Operations Research and the case of the missing data

Christopher Thomas Ryan, September 11, 2025
(with illustrations courtesy of ChatGPT)

As an undergraduate, I studied "pure" mathematics. One of the things I was drawn to about it was its absolute cleanliness. It was a world that felt perfectly ordered: starting from axioms and proceeding to clever proofs of elegant statements.

The textbooks were occasionally "impurified" with applications—usually to physics, engineering, or economics. My embarrassing admission is that I often skipped those sections. I was content learning definitions and working through algorithms; I had not signed up for interpreting things in contexts I did not understand. Over time, I even developed an aversion to any kind of "example". I did not want to look at numbers. I recoiled especially at seeing the "real world" translated into numbers—what seemed to me a clumsy process—and then shoe-horned into my beautiful mathematical structures.

When I first came into Operations Research, I carried over this sense of "purity". Yet from what I know of OR's history now, I realize that mathematical purity was far from OR's starting point. Two early and influential definitions are telling: Kittel's description of OR as "using the scientific method to provide a quantitative basis for executive decisions," and Goodeve's phrase "quantitative common sense."[1] The key word here is "quantitative"; i.e., full of messy, "worldly" numbers. The word mathematics does not appear.

What strikes me now is how, after a few short years, OR struggled to cultivate precisely this ethos: support for real decisions based on real "quantities" from the field, typically gathered through careful experimentation. For all the wartime mythology of operational analysis teams descending on airfields, clipboards in hand, observing and counting, modern definitions of OR do not even mention "quantification" or even "science". The Wikipedia entry today (September 2025) calls Operations Research "a branch of applied mathematics that deals with the development and application of analytical methods to improve management and decision-making."

This erasure is not just an artifact of today's encyclopedias. Already in 1955, Philip Morse—one of the wartime scions of the field, founder of MIT's Operations Research Center, and respected theoretical physicist—was asking where all of the numbers had gone. His short article provocatively titled "Where is the new blood?" in the *Journal of the Operations Research Society of America* (now simply *Operations Research*) delivered this word of warning:

> ...the development of experimental techniques seems to be almost totally neglected. Operations research is an experimental science, concerned with the real world. It is not an exercise in pure logic. We must make our theories correspond to actual operations, and to do this we must compare predictions with actual occurrences in a quantitative manner.[2]

[1] Goodeve, Charles. "Operational research." Nature 161.4094 (1948): 609-609.

[2] Morse, Philip M. "Where is the new blood?." Journal of the Operations Research Society of America 3.4 (1955): 383-387, page 384-5.

To hear Morse describe OR in those terms, only ten years after the end of the war, is to feel how quickly the center of gravity shifted. An earlier concern in this direction I already voiced in a previous essay, but it is worth repeating here:

> ...I have been quite disturbed at some recent meetings on operations research to hear so much talk about the mathematical methods for the manipulation of data; to my mind, I have heard far too little discussion of methods for collecting data and of new data that have been collected. At one meeting that I attended not long ago, I felt as though someone had advertised a school for carpenters, but then, when the students turned up to learn carpentry, they were being taught how to make a saw or a hammer.[3]

A field that had once prided itself on close observation and practical trial had quickly become absorbed into tools and abstraction.

Learning to build tools, but not to use them.

Of course, even during the war, "experiment" in OR had its own character. These were not small and local lab experiments, but efforts at large-scale data collection. Patrick Blackett described how regularities emerged in large-scale quantification, even in the face of apparent randomness:

> [stability] appears rather unexpected in view of the large number of chance events and individual personalities and abilities that are involved in even a small operation. But these differences in general average out for a large number of operations and the aggregate results are often found to remain comparatively constant ....[4]

This miracle of stability was nothing other than "law of large numbers" come alive in the field. OR analysts amassed vast amounts of data from airplane sorties and convoy sailings, allowing signal to rise above noise. But this reliance on scale contained a hidden assumption about OR's proper domain. Writing in 1947, Kittel observed that

> "[large] enterprises, because of their national character and size, lend themselves more suitably to the application of operations research than do small local enterprise."[5]

Smaller enterprises must rely on something else: tacit knowledge, shared understanding, intuition, and trust. In these settings, the law of large numbers cannot be summoned to substitute for judgment.

Theodore Porter's influential book *Trust in Numbers* offers historical context for this insight.[6] Quantification, he argues, most strenuously develops in situations where trust in authority is weakened. In

[3] O. Solandt, Observation, Experiment and Measurement in Operations Research', *Journal of the OR Society of America* (now *Operations Research*), Vol. 3 (1955), 1-15.

[4] Quoted in Kittel, Charles. "The nature and development of operations research." Science 105.2719 (1947): 150-153, page 192

[5] Kittel, 1947, page 153

[6] Porter, Theodore M. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton University Press, 1995.

post-revolutionary France, for example, the elite engineers of the École Polytechnique could rely on their training and social standing to legitimate decisions without heavy quantification; the state trusted them as individuals. They were trained in abstract mathematics, but mathematics here was understood more as training in judgment and reasoning (and as a proxy for elite social status) than as a toolbox for manipulating numbers.[7]

By contrast, in the United States, the Army Corps of Engineers developed quantity-intensive cost–benefit analysis to justify projects to Congress and the public.[8] Where personal authority was insufficient, numbers became the arbiter. Something similar held in the war. The armed services, long run as jealous fiefdoms, were suddenly swept into centralized coordination. Scarce resources had to be allocated across competing demands. Numbers were demanded, not just for persuasion but for coordination at scales intuition could not handle. OR thrived in this climate: it introduced quantification where none had existed, turned opinion into analysis, and enabled decisions to be made across continents.

But once the war ended, the coercive power of the state to demand transparency of "quantity" greatly diminished. Companies and bureaucracies had little reason to open their operations to scrutiny. The sense of urgency was gone; the "all hands on deck" spirit was replaced by proprietary caution. An analyst might hope to earn the trust of one unit or department, but rarely the whole organization. Operational data was seen as private knowledge, bound up with local advantage. Unlike accounting, where regulation compels disclosure, or finance, where investors demand transparency, or marketing, where interventions are often public by nature, operations remained hidden in the back office.

This was not merely a matter of stubbornness. Generating verified "quantities" is simply not easy, especially when those quantities need to be generated through careful experimentation (as we saw in the "depth charge" example of OR during the war). As Porter notes:

> ... replication is not at all easy .... [n]otwithstanding the attractive solidity and impersonality of a rhetoric of 'experimental fact,' it may often be easier to form a community of theoretical than of experimental investigation. Theory, especially of a mathematical sort, ...appears on the printed page [and] is largely self-contained. .... There are ...scientific communities committed mainly to mathematical theory: for example, eighteenth-century rational mechanics, or modern neoclassical economics. Both have been abstract and unworldly in order to be rigorous; and one advantage of mathematical rigor is that it helps to form and preserve scientific communities concerned with phenomena that are not yet well controlled in the laboratory or observatory, or with understandings that are contested .... Methodological strictness serves as an alternative to shared beliefs and as a check on the expression of idiosyncratic personal opinions.

According to my understanding of the history of OR, Porter could have added post–World War II Operations Research to his list, alongside rational mechanics and neoclassical economics. How OR transformed from "quantitative common sense" to "applied mathematics" may be in part due to how methodological strictness offered a way to build community in a domain where "operational facts" were contested and difficult to establish.

[7] See Chapter 6 of Porter, 1995

[8] See Chapter 7 of Porter, 1995

The difficulty of finding quantifiable "operational facts" has never gone away. Yet Morse's lament still rings true: the field has long struggled to develop a robust experimental wing to ground itself in "experimental fact" the way Morse witnessed in physics.[9] The reasons are structural, not a matter of individual effort. Experiments initiated by OR academics are difficult to run and even harder to replicate.[10] According to Porter, a community grounded in mathematical abstraction is simply easier to sustain.

I am a child of the "abstract" school of OR, only recently have I begun to take seriously other paths. But I have quickly learned from personal experience that the challenge is formidable. I often feel untrained or unqualified to even "look" at the real world, let alone say things about it. I find the task of getting data from large organizations daunting, and I have failed in all of my attempts. If one is to heed Porter's historical lessons about what drives quantification, organizations with high internal trust and low trust in outsiders may not even bother to record relevant operational data. This is to speak nothing of their willingness to share.

I started thinking recently about another way forward, not to lament the absence of large-scale data or to dream of recreating the wartime ethos. I felt I should start from the other end: with the small, the particular, the local. This is the spirit of a project I am currently undertaking in collaboration with small businesses—beauty salons, cafés, bookstores, shoe repair shops, after-school tutors, bubble tea shops, martial arts studios. These enterprises rarely collect systematic data. They make decisions based on intuition, on negotiation with trusted employees and customers, guided by circumstance and conversation.

This work is a *very* long way from my roots. Optimization offers little help. Most days I feel like an imposter. So I started at the beginning. I asked my small-business owner collaborators the simplest of questions: What operational challenge do you face? Where do you turn for help? What kind of help would you like? Their answers are not numbers but stories, not datasets but narratives of how work gets done.[11]

My interest in qualitative work with small businesses is not in any way to deny the value of mathematical abstraction. But I feel this opens up another source of "new blood" to drive the future of OR, outside of the usual mathematics, engineering, and computer science departments. These investigators may come

[9] This comment is not to suggest there has not been great effort, and success, in bringing "experimental fact" to modern OR. One needs only to look at the recent work of Samantha Kepplar, Rob Bray, Yannis Stamatopoulos, Jun Li, Clare Snyder, Park Sinchaisri, Jordan Tong, Christian Terwiesch, Kris Ferreira, Toni Moreno, Elena Katok, Ryan Buell, Brad Staats, and Hummy Song, among many others, to see that this a growing tradition. This work is challenging for reasons discussed in this essay, which I hope, impresses the reader even more regarding the accomplishments of these researchers.

[10] A praiseworthy attempt at replication was recently published in *Management Science*, an encouraging step in this direction: Davis, Andrew M., et al. "A replication study of operations management experiments in management science." *Management Science* 69.9 (2023): 4977-4991.

[11] As with all research directions, I am not the first to be convinced of a need for more qualitative research in Operations Research. One antecedant is the "Soft OR" movement. See, for example, Checkland, Peter. *Systems Thinking, Systems Practice.* Chichester: Wiley, 1981; Rosenhead, Jonathan, ed. *Rational Analysis for a Problematic World: Problem Structuring Methods for Complexity, Uncertainty and Conflict.* Chichester: Wiley, 1989; Mingers, John. *Multimethodology: The Theory and Practice of Combining Management Science Methodologies.* Chichester: Wiley, 1997; Jackson, Michael C. Systems Methodology for the Management Sciences. New York: Plenum Press, 1991. A recent resource in the operations management literature is Barratt, Mark, Thomas Y. Choi, and Mei Li. "Qualitative case studies in operations management: Trends, research outcomes, and future research implications." *Journal of Operations Management* 29.4 (2011): 329-342. I was also directly inspired by the qualitative work of Samantha Kepplar, Wichinpong Park Sinchaisri, and Clare Snyder in "Making ChatGPT work for me." *Proceedings of the ACM on Human-Computer Interaction* 9.2 (2025): 1-23.

instead from corner cafés, neighborhood bookstores, martial arts studios, and bubble tea shops. Their problems resist quantification, but their decisions matter profoundly and are close to where we all live.

I am well aware that this path runs against the prevailing current of our age of AI and "big data." My vision for a different future—and for "new blood" in OR—stands in stark contrast to those who urge us to embrace every new technology, from large language models to the next tools not yet named. But why not imagine both? There is a vast archives of human experience in operational decision-making in the heads of people who make such decisions every day but have never written them down. In an era of machines that devour every imaginable trace of recorded data, perhaps the final frontier lies in what remains unrecorded.