Non-Profit Operations Management

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My foray into non-profit operations

United Care Development Services, also know an UC (https://www.yousee.in), is a philanthropy exchange which provides a wider giving platform through the four donations for development ("*Chaar Daan, Chaar Dhaam*") initiative, which invites contributions in the form of

1. Volunteering (Shram Daan),
2. In kind donations (Vastu Daan),
3. Waste donations (Kachra Daan), and
4. Financial (*PostPay*) Donations (Dhan Daan).

UC's objective is to generate **Resources for Result** oriented social work, in the areas of Education, Health and Environment. The work at UC is almost entirely led by **dedicated volunteers**.

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The non-profit sector

- Significant portion of the world economy
  - Non-profit operating expenditure was worth about 2.2 trillion USD
  - Non-profit employment close to 6% of total labor force
- In India
  - The first ever sample survey of the size of the non-profit sector in India places the number of such organizations at 1.2 million
  - These groups involve as many as 19.2 million people, many of whom work on a voluntary basis
- Characteristics of typical non-profit organizations (NPOs)
  - Non-distribution constraint: Cannot distribute surplus from activities to board / founders
  - Provision of public goods: **Provide goods/services that benefit many individuals simultaneously**
  - Resource constrained
    - Major source of funds include government grants, fee for services, voluntary contributions by donors

What is non-profit operations management?

Feng and Shanthikumar. Not-for-profit Operations Management. 2016.

"Broadly, *non-profit operations management* refers to managing the process of product or service delivery that is not aiming toward (eventual) profitability but toward certain welfare, social, environmental, or culture values."

What's in it for operations management researchers?

Because non-profit operations covers a wide range of activities and concern a large number of products and services, each with some unique operational characteristics, operations management researchers can contribute along many important dimensions.

Though the non-profit sector is an extensively studied area in economics, sociology and political science, only recently have operations researchers began to pay considerable attentions to challenges faced by this sector.

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Two recent examples: Funding and Human Resources

Funding models for non-profit operations

Sripad Devalkar, Milind Sohoni, and Neha Sharma. 2017. "*Payment for Results: Funding non-profit operations*."

Increasing volunteering in the non-profit sector

Milind Sohoni, Sandeep Chitla, Arun Rout, and Aditya Mallya. 2018. "*How should a NPO increase volunteering commitment: Empirical evidence from Teach For India*."

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Analyzing funding models

Funding models for non-profit operations

Sripad Devalkar, Milind Sohoni, and Neha Sharma. 2017. "*Payment for Results: Funding non-profit operations*."

Traditional funding (TF) approach

- Ex-ante, upfront grant or funding to the NPO to implement projects
  - Tied to inputs and resources used by the NPO
- Challenges
  - NPO's efficiency is private information
    - Nonprofits' financial reports do not provide full information on efficiency (Kaplan and Grossman, HBR 2010, Privett and Erhun, MSOM 2011)
    - Financial ratio widely used by nonprofit analysts—administrative expenses divided by funds raised or disbursed - is misleading
    - Underinvestment in overheads – infrastructure, managerial capacity, training of staff – severely undermines NPOs' effectiveness (Nonprofit Overhead Cost Study)
  - Final outcome affected by factors beyond donor's or NPO's control
    - Exposes donor / grant giver to uncertainty

Payment-for-Results (PfR) approach

- Ex-post, based on actual benefits delivered by NPO
- Tied to output (benefit delivered) rather than inputs and resources used by the NPO

- Examples
  - Dept. for Intl. Development (DFID) - Using a "Payment by Results" approach to fund education results in Ethiopia
    - Maximum amount of £30 million to be awarded, depending on number of students completing lower secondary education
  - Educate Girls, a NPO in India – Using a "Pay by Results" program to provide new funds to expand services

- Challenges
  - NPOs are resource constrained and often do not have the funds needed to implement project
    - Discourages small NPOs from participating
  - Exposes NPOs to financial risk as uncertain outcomes make future payments risky
    - NPOs bid for PfR contracts only when proven methods exist for the project at hand
    - Negates the intention of PfR to focus on outcomes rather than inputs

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Making PfR work

Educate Girls Development Impact Bond (India) for £ 267,000

Children's Investment Fund Foundation (CIFF) is the outcome payer

Ultimate donor / Govt evaluates results and pays investors based on results achieved

Instiglio is the outcome evaluator

Financial / Social investors provide upfront funding to NPO

UBS Optimus Foundation is the social investor

NPO implements the project using the funds provided

Educate Girls is the NPO implementing the project

Illustration from http://www.payforsuccess.org/learn/basics/#what-is-pay-for-success

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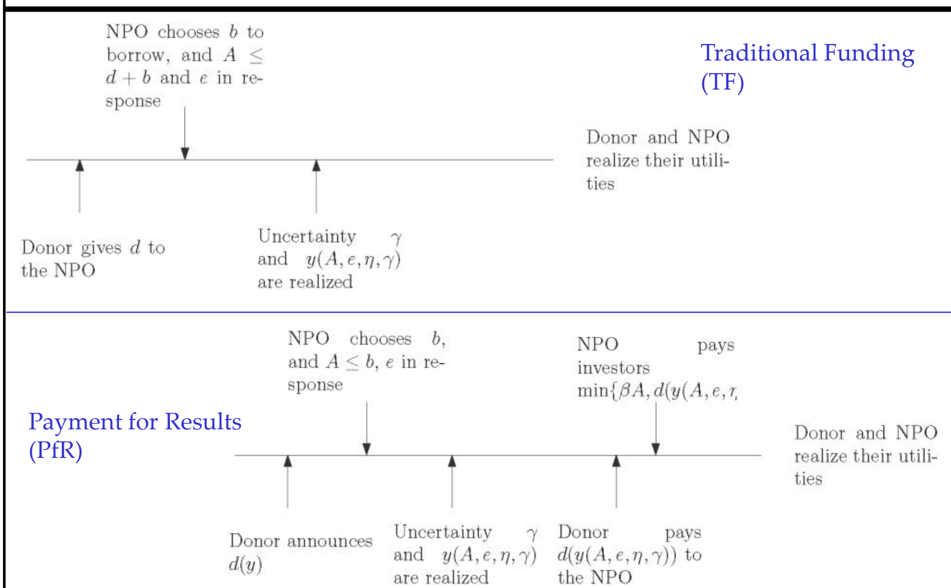
What is interesting about the PfR model?

The strategic interactions between the donor and the NPO under PfR as follows:

- Donor chooses target output level to be delivered and the ex-post contribution as a function of the benefit delivered
- The NPO chooses the amount of funds to borrow from social investors and the effort to exert to implement the project and achieve the desired outcome
- The outcome is subjected to an additional exogenous shock and determines the final benefit delivered by the project
- The donor pays the NPO an amount proportional to the benefit delivered or the total amount promised at the outset

Two funding models



Research questions

- How should the donor design a PfR contract?
- How should the NPO decide on funds to borrow and effort to exert?
- Under what conditions does PfR lead to higher expected utility for the donor compared to TF, and vice-versa?

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What do we find?

- Higher targets do not always lead to higher actual benefit
  - Targets need to be tailored according to NPO's cost of financing from social investors and project outcome uncertainty
- When comparing the performance of PfR and TF mechanisms, we find that
  - The donor has a higher expected utility under the PfR mechanism when the probability of a negative outcome shock is either high or low, and is better off using a TF approach otherwise.
  - On the other hand, when the donor's opportunity cost of funding the project is high, the donor is better off using a PfR mechanism when her belief about the NPO having low efficiency is sufficiently high.
- Our results suggest that donors need to be careful about selecting projects for which to tie funding to actual results

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What has been observed in practice?

Many of our theoretical results are corroborated by observations in practice suggesting a growing concerns about the efficacy of the PfR approach. To the best of our knowledge, this paper is amongst the first ones to provide a theoretical model and understand some of the shortcomings of the PfR mechanism.

H. Azemati, M. Belinsky, R. Gillette, J. Liebman, and A. Sellman. 2013.
Social Impact Bonds: Lessons learnt so far. *Community Development Investment Review:* 1: 23-33

Future research

- Hybrid funding, with part upfront grant and remaining tied to results
  - Will allow a larger number of NPOs to participate in PfR
- Competition amongst intermediaries/NPOs for funds
- Impact of capacity building (skill development) on enabling PfR
- Impact of PfR on process/service innovation

The Human Resources Problem

Increasing volunteering in the non-profit sector

Milind Sohoni, Sandeep Chitla, Arun Rout, and Aditya Mallya. 2018. *"How should a NPO increase volunteering commitment: Empirical evidence from Teach For India."*

Education challenges in India

- Millennium development goal: Universal primary education by 2015
- Right of children to free and compulsory education act, 2009
- 52% of grade 5 students could not read a grade 2 text
- 72% of grade 3 students could not do a 2-digit subtraction
- 86% failure rate in the central teacher eligibility test in 2016
- A crisis in leadership lies at the root of the crisis in education
- Deficit of committed people like teachers, school principals, visionary bureaucrats, politicians and policy makers

Teach For India (TFI) Fellowship model

- **Objective:** Train individuals to attain leadership positions in education system
- **Means:** Have the fellows serve as full time teachers for two years
- Allowance: Rs 19,000 ($250) per month
- Model: Full time volunteering
  - High opportunity cost
  - Candidates do not join for money
  - Not a career option

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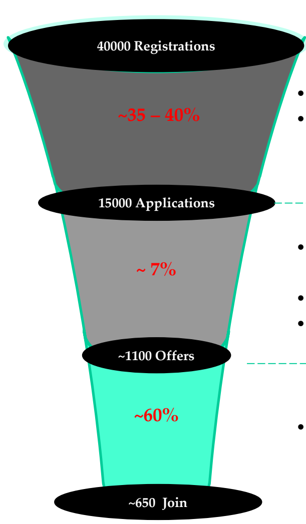
The recruitment, selection, and matriculation process



Recruitment

- Increase awareness by conducting outreach activities
- Provide application support to candidates

Selection

- Initial screening, telephonic interviews and assessment center
- Evaluate eight competencies
- Barriers that might hinder matriculation

Matriculation

- Institute and matriculation

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Matriculation events

- Experiential events
  - Classroom visits
  - Community visits
- Informative events
  - Application support meetings
  - Fellow and alumni meetings
  - Coffee chats

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Research questions

- How are candidate characteristics related to matriculation rate?
- Do events improve the probability of matriculation?
- How can we improve the yield of a cohort by optimally assigning candidates to events?

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Initial hypotheses

- **H1 (Gender)**: Matriculation rate is similar for male and female candidates
- **H2 (Age)**: Matriculation rate does not change with age
- **H3 (Employment)**: Matriculation rate is similar for employed and unemployed candidates
- **H4 (Human capital)**: Human capital doesn't effect matriculation rate
- **H5 (Education)**: Undergraduate major doesn't impact matriculation rate

Results from our logistic regression analysis

- **H1 (Gender):** Male and female candidates have similar matriculation rate
- **H2 (Age)**: Matriculation rate decreases as age increases
- **H3 (Employment):** Current employment status has no impact on matriculation
- **H4 (Human Capital)**: Higher the human capital, lower the matriculation rate
- **H5 (Education) :** Matriculation rate is higher for humanities graduates as compared to engineering graduates

But do matriculation events matter?

	Model 1	Model 2	Model 3	Model 4	Model 5
Info events before offer		0.77*** (-0.22)			0.45* (-0.23)
Info events after offer			1.75*** (-0.17)		1.62*** (-0.18)
Exp events				1.409*** (-0.194)	1.162*** (-0.201)
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1					

Experiential and Informative Events: Candidates who attended these events have higher matriculation rate

But how do you account for self-selection bias?

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Do matriculation events matter?

- **Self-Selection Bias**: If the candidates who attend the events have already decided to matriculate
- **Randomized Control Trial**: Practically infeasible
- **Observational Studies:** Replicate RCT using *matching*
- Causal Assumptions:
  - **Positivity:** Every candidate must have a chance to attend an event
  - **SUTVA:** Outcome of one candidate must be independent of event attendance of other candidates
  - **Ignorability:** Event attendance is independent of the decision to join the Fellowship

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Results of our observational studies

		Experiential events	Informative events after
Mahalanobis distance matching	Average treatment effect	0.263***	0.304***
	95% confidence interval	(0.180,0.347)	(0.239,0.368)
	No of treated units	220 (of 220)	316 (of 316)
	No of matches	220 (of 2765)	316 (of 2669)
	Xbalance (p-value)	0.998	0.999
Propensity score matching	Average treatment effect	0.217***	0.321***
	95% confidence interval	(0.130,0.304)	(0.255,0.388)
	No of treated units	207 (of 220)	305 (of 316)
	No of matches	207 (of 2765)	305 (of 2669)
	Xbalance (p-value)	0.994	0.929
Coarse exact matching	Average treatment effect	0.223***	0.292***
	95% confidence interval	(0.114,0.332)	(0.216,0.381)
	No of treated units	98 (of 220)	154 (of 316)
	No of matches	211 (of 2765)	283 (of 2669)

Robustness of our "strong association" (causality)

We match the candidates across all the variables that are significant in predicting the probability of matriculation and also the probability of attending an event. Although there is a possibility of unmeasured confounding, due to which the inference could be biased, we address this issue by performing ***sensitivity analysis*** on the study. A detailed description of the sensitivity analysis can be found in Rosenbaum, 2016.

Paul R. Rosenbaum. 2015. Two R packages for sensitivity analysis in observational studies. *Observational Studies.* 1(1) 1-17.

A data-driven optimization model to assign events

- Our finding that events increase the chance of matriculation significantly leads to setting up a natural optimization problem that maximizes matriculation "yield"
- First, we estimate the propensity (probability estimates) of attending an event for each offered candidate. Then, we solve, iteratively, a constrained assignment problem after each application round

maximize	Expected matriculation yield,
by	Deciding which events to offer (after an application round) and which candidates to invite (including ones from previous rounds)
subject to	Capacity and budgetary constraints.

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Our initial computational results

Using a simulation study we demonstrate an increase up to 7% in matriculation yield for 2017 and 2018.

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Future research

First, TFI, is now considering piloting a project to operationalize some of our findings.

Second, TFI will continue to work with us to understand participant attrition during the two years of the Fellowship program.

So, what can OM researchers think about?

There still are several unexplored questions. Particularly in India!

OM/OR for developmental studies

- Feng and Shanthikumar (2016) list several areas in their survey article, some these areas include
  - Resource allocation,
  - Funding models,
  - Innovation and entrepreneurship,
  - Product and service design

- Naval Research Logistics (NRL) has an upcoming special issue: **OR models for Developmental Studies**
  - Sridhar Seshadri and I are co-editing it
  - Please consider submitting any of your relevant work to this issue

Thank you

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