

# Transportation Research for Social Impact in a Changing World

Karen Smilowitz  
Northwestern University



TRISTAN Okinawa 2025  
June 2025

[www.redcross.org](http://www.redcross.org)

Northwestern

## *Today's discussion*

Can we create social impact through our work?

How has this work changed over time?

Initiatives at *Transportation Science* to promote this work

Some parting advice for junior researchers

## *Can we create social impact through our work?*

Adventures in policy modeling! Operations research in the community and beyond<sup>☆</sup>

Edward H. Kaplan<sup>a, b, c, \*</sup>

“The art of modeling serves to tease out the *implications of various conjectures or hypotheses*, and *suggests what variables could be key, what data should be collected*, and perhaps even *how a solution can be implemented* by focusing attention on *decisions that must be made* and *their operational consequences*.”

“. . .operations research, through its insistence on precise definition and quantification, limits itself to handling only ‘second rate’ problems”

*“Quibbling over which approaches can and cannot be employed pales in my view to actually setting out to do the work.”*

# Disasters, broadly defined

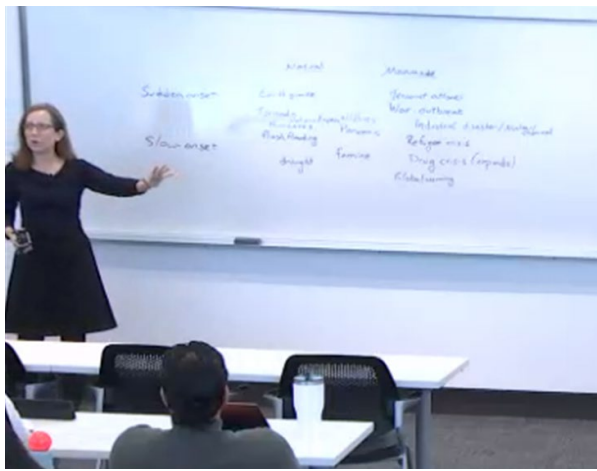
Blackett Memorial Lecture<sup>†</sup>  
Humanitarian aid logistics: supply chain  
management in high gear

LN Van Wassenhove\*

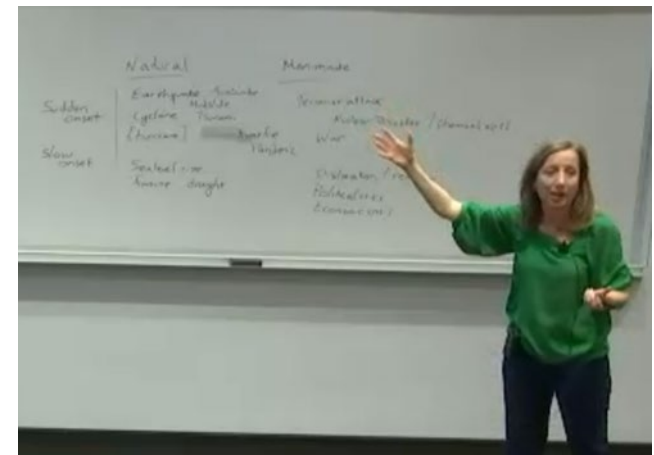
*INSEAD, Fontainebleau, France*

|              | Natural | Man-made |
|--------------|---------|----------|
| Sudden-onset |         |          |
| Slow-onset   |         |          |

Recreation of Figure 1 from Van Wassenhove "Humanitarian aid logistics: supply chain management in high gear."  
Journal of the Operational research Society (2006)

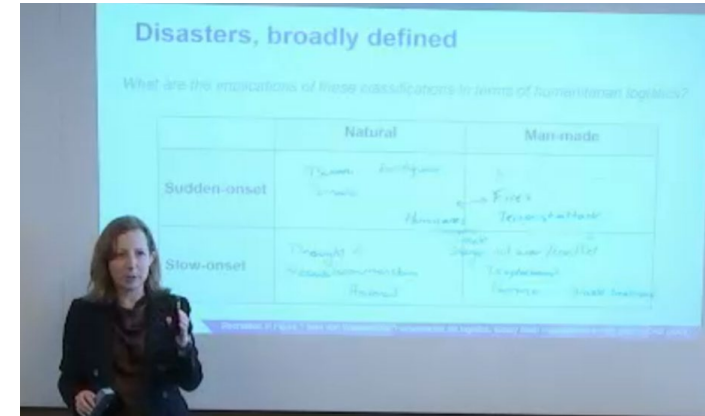


Over time, the examples in each cell have grown and the demarcation between cells has become blurred



|              | Natural                              | Man-made                                         |
|--------------|--------------------------------------|--------------------------------------------------|
| Sudden-onset | Earthquake<br>Tornadoes<br>Hurricane | Terrorist attack<br>Coup d-Etat<br>Chemical leak |
| Slow-onset   | Drought<br>Famine<br>Poverty         | Political crisis<br>Refugee crisis               |

Recreation of Figure 1 from Van Wassenhove (2006)



# Challenges of humanitarian logistics

**Timely distribution** of essential supplies is crucial; urgency dependent on the situation

**Efficient and equitable** distribution is important

**Significant uncertainty** exists in almost every aspect

**Multiple players in relief operations** can create collaboration challenges

**Limited information & technological support** dependent on many factors

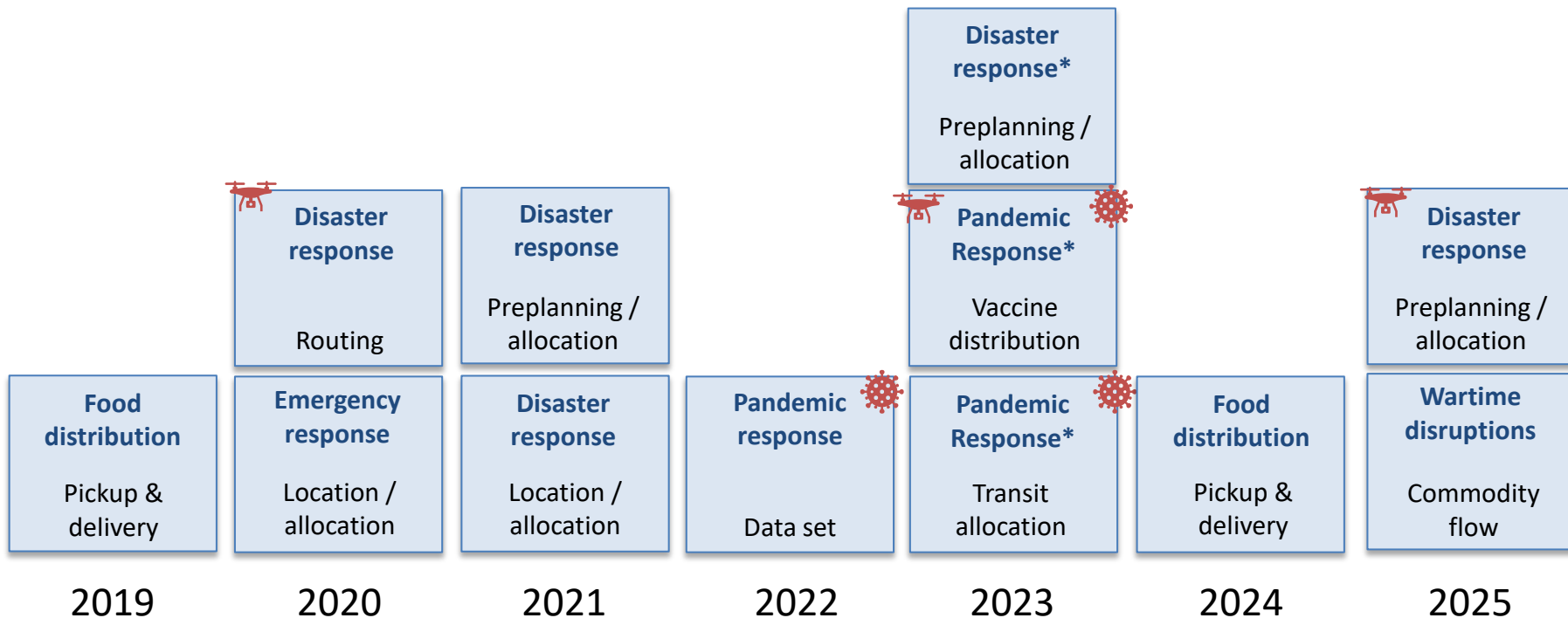
**Layering of disasters** as frequency and magnitude of crises increase

*What are the implications of the categories?*

|              | Natural                              | Man-made                                          |
|--------------|--------------------------------------|---------------------------------------------------|
| Sudden-onset | Earthquake<br>Tornadoes<br>Hurricane | Terrorist attack<br>Coups d'Etat<br>Chemical leak |
| Slow-onset   | Drought<br>Famine<br>Poverty         | Political crisis<br>Refugee crisis                |

Recreation of Figure 1 from Van Wassenhove (2006)

# Research progress through articles in *Transportation Science*



\*Special Issue on  
Emerging Topics

# Pre-positioning and distribution network design

**Timely distribution** of essential supplies is crucial;  
urgency dependent on the situation

**Efficient and equitable** distribution is important

**Significant uncertainty** exists in almost every aspect

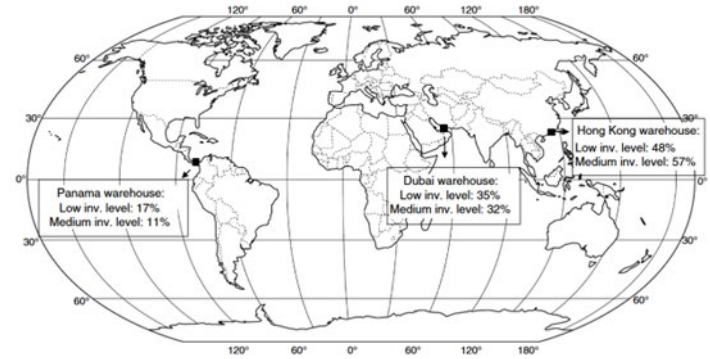


Figure 3: The map shows optimal locations and inventory allocations for three pre-positioning warehouses with low or medium inventory.

Duran, Gutierrez, and Keskinocak (2011)

Georgia Tech & CARE International collaboration developing a pre-positioning model to determine network configuration

- Showed how OR models can be used in practice
- Spurred decades of research in pre-positioning

Interfaces

Vol. 41, No. 3, May-June 2011, pp. 223-237  
ISSN 0092-2102 | EISSN 1526-551X | 11 | 4103 | 0223

informs

doi:10.1287/inte.1100.0526  
© 2011 INFORMS

## Pre-Positioning of Emergency Items for CARE International

Serhan Duran

Department of Industrial Engineering, Middle East Technical University, Ankara, Turkey, sduran@ie.metu.edu.tr

Marco A. Gutierrez, Pinar Keskinocak

H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332 [marco.gutierrez@gatech.edu, pinar@isye.gatech.edu]

# Evolution in preplanning for disasters and local emergencies

  
<http://pubsonline.informs.org/journal/trsc>

TRANSPORTATION SCIENCE  
Vol. 54, No. 6, November–December 2020, pp. 1471–1494  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

## Probabilistic Envelope Constrained Multiperiod Stochastic Emergency Medical Services Location Model and Decomposition Scheme

Chun Peng,<sup>a,b</sup> Erick Delage,<sup>a</sup> Jinlin Li<sup>b</sup>

  
<http://pubsonline.informs.org/journal/trsc>

TRANSPORTATION SCIENCE  
Vol. 55, No. 2, March–April 2021, pp. 275–296  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

- Repeated events (local emergency services)
- **Stochastic programming** approach to position emergency vehicles

## A Stochastic Programming Approach for Locating and Dispatching Two Types of Ambulances

Soovin Yoon,<sup>a</sup> Laura A. Albert,<sup>b</sup> Veronica M. White<sup>c</sup>

  
<http://pubsonline.informs.org/journal/trsc>

TRANSPORTATION SCIENCE  
Vol. 55, No. 3, May–June 2021, pp. 791–813  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

- Events with some warning (hurricanes, flood)
- **Robust optimization** approach to determine centralized supply location and inventory

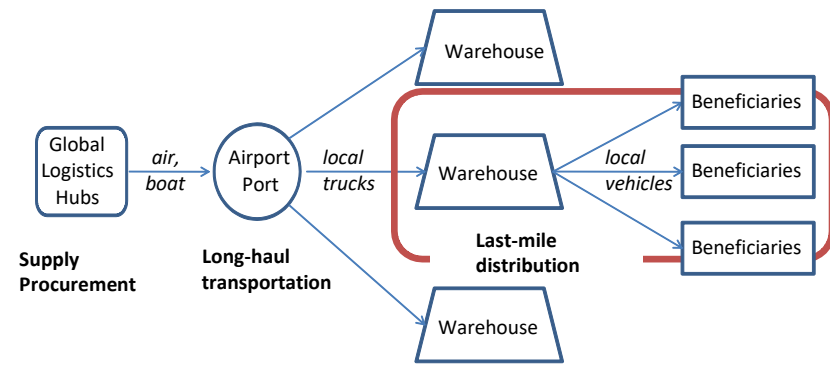
## Robust Emergency Relief Supply Planning for Foreseen Disasters Under Evacuation-Side Uncertainty

Jyotirmoy Dalal,<sup>a</sup> Halit Üster<sup>b,\*</sup>

# Last-mile distribution

**Timely distribution** of essential supplies is crucial; urgency dependent on the situation

**Efficient and equitable** distribution is important



Balcik, Beamon, and Smilowitz (2008)

Knott R. (1987). The logistics of bulk relief supplies. *Disasters*

- Linear programming approach to last mile delivery of food supplies
- Acknowledges the challenges of handling contingencies for insufficient supply and concludes that the problem is too complex for classical operations research models and solution techniques

Our work expanded to relief items with needs that vary over time

- Consideration of equity and urgency

# Evolution in distribution for disaster relief



TRANSPORTATION SCIENCE  
Vol. 59, No. 2, March–April 2025, pp. 360–390  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

## The Stochastic Dynamic Postdisaster Inventory Allocation Problem with Trucks and UAVs

R. M. van Steenbergen,<sup>a,\*</sup> W. J. A. van Heeswijk,<sup>a</sup> M. R. K. Mes<sup>a</sup>

- Explore the potential use of cargo UAVs, considering transportation and deprivation costs
- **Stochastic dynamic allocation**

- Uncertainty in travel times with information revealed over time
- **Adjustable robust optimization** approach



TRANSPORTATION SCIENCE  
Vol. 57, No. 4, July–August 2023, pp. 1096–1114  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

## Humanitarian Relief Distribution Problem: An Adjustable Robust Optimization Approach

Farzad Avishan,<sup>a</sup> Milad Elyasi,<sup>a,b</sup> İhsan Yanıkoğlu,<sup>a,\*</sup> Ali Ekici,<sup>a</sup> O. Örsan Özener<sup>a</sup>

# Efficient and equitable distribution

## Routing for Relief Efforts

Ann Melissa Campbell

Department of Management Sciences, University of Iowa, Iowa City, Iowa 52242,  
ann-campbell@uiowa.edu

Dieter Vandenbussche

Axioma, Inc., Atlanta, Georgia 30350, dvandenbussche@axiomainc.com

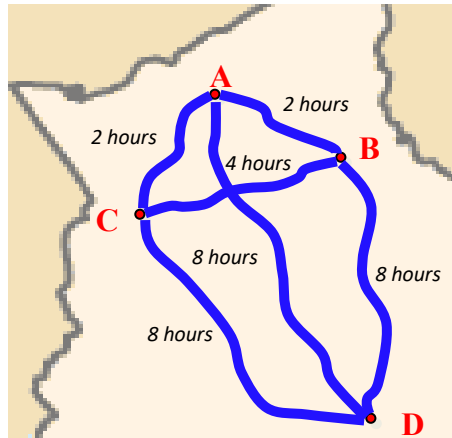
William Hermann

Mechanical and Industrial Engineering, University of Illinois, Urbana, Illinois 61801,  
hermann2@uiuc.edu

**Task:** Deliver supplies from depot at A to beneficiaries at B, C and D starting at midnight

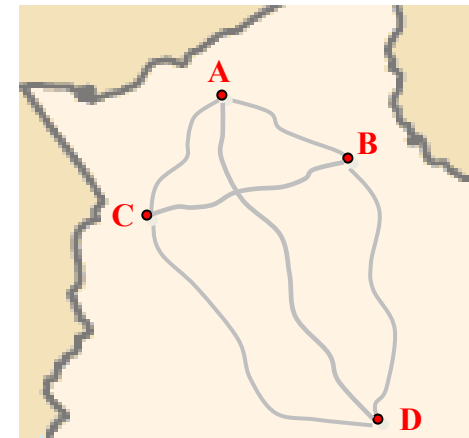
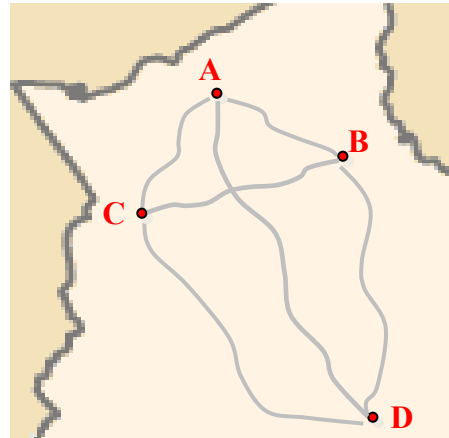
**Efficient  
objective**

*Best use of  
resources*



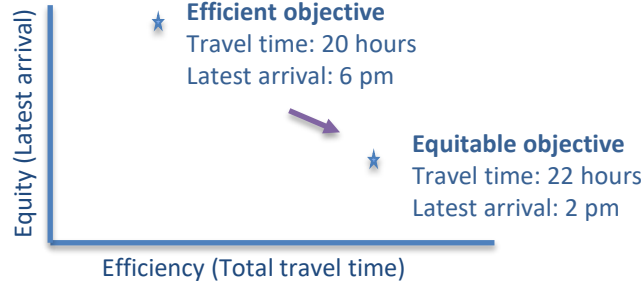
**Equitable  
objective**

*Fair use of  
resources*



Adapted from Campbell, Vandenbussche, Hermann, "Routing For Relief Efforts". *Trans. Sci.* (2008).

# Exploration of trade-offs



## Routing for Relief Efforts

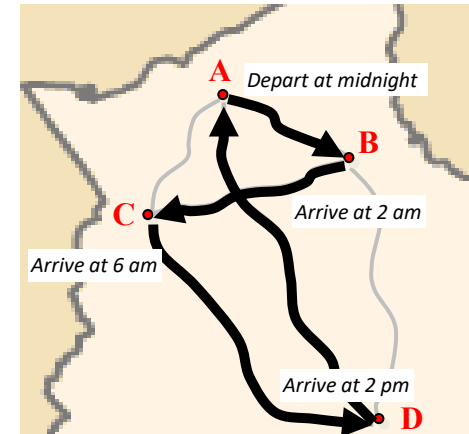
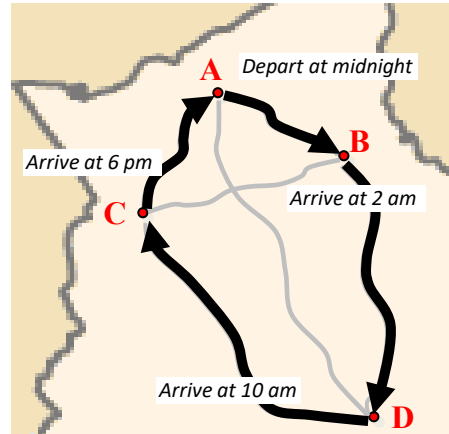
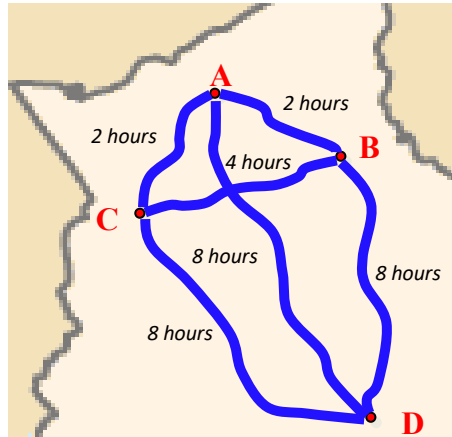
Ann Melissa Campbell  
Department of Management Sciences, University of Iowa, Iowa City, Iowa 52242,  
ann-campbell@uiowa.edu  
Dieter Vandenbussche  
Axioma, Inc., Atlanta, Georgia 30350, dvandenbussche@axiomainc.com  
William Hermann  
Mechanical and Industrial Engineering, University of Illinois, Urbana, Illinois 61801,  
hermann2@uiuc.edu

**Efficient  
objective**

*Minimize  
travel time*

**Equitable  
objective**

*Minimize  
last arrival*



Adapted from Campbell, Vandenbussche, Hermann, "Routing For Relief Efforts". *Trans. Sci.* (2008).

# Equity and efficiency in food distribution



TRANSPORTATION SCIENCE  
Vol. 53, No. 5, September–October 2019, pp. 1389–1408  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

**A Segment-Based Formulation and a Matheuristic for the Humanitarian Pickup and Distribution Problem**

- Pickup & delivery setting
- **Segment-based approach** to balance equity and efficiency

- **Stochastic dynamic routing and resource allocation** to balance equity and efficiency



TRANSPORTATION SCIENCE  
Vol. 58, No. 4, July–August 2024, pp. 821–840  
ISSN 0041-1655 (print), ISSN 1526-5447 (online)

**The Dynamic Pickup and Allocation with Fairness Problem**

Gal Neria,<sup>a</sup> Michal Tzur<sup>a,\*</sup>

# Development of coordination tools

**Multiple players in relief operations** can create collaboration challenges

- Relief players often include UN agencies, international and local NGOs, IFRC, governments of the affected region and military
- Organizations have different logistics capability, size, authority, organizational structure, political position and level of experience, all of which are potential obstacles for collaboration

2001 India earthquake, over 300 agencies

2004 Asian Tsunami, over 40 countries and 700 NGOs

2010 earthquake in Haiti, over 2,000 agencies

“Dozens or even hundreds of groups swarm into disaster zones, tripping over one another, duplicating efforts, and competing for trucks, fuel, and food.”  
- Wired 2010

# Development of coordination tools

**Multiple players in relief operations** can create collaboration challenges

**Limited information & technological support** dependent on many factors



*Photos from Dr. Jennifer Chan, Feinberg School of Medicine  
Names removed and images blurred for privacy*

## Somali crisis

Telephone & radio-based communication methods

## Kosovo crisis

Mobile satellite communication systems, the Internet, and geographical data tools (GIS and GPS)

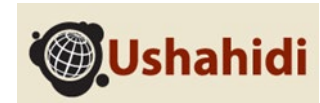
## Haiti earthquake

Free wireless access from telecom carriers

Crowd-sourced data available through Google Crisis Response, CrisisCommons, Crisis Mappers; Ushahidi

## Japan earthquake & tsunami

Availability of in-country technology



1992-1993

1998-9

2010

2011

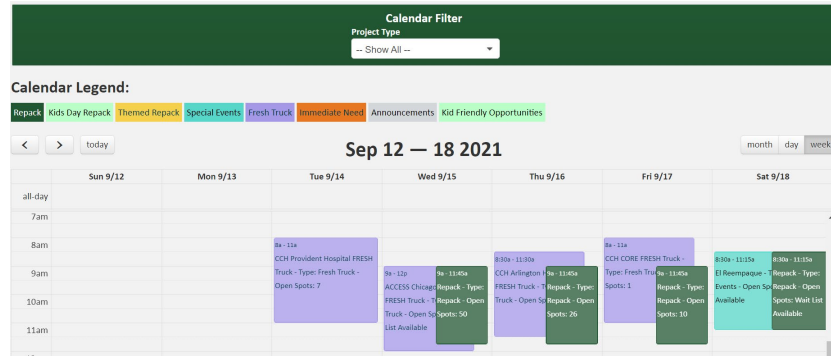
# New ways to coordinate volunteers with online platforms

Find Volunteer Opportunities Organizations

Search by City or Zip Code:  Opportunity Type:   Cause Areas:  Skills:  More Filters:  COVID-19:  Search by Keyword:

CLEAR ALL FILTERS

<https://www.volunteermatch.org/search>



<https://www.chicagosfoodbank.org/>

Mobilize

deedmob

MealConnect™

VolunteerMatch

# Dynamic staffing levels and active notifications



OPERATIONS RESEARCH  
Vol. 67, No. 2, March–April 2019, pp. 295–314  
ISSN 0030-364X (print), ISSN 1526-5463 (online)

## Dynamic Volunteer Staffing in Multicrop Gleaning Operations

Barış Ata,<sup>a</sup> Deishin Lee,<sup>b</sup> Erkut Sönmez<sup>c</sup>

- **Dynamic models** to notify volunteers when needed
- “...To encourage volunteers to complete a task, platforms use nudging mechanisms to notify a subset of volunteers ...excessive notifications may reduce volunteer engagement”

- **Dynamic models** to adjust staffing needs
- “...build some safety capacity in the requested staffing level... downside to this is that there may be excess volunteers on an early trip and not enough volunteers for a later trip.”



MANAGEMENT SCIENCE  
Articles in Advance, pp. 1–19  
ISSN 0025-1909 (print), ISSN 1526-5501 (online)

## Online Policies for Efficient Volunteer Crowdsourcing

Vahideh Manshadi,<sup>a</sup> Scott Rodilitz<sup>b</sup>

# Encouraging commitment to tasks and guiding volunteer choices

## Commitment on Volunteer Crowdsourcing Platforms: Implications for Growth and Engagement

Irene Lo,<sup>a</sup> Vahideh Manshadi,<sup>b,\*</sup> Scott Rodilitz,<sup>c</sup> Ali Shameli<sup>d</sup>

- Increase schedule coverage by guide volunteers to time slots
- Need to model how volunteers will react to a reduction in the time slots

- Given recurring tasks (donations to be delivered),
- Volunteers can either  
**Claim:** one-time task completion  
**Adopt:** commit to recurring task completion



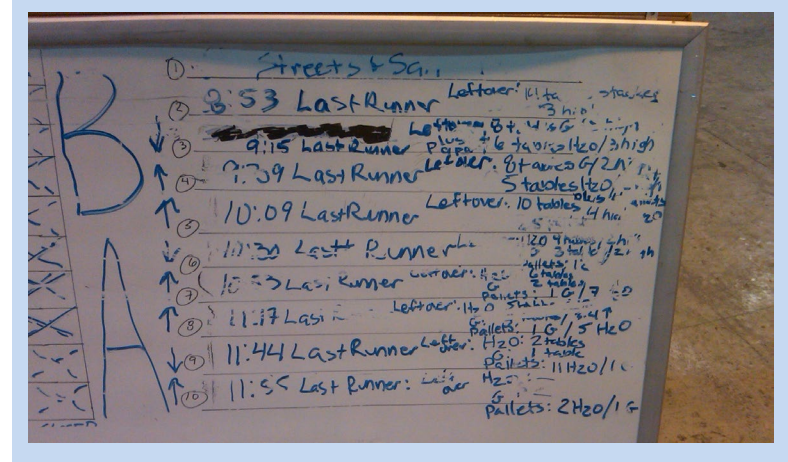
# The prior platform examples are based on repeated interactions, How do we think about larger disaster?

*“... only those individuals directly involved [in disaster response] are familiar with the intricate details of the operations. In our view this represents a major obstacle to the development of relevant analytical models, since **it is not possible to develop accurate models of a system that is poorly understood.**”*

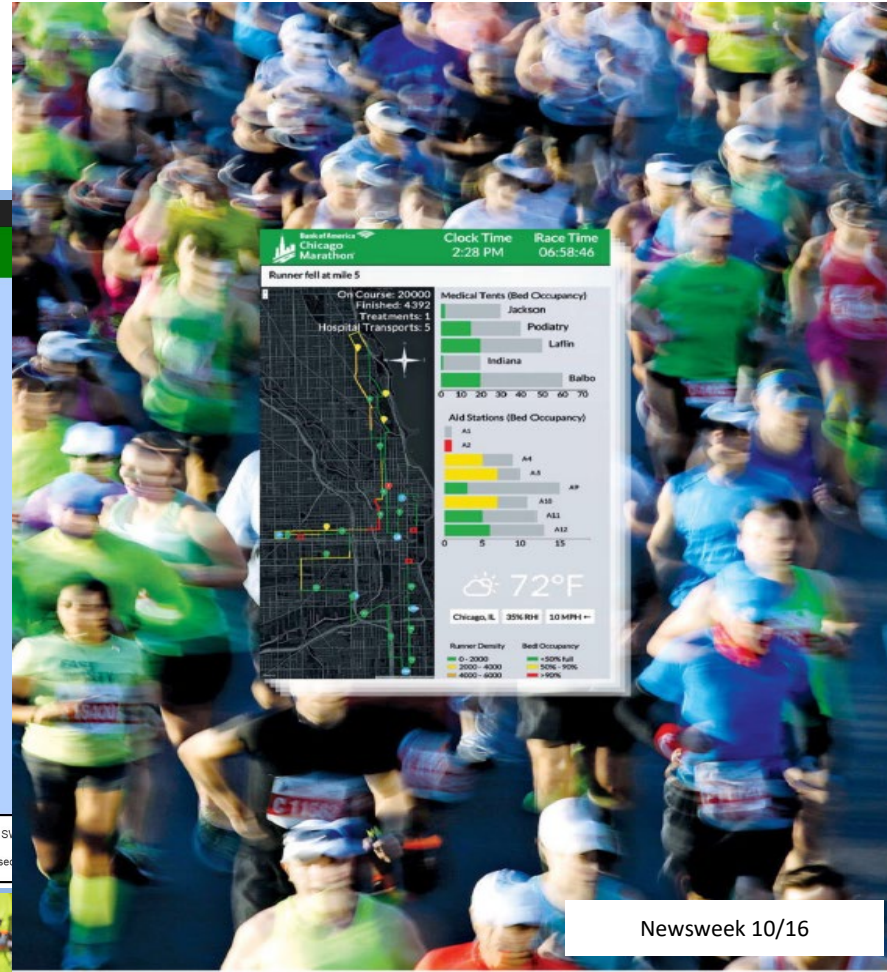
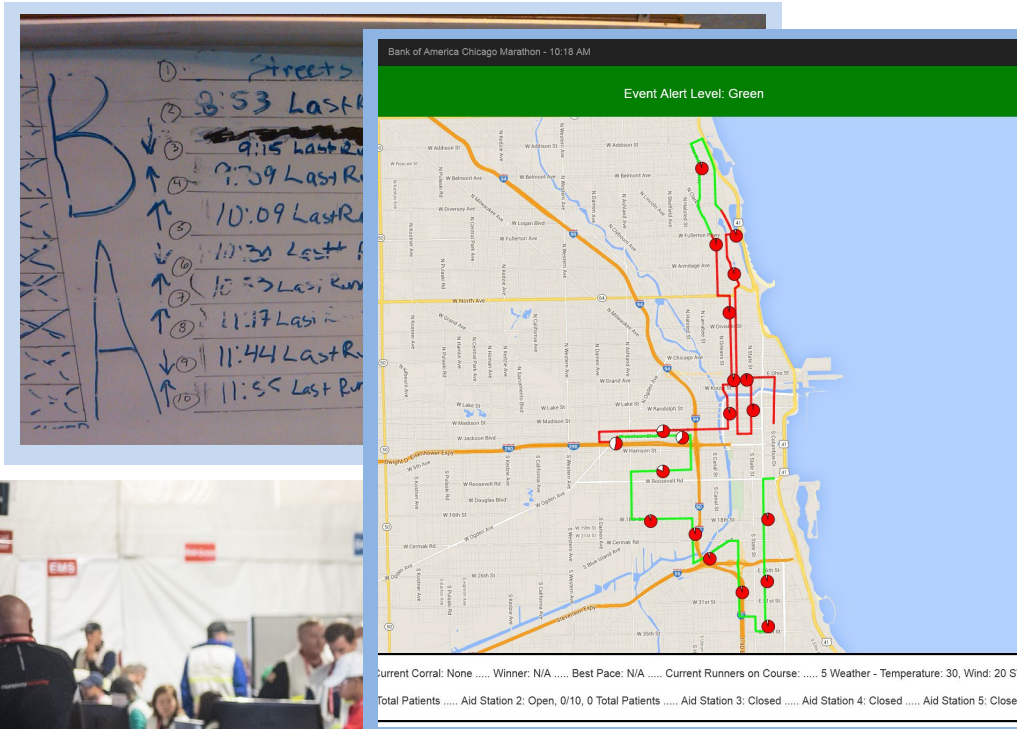


# The Chicago Marathon

- Mass participation event
  - 2<sup>nd</sup> largest marathon in the world
  - Approximately 45,000 runners
  - Estimated 1.7 million spectators
- Number of Medical Volunteers: >1400
- Medical incidents
  - 1,000 – 2,000 patient encounters in a 5-7 hour period



# Evolution of data visualization



Newsweek 10/16

# The Chicago Marathon

in Under Two Minutes

# Challenges of humanitarian logistics

**Timely distribution** of essential supplies is crucial;  
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**Layering of disasters** as frequency and magnitude of  
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|              | Natural                              | Man-made                                          |
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| Sudden-onset | Earthquake<br>Tornadoes<br>Hurricane | Terrorist attack<br>Coups d'Etat<br>Chemical leak |
| Slow-onset   | Drought<br>Famine<br>Poverty         | Political crisis<br>Refugee crisis                |

*Many opportunities to continue  
to advance the field and have  
impact in society*

# Interested in creating social impact through your work?

## Northwestern | ENGINEERING

### Karen Smilowitz

James N. and Margie M. Krebs Professor in Industrial Engineering and Management Sciences

#### Research Overview

In my research, we consider the opportunities and challenges of introducing operational flexibility into logistics systems. With more flexibility, it is possible to significantly improve system efficiency (greater utilization of employees and equipment, reduction in empty miles traveled, etc.). At the same time, increasing flexibility expands the set of operational choices (possible vehicle routes, load assignments, etc.) which complicates already difficult routing and scheduling problems. Often analysis of these complex freight transportation systems requires approximations and simplifications in modeling and solution methods to obtain solutions with acceptable computational effort (i.e. computer time and memory).

Home

Research Overview

Nonprofit Operations

Transportation

Publications

Teaching

Research Group

Education

Curriculum Vitae



Check out the references from my recent talk at TRISTAN 2025

Nonprofit Operations | Transportation Systems  
| Project Funding



Transportation Research for Social Impact in a Changing World  
Karen Smilowitz, Northwestern University  
Tristan 2025  
References

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[Van Wassenhove, Luk N. "Humanitarian aid logistics: supply chain management in high gear." \*Journal of the Operational Research Society\* 57.5 \(2006\): 475-489.](#)

[Duran, Serhan, Marco A. Gutierrez, and Pinar Keskinocak. "Pre-positioning of emergency items for CABI International." \*Interfaces\* 41.3 \(2011\): 223-237.](#)

[Balci, Burcu, Benita M. Beamon, and Karen Smilowitz. "Last mile distribution in humanitarian relief." \*Journal of Intelligent Transportation Systems\* 12.2 \(2008\): 51-63.](#)

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[Ata, Barış, Deishin Lee, and Erkut Sönmez. "Dynamic volunteer staffing in multicrop cleaning operations." \*Operations Research\* 67.2 \(2019\): 295-314.](#)

[Vahideh Maneshadi and Scott Rodilitz. "Online Policies for Efficient Volunteer Crowdsourcing." \*Management Science\* 68.9 \(2022\): 6572-6590.](#)

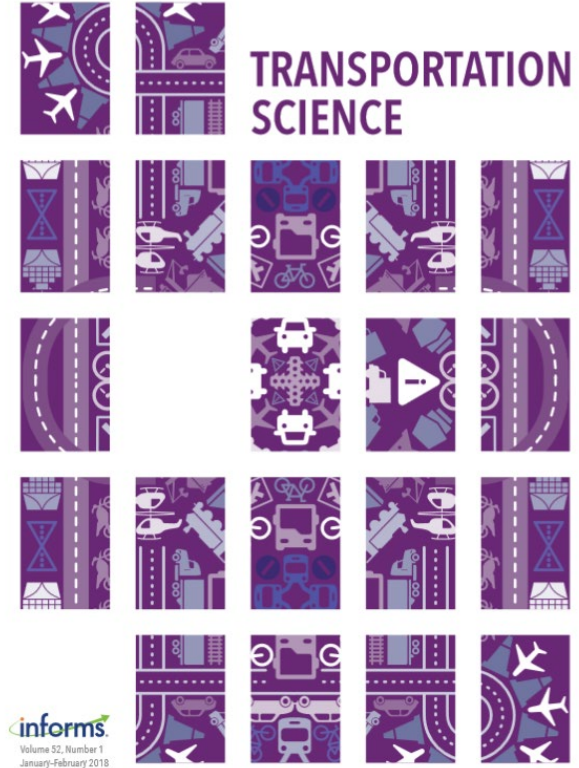
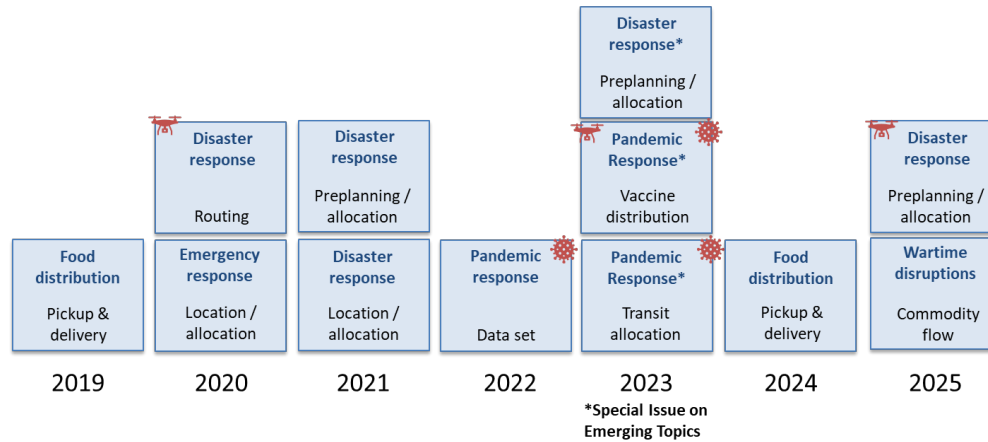
[Lo, Irene, et al. "Commitment on volunteer crowdsourcing platforms: Implications for growth and engagement." \*Manufacturing & Service Operations Management\* 26.5 \(2024\): 1787-1805.](#)

[Escallon-Barrios, Mariana, Reut Noham, and Karen Smilowitz. "Dual mode scheduling in volunteer management." \*Socio-Economic Planning Sciences\* 92 \(2024\): 101796.](#)

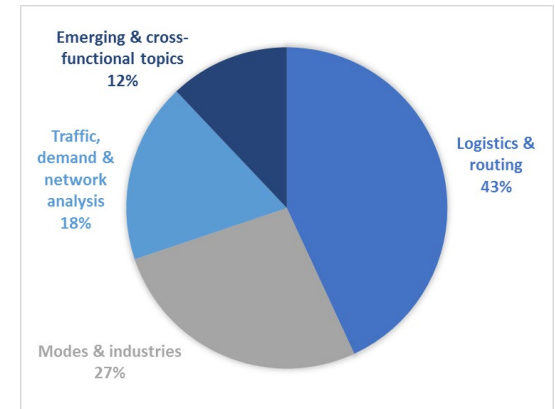
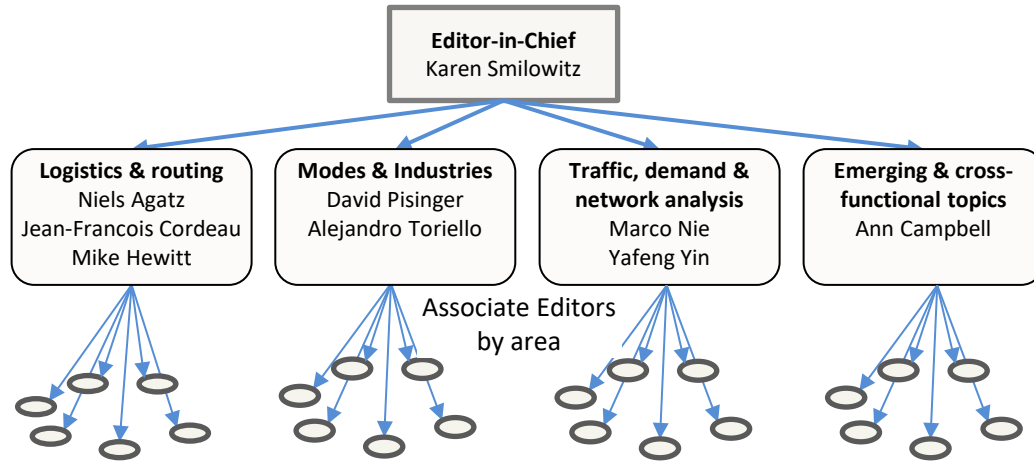
[Holguin-Veras, José, et al. "On the unique features of post-disaster humanitarian logistics." \*Journal of Operations Management\* 30.7-8 \(2012\): 494-506.](#)

[Basdere, Mehmet, et al. "Safe: a comprehensive data visualization system." \*INFORMS Journal on\*](#)

# Initiatives at *Transportation Science* to promote this work



# Editorial structure (as of Jan 2021)



*Transportation Science* papers by area from Jan 2019 to Mar 2020

**Logistics & routing:** models, methods and innovative applications of vehicle routing and logistics

**Modes & industries:** research grounded in a particular mode or industry, including economics of transportation system supply and evaluation

**Traffic, demand & network analysis:** transportation systems analysis; vehicular and human traffic flow theories, traffic operations and management; network equilibrium and dynamics; demand modeling

**Emerging & cross-functional topics:** New and/or unconventional topics that do not fit within the three areas above

What topics / papers  
would like to see featured  
more in the journal?

agree

Interaction  
(behavior) in  
transport and  
logistics

More research  
with tangible  
societal  
impact +2

**Big  
(societal)  
questions  
!**

using methods we  
have not seen so  
frequently in  
transportation  
science yet (not only  
data science)

**My own  
papers ;-)**

Promoting  
conceptual novelty  
and modeling as  
much as  
methodological  
novelty.

potentially integrate  
this with DEI: feature  
articles of people who  
are not commonly  
submitting to TS (no  
matter which  
dimension of DEI) ...  
clearly not talking  
about accepting  
because of it, but only  
featuring it because of

**Vision  
papers?**

**Equity in  
new  
mobility  
systems**

Learning-Based  
Optimization in TS

**Innovative  
integration of  
transportation  
data in  
optimization**

interrelations  
between  
information  
characteristics and  
methodology  
performance

**Data science  
is fine. But I  
hope it does  
not take over  
this journal  
also. +2**

**More real  
problems of  
real size. Less  
pretty math  
for small  
instances +1**

Innovative ideas and  
new concepts that  
could create new  
transportation and  
logistic capabilities  
(It's ok to have  
research be leading  
practice).

New methods and  
models tested in  
environments that  
do not correspond  
to their  
assumptions. +1

contributions in  
new automated  
systems  
(warehouses,  
transportation, etc.)

**futuristic  
models - such  
as airborne  
warehouses**

**Research  
related to  
platforms  
+1**

Methods that can be  
applied well in  
practice, not only  
theoretical papers  
(with strong  
simplifications) +1+1  
+1

**cool  
idea+1**

agreed!  
Alternatively, an  
analysis of the  
scientific method's  
general  
functionality and a  
transfer to a more  
simple method +1

Research that is  
actually  
implemented in  
practice -  
connection to  
human planners +3

Intra-logistics

**intermodal  
transport**

Do we want them to  
provide code (for  
algorithms etc), too?  
Or would that just  
get out of hand?

I would not  
make that  
mandatory!

**Papers that  
provide their  
data /  
instances**

# Why aren't we seeing those submissions at TS?

Perception that review process is too long +1

Any fast-track submission for TS?

Referees are too focused on technical work, and AEs/EIC do not want to make tough overruling decision.

Reviewers seem to require a whole new paper as a major revision

Referees should not look for the paper THEY would write. They should judge the paper as it is written.

*Significantly reduced review times (3-4 months, mean & median)*

*Importance of AE reports*

\*Classical\* papers (intro-lit review-model-experiments) seem to work better

Give up if it is not exact optimization

common perception that TS is ONLY routing +1

'Practical' papers are not 'classical'

*Broaden definition of contributions*

TS is not on the FT50  
+++++

*Working group to look at broader B-school issues*

# Information for Reviewers

## Templates

We encourage reviewers to use templates to help standardize the review process.

*First-round reviews (updated in 2025)*

A LaTeX template for reviewers is available [here](#).

A Microsoft Word template is available [here](#).

*Revision reviews (new in 2025)*

A LaTeX template for reviewers is available [here](#)

A Microsoft Word template is available [here](#).

Check out the new **2025 Transportation Science Review Guidelines**, created by our editorial board to assist reviewers in using the templates, which can be found [here](#).

## *Transportation Science Review Form for First-round Reviews*

Reviewers are asked to address the following in their review to standardize the review process and provide useful feedback to authors. Please use this template the first time you review a paper. You can find the template for revisions at <https://pubsonline.informs.org/page/trsc/reviewer-guidelines>.

### 1. What is the paper about?

*Provide a brief summary of the paper*

### 2. What are the main contributions of the paper?

*Briefly state the main contributions of the paper in terms of problem novelty, scientific methodology, technical results, and/or practical implications. Note: a paper does not need to contribute in all of these ways; please clearly specify the areas of contributions.*

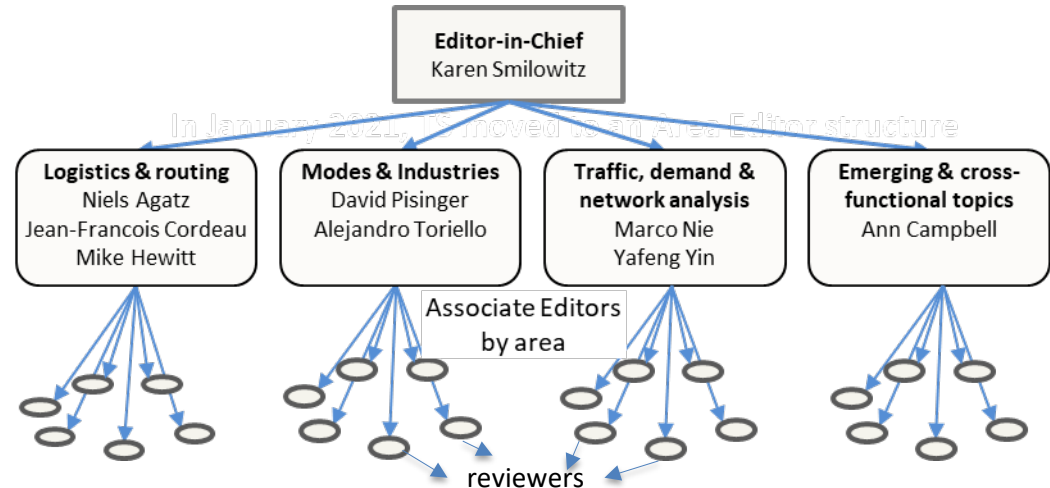
## Transportation Science Reviewer Guidelines January 2025

A few years ago, we engaged the Transportation Science & Logistics community in a discussion of the future of the journal. We posed the following question: *What topics / papers would like to see featured more in the journal?* Responses showed a broad range of topics, including emerging modes of transportation, automation, and a focus on work with societal impact. Responses also showed a range in terms of the key contributions of a paper, including those promoting conceptual novelty, implementation in practice, in addition to advances in methods and models. This call for a broader definition of “what makes a *Transportation Science*” paper is in line with the vision of the editorial board to publish research that combines innovative quantitative methodologies with important applications in the realm of transportation, logistics and related areas. Translating this vision to practice within the confines of the review process is a challenge. We asked a follow up question in the community discussion: *Why aren't we seeing those submissions at Transportation Science?* A large number of responses focused on the review process, including concerns that “classical papers” fare better in the review process compared with novel and/or practice-oriented papers. This document is intended to provide guidance to referees in the review process.

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**Interested in becoming an author?** (1) *Check out the papers cited in this talk and read the topical area editorial statements* (2) *Submit your papers!*

**Interested in organizing a Special Issue?** (1) *Reach to me for information on proposals* (2) *Connect with an Associate Editor*



Thank You!