Identifying Cost-Effective Interventions

Capturing and Analyzing Costs of Interventions
Summary of Presentation

1. Why is Cost Analysis Important
2. What Should Cost Data Look Like
3. Capturing Costs
4. Analyzing Costs
5. Questions?
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Three Key Applications

1. Identifying Good Investments

2. Opportunities for Savings

3. Informing Scale-up
1. Identifying Good Investments
Example: Primary School Investments in Northern Brazil

Which investment would you implement????

Invest in general package of “Hardware”

Impact on Portuguese score = 8.97

Cost per student = $16.06

Cost Effectiveness Ratio = $16.06/8.97 = $1.79 to raise score 1pt per child

Investment in writing materials

Impact on Portuguese score = 4.70

Cost per student = $1.76

Cost Effectiveness Ratio = $1.76/4.70 = $0.37 to raise score 1pt per child
Lessons

• Impact alone is incomplete

• Cost metrics help with “preference setting”

• Policy makers will ask: “IS THIS A GOOD DEAL??”
Types of Analysis

• Cost-effectiveness Analysis (The Cost Per Outcome Measure)
  
  Incremental Cost Effectiveness Ratio (CER) = C / E

  ex. .17 sd change in test scores for $2.33 cost per pupil.
  -CER = $2.33 / .17 / 10 = $1.37 per .1 sd change per student

• Cost-Benefit Analysis (Total Benefits vs. Total Costs)

\[
NPV = \sum_{t=0}^{n} \frac{B_t}{(1 + r)^t} - \sum_{t=0}^{n} \frac{C_t}{(1 + r)^t},
\]

• Cost Utility Analysis (Cost Per Multiple Outcome Measures):
  
  Cost / Quality Adjusted Life Years (QALY)
2. Opportunities for Savings
Hypothetical Teacher Training Program
What’s wrong here???

Cost Categories

- Supplies
- Equipment
- Frontline Personnel
- Management and Overhead
- Contracted services
- Curriculum development
Take a look at the expenditures
Which expenditure line is off???

<table>
<thead>
<tr>
<th>Input</th>
<th>Billing Code</th>
<th>Ingredient</th>
<th>Nature of Unit</th>
<th>Units</th>
<th>Price</th>
<th>Expenditure USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing Charges</td>
<td>GLC4912</td>
<td>Supplies</td>
<td>Pages</td>
<td>3225</td>
<td>$0.45</td>
<td>$1,451.25</td>
</tr>
<tr>
<td>Training booklets ordered</td>
<td>GLC2124</td>
<td>Supplies</td>
<td>Package</td>
<td>132</td>
<td>$30.00</td>
<td>$3,960.00</td>
</tr>
<tr>
<td>Lenovo T450 computers</td>
<td>GLC3321</td>
<td>Equipment</td>
<td>Purchases</td>
<td>15</td>
<td>$600.00</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>Rental Space</td>
<td>GLC3256</td>
<td>Training</td>
<td>Days</td>
<td>40</td>
<td>$500.00</td>
<td>$20,000.00</td>
</tr>
<tr>
<td>Cookies for participants</td>
<td>GLC9421</td>
<td>Supplies</td>
<td>Cookies</td>
<td>63241</td>
<td>$16.00</td>
<td>$1,011,856.00</td>
</tr>
<tr>
<td>Trainer salaries</td>
<td>GLC2000</td>
<td>Frontline - Personnel</td>
<td>Trainer/days</td>
<td>750</td>
<td>$150.00</td>
<td>$112,500.00</td>
</tr>
<tr>
<td>Projectors purchases</td>
<td>GLC5999</td>
<td>Equipment</td>
<td>Purchases</td>
<td>4</td>
<td>$300.00</td>
<td>$1,200.00</td>
</tr>
<tr>
<td>Program Manager Salary</td>
<td>GLC2100</td>
<td>Management</td>
<td>Salary days</td>
<td>90</td>
<td>$450.00</td>
<td>$40,500.00</td>
</tr>
<tr>
<td>Procurement manager</td>
<td>GLC2300</td>
<td>Management</td>
<td>Salary days</td>
<td>10</td>
<td>$250.00</td>
<td>$2,500.00</td>
</tr>
</tbody>
</table>
Real Example - Possum Control in New Zealand

**Problem:** Bait contributing the largest proportion of cost.

- **Cost Saving Solution:** Use carrots (cheaper)

**Problem:** Over-use of helicopters for sowing bait over small areas

- **Cost Saving Solution:** Use vans

**Problem:** Excessive Contractor costs. Some wasting 2 days on planning

- **Cost Saving Solution:** Get better contractors
3. Inform Scale-up
How Could this Parent Education Program Be Improved During Future Implementation?

**Insights:**

- Increase Scale → increased program efficiency
- Cheap opportunities for quality improvements

![Pie chart showing the distribution of costs and insights](chart.png)
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Disaggregate! Disaggregate! Disaggregate! Disaggregate!

A program’s budget and financial information must be disaggregated using the ingredients method if you want to gain insights from cost analysis.

You can also think of it as an investigation into the cost details of an intervention.
What CAN’T we do with aggregate or only partially disaggregated data?

- Cost different activities within the same program?
- Differentiate marginal costs from total program costs
- Achieve accuracy and precision
- Show how costs evolve over time
- Identify cost savings
- Conduct sensitivity analysis or help scale program
Aggregate / Poorly Disaggregated Data

What is this data missing?

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Project Personnel</td>
<td>$30,987</td>
</tr>
<tr>
<td>2. Travel</td>
<td>$6,145</td>
</tr>
<tr>
<td>3. Software registration</td>
<td>$5,500</td>
</tr>
<tr>
<td>4. In country staff</td>
<td>$19,141</td>
</tr>
<tr>
<td>5. Overhead</td>
<td>$21,776</td>
</tr>
<tr>
<td>6. Office Rent</td>
<td>$11,458</td>
</tr>
<tr>
<td>7. Data Collection</td>
<td>$450</td>
</tr>
<tr>
<td>8. Supplies</td>
<td>$3,485</td>
</tr>
<tr>
<td>9. Other Direct Costs</td>
<td>$9,529</td>
</tr>
</tbody>
</table>

| Total Direct Costs                | $108,471 |
| Overhead and Contingency          | $22,680  |

| Overhead - HQ                     | $12,505  |
| Overhead - Other Offices          | $10,175  |
| Total Costs                       | $142,813 |
The Ingredients Method

An Investigation that uncovers, quantifies and values all resources and efforts required to make an intervention happen

(counterfactual: what ingredients would still exist without the intervention vs. with the intervention)
The Ingredients Method

- **List All Inputs to the Program** (obtain from budgets, papers, interviews, expenditure reports, grant docs)

- **Tag inputs with ingredients:** Personnel, Equipment/capital goods, supplies, admin and overhead, etc.

- **Valuing ingredients:** quantities and prices, nature of unit cost.

- **Timeline**

- **Allocation Percentage** (obtain from interviews with project team, or regular reporting on time and effort data)

### Input / Activity

<table>
<thead>
<tr>
<th>Item category</th>
<th>Partial honorarium for 3-4 years intervention teachers (Gross)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of unit cost</td>
<td>Number of units 2016 2017</td>
</tr>
<tr>
<td>Teacher months</td>
<td>1040 1240</td>
</tr>
</tbody>
</table>

### Allocation to Intervention

<table>
<thead>
<tr>
<th>Allocation to Intervention 2016 2017</th>
<th>50% 50%</th>
</tr>
</thead>
</table>

### Table: Costing Input / Activity

<table>
<thead>
<tr>
<th>Costing Input / Activity</th>
<th>Nature of unit cost</th>
<th>Tracking necessary? (y/N)</th>
<th>Fixed / Lumpy / Variable</th>
<th>Data Source</th>
<th>Item category</th>
<th>Number of units 2016</th>
<th>Number of units 2017</th>
<th>Nominal unit price 2016</th>
<th>Nominal unit price 2017</th>
<th>Allocation to Intervention 2016 2017</th>
<th>Nominal estimated cost 2016 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial honorarium for 3-4 years intervention's teacher months</td>
<td>Monthly</td>
<td>Variable</td>
<td>SCI</td>
<td>Personnel - frontline/direct</td>
<td>1040</td>
<td>1240</td>
<td>1250</td>
<td>1250</td>
<td>50% 50%</td>
<td>650,000 775,000</td>
<td></td>
</tr>
</tbody>
</table>
Information Used for Disaggregated Costs

1. Log-frames (list of activities, outputs, outcomes)
2. Quantity and price data
3. Time and effort data
4. Budget and actuals data
5. Interviews with project staff
6. Observational data
Hypothetical: Through an interview with a project lead, you discover that a number of cars are being used by intervention staff. What data do you need on this input?

- How many cars are used?
- Were the cars purchased? Contracted? Already owned?
- How much do the car’s cost to maintain and use? Fuel?
- How much of the car’s use is allocated to your project?
- What are they used for? Fixed or variable cost?
- Was the car used in for an impact evaluation?
# Time and Effort Data

## Aggregate Salary (from budget)

<table>
<thead>
<tr>
<th>Budget Line</th>
<th>Schools</th>
<th>Personnel Cost Per School</th>
<th>Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Personnel</td>
<td>467</td>
<td>$5,643.00</td>
<td>$2,635,281.0</td>
</tr>
</tbody>
</table>

## Salaries Disaggregated

<table>
<thead>
<tr>
<th>Cost Ingredient</th>
<th>Price (Gross monthly Salary)</th>
<th>Quantity (number of personnel working on reading module)</th>
<th>Time (Months worked in which reading module implemented)</th>
<th>Effort (percent of hours spent on reading module during months implemented)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Teacher</td>
<td>$404.04</td>
<td>432</td>
<td>6.21</td>
<td>31%</td>
<td>$336,017.12</td>
</tr>
<tr>
<td>School Principals</td>
<td>$943.00</td>
<td>41</td>
<td>5.23</td>
<td>15%</td>
<td>$30,331.12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>$366,348.24</strong></td>
</tr>
</tbody>
</table>

*How do we get the data on Time and Effort? The below template is distributed to all headmasters*

## Time and Effort Collection Template (to be answered by school headmaster)

<table>
<thead>
<tr>
<th>Question</th>
<th>Time/Effort Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>During how many months in the last quarter was the reading module implemented</td>
<td></td>
</tr>
<tr>
<td>During the months it was taught, how many days per week was the reading module conducted</td>
<td></td>
</tr>
<tr>
<td>During the days it was taught, what percentage of work hours did teachers devote to the reading module</td>
<td></td>
</tr>
<tr>
<td>How many months did you personally have to monitor and supervise the reading module intervention</td>
<td></td>
</tr>
<tr>
<td>During the months that you monitored and supervised the reading module, what percentage of your time did you devote to the intervention</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Presentation

1. Why is Cost Analysis Important
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Four Steps

1. Take stock of budgets
   - Ascertain all relevant budget and financial material and discuss data sources with program team

2. Ex-Ante Analysis
   - Assess the state of all existing financial data about the project, and whether the structure of this data can answer all important questions about the cost structure of the program

3. Data Collection Plan
   - Determine what data needs to be collected in real-time to ensure accuracy of cost projection

4. Finalize Cost Estimate
   - Fill in cost model with final actual expenditure data, as well as time, effort, quantity and price data; Generate final unit cost estimates

Steps 1-3 have to happen before the intervention even starts!
1. Take Stock of Budgets
Getting Started

1. Get budget and logframe

2. Identify who to talk to about scope and use of each budget line

3. What activities = intervention
Some Questions to Ask the Project Team?

- Which orgs are funding and implementing?

- Evaluate program as a whole, or each component separately.

- What sources of data are available, and how are these sources organized and updated?

- Are there major funding sources or resources that do not need to be considered, such as construction costs?
2. Ex-Ante Analysis

Analytical investigation leading up to the ingredients method, and all conducted BEFORE the intervention
Why Ex-Ante?

- Most costing done after close of interventions (retrospective / ex-post analysis).

- Retrospective analysis is likely very inaccurate in many interventions. **Recall bias** + sources are hard to track down after intervention close.

![Figure 13: Expenditure Recall in Ghana](source: Adapted from Scott & Amenuvegbe 1990.)
What Are the Goals of Costing?

Let’s take a hypothetical ECD program with four components:

1. Pre-primary centers
2. School lunches program
3. Parent education program
4. Technical assistance to MoE
Some Possible Goals Could Include:

1. Determine marginal cost effectiveness of adding school lunches vs. parent education to existing ECD centers?

2. Compare cost-effectiveness of the full program with a private school initiative

3. Determine how cost-effective the program would be at scale.

4. Be able to project cost of implementing program in a different geographic location

5. Financial planning on a 3-10 year time horizon for the MoE.
Social Perspective?

- Social perspectives are usually adopted for economic evaluations (especially cost-benefit analyses) but may also be necessary in a cost-effectiveness study.

- “Imputed,” and “averted” costs are included in social costs.

- Do you include:
  a) Costs to beneficiary / opportunity costs of time contributions
  b) Volunteer time or in-kind donations
  c) Negative or positive externalities, spillover effects
  d) Institutional or organizational opportunity costs (resources that were diverted away from other funding sources as a result of the intervention)
  e) Transfer payments?
Calculating Yearly Societal Costs Example: CBA Analysis – Private School Voucher Lottery Program in Colombia

**YEARLY COSTS PER BENEFICIARY (+)**

- **Cost to beneficiary:** +$52 extra school fees relative to non-lottery winner
- **Cost to beneficiary:** +$41 reduced earnings due to extra time spent in school (.71 cents X 1.2 fewer hrs working X 48 weeks per year = $41)
- **Cost to government:** +$24 extra cost to government per beneficiary as relative to accommodating pupil in public school (due to voucher)

**YEARLY COST SAVINGS PER BENEFICIARY (-)**

- **Direct savings to beneficiary:** -$74 per beneficiary is the average value of the vouchers received as compared with non-lottery winners

**TOTAL YEARLY SOCIAL COST PER BENEFICIARY**

- $52 (school fees) + $41 (reduced earnings) + $24 (gov. cost) – $74 (vouchers) = **$43 per beneficiary per year in societal costs.**
How does a program’s marginal cost change when scaled?

- Curriculum development
- Textbooks for students
- Software license
- Cash transfers to beneficiaries
- Construction of new schools
- Investments in municipal institutions

- Fixed
- Variable
- Lumpy
What is the Scope of Analysis?

Be careful when there is significant variation in:

1. Service Delivery (different type or intensity of services provided)
2. Geographic analysis (i.e. program implemented differently across locations)
3. Administrative Analysis (different models for management)

Consider choosing between **Activity Based** costing and **Variant (geographic/population) Based** costing
3. Data Collection Plan

A monthly or quarterly data collection plan may be required based on what you discover in your ex-ante analysis.
**Example time and effort data collection plan for teachers**

**Problem:** unclear % of work hrs school staff put into a reading module being costed

- **Monthly Logs**
  - Teachers fill out monthly log estimating 1) number of days worked on reading module and 2) how many hours were typically spent on the reading module on days where it was taught.

- **School Report (Quarterly)**
  - Principals compile monthly logs in school-wide report
  - Principals record percent of their own time spent on managing reading module over the quarter
  - Principals record quarterly estimate of supplies and equipment used for reading module

- **HQ Report**
  - Finance staffer responsible for cost reporting compiles all principal reports into a master report on time and effort
  - Allocation percentages generated for the cost model based on master report
Regularly reporting data can allow cost experts, finance personnel, or research teams to generate expenditure analyses in real-time!

This can help project teams realize savings and make mid-intervention adjustments.
4. Finalize Cost Estimate
Finalize Cost Estimate

• Replicate the steps taken in the ex-ante analysis with the finalized actual expenditure data.

• Determine total cost for each relevant Intervention or Variant you are costing.

• Develop a final model that analyzes costs and breaks them down into categories.

• PUBLISH findings of cost-effectiveness.

When a project closes, you should already be able to estimate cost!
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Cost Sensitivities: Getting to a Transparent and Usable Analytical Model

- Discount rates
- Price fluctuations (or price differences across locations)
- Pilot and startup bias?
- Changing costs over time
- Does the “margin” change when the program is scaled
- Currency
  - PPP exchange rates vs. nominal exchange rates

Is the model detailed enough?!
Sensitivity Analysis Example

Cost-effectiveness: Sensitivity to exchange rates
(Additional years of education per $100 spent)

AFRICA
- Standard exchange rate
- PPP exchange rate
- Program achieves multiple outcomes

1. Information on returns to education for parents (Madagascar)
2. Deworming through primary schools (Kenya)
3. Free primary school uniforms (Kenya)
4. Merit scholarships for girls (Kenya)

Source: Dhaliwal, JPAL Presentation
References

• Dhaliwal, JPAL Presentation
• Iqbal Dhaliwal, Esther Duflo, Rachel Glennerster, Caitlin Tulloch, "Comparative Cost-Effectiveness Analysis to Inform Policy in Developing Countries: A General Framework with Applications for Education”, JPAL, 2012.
• McEwan, P. 2012. CEA of Education and Health in Developing Countries. Journal of Development Effectiveness
Questions