Developing a Convincing Benefit-Cost Analysis for Grants

Stephen R. Galati, CGW, CP APMP

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Stephen R. Galati, CGW, CP APMP

Stephen Galati is the Manager of National Proposals with TRC Environmental Corporation working out of Augusta, Maine. He has 20 years of proposal management, technical writing, grant writing, marketing communications, training and training course development, and electrical engineering experience throughout the United States and for global opportunities.

He is the author of *Geographic Information Systems Demystified*, a textbook published by Artech House, and has numerous publications to his credit concerning environmental consulting, proposal writing, grant management, and public / private funding.

He is currently finishing his Doctorate Degree in Management with the University of Phoenix, and holds a Master’s Degree in English Rhetoric from the City University of New York, a Bachelor’s Degree in Electrical Engineering from Pratt Institute, an Associate’s Degree in Liberal Arts and Science from the City University of New York, and a Professional Development Certificate in Emergency Management from the FEMA Institute.

He currently holds two Field of Interest Chairs for the American Grant Writers Association covering the Environment and Homeland Security, and is a Chemical-Terrorism Vulnerability Information (CVI) Authorized User.

An excerpt from his short story “Starscraper” was recently selected for inclusion in *Engineering News Record* magazine’s *Imagining the Future – Construction Science Fiction Collection*. 
Discussion Agenda

- What is a BCA?
- Why is a BCA Important?
- Case Study
  - MBTA Drawbridge Grant BCA
  - Grant Project Conditions (Obstacles, Timeframe, Resource Restraints, etc.)
- What Discussions Should a BCA Contain?
- Case Study Reprise
  - Visualizing the Project
  - Understanding who will be impacted by the Project
  - Conducting the Data Collection and Analysis
- Doing the Math…
  - Understanding and Calculating Present Value, Net Present Value, Discounts, and the Benefit-Cost Ratios
- Wrapping Everything Up with a Persuasive Bow
- Conclusion: So did we Win the MBTA Drawbridge Grant?
- Further Reading and Resources
What is a BCA?

According to the Federal Government in OMB Circular A-94…….
- A Benefit-Cost Analysis is “a systematic quantitative method of assessing the desirability of government projects or policies when it is important to take along view of future effects and a broad view of possible side-effects.”

According to US Department of Transportation through the TIGER Grants…….
- “A benefit-cost analysis measures the dollar value of the benefits and costs to all the members of society. The benefits, for example, are the dollar value of what all the people in society would be willing to pay to have the project built. If people would be willing to pay more than the project actually costs, then the project has positive net benefits (benefits minus costs).”

According to Heinzerling & Ackerman (2002) from the Georgetown Environmental Law and Policy Institute…
- “Cost-benefit analysis tries to mimic a basic function of markets by setting an economic standard for measuring the success of the government’s projects and programs. That is, cost-benefit analysis seeks to perform, for public policy, a calculation that markets perform for the private sector. In evaluating a proposed new initiative, how do we know if it is worth doing or not? The answer, it turns out, is much simpler in business than in government.”
My Take on What is a BCA?

- My Understanding of a BCA........
  - “The Benefit Cost Analysis looks at the prospective project from the standpoint of society as a whole, and accounts for the net benefits and net costs based on the criteria described in the Grant Notice of Funding Availability. The analysis seeks to answer the question, “Is society better off with the project or without the project?” The analysis addresses, at a minimum, travel time savings, operating and maintenance costs and savings, emission reduction, and economic development. Recognizing the overall benefit of the project, the analysis delivers a benefit-to-cost ratio for the project over a period of years (typically 30 years) and discounted to present value at the alternative rates of 3% and 7.”
Why is a BCA Important?

- Quantifies the overall benefits of a proposed project long before the “shovel hits the dirt.”
- Enables short-term and long-term views of the proposed project with regard to the impacts and benefits to the surrounding community.
- Allows a comprehensive understanding of why money should be allocated and spent on the project.
- Enables businesses and agencies to be forward-looking with regard to their long-term planning and revenue streams.
- Looks at the benefits along all avenues of economic growth and public/community interests surrounding the project.
Case Study

Massachusetts Bay Transportation Authority (MBTA) Annisquam Railroad Drawbridge Project

- MBTA Drawbridge Grant BCA
- Grant Project Conditions
MBTA Drawbridge Grant BCA

- Project to Replace an MBTA two-track drawbridge
- Existing drawbridge and tracks were deemed in structural disrepair
  - Replacement was inevitable
  - 2 years maximum left for operation assuming nothing went wrong
- Extremely expensive to Maintain in Current State
  - Monthly Routine Structural Inspections
  - Quarterly Major Structural Inspections
  - General cost of continuous repairs and “patches”
- Other Limitations and Restrictions from Current State
  - Limitations of train traffic due to structural problems and weight restrictions
  - Limitations of ridership travel
  - Much slower train speeds required for the current bridge
  - Public Safety factors
Grant BCA Conditions

- **Limited Resources**
  - I was responsible for the entire BCA
  - Pick the “brains” of two structural engineers/project managers from MBTA
  - Publicly accessible data and very limited internal data

- **Short Timeframe**
  - Ten days
  - MBTA was late to decide to pursue grant
  - Over two weekends – limited MBTA staff availability

- **Poor Understanding of the Scope of a Persuasive BCA**
  - MBTA staff assigned have not conducted a BCA before
  - No one understood what was really involved in a “winning” BCA
  - No one understood how competitive grants are (especially TIGER grants)

*More on this case study later……….**
What Discussions Should a BCA Contain?

- **Remember: it is about Benefits!**
  - To Society
  - To the Surrounding Community
  - To Economic Development
  - To Public Well-Being and/or Interest

- **Think in terms of project costs versus the array of project benefits**
  - Put your Marketing Hat on and **Sell, Sell, Sell**

- **Be Persuasive**
  - Accentuate the positives
  - Be realistic about the negatives
  - Quantify Everything
Some possible discussions can include:

1. **Discuss the Current Costs**
   - Realistic Short and Long-Term Project Costs
   - State of Good Repair of Current Infrastructure
   - Current and Future Maintenance and Operational Costs
   - Costs related to Missing Infrastructure / Facility / Park / Project Structure or Objective
   - Deepening Impacts and Needs of the Community (Monetized)
   - Current Impediments that Cost Money, Wastes Time, and Lessens the Public’s Interest or Value (Monetized)
2. Discuss what may happen if the Project is **Not** Funded
   - Public Safety Concerns
   - Environmental Concerns
   - Increased Pollution / Emissions
   - Increased Public / Community Needs without Resolution
   - Increased Maintenance and Operational Costs
   - Increased Public Travel Time and Nuisances
   - Increased Public Dissatisfaction
   - Loss of Revenue
   - Loss of Public Use or Interest
   - Loss of Tourism, Visitor Dollars, and Tax Revenue
   - Local Economic Downfall or Recession
   - Other Adverse Community Impacts (i.e., Property Value impacts)

*Think: How much will this “Non-Project” option cost over time!*
What Discussions Should a BCA Contain? (continued)

3. Discuss what will happen if the Project is Funded

*Think: Benefits and Savings!*

- Reduction of Public Safety Issues
- Reduction of Environmental Concerns, such as Pollution, Emissions, Greenhouse Gases
- Addressing the Public and Community Needs….Keeping the Public Happy!
- Saving Travel / Commuting Time
- Minimizing Maintenance and Operational Costs
- New Revenue Streams and Opportunities for Additional Capitalization
- Maximizing Public Use and Interest
- New Tourism opportunities, Increased Visitors, and More Tax Revenue
- Fueling the Local Economy through Economic Development
- Adding Jobs in the Area
- New Infrastructure and Parkland
- Other Positive Community Impacts (i.e., property value rise)

*Think: How much Money and how many Benefits will this “Project” option bring to the community over time!*
Case Study Reprise

Massachusetts Bay Transportation Authority (MBTA)
Annisquam Railroad Drawbridge Project

- Visualizing the Project
- Understanding Who will be Impacted by the Project
- Conducting Data Collection and Analysis
Visualizing the Project
Visualizing the Project
Visualizing the Project
Visualizing the Project

Case Study

PROPOSED TRACK RECONFIGURATION AT GLoucester Drawbridge
01-19-11
SYSTRA Consulting, Inc
Visualizing the Project

**Case Study**

**CONSTRUCTION STAGING**

**DUTCH-STYLE BASCULE BRIDGE**

**AERIAL VIEW**

**STAGE 1**
- **REMOVE SOUTH TRACK, HALF OF EXISTING TRUINIION, APPROACH, AND TIMBER TRESTLE**
- **REMOVE COUNTERWEIGHT**

**PLAN**

**STAGE 1**
- **MAINTAIN GLOUCESTER/ROCKPORT SERVICE ON NORTH TRACK**

**AERIAL VIEW**

**STAGE 2**
- **ERECT NEW STRUCTURE**

**PLAN**

**STAGE 2**
- **SHIFT TRACK 6'-6" SOUTH**
- **RETAINING WALLS & FILL**
- **SHIFT SERVICE TO NEW STRUCTURE AND REMOVE EXISTING NORTH TRACK STRUCTURES**
Understanding Who will be Impacted by the Project

- **MBTA Commuters to and from the Gloucester – Rockport Areas**
  - Faster moving Trains (no more speed restrictions over the spans)
  - More Trains per hour (use of two tracks at one time)

- **Sea Vessel accessibility to Gloucester**
  - Working Drawbridge

- **Surrounding Communities**
  - Lower Emissions, Better Air Quality
  - The “eye sore” infrastructure replaced by a More Attractive Infrastructure
  - Property Values

- **Local Tourism**
  - More Visitors; Better Tourism Opportunities
  - More Tourism Dollars

- **Local Businesses**
  - More Visitors, More Business
  - Better Commuting, More Business
  - Better Accessibility, More Business Opportunities
Conducting the Data Collection and Analysis

Ridership and Service Statistics
Thirteenth Edition
2010

Massachusetts Bay Transportation Authority

Emission Facts
Greenhouse Gas Emissions from a Typical Passenger Vehicle

The U.S. Environmental Protection Agency (EPA) developed this series of four fact sheets to facilitate consistency of assumptions and practices in the calculation and estimation of greenhouse gas (GHG) emissions from light-duty passenger vehicles and mobile sources. They are intended as a reference for anyone estimating emissions benefits of mobile source air pollution control programs.

Issue
Each EPA voluntary climate change program has used slightly different assumptions to translate the greenhouse gas (GHG) reductions associated with the program to the equivalent GHG emissions of a number of cars on the road. The result is that different numbers for the greenhouse gas emissions associated with a passenger vehicle have been used for different programs. The purpose of this fact sheet is to determine consistent assumptions and produce a number that is accepted for the annual GHG emissions associated with a passenger vehicle. The estimate calculated here is for vehicle emissions only, and does not include lifecycle emissions such as emissions associated with the production and distribution of fuel.

Corporate Average Fuel Economy for MY 2012-MY 2016
Passenger Cars and Light Trucks

Office of Regulatory Analysis and Evaluation
National Center for Statistics and Analysis
March 2010
Getting Accurate Data is Hard!

- Tracked Down Area Tourism Board Researchers for Area Visitor Data
- Worked with MBTA Staff to Acquire Latest Ridership Data
- Researched Websites, Library Collections, and Associations
- Tracked Down and Read Through Documentation from the US DOT, US EPA, MBTA, and Many Other Sources on:
  - Standard Costs for Idle Traffic Emissions
  - Costs of Accidents
  - Costs of Greenhouse Gas Emissions
  - CO2 Emission Reduction Costs
  - Typical Layover Facility Construction Costs
  - Local Tax Revenue, and
  - Other Ancillary Facts to help Quantify Costs and Benefits

- Learned the Value of Statistical Life
  - $6,200,000 per fatality (source: US DOT, 2011)
Doing the Math...

YOU SHOULD DO A COST-BENEFIT ANALYSIS.

THE COST OF DOING A COST-BENEFIT ANALYSIS...

...EXCEEDS THE BENEFIT.
Present Value (PV)
- After understanding the project costs, benefits, and total impacts to the community, you need to calculate the present value of the costs and benefits.
- What are the values for costs and benefits in the present-day market.

Present Discounted Value
- Typically 3% and 7% discounts throughout all yearly calculations.

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

- \(PV\) = Present discounted Value of a future payment from year \(t\)
- \(FV\) = Future Value of payment in year \(t\)
- \(i\) = Discount Rate applied
- \(t\) = Years in the future for payment (base year is \(t=0\))

Example: Say we will have an Emission Savings Benefit in 2020 of $34,580.00.
NPV in 2013 (for year 2020 benefits @ 3% Discount)
\[
NPV = \frac{34580.00}{(1.03)^7} = 28,116.70
\]
Net Present Value (NPV)

- The difference between the discounted present value of the Benefits and the discounted present value of the costs

\[
NPV = \text{Benefits}_{\text{PV}} - \text{Costs}_{\text{PV}}
\]

Benefit-Cost Ratios (BCR)

- The BCR is an indicator of the relationship between the PV of Total Benefits to the PV of Total Costs
- BCR is over the total forecast of the Analysis (typically 30 years)
- You will have a different BCR for No Discount, 3% Discount, and 7% Discount.

\[
\text{BCR} = \frac{\text{Total Benefits}_{\text{PV}}}{\text{Total Costs}_{\text{PV}}}
\]
### 3% Discount Calculation Sheet

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Construction Costs</th>
<th>Net Operations &amp; Maintenance Costs</th>
<th>Total Costs</th>
<th>Total Present Value</th>
<th>Frozen in Place</th>
<th>Retained Engineering</th>
<th>Retained Tourist &amp; Tax Revenues</th>
<th>Total Benefits</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>$74,650,000</td>
<td>$7,967,800</td>
<td>$82,617,800</td>
<td>$6,704,160,902</td>
<td>$6,731,160,902</td>
<td>$6,833,260,902</td>
<td>$6,915,360,902</td>
<td>$27,339,362</td>
<td>$2,693,362</td>
</tr>
<tr>
<td>2014</td>
<td>$78,400,000</td>
<td>$8,140,800</td>
<td>$86,540,800</td>
<td>$6,771,160,902</td>
<td>$6,808,160,902</td>
<td>$6,905,280,902</td>
<td>$6,984,380,902</td>
<td>$31,224,382</td>
<td>$2,753,382</td>
</tr>
<tr>
<td>2015</td>
<td>$82,450,000</td>
<td>$8,367,800</td>
<td>$90,817,800</td>
<td>$6,868,160,902</td>
<td>$6,885,160,902</td>
<td>$6,977,280,902</td>
<td>$7,064,380,902</td>
<td>$35,604,382</td>
<td>$2,840,382</td>
</tr>
<tr>
<td>2016</td>
<td>$86,800,000</td>
<td>$8,650,800</td>
<td>$95,450,800</td>
<td>$6,985,160,902</td>
<td>$6,962,160,902</td>
<td>$7,054,280,902</td>
<td>$7,143,380,902</td>
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<td>$2,940,382</td>
</tr>
</tbody>
</table>

### DISCOUNT SUMMARY

**3% Discount Rate**

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<td>$38.7</td>
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<td>Layover Facility Construction Savings</td>
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</tr>
<tr>
<td>Retained Tourist and Tax Revenue</td>
<td>$1,410.0</td>
</tr>
<tr>
<td>CO2 Emissions Reduction</td>
<td>$0.7</td>
</tr>
<tr>
<td><strong>TOTAL BENEFITS</strong></td>
<td><strong>$1,469.3</strong></td>
</tr>
</tbody>
</table>

**PV of Total Benefits** | **$581.1**

### 2% Discount Calculation Sheet

<table>
<thead>
<tr>
<th>Year</th>
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<th>Total Costs</th>
<th>Total Present Value</th>
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### COSTS

<table>
<thead>
<tr>
<th>Year</th>
<th>Operations &amp; Maintenance Costs</th>
<th>Total Present Value</th>
<th>PV of Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$17,800,000</td>
<td>$17,800,000</td>
<td>$17,800,000</td>
</tr>
<tr>
<td>2013</td>
<td>$19,200,000</td>
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<tr>
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<tr>
<td>2015</td>
<td>$20,928,000</td>
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</tr>
<tr>
<td>2016</td>
<td>$21,465,600</td>
<td>$21,465,600</td>
<td>$21,465,600</td>
</tr>
</tbody>
</table>

**TOTAL COSTS** | **$95,523,200**

**PV of Total Costs** | **$2,204,138**

### Net Present Value (NPV)

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Present Value (NPV)</th>
<th>Benefit Cost Ratio (BCR)</th>
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<tbody>
<tr>
<td>2012</td>
<td>$34.7</td>
<td>12.5</td>
<td>18.8</td>
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**Net Present Value (NPV)** | **$294.2**

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1. CO2 emissions calculations are based on the suggested technical methodologies for calculating the Social Cost of Carbon as recommended by the U.S. Department of Transportation's Office of the Secretary. 2.These DOT TCIGs are supported by the Integrated Research Initiative on Social Cost of Carbon, United States Government. Technical Support Document: Social Cost of Carbon for Federal Impact Analysis (Under Executive Order 13563) (February 2015). As recommended, the CO2 calculations use a 3% discount. A 2% discount applies to all other benefits presented.
Wrapping Everything Up with a Persuasive Bow

- Remember you are Selling the Project
- Be Realistic with Costs; Be Generous with Benefits
- Make it Obvious why the World Needs this Project Funded
- Show that it will have Long-Lasting Benefits
- Show that the Project will Make Money

- Scream out the Facts
  – But Keep your Opinions Silenced…unless you can validly quantify them.
Conclusion

- Understand the Project from Different Vantage Points
- State why the Project is a “MUST DO”
- Market the Project like you would Market a Product: Sell, Sell, Sell
- Be Realistic with Projections, Calculations, and Assumptions
- Don’t Underplay the Actual Project Costs
- Double-check all calculations
- Quantify everything, even human life!
- Remember the Benefit-Cost Analysis is only a part of the whole Grant Proposal!
So Did We Win the MBTA Drawbridge Grant?

NO!

- The BCA was an Important Part of the Grant Proposal
  BUT NOT THE ONLY PART
- I Know What I Did; I Don’t Know What MBTA Did
- Politics Got in the Way (i.e., Joplin, MO Tornado)
- Massachusetts got too much money in past years
- We were not competitive enough.
Further Reading and Resources

White House – OMB Circular A-94
http://www.whitehouse.gov/omb/circulars_a094#1

FEMA Benefit Cost Analysis Reference Guide
http://www.fema.gov/media-library/assets/documents/22970?id=4830

FEMA Benefit-Cost Analysis Tool
http://www.fema.gov/benefit-cost-analysis

TIIGER Benefit-Cost Analysis Resource Guide

Pricing the Priceless: Cost Benefit Analysis of Environmental Protection


Milan School Cost Benefit Analysis of Investment Projects (European)

San José State University, Department of Economics – An Introduction to Cost Benefit Analysis.
http://www.sjsu.edu/faculty/watkins/cba.htm
Available BCA Samples


Neponset River Greenway Corridor – Completion Project TIGER Application [http://www.env.state.ma.us/Neponset_River_Greenway_Corridor/Documents/NepCorApp.pdf](http://www.env.state.ma.us/Neponset_River_Greenway_Corridor/Documents/NepCorApp.pdf)


City of Hartford, CT – Hartford’s Intermodal Triangle Project TIGER IV Application [http://planning.hartford.gov/Oneplan/Transit%20Center/TIGER%20IV/Appendix.pdf](http://planning.hartford.gov/Oneplan/Transit%20Center/TIGER%20IV/Appendix.pdf)

Questions?

Stephen R. Galati, CGW, CP APMP
AGWA Field of Interest Chairperson - Homeland Security
AGWA Field of Interest Chairperson - Environment

P: 207.620.3874 | E: homelandsecurity@agwa.com
C: 207.485.1901 | E: environment@agwa.com

www.agwa.us
www.trcsolutions.com
## DISCOUNT SUMMARY

### 7% Discount Rate

<table>
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<tr>
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<th>Millions of 2012$</th>
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<tr>
<td>Operations &amp; Maintenance Costs</td>
<td>$17.6</td>
</tr>
<tr>
<td>Capital Costs</td>
<td>$41.9</td>
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<tr>
<td><strong>TOTAL COSTS</strong></td>
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<tr>
<td><strong>PV of Total Costs</strong></td>
<td><strong>$46.5</strong></td>
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</table>

- Net Present Value (NPV): $534.7
- Benefit-Cost Ratio (BCR): 12.5

### 3% Discount Rate

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<tr>
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<td>Layover Facility Construction Savings</td>
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<td>Retained Tourism and Tax Revenue</td>
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<td>CO₂ Emissions Reduction</td>
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<td><strong>TOTAL BENEFITS</strong></td>
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<tr>
<td><strong>PV of Total Benefits</strong></td>
<td><strong>$976.9</strong></td>
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- Net Present Value (NPV): $924.9
- Benefit-Cost Ratio (BCR): 18.8
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### 7% Discount Calculation Sheet

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### Notes

1. CO2 emissions calculations are based on the suggested technical methodologies for calculating the Social Cost of Carbon as recommended by the U.S. DOT’s TIGER Benefit-Cost Analysis (BCA) Resource Guide updated 2/1/2012. These US DOT suggestions are supported by the Interagency Working Group on Social Cost of Carbon, United States Government, Technical Support Document: Social Cost of carbon for Regulatory Impact Analysis Under Executive Order 12866 (February 2010). As recommended, the CO2 calculations use a 3% discount. A 7% discount applies to all other benefits presented herein.