Reporting and Metrics

PCMC Meeting
Peter M. Radcliffe
Office of Planning and Analysis
December 10, 2009

University of Minnesota
Driven to Discover™
Introductions and Background

• Who is here?
• What sorts of projects are you working on?
• What information would help you?
Metrics for Projects and Initiatives

• Project performance
  – On time, on scope, on budget, etc.

• Project impact
  – Was this worth doing in the first place?
  – Have we made things better?

• Our focus will be exclusively on impact
Goals

1. Create an outline of a plan to measure the impact of your project, work, or initiative.
2. Devise a plan for positioning your project or initiative in the context of the University’s metrics and decision-making structures.
3. Choose data collection, analysis, and presentation approaches that match your goals and the attributes of your data.
Outline

1. Motivation
2. Institutional context
3. Data collection strategies
4. Measurement issues
5. Communication strategies

We will pause after each section to discuss how this might apply to your projects and answer questions, but please interrupt freely.
Outline

1. Motivation
   1. Why use data?
   2. What can and can’t it tell us?
2. Institutional context
3. Data collection strategies
4. Measurement issues
5. Communication strategies
How do we make good decisions?

Good decisions bring together...

• Evidence
  – What does reality look like?
  – How do the parts fit together?

• Context
  – How will stakeholders respond?
  – What resources are available?
  – What are our goals?
How do we make bad decisions?

• Evidence is wrong
  – Data is inaccurate
  – Model (understanding of what factors lead to what outcomes) is faulty

• Context is wrong
  – Local culture is different or changing
  – Resources are unavailable
  – Contrary to goals of organization
How can data help us?

• More comprehensive than our personal experience
• More recent than our personal experience
• Clearer representation of underlying trends
• Challenges us to examine our biases and assumptions
How should we use data at the U?

• It depends!
  – What topics?
  – Over what time period?
  – For what purpose?
  – Using what resources?
  – For what audience?
What should be measured?

• Efficiency
  – Same output for less time or money
• Productivity
  – More output from process
• Effectiveness
  – More impact on desired outcomes
• Satisfaction
  – Stakeholders happier with process
The bottom line

• Because the University is non-profit, it is often concerned about contribution to the mission more than cost

• As budgets become tighter, however, the importance of money has grown

• Always helps to be able to place a dollar figure on a decision – is this a $1,000 choice or a $1,000,000 choice?
Context matters

• Data never “speak for themselves”
• Data are part of a story
• They help make observations more concrete, more specific, more generalizable, and more easily translatable from one person to another
• Qualitative information can provide deeper context and more emotional response
The answer is... 6
The full answer is...

• Under our new process, we scored six on a seven-point satisfaction scale, where one is the lowest and seven is the highest level of satisfaction.
• Under our previous process, we never scored above 5.2.
• The new process is no more expensive or time-consuming.
• The average response for our peers on this measure is 5.1.
Compared to what?

• History
• Control group
• Peers
  – Other units at the UofM
  – Other institutions
  – Private industry
  – Professional standards
• Goals
Theoretical models

• To give your measures context, you need some kind of theory of the phenomena of interest.

• A simple working hypothesis is sufficient, unless your aim is to publish the results of your work in scholarly journals.

• Question is what leads to what?
Example of a simple model

• Big picture: Improve declaration of major process to improve graduation rates

• Working theory
  – Declaration of major process is cumbersome
  – Students avoid process, do not declare majors in a timely manner
  – Students do not get connected with their departments and disciplines early in their careers
  – Time is lost and poor curricular decisions are made
  – Graduation is slowed or student drops out
Discussion One

• For your projects, what are the specific, concrete goals?

• What is your working model for how your project influences the outcomes you care about?

• Is it direct, or is it mediated through other processes
Outline

1. Motivation

2. Institutional context
   2. Criteria for Academic Decision-Making
   3. Metrics Framework and Key Indicators

3. Data collection strategies

4. Measurement issues

5. Communication strategies
Future Financial Resources Task Force

1. Grow a larger and more diversified portfolio of resources
2. Grow tuition revenue while ensuring financial access for qualified students from families of modest financial means
3. Substantially increase administrative and academic efficiencies, reduce costs, and boost efficiency
4. Narrow the scope of the University’s mission to advance a distinctive constellation of excellence
5. Develop and execute long-term financial plans, along with budget and planning processes that advance the vision and discipline the setting of priorities
Criteria for decision-making

1. Centrality to mission
2. Quality, productivity, and impact
3. Uniqueness and comparative advantage
4. Enhancement of academic synergies
5. Demand and resources
6. Efficiency and effectiveness
7. Development and leveraging of resources

http://www1.umn.edu/systemwide/strategic_positioning/decision.html
University of Minnesota Metrics Framework

Principles – The University’s metrics framework must:

• Use measures that reflect essential mission and support activities and are relevant, valid, reliable, adaptable, parsimonious and clear
• Support University leadership in assessing progress and performance on agreed-upon goals, objectives, and strategies
• Support data-driven decision-making and assessment
• Be meaningful internally as a management tool for continuous improvement purposes and externally for accountability purposes
• Be responsive to the governing policies of the Board of Regents
Definition of Indicator

Indicators are:
- Observable
- Measurable
- Connected to policy decisions and accountability requirements
- Focused on outcomes wherever possible

Key indicators are all-University measures that assess our standing, performance and progress.

- **Strategic:** How is the University progressing on the strategies that forward its mission and are the right strategies being pursued?
- **Operational:** How well are our operations supporting the mission, strategies, and goals?

Collectively, these are the measures on which we are accountable to the Board of Regents, state and federal agencies, accreditors, associations and more.
Anchoring of Indicators

Indicators are drawn from measures that are anchored in:

- Board of Regents and University policy
- State and federal reporting requirements
- Accreditation standards
- Granting agency reporting requirements
- Inter-institutional agreements
- National and international comparison data

Example: The test scores of incoming students are reported to the federal government through the Integrated Postsecondary Education Data System (IPEDS), and to the Voluntary System of Accountability (VSA), an alliance of public universities.
VISION: Improve the Human Condition Through the Advancement of Knowledge

MISSION: Extraordinary Education • Breakthrough Research • Dynamic Public Engagement

GOAL: Become one of the Top Three Public Research Universities in the World

EXCEPTIONAL STUDENTS
Recruit, educate, challenge, and graduate outstanding students who become highly motivated lifelong learners, leaders, and global citizens.

EXCEPTIONAL FACULTY AND STAFF
Recruit, mentor, reward, and retain world-class faculty and staff who are innovative, energetic, and dedicated to the highest standards of excellence.

EXCEPTIONAL ORGANIZATION
Be responsible stewards of resources, focused on service, driven by performance, and known as the best among our peers.

EXCEPTIONAL INNOVATION
Inspire exploration of new ideas and breakthrough discoveries that address the critical problems and needs of the University, state, nation, and world.

FOUNDATION FOR SUCCESS: Foster Culture of Excellence • Cultivate International Learning
Advance Interdisciplinary Frontiers • Build Diverse Community • Generate Critical Resources • Account for Results

UNIVERSITY OF MINNESOTA

MAY 2006
The University’s mission and the pillars

• The University’s mission of education, research, and outreach & service roughly connect with the pillars of “Exceptional Students” and “Exceptional Innovation”

• The pillars of “Exceptional Faculty and Staff” and “Exceptional Organization” roughly correspond to the University’s capacity to deliver its mission
Goals: Mission and Capacity

**Mission**

- **Extraordinary Education** – Recruit, educate, challenge, and graduate outstanding students who become highly motivated lifelong learners, leaders, and global citizens.

- **Breakthrough Research** – Explore new ideas and breakthrough discoveries that address the critical problems and needs of the state, nation, and world.

- **Dynamic Outreach and Service** – Connect the University’s academic research and teaching as an engine of positive change for addressing society’s most complex challenges.

**Capacity**

- **World-Class Faculty and Staff** – Engage exceptional faculty and staff who are innovative, energetic, and dedicated to the highest standards of excellence.

- **Outstanding Organization** – Be responsible stewards of resources, focused on service, driven by performance, and known as the best among peers.

**Transforming the U Pillars**

- **Exceptional Students**
- **Exceptional Innovation**
- **Exceptional Faculty and Staff**
- **Exceptional Organization**
**Extraordinary Education** – Recruit, educate, challenge, and graduate outstanding students who become highly motivated lifelong learners, leaders, and global citizens.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Key Indicators</th>
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<tbody>
<tr>
<td>Recruit highly prepared students from diverse populations</td>
<td>Incoming student preparation</td>
</tr>
<tr>
<td>Challenge, educate and graduate students</td>
<td>Student diversity</td>
</tr>
<tr>
<td>Ensure affordable access for students of all backgrounds</td>
<td>Graduation and retention rates</td>
</tr>
<tr>
<td>Develop lifelong learners, leaders and global citizens</td>
<td>Placement of graduates</td>
</tr>
<tr>
<td></td>
<td>Student learning outcomes (in process)</td>
</tr>
<tr>
<td></td>
<td>Internal support for scholarships</td>
</tr>
<tr>
<td></td>
<td>Average net cost for students</td>
</tr>
<tr>
<td></td>
<td>Student engagement</td>
</tr>
<tr>
<td></td>
<td>Participation in study abroad and international experiences</td>
</tr>
<tr>
<td></td>
<td>Student development outcomes (in process)</td>
</tr>
</tbody>
</table>
Strategies and Key Indicators: Research

**Goal**

**Breakthrough Research** – Explore new ideas and breakthrough discoveries that address the critical problems and needs of the state, nation, and world.

**Strategies**

- Foster an environment of creativity that encourages evolution of dynamic fields of inquiry
- Develop innovative strategies to accelerate the efficient and effective transfer of knowledge for the public good

**Key Indicators**

- Highly cited research publications
- National academy members and other faculty awards
- Major research awards, research center awards and centers of excellence
- Research expenditures and competitive ranking
- Technology disclosures, licenses and startups
Strategies and Key Indicators: Outreach

**Dynamic Outreach and Service** – Connect the University’s academic research and teaching as an engine of positive change for addressing society’s most complex challenges.

**Goal**

- Promote and secure the advancement of the most challenged communities
- Build community partnerships that enhance the value and impact of the University’s research and teaching
- Be a knowledge, information, and human capital resource for the betterment of the state, nation, and world

**Key Indicators**

- Longitudinal changes in communities where the University is actively engaged (in development)
- Active partnerships and assessments of impact (in development)
- Faculty, staff, and student engagement and community service (in development)
## Strategies and Key Indicators: Faculty and Staff

**World-Class Faculty and Staff** – Engage exceptional faculty and staff who are innovative, energetic, and dedicated to the highest standards of excellence.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Key Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruit and place talented and diverse faculty and staff to best meet organizational needs</td>
<td>Quality of incoming faculty and staff</td>
</tr>
<tr>
<td>Mentor, develop, and train faculty and staff to optimize performance</td>
<td>Faculty and staff diversity</td>
</tr>
<tr>
<td>Recognize and reward outstanding faculty and staff</td>
<td>Supervisor and departmental support satisfaction</td>
</tr>
<tr>
<td>Engage and retain outstanding faculty and staff</td>
<td>Employee training and development index (in development)</td>
</tr>
</tbody>
</table>

- **Engage and retain outstanding faculty and staff**
  - Faculty and staff salary and total compensation
  - Faculty and staff awards and distinctions
  - Employee engagement index
  - Employee retention index
**Outstanding Organization** – Be responsible stewards of resources, focused on service, driven by performance, and known as the best among peers.

**Strategies**

1. Ensure the University’s financial strength
2. Be responsible stewards of resources
3. Promote performance, process improvement, and effective practice
4. Foster peer-leading research competitiveness, productivity, and impact
5. Ensure a safe and secure environment for the University community
6. Focus on quality service

**Key Indicators**

- Bond rating: resources and leverage; liquidity and operating cushion
- Private giving and endowment
- Carbon footprint
- Facilities Condition Needs Index (FCNI)
- External awards to units for performance, quality, and innovation (in development)
- Research proposals and awards
- Technology commercialization agreements
- Research space productivity
- Workplace injuries
- Crime and perceptions of safety
- Faculty and staff satisfaction with support services
Integrated Metrics Framework

University-Wide

U-Wide Goals

U-Wide Strategies

U-Wide Key Indicators

Unit-Level

Unit-Level Goals

Unit-Level Strategies

Unit-Level Measures
Example: OIT Balanced Scorecard

University-Wide

World-Class Faculty and Staff

Engage and retain exceptional faculty and staff

Employee Engagement Index (PULSE survey)

Unit-Level

Maximize staff member contributions through engagement, growth, and development

OIT Employee Engagement

OIT Climate Survey Results

OIT Pulse Responses
Example: Undergraduate Education

University-Wide

- Extraordinary Education
- Challenge, educate and graduate students
- Graduation and retention rates
- Student learning outcomes
- Placement of graduates

Unit-Level

- Challenge, educate and graduate students
- Undergraduate retention, graduation and outcomes
- First-year retention
- Second-, third- and fourth-year progress toward degree
- Four-year graduation rates
- Structure of degree program requirements
- Effective curricular scheduling
- Quality of instruction
Example: Undergraduate Education

Accountability Structure

Senior Vice President for Academic Affairs & Provost

Vice Provost & Dean of Undergraduate Education

- McNamara Academic Center for Student Athletes
- Access to Success (ATS)
- University Honors Program (UHP)

Deans

- College-based Student Services
- Departments
- Directors of Undergraduate Study
- Student Services
What does this mean for analysts and project leaders?

• Framework has been endorsed by Board of Regents and Executive Team
• Framework is being incorporated into presentations to the Board of Regents, with aim to provide coherence to the many presentations of data they see through the year
• Increased attention to alignment of measures
Cascading scorecards: making it local

• Existing strategic plans and measurement strategies unlikely to neatly align with framework
• Does NOT mean units should start over
• Framework may suggest a clean left-right hierarchy, but we know units and initiatives will map to many strategies
• Framework provides context, not control
The law of available data

• Many of the currently identified key indicators cannot currently be readily measured, collected, and reported

• Gaps between our desired measurements and our current capacities suggest future investments

• Want to avoid letting current data availability limit our thinking about the right way to assess progress
What could possibly go wrong?

Dogbert Consults:

- You need a dashboard application to track your key metrics.
- That way you’ll have more data to ignore when you make your decisions based on company politics.
- Will the data be accurate?
- Okay, let’s pretend that matters.
Discussion Two

• Taking the project goals you listed earlier, think about how the concepts connect or do not connect to the FFR strategies, criteria for decision-making, and/or metrics framework

• Mapping need not be one-to-one, nor does it have to be exhaustive – focus on the highest priority goals and the clearest fit
Outline

1. Motivation
2. Institutional context
3. **Data collection strategies**
   1. Passive data collection
   2. Active data collection
4. Measurement issues
5. Communication strategies
Data collection strategies

• Logging of activity
  – Automated
  – Manual

• Analysis of institutional records

• Surveys
“Passive” data collection

- Transactional systems allow recording of activity as it happens
- Measurement is therefore a byproduct of an existing process, rather than an additional process
- Records behavioral data, which is frequently more reliable and valid than self-report
User burden and sustainability

• Systems that require extensive manual tracking and data entry are hard to sustain
• Burdensome data collection reduces efficiency and productivity gains
• Asking users to enter data more than once generates anger and resistance
The standard solution

I just got our consultant's report. He's identified our biggest problem.

I recommend that we build a tracking database.

Would you like to hear what the problem is first?

We can put it on the network.

I hate to dwell on the negative.

We like databases.
Survey says...

Surveys are useful ways to solicit feedback. However, there are several challenges:

• Survey fatigue
• Recall, recency, and priming
• Demand characteristics
• Expertise deficits
• Wording and question structure
Discussion Three

• How would you design a data collection strategy for your project?
• Can you take advantage of existing systems?
• If you need to build new systems, how can you make those sustainable?
• From whom do you need data?
Outline

1. Motivation
2. Institutional context
3. Data collection strategies
4. Measurement issues
   1. Measurement theory
   2. Descriptive statistics
   3. Inferential statistics
5. Communication strategies
Fundamentals of Measurement

• Reliability – the ability of a measurement instrument to consistently return the same value when measuring the same quantity

• Validity – the ability of a measurement instrument to accurately represent the concept being measured
CONSISTENCY

It's only a virtue if you're not a screwup.
Levels of measurement

- Nominal – unordered categories
- Ordinal – ordered categories
- Interval – order and units
- Ratio – order, units, and a meaningful zero

Represent the quantity of information in your measure and determine what techniques are appropriate to analyze and communicate it.
Descriptive vs Inferential Statistics

• Descriptive statistics
  – Measures of central tendency and dispersion
  – Mode works at all levels of measurement
  – Medians require ordinal data
  – Means require interval data

• Inferential statistics
  – Isolating the impact of interventions
  – Techniques depend on level of measurement
Differences in Means

• T-tests for
  – Difference of means between groups
  – Paired difference (change scores)

• Analysis of Variance
  – Comparisons between means from multiple groups
Linear Models

• Output = Impact * Input + Error
• OLS regression:  \( y = a + bx \)
• Models depend on level of measurement of dependent variable
  – Nominal: Logit/probit or multinomial logit/probit
  – Ordinal: ordinal logit/probit
  – Interval/Ratio: OLS regression
  – Many, many, many other techniques for specific circumstances
Tools of the trade: Basic

- Data management
  - Excel
- Statistical analysis
  - Excel
- Graphical design
  - Excel
- Communications
  - Word, Excel
Tools of the trade: Advanced

• Data management
  – Access, SQL Server, Oracle, MySQL

• Statistical analysis
  – SPSS, SAS, Stata, JMP, R

• Graphical design
  – Adobe Creative Suite, Tableau

• Communication
  – Web applications, BI suites, Adobe Creative Suite
Discussion Four

• How would you devise instruments to capture the information you need?
• What kind of statements and comparisons do you want to be able to make?
• What is the nature of the information you are capturing? (e.g. opinions, task completion times, tasks accomplished)
Outline

1. Motivation
2. Institutional context
3. Data collection strategies
4. Measurement issues
5. Communication strategies
   1. Visual presentations of data
   2. Appropriately incorporating data into communications
Audience and purpose

• To whom do you need to communicate your results?
• What is their level of domain knowledge and statistical sophistication?
• What media will best reach that audience?
• What impact do you want to have on your audience? Funding support? Adoption of policy/process? Providing accountability?
Tables versus charts

• Tables excel at:
  – Presenting large amounts of data
  – Providing specific values

• Charts excel at:
  – Providing a quick overview
  – Making comparisons between a limited number of alternatives
Data tables

- Tables can display large quantities of data
- Allow quick, detailed comparisons between values
- Fewer challenges in reproduction by copiers
- Can be harder to see overall patterns

<table>
<thead>
<tr>
<th>Level of Satisfaction</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very satisfied</td>
<td>60</td>
<td>20.0%</td>
</tr>
<tr>
<td>Satisfied</td>
<td>105</td>
<td>35.0%</td>
</tr>
<tr>
<td>Neutral</td>
<td>75</td>
<td>25.0%</td>
</tr>
<tr>
<td>Dissatisfied</td>
<td>45</td>
<td>15.0%</td>
</tr>
<tr>
<td>Very dissatisfied</td>
<td>15</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>300</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Tables for statistical results

- In presenting results from statistical tests and models, should generally present coefficients, errors, test scores, and p-values.
- Often helpful to display tables of predicted values.

### OLS Regression of Time to Degree

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef</th>
<th>Std Error</th>
<th>T-score</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.54</td>
<td>0.45</td>
<td>4.70</td>
<td>.0000</td>
</tr>
<tr>
<td>ACT/SAT</td>
<td>0.62</td>
<td>0.25</td>
<td>2.48</td>
<td>.0050</td>
</tr>
<tr>
<td>HS Rank</td>
<td>0.84</td>
<td>0.21</td>
<td>4.00</td>
<td>.0001</td>
</tr>
<tr>
<td>Timely major</td>
<td>0.33</td>
<td>0.15</td>
<td>2.20</td>
<td>.0040</td>
</tr>
</tbody>
</table>

*Source: Completely made up*
Graphical presentations

• Pie charts
• Bar charts
• Line graphs
• Specialty graphs
Pie charts

- Most appropriate for nominal or ordinal data
- Work best with few data points
- Convey general proportions
- Labeling to provide more information impairs visual
- Frequently inferior to a simple table

**Service Satisfaction**

- Very satisfied: 20%
- Satisfied: 35%
- Neutral: 25%
- Dissatisfied: 15%
- Very dissatisfied: 5%
Bar charts

- Good for quick comparisons between groups
- Like line charts, can show change over time well
- Labeling can overwhelm display
- Can be difficult to reproduce in B&W
Line Chart

- Best for showing change over time
- Provides quick, easy summary of trends
- Scaling can present a significant challenge and potential for misrepresentation

![Graph: Line Chart showing service satisfaction over fiscal years FY06 to FY10. The blue line represents satisfied, and the red line represents dissatisfied. The percentage decreases from FY06 to FY10 for dissatisfied, while it increases for satisfied.]
It’s a gift to be simple
The color of clarity

• Color conveys meaning
  – Be sure the colors you use are consistent with your intended meaning, and look good together
  – Even if you produce a document in color, it is highly probable it will be reproduced in black and white
  – Books and training on color theory are available
Resources on visual presentations

• Edward Tufte
  – Political scientist and expert on the visual presentation of data
  – Regularly teaches seminars on visual presentations, and author of several books
    – [http://www.edwardtufte.com](http://www.edwardtufte.com)

• Stephen Few
  – Visual presentation consultant, author, teacher
Memos

• The “unit of decision” at the University of Minnesota
• Brevity is paramount, both in words and data
• Formula:
  1. What is the evidentiary question?
  2. What is the answer?
  3. What is the evidence?
Memo template

Dear decision-maker,

In response to your question about [topic], we have assembled the following information.

There are two important questions to examine regarding [topic]:
• Does [x] increase with [y]?
• How do we compare to our peers on [x]?

Our evidence suggests that:
• [x] does increase with [y]
• We are low compared to our peers with respect to [x]

To examine the relationship between [x] and [y] we followed the following procedure... (description, with data definitions, sources, and results)
Examining [source], we find that we rank [#] out of [#] among our peers on [x]

Sincerely, analyst
Discussion Five

- Who are the audiences for your results?
- What media will you use to communicate?
- What kinds of presentation forms would be most effective for communicating your results?
- What formats will your data support?
Thank you!
SMART Goals

• Specific
• Measureable
• Actionable
• Reasonable
• Time-bound