

Finance for Engineers

You understand technology, but what about finance?

It turns out that MBAs are right – engineering projects are financial investments, and a poor ROI means a poor future. Understanding financial fundamentals helps you improve results, and you'll be better at discussing your work with business-oriented executives and technically-oriented peers.

The Briefing:

There's a language barrier surrounding finance and investments. Investment equations are simple for engineers – the trick lies in knowing what they mean and how to apply them. Phrases such as cost of capital, internal rate of return, and net present value can be hard to follow when you don't understand the language of finance.

After this briefing, participants will be able to say “internal rate of return” like a native. They will be able to calculate basic financial investment metrics and participate fully with executives in financial discussions about engineering projects and business investments, including portfolio decisions and opportunity ranking.

Technical executives, managers, and principals from all functional areas will benefit from a shared perspective on business investments and finance.

What Will Participants Learn?

The briefing covers the ideas, concepts, and tools for:

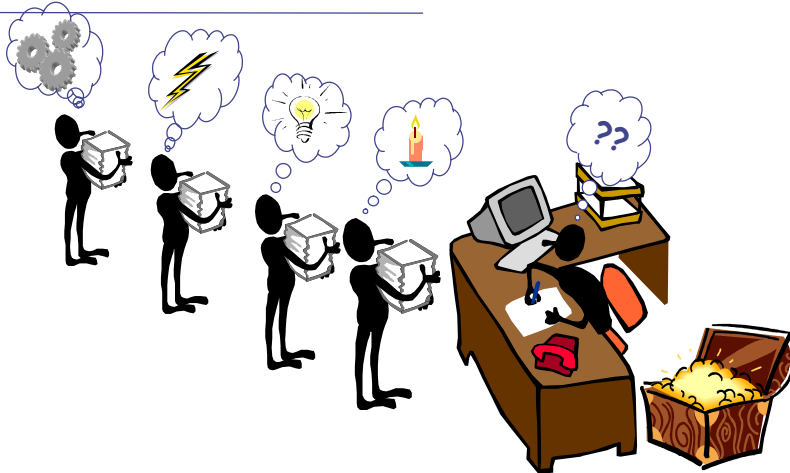
- Measuring engineering projects as financial investments
- Analyzing investments using discounted cash flow
- Calculating and comparing financial metrics
- Using Excel functions for financial calculations
- Building project portfolios to optimize return on limited resources

Outline:

Using an example of new product portfolio planning, the briefing covers

1. Business economics and investments
2. Time value of money
3. Comparing and ranking opportunities
4. Shortcomings of oversimplified project metrics
5. Example applications using Excel financial functions

Investment Allocation



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Finance for New Products

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Constellation Systems, Inc.

- ◆ Executives: Maximize financial returns

- All projects > 16% return
 - Select portfolio to optimize returns
- MAR** Hurdle rate
cost of capital



Dan –
marketing

- ◆ Laboratory Analytics Division

- 2 ongoing projects
- 4 new projects to consider
- ◆ Planning meeting in 2 months



Amy –
engineering

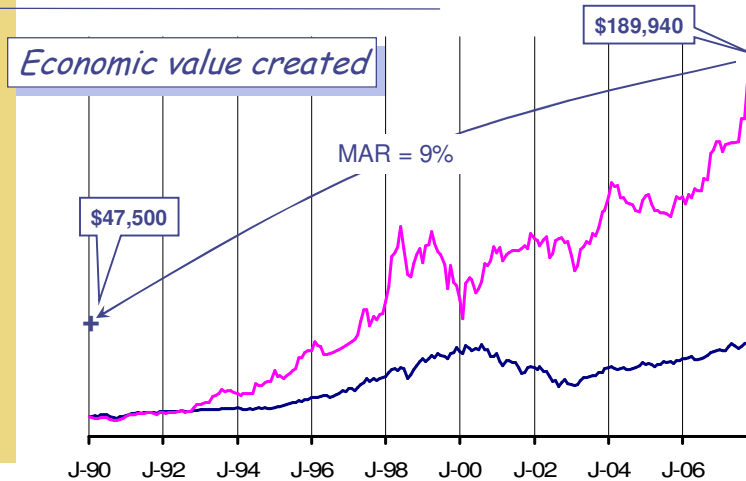
Investment Metrics

Comparing Investments

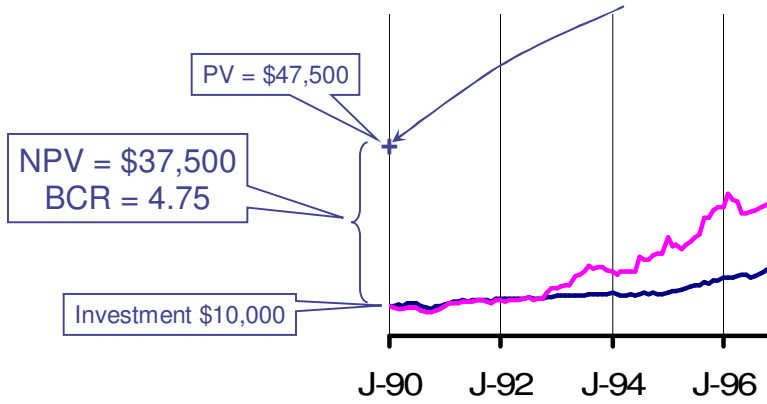
- ◆ Make a \$1,000 loan to Ann or Bob
 - Ann: repay \$1,300
 - Bob: repay \$1,600



Present Value



Present Value Metrics

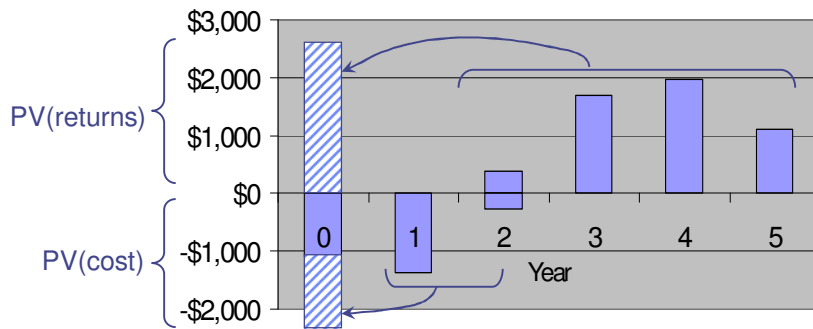


BCR > 1: Investment value > cost

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PV - Multiple Cash Flows

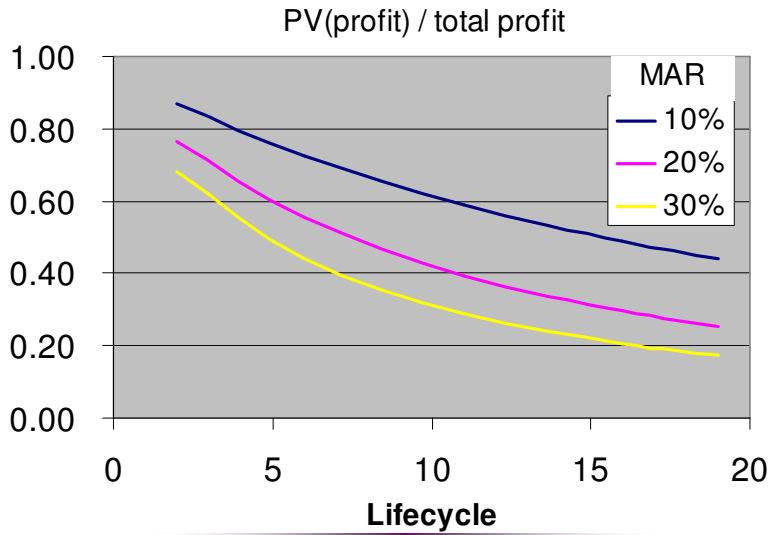


$$\text{BCR} = \text{PV(returns)} / \text{PV(cost)}$$

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PV vs. Lifecycle



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Case Study - BCR

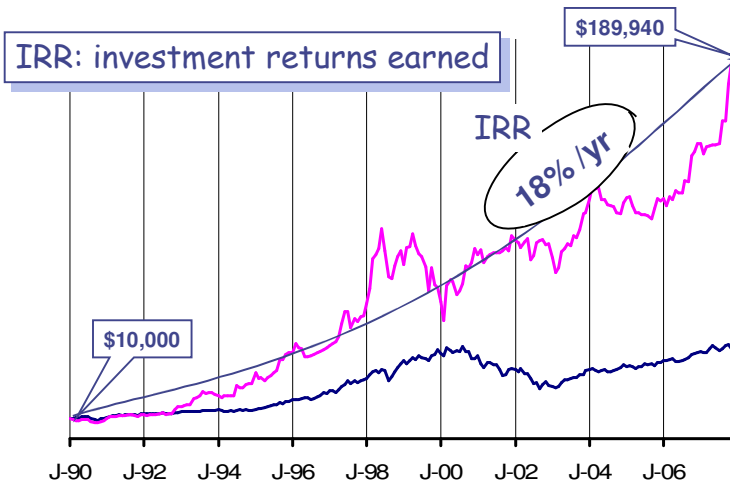
| (\$000) | Charlie | Delta | Zulu |
|--------------|---------|-------|-------|
| Cost | 1,000 | 2,000 | 3,000 |
| Tot. Profit | 3,000 | 3,500 | 4,500 |
| Lifecycle | 15 y | 5 y | 10 y |
| Disc factor? | | | |
| PV(profit)? | | | |
| BCR? | | | |

MAR = 10%

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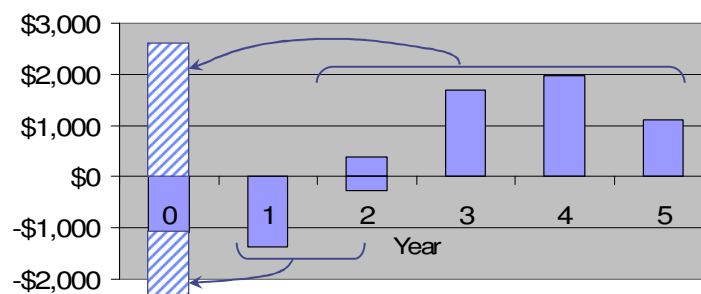
Return Rate Metric



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IRR - Multiple Cash Flows

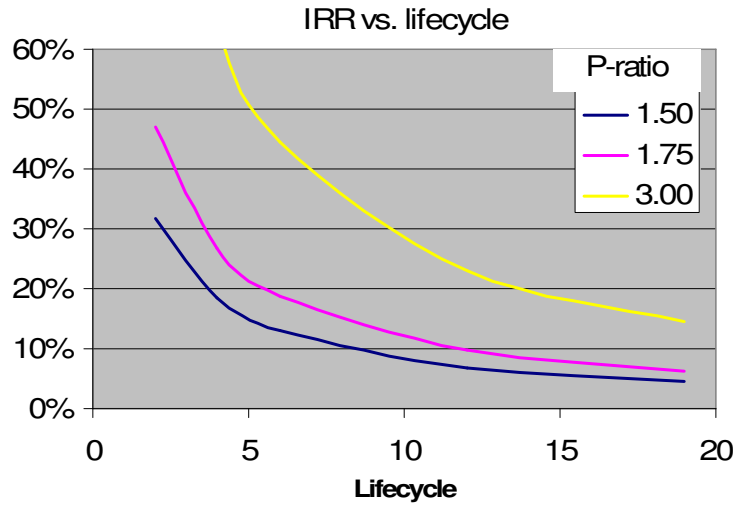


IRR = discount rate to make BCR = 1

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IRR vs. Lifecycle



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Case Study - IRR

| (\$000) | Charlie | Delta | Zulu |
|---------------|---------|-------|-------|
| Cost | 1,000 | 2,000 | 3,000 |
| Tot. Profit | 3,000 | 3,500 | 4,500 |
| Lifecycle | 15 y | 5 y | 10 y |
| Profit ratio? | | | |
| IRR? | | | |

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Decisions, Decisions...

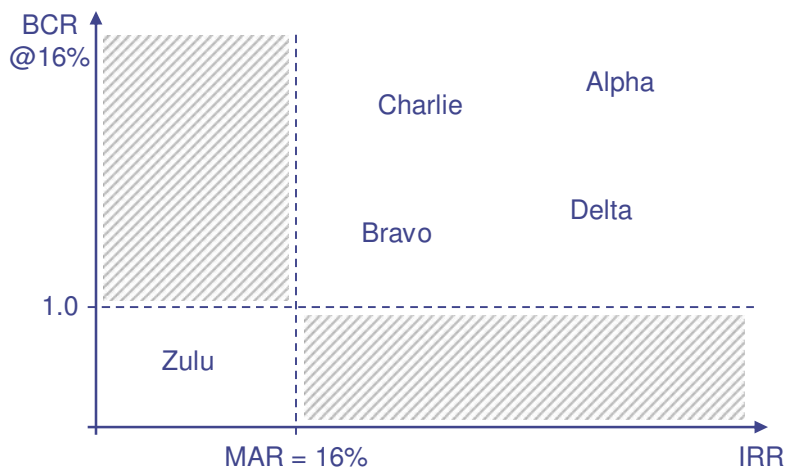
◆ Accept/reject

- Is economic value created?
- $BCR(@MAR) > 1.0$
- $IRR > MAR$

◆ Ranking

- Which opportunity is better?
- Optimize portfolio returns
- Rank by BCR or IRR?

BCR or IRR?



Portfolio Management

Accept/reject decisions
Sunk costs

Project List



R&D budget:
\$5,000

| | 2009 Yr0 cost | Tot cost | Tot retrns | Tot profit | |
|---------------|------------------|----------|------------|------------|----------------|
| Pegasus | 1,500 | 3,000 | 3,545 | 545 | Ongoing |
| Phoenix | 1,300 | 3,940 | 4,218 | 278 | Ongoing |
| Canis Major | 2,200 | 5,000 | 8,500 | 3,500 | } Alternatives |
| Aquarius | 2,500 | 3,000 | 5,728 | 2,728 | |
| Aquarius Lite | 2,000 | 2,000 | 4,011 | 2,011 | |
| Centaurus | 1,000 | 1,000 | 1,820 | 820 | |

Business Case

| Year | 0 | 1 | 2 | 3 | 4 |
|----------------------|--------|--------|-------|-------|-------|
| Selling price | | | 6.820 | 6.138 | 5.524 |
| Unit sales | | | 167 | 926 | 1,440 |
| Revenue | | | 1,136 | 5,682 | 7,955 |
| Unit cost | | | 3.40 | 3.33 | 3.27 |
| COGS | | | 567 | 3,085 | 4,702 |
| Gross Profit | | | 570 | 2,598 | 3,253 |
| Alloc expns (16%) | | | 182 | 909 | 1,273 |
| Profit from sales | 0 | 0 | 388 | 1,688 | 1,980 |
| R&D | 1,100 | 1,375 | 275 | | |
| Pretax profit (OPBT) | -1,100 | -1,375 | 113 | 1,688 | 1,980 |
| Taxes (35%) | -385 | -481 | 40 | 591 | 693 |
| After tax profit | -715 | -894 | 73 | 1,098 | 1,287 |

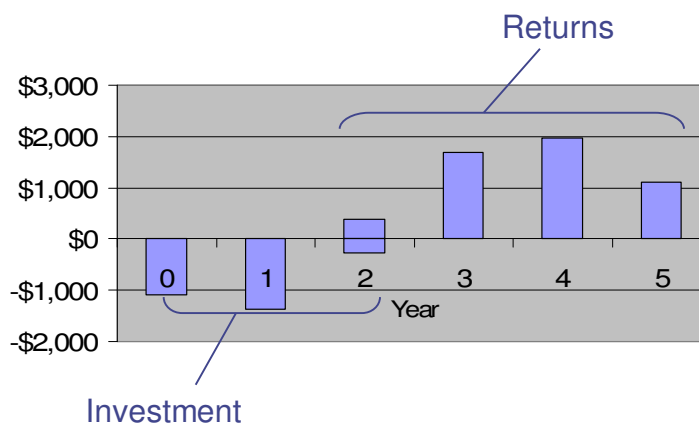
Returns

Cost

Net returns

Capitalized expenses??

Typical Cash Flows

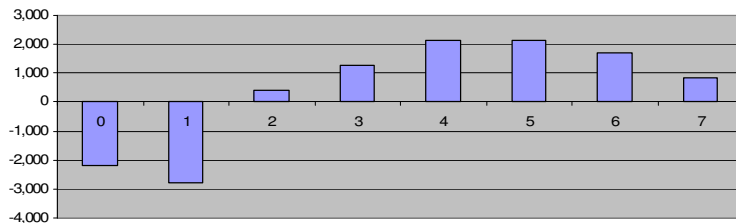


Project List v1.5



| | ↓ Tot profit | BCR@16% | IRR |
|---------------|-----------------|---------|-------|
| Pegasus | 545 | 0.74 | 5% |
| Phoenix | 278 | 0.65 | 2% ! |
| Canis Major | 3,500 | 0.94 | 14% ! |
| Aquarius | 2,728 | 1.16 | 21% |
| Aquarius Lite | 2,011 | 1.21 | 23% |
| Centaurus | 820 | 1.15 | 22% |

Canis Major

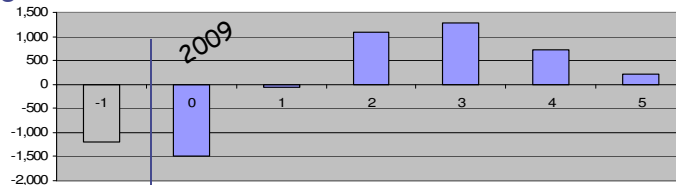


| | | |
|-------------|-------|------------------------|
| MAR | 16% | |
| PV(cost) | 3,977 | PV(cost) > PV(returns) |
| PV(returns) | 3,721 | |
| IRR | 14% | |
| BCR | 0.94 | |

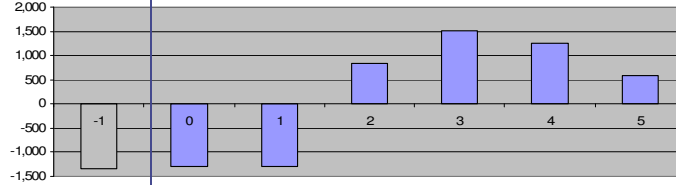
BCR < 1 and IRR < MAR: reject the project

Ongoing Projects

Pegasus



Phoenix



← Sunk Future →

"sunk costs"

Future Costs Only

Pegasus

| MAR | 16% | |
|-----|----------------|-------------|
| | Including sunk | Future only |
| IRR | 5% | 30% |
| BCR | 0.74 | 1.33 |

Handsome returns

Phoenix

| MAR | 16% | |
|-----|----------------|-------------|
| | Including sunk | Future only |
| IRR | 2% | 19% |
| BCR | 0.65 | 1.07 |

Acceptable returns

*As investments, ignore sunk costs
... but correct forecasting process!*

Project List v2.0



| | Tot profit | BCR@16% | IRR | |
|---------------|------------|---------|-----|--------------------|
| Pegasus | 545 | 1.33 | 30% | } Future cost only |
| Phoenix | 278 | 1.07 | 19% | |
| Aquarius | 2,728 | 1.16 | 21% | |
| Aquarius Lite | 2,011 | 1.21 | 23% | |
| Centaurus | 820 | 1.15 | 22% | |
| Capricorn | 415 | 1.10 | 26% | |
| Canis Major | 3,500 | 0.94 | 14% | |

Portfolio Management

Ranking decisions

Project List v2.0

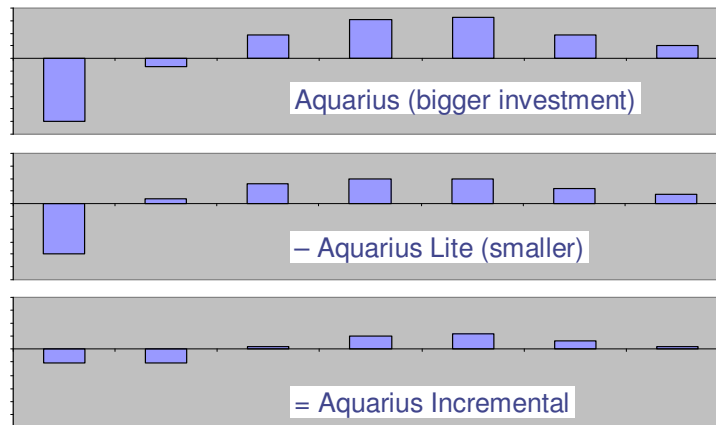


| | Tot profit | BCR@16% | IRR |
|---------------|------------|---------|-----|
| Pegasus | 545 | 1.33 | 30% |
| Capricorn | 415 | 1.10 | 26% |
| Aquarius Lite | 2,011 | 1.21 | 23% |
| Centaurus | 820 | 1.15 | 22% |
| Aquarius | 2,728 | 1.16 | 21% |
| Phoenix | 278 | 1.07 | 19% |

Aquarius or Aquarius Lite?

Investments: "Mutually Exclusive Alternatives"

Incremental Investments



Arithmetic difference, not a real project

Project List v2.5



| | Tot profit | BCR@16% | IRR |
|-----------------|--------------|-------------|------------|
| Pegasus | 545 | 1.33 | 30% |
| Capricorn | 415 | 1.10 | 26% |
| Aquarius Lite | 2,011 | 1.21 | 23% |
| Centaurus | 820 | 1.15 | 22% |
| Phoenix | 278 | 1.07 | 19% |
| Aquarius incr | 717 | 1.05 | 18% |
| Aquarius | 2,728 | 1.16 | 21% |

*Incremental investment analysis
Clarifies portfolio decisions
Can improve resource use*

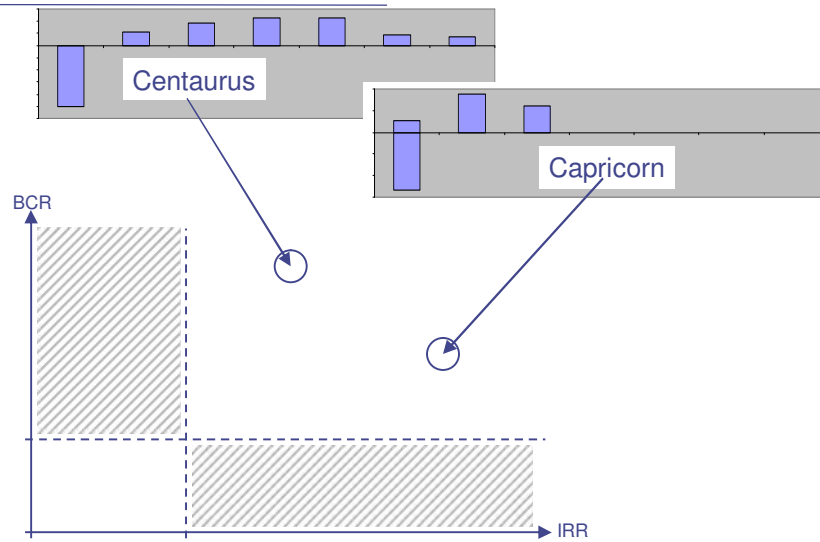
Project List v2.5



| | Yr0 cost | BCR@16% | IRR |
|---------------|----------|---------|-----|
| Pegasus | 1,500 | 1.33 | 30% |
| Capricorn | 1,350 | 1.10 | 26% |
| Aquarius Lite | 2,000 | 1.21 | 23% |
| Centaurus | 1,000 | 1.15 | 22% |
| Phoenix | 1,300 | 1.07 | 19% |
| Aquarius incr | 500 | 1.05 | 18% |

> ?

BCR or IRR?



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The Portfolio Decision



Budget = \$5,000



| | Yr0 cost | BCR@16% | IRR |
|---------------|----------|---------|-----|
| Pegasus | 1,500 | 1.33 | 30% |
| Capricorn | 1,350 | 1.10 | 26% |
| Aquarius Lite | 2,000 | 1.21 | 23% |
| Centaurus | 1,000 | 1.15 | 22% |
| Phoenix | 1,300 | 1.07 | 19% |
| Aquarius incr | 500 | 1.05 | 18% |

Plan vs. budget: \$4850 vs. \$5000

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At the Planning Meeting



Final:

| | Yr0 cost | Fut profit | BCR | IRR |
|------------------------|--------------|--------------|-------------|------------|
| Pegasus | 1,500 | 1,745 | 1.33 | 30% |
| Capricorn | 1,350 | 415 | 1.10 | 26% |
| Aqu LT | 2,000 | 2,011 | 1.21 | 23% |
| Final portfolio | 4,850 | 4,171 | 1.22 | 26% |

Original plan:

| | Yr0 cost | Fut profit | BCR | IRR |
|------------------------|--------------|--------------|-------------|------------|
| Pegasus | 1,500 | 1,745 | 1.33 | 30% |
| Phoenix | 1,300 | 1,618 | 1.07 | 19% |
| Canis Major | 2,200 | 3,500 | 0.94 | 14% |
| Orig. portfolio | 5,000 | 6,863 | 1.05 | 18% |



Questions? Comments?



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