounted future cash flows
 - Expresses return as an amount of money
- Return on Investment (ROI) / Internal Rate of Return
 - The interest rate at which $NPV = 0$
 - That is, at which you'd be indifferent to the investment
 - Expresses return as a percentage
- Discounted payback period
 - Amount of time before discounted returns equal the investment
 - Expresses return as an amount of time



Today's agenda

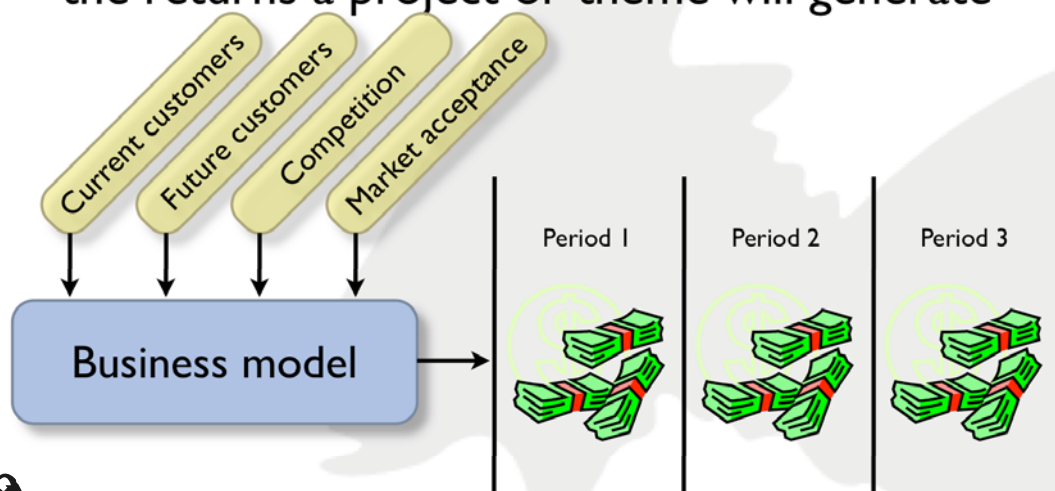


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You need a business model

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



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A relatively simple way to model

- Consider your revenue sources and group them
- These four often work well:
 1. New revenue
 2. Incremental revenue
 3. Retained revenue
 4. Operation efficiency

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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

• An eCommerce site decides to offer gift wrapping for \$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



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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



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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



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Facts about WebPayroll

- Average customer – pays \$400/year in fees
- Overnight delivery will appeal to smaller customers, paying an average of \$200/year
- We think we'll make another \$100/year per customer that uses the over night service
- Average new customer is then worth \$300/year (\$200+\$100), or \$75/quarter
- New feature will take four months to deliver



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WebPayroll: new revenue

- Sales says 50 new customers/quarter this year; 100 next year

Quarter	New Customers	Revenue per Customer	New Revenue
1	0	\$0	\$0
2	50	\$50	\$2,500
3	50	\$75	\$3,750
4	50	\$75	\$3,750
5	100	\$75	\$7,500
6	100	\$75	\$7,500
7	100	\$75	\$7,500
8	100	\$75	\$7,500



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WebPayroll: incremental revenue

- We estimate we'll sign up 100 existing members per quarter until we have 400

Quarter	Customers	Revenue per Customer	Incremental Revenue
1	0	\$0	\$0
2	100	\$16	\$1,600
3	200	\$25	\$5,000
4	300	\$25	\$7,500
5	400	\$25	\$7,500
6	400	\$25	\$10,000
7	400	\$25	\$10,000
8	400	\$25	\$10,000



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WebPayroll: retained revenue

- Sales say we'll retain 10 customers per quarter

Quarter	Retained Customers	Total Retained	Revenue per Customer	Retained Revenue
1	10	10	\$100	\$1,000
2	10	20	\$100	\$2,000
3	10	30	\$100	\$3,000
4	10	40	\$100	\$4,000
5	10	50	\$100	\$5,000
6	10	60	\$100	\$6,000
7	10	70	\$100	\$7,000
8	10	80	\$100	\$8,000



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Operational efficiency

- We can avoid hiring a new payroll clerk a year from now at a fully burdened labor cost of \$30,000/year.

Quarter	Payroll Clerks Not Needed	Fully Burdened Labor Cost	Operational Efficiencies
1	0	\$0	\$0
2	0	\$0	\$0
3	0	\$0	\$0
4	0	\$0	\$0
5	1	\$7,500	\$7,500
6	1	\$7,500	\$7,500
7	1	\$7,500	\$7,500
8	1	\$7,500	\$7,500



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All the numbers for WebPayroll

Q	Dev Cost	New Revenue	Incr. Revenue	Retained Revenue	Oper. Efficiencies	Net Cash Flow
1	-\$90,000	\$0	\$0	\$1,000	\$0	-\$89,000
2	-\$30,000	\$2,500	\$1,600	\$2,000	\$0	-\$23,900
3		\$3,750	\$5,000	\$3,000	\$0	\$11,750
4		\$3,750	\$7,500	\$4,000	\$0	\$15,250
5		\$7,500	\$7,500	\$5,000	\$7,500	\$27,500
6		\$7,500	\$10,000	\$6,000	\$7,500	\$31,000
7		\$7,500	\$10,000	\$7,000	\$7,500	\$32,000
8		\$7,500	\$10,000	\$8,000	\$7,500	\$33,000



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WebPayroll - NPV

Quarter	Net Cash Flow	$(1+i)^{-t}$	Present Value
1	-\$89,000	0.971	-\$86,419
2	-\$23,900	0.943	-\$22,538
3	\$11,750	0.915	\$10,751
4	\$15,250	0.888	\$13,542
5	\$27,500	0.863	\$23,733
6	\$31,000	0.837	\$25,947
7	\$32,000	0.813	\$26,016
8	\$33,000	0.789	\$26,037
NPV (12%) =			\$43,106



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WebPayroll - ROI

	A
1	0
2	-\$89,000
3	-\$23,900
4	\$11,750
5	\$15,250
6	\$27,500
7	\$31,000
8	\$32,000
9	\$33,000

+irr(A1:A9, .10)

6%



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WebPayroll - Payback Period

Quarter	Net Cash Flow	Running Total
1	-\$89,000	-\$89,000
2	-\$23,900	-\$112,900
3	\$11,750	-\$101,150
4	\$15,250	-\$85,900
5	\$27,500	-\$58,400
6	\$31,000	-\$27,400
7	\$32,000	\$4,600
8	\$33,000	\$37,600

Payback period = 7 quarters



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WebPayroll - Discounted Payback Period

Quarter	Net Cash Flow	$(1+i)^{-t}$ 3%	Present Value	Running Total
1	-\$89,000	0.971	-\$86,419	-\$86,419
2	-\$23,900	0.943	-\$22,538	-\$108,957
3	\$11,750	0.915	\$10,751	-\$98,206
4	\$15,250	0.888	\$13,542	-\$84,664
5	\$27,500	0.863	\$23,733	-\$60,931
6	\$31,000	0.837	\$25,947	-\$34,984
7	\$32,000	0.813	\$26,016	-\$8,968
8	\$33,000	0.789	\$26,037	\$17,069

Discounted payback period = 8 quarters

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You need to know the cost

- To prioritize you must know the cost
 - If you had no idea of the costs, which car would you be inclined to buy?
- Estimate the development time of each project
 - Person-weeks, story points, ideal days
- Calculate your cost per that unit
 - \$4,500 per person-week
 - \$3,100 per story point



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Calculating cost per person-week

Development budget last year	\$2,100,000
Person weeks worked	$6 \times 52 + 1 \times 39 = 351$
Cost per week	$\$2.1M / 351 = \$5,982$

So, if a project is estimated at 25 person-weeks:
- $25 \times \$6000 = \$150,000$



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Using story points

Development budget last year	\$2,100,000
Total story points finished last year	343
Cost per story point	$\$2.1M / 343 = \$6,122$

So, if a project is estimated at 25 story points:
 - $25 \times \$6000 = \$152,500$



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Theme (project) comparison matrix

	Person Weeks	Cost	3-Year Return	NPV	IRR	D. Payback (Quarters)
Theme A	25	\$150	\$1,085	\$448	133%	2
Theme B	32	192	\$2,109	\$940	172%	4
Theme C	90	\$540	\$2,537	\$883	89%	2
Theme D	48	\$288	\$1,360	\$443	76%	4
Theme E	55	\$330	\$900	\$191	48%	2
Theme F	79	\$474	\$1,365	\$331	56%	4
Theme G	90	\$540	\$5,964	\$2,519	139%	5
Theme H	50	\$300	\$2,415	\$1,023	146%	2
Theme I	15	90	\$1,600	\$747	221%	1
Theme J	30	\$180	\$640	\$182	65%	2
Theme K	75	\$450	\$516	(\$104)	5%	NA
Theme L	40	\$240	\$171	(\$110)	(12%)	NA
Theme M	80	\$480	\$1,025	\$142	36%	3
Theme N	18	\$108	\$185	\$7	24%	2
Theme O	6	36	\$155	\$53	90%	1
Theme P	12	\$72	\$1,505	\$748	355%	1



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What do you select?



It's March 18 and you are meeting to plan the April-June quarter.

Your team now has 7 people. That's $7 \times 13 = 91$ person-weeks in a quarter.

What do you select?



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Theme F	79	\$474	\$1,365	\$331	56%	4
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Theme H	50	\$300	\$2,415	\$1,023	146%	2
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Theme J	30	\$180	\$640	\$182	65%	2
Theme K	75	\$450	\$516	(\$104)	5%	NA
Theme L	40	\$240	\$171	(\$110)	(12%)	NA
Theme M	80	\$480	\$1,025	\$142	36%	3
Theme N	18	\$108	\$185	\$7	24%	2
Theme O	6	36	\$155	\$53	90%	1
Theme P	12	\$72	\$1,505	\$748	355%	1



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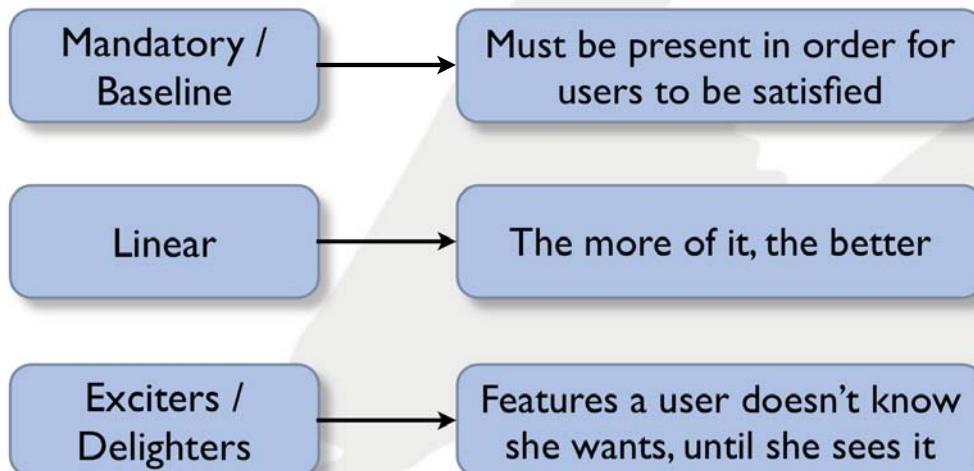


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Kano analysis

Three types of features



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Surveying users

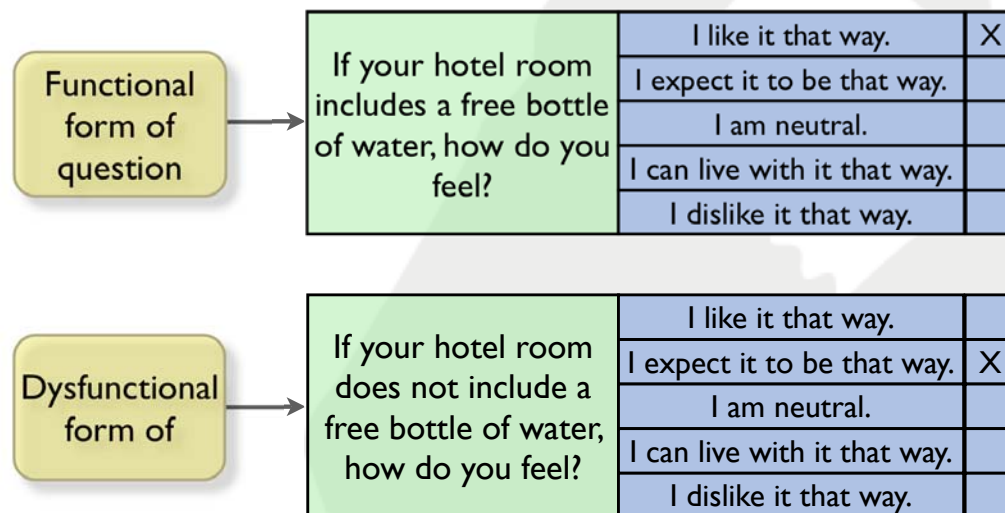
- To assess whether a feature is baseline, linear, or exciting we can:
 - Sometimes guess
 - Or survey a small set of users (20-30)
- We ask two questions
 - A functional question
 - How do you feel if a feature is present?
 - And a dysfunctional question
 - How do you feel if that feature is absent?



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Functional and dysfunctional forms



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Categorizing an answer pair

		Dysfunctional Question				
		Like	Expect	Neutral	Live with	Dislike
Functional Question	Like	Q	E	E	E	L
	Expect	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

M Mandatory
 L Linear
 E Exciter
 Q Questionable
 R Reverse
 I Indifferent

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Aggregating results

Theme	Exciter	Linear	Mandatory	Indifferent	Reverse	Questionable
Apply formatting themes	3	11	31	1	3	2
Automate report execution	4	22	20	4	1	0
Export reports to PowerPoint	21	9	14	5	1	1

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What to include

- All of the baseline features
 - By definition, these must be present
- Some amount of linear features
- But leaving room for at least a few excitors



Relative weighting

- Assess the impact of having a story/theme from 1-9
- Assess impact of NOT having it from 1-9
- Calculate the value of each story or theme relative to the entire product backlog
 - This gives you the relative value of that story or theme
- Estimate the cost of each story theme
- Calculate the cost of each story or theme relative to the entire product backlog
 - This gives the relative cost of that story or theme
- Priority is given by $(\text{Relative Value} \div \text{Relative Cost})$



Relative weighting: an example

		Relative Benefit	Relative Penalty	Total Value	Value Percent	Estimate	Cost Percent	Priority
Themes	More investment choices	8	6	14	40	64	44	91
	Portfolio rebalancing	9	2	11	31	40	27	115
	Comply with new law	1	9	10	29	42	29	100
	Total			35	100	146	100	

$$\text{Total Value} = \text{Relative Benefit} + \text{Relative Penalty}$$

$$\text{Value Percent} = \text{Total Value} / \sum (\text{Total Value})$$

$$\text{Cost Percent} = \text{Estimate} / \sum (\text{Estimate})$$

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An example with weights

		Weight →		Relative Benefit	Relative Penalty	Total Value	Value Percent	Estimate	Cost Percent	Priority
		2	1							
Themes	More investment choices	8	6	22	41	64	44	93		
	Portfolio rebalancing	9	2	20	38	40	27	141		
	Comply with new law	1	9	11	21	42	29	72		
	Total			53	10	14	10			

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Upcoming public classes

Date	What	Where
September 26-27	Certified ScrumMaster	London
September 28	Agile Estimating & Planning	London
November 7-8	Certified ScrumMaster	Santa Clara
November 9	Agile Estimating & Planning	Santa Clara
November 29-30	Certified Product Owner (with Ken Schwaber)	Boulder
January 16-17	Certified ScrumMaster (with Ken Schwaber)	Orlando

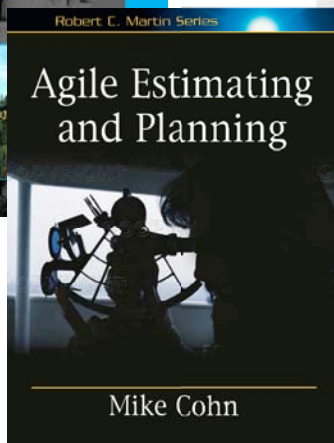
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