What Was New in OR

Christopher Thomas Ryan, September 5, 2025
(with images generated by ChatGPT)

My first term at the business school I drew the "core" course in Operations Management (OM). As I mentioned in an earlier essay, I had always been fascinated by history, so naturally, I wanted to include a "history of OM" slide in my course material. I liked history but hadn't taken it seriously. So I wrote a slide: "Operations began in World War II with Operations Research (OR)." In my mind, OM was just applied OR.

After all, if OM is applied OR, then OR must have come first, right? I thought this made perfect sense. I was wrong. OR didn't come first, and OM isn't its footnote.

The evidence was clear in the material I taught. Our 'core' OM course mirrored what was taught at business schools across North America at the time. I covered topics like process flows, quality control, waitline theory, and inventory theory. None of these topics began with OR.

Consider the history of process flow theory, for instance. It had its roots in the early 20th century, with two fundamental concepts — process flows (1921)[1] and Gantt charts (1903)[2] — first formally developed by Frank and Lilian Gilbreth and Henry Gantt, respectively. A scientific approach to quality control dates to Walter Shewhart (1924).[3] Waitline theory can be traced to 1917 and the work of Erlang.[4] Ford Harris introduced the Economic Order Quantity (EOQ) model in 1913.[5] The newsvendor model was discussed by Edgeworth in 1888.[6]

Yet none of these names or dates appeared in my OM slides or the materials I used to prepare for class.

Was it because these theories were random discoveries by isolated thinkers? Was it at least accurate to claim that the early practitioners of OR were responsible for organizing these ideas into a coherent movement?

As discussed in an earlier essay, one of the first definitions of OR was given by Kittel:

> ...a scientific method for providing executive departments with a quantitative basis for decisions.[7]

[1]Gilbreth, Frank B., and Lillian Moller Gilbreth. "Process charts: First steps in finding the one best way to do work." *Transactions of the American Society of Mechanical Engineers* 43 (1921): 1029-1043.

[2]Henry L. Gantt, "A Graphical Daily Balance in Manufacture," *Transactions of the American Society of Mechanical Engineers* 24 (1903):1322–1336

[3]Shewhart, Walter A. "Some applications of statistical methods to the analysis of physical and engineering data." *Bell System Technical Journal* 3.1 (1924): 43-87.

[4]Erlang, A.K. "Løsning af nogle Problemer fra Sandsynlighedsregningen af Betydning for de automatiske Telefoncentraler." *Elektroteknikeren (Copenhagen)*, 13 (1917): 5–13. (English translation: "Solution of Some Problems in the Theory of Probabilities of Significance in Automatic Telephone Exchanges," reprinted in *The Life and Works of A.K. Erlang*, ed. E. Brockmeyer, H. L. Halstrøm, A. Jensen, Copenhagen Telephone Company, (1948): 138–155.

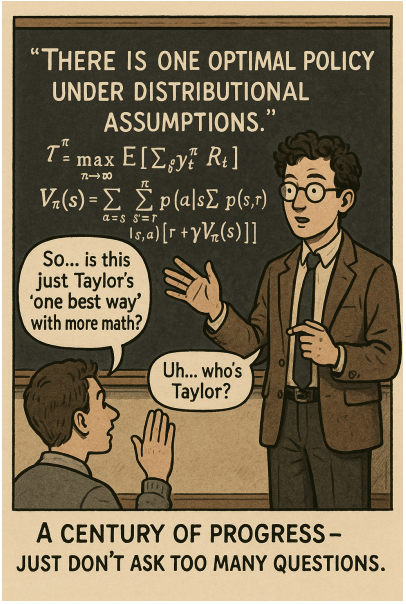
[5]Harris, Ford. "How Many Parts to Make at Once?", *Factory: The Magazine of Management*, 10.2 (1913): 135-13

[6]Edgeworth, F. Y. "The Mathematical Theory of Banking." *Journal of the Royal Statistical Society*, (1888) 51(1):113–127.

[7]Kittel, Charles. "The nature and development of operations research." *Science* 105.2719 (1947): 150–153.

Was it the first such movement to describe itself this way? Apparently, no.

There was another influential movement—arguably even more popular than OR in its time— that came to prominence long before World War II (and in fact, even before World War I): "Scientific Management."



The emblem of Scientific Management was Frederick Winslow Taylor, a movement that applied scientific methods to the study and practice of management. In Taylor's own words:

> "Scientific management is the substitution of exact scientific investigation and knowledge for the old individual judgment or opinion, either of the workman or the boss, in all matters relating to the work done in the establishment.[8]

Sound familiar? While not all of the ideas Taylor and his contemporaries promoted were novel to them, the way they systematically pursued them was groundbreaking. They were the first to organize these practices in a concerted way.

It's difficult to capture the full breadth of Taylor's life and influence, but I want to emphasize that Taylor's ideas were not only transformational in the business world but seemed to penetrate almost every aspect of society in that era. Three thick biographies and shelves of papers and books chart his influence; this sketch will be brief.[9]

The basic premise of Taylor's Scientific Management was straightforward: apply the methods of science to "control" business operations. This idea emerged at a time when science was becoming more popular in society at large, especially in light of groundbreaking discoveries like evolution, steam, and electricity, which had "shaken" many pre-scientific views of the world.

[8] Taylor, Frederick Winslow. Testimony, 25 January 1912. Hearings Before the Special Committee of the House of Representatives to Investigate the Taylor and Other Systems of Shop Management, 62nd Cong., 2nd sess., vol. 3, U.S. Government Printing Office, 1912, p. 1387.

[9] The three biographies of Taylor's life include: Kanigel, Robert, *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency*, London: Little, Brown and Company (1997), Nelson, Daniel Melvin. *Frederick W. Taylor and the Rise of Scientific Management*. Cambridge: The MIT Press (1970), and Copley, Frank Barkley. *Frederick W. Taylor: Father of Scientific Management.* Harper and Brothers (1923). Five other books I recommend as enlightening reading are the influential Marxist critique of Scientific Management: Braverman, Harry. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, Monthly Review Press (1974). Details of how Scientific Management spread beyond the United States to Europe: Merkle, Judith A. *Management and Ideology: The Legacy of the International Scientific Management Movement*. University of California Press (1980). How Scientific Management interacted with the progressive political movement in the United States: Haber, Samuel. *Efficiency and Uplift: Scientific Management in the Progressive Era, 1890–1920* University of Chicago Press (1964). Scientific Management's influence on Japan: Tsutsui, William M. *Manufacturing Ideology: Scientific Management in Twentieth-Century Japan*. Princeton University Press (1998).

Taylor applied an experimental method to improve the cutting of steel, earning him his initial wealth that set him on a path to spread his ideas. What transformed this approach into a true movement was not just the application of experiments to specific work practices — something that had been done for centuries — but the introduction of the role of engineers, working as trained professionals to improve industry's efficiency.

Taylor himself was uniquely suited for this role. Born into wealth, he witnessed firsthand the decline of the whale oil industry—that was the basis of his family's wealth—as new technologies took over. His father was trained as a lawyer (although he never practiced, as was tradition in his family at the time), but Taylor sought a more industrious path. He took a job in a factory owned by his father's friend. There, he saw the inefficiencies and perceived laziness of both the owners and the workers, and he set out to address them using scientific methods.

Taylor imagined a role for professional engineers who could exert authority through the legitimacy of science to replace traditional concepts of how to manage production. But why would either owners or workers accept this new authority? Taylor's solution was a "mental revolution" in which planners, trained to identify inefficiencies, would play a pivotal role in optimizing the organization's operations. With the promise of greater efficiency, both sides could benefit.

Taylor's ideas gained widespread prominence following the "Eastern Rates Case" of 1910. The Eastern Railway Company sought to raise freight rates due to rising operational costs, but companies using the service argued that the rising costs could be eliminated by applying scientific management techniques to identify and address inefficiencies. Taylor and his followers spoke at the trial, and the idea of "efficiency" took off. Taylor's ideas also found a home in early business academia, his writing forming a basis for curricula at places like Harvard Business School, where Taylor himself taught from 1909 to 1914.

Given this rich history, a natural question arises: if both OR and SM aimed at improving efficiency through scientific methods, why was "Scientific Management" not the name given to the movement that shaped the war effort during World War II? What distinguishes Scientific Management from Operations Research? Why, in other words, was there a need for a new movement?

I am not the first to ask this; in fact, there were efforts in the early days of Operations Research to distinguish it from Scientific Management.[10] Some have argued that the most significant difference is one that lies close to the surface.[11] Taylorism believed in a deterministic and mechanistic world. It aimed for 'one best way'—a set formula for success. OR, by contrast, embraced uncertainty, modeling the unpredictability of complex systems, employing stochastic processes and probabilistic models to approach these issues. A somewhat crude way to express this difference is in terms of mathematical sophistication alone:

> The goals of Taylor's industrial engineering and those of operations research do not differ. Operations research just adds mathematical sophistication and tools that didn't exist

[10]Morse, Philip M., and George E. Kimball. *Methods of Operations Research*. MIT Press and John Wiley & Sons, 1951. Kittel, Charles. "The Nature and Development of Operations Research." *Science*, vol. 105, no. 2719, 1947, pp. 150–153. Blackett, P. M. S. "Operational Research." Operational Research Quarterly, vol. 1, no. 1, Mar. 1950, pp. 3–6.

[11]Fortun, Michael, and Silvan S. Schweber. "Scientists and the legacy of World War II: The case of operations research (OR)." *Social Studies of Science* 23.4 (1993): 595-642.

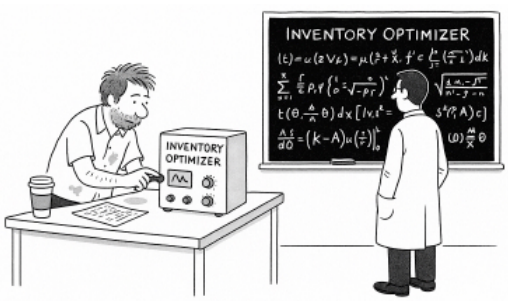
previously.[12]

This seems to suggest in some way that Taylor was averse to using mathematical methods to improve decisions. As far as I know, there is little evidence of this, and Taylor and his acolytes often prized mathematization when feasible.[13] Applied mathematical tools were under rapid development in intervening years between SM and OR, so why should the inclusion of mathematics alone change the nature of the movement? Couldn't we have just added some new tools and kept the name "Scientific Management"?

In my understanding, the sharper divide was social. While Scientific Management was primarily initiated by engineers and consultants embedded in industry, Operations Research was started by scientists — physicists, chemists, biologists, mathematicians — who were mobilized during the war effort to enter halls of decision-making. It is unlikely they would have even considered such managerial questions otherwise. After the war, the military continued to be a primary contributor to the development of OR.[14] For example, the RAND Corporation–a hotbed for post-war innovation in OR–was initially an arm of the US Air Force.[15]

As sociologists of science have forcefully pointed out,[16] fields evolve as much according to the culture and identity of the people involved as any intellectual differences. In attempting to differentiate Management Science (and by implication, Operations Research) from Scientific Management, Merrill Flood put it bluntly:

> ... the choicest management principles to be found in the management literature are generally referred to as clichés by the scientist, who sees in them neither operationally verifiable meaning nor evidence of established generality of applicability.[17]



When scientists do science... it's different.

The thinking here was that while Taylor started a movement of engineers applying science to their work of decision-making, operations research was done by the scientists themselves. And while Taylor may have had some good ideas, those ideas do not reach the level of "science".

Another key distinction lies in the human side of the story. Lilian Gilbreth, a prominent industrial psychologist, played a significant role in the development of SM and its focus on the worker side of the

[12] Whiteside, Gary E. and Wechsler, Ben L. *Applied Operations Research: A Survey* New York: John Wiley & Sons (1976), page 1.

[13] See, for example, the formulas given on page 109 of Taylor, Frederick Winslow, *The Principles of Scientific Management*. Harper (1911). See also the paper that introduced "Taylor's Equation" for tool life: Taylor, Frederick W. "On the Art of Cutting Metals." *Transactions of the American Society of Mechanical Engineers* (1907) 28: 31–350.

[14] Mirowski (1999).

[15] Abella, Alex. *Soldiers of Reason: The RAND Corporation and the Rise of the American Empire*. Houghton Mifflin Harcourt (2009).

[16] See, for instance, Latour, Bruno. *Science in Action: How to Follow Scientists and Engineers Through Society*. Harvard University Press (1987)

[17] Flood, Merrill M. "The objectives of TIMS." *Management Science* 2.2 (1956): 178-184, page 181

equation, not just management. However, in the postwar period, OR, with its emphasis on abstraction and mathematical rigor, placed much less focus on the human side of management. The first textbook on OR by Kimball and Morse does not use the word "human", with "people" appearing only once in passing.[18]

Despite these differences, there can be little doubt that the overarching goal of both SM and OR was remarkably similar: to improve decision-making through scientific methods. But this raises an even more poignant question: How could I, having completed five years of a PhD under the title "Management Science" and taught hundreds of students about my field, not even have known Taylor's name? Inverting the words "Scientific Management" to "Management Science" and having its students ignorant of any connection smells a little too Orwellian for my comfort.

An answer may lie in the general ahistoricity of technical fields.[19] The mathematical underpinnings of modern OR — with its axioms, models, and formalism — can instill an air of timelessness, as if the methods and tools were handed down from the gods. But what of the history that led us to these tools? Was it simply forgotten as irrelevant or more consciously erased?

There are some legitimate reasons to get distance from SM and not claim it as your own. One obvious factor is SM's association with totalitarian regimes — including Soviet Russia, Imperial Japan, Fascist Italy, and Nazi Germany.[20] The history of Scientific Management in the United States also had its dark moments, with some citing it as an irritant leading to labor unrest and accusations of its dehumanizing aspects.[21] But a possibly even darker current is the association of Taylor's movement with proto-totalitarian forces within the United States. For instance, Henry Gantt, famed for his Gantt chart, sought to apply scientific principles beyond the factory and into political realms. Gantt emerged as the leader of a clique of engineers who called themselves "The New Machine",

> ... an organization for the acquirement of political as well as economic power ... [for] advancing the fortunes of its members by cheapening supplies and service to the elemental needs of the community.[22]

Gantt's movement caught the attention of noted economists Thorstein Veblen, who wrote a book that presaged an era where a "Soviet of Engineers" would take political power in the United States.[23] Inspired by this message, the political party "Technology, Inc." tried to do exactly this in the 1930s and 1940s.[24]

Emerging from the military context, OR understood the importance of maintaining the hierarchical structure of decision-making, distancing itself from the political aspirations associated with groups tied to SM. Blackett wrote:

---

[18] Morse, Philip M., and George E. Kimball. *Methods of Operations Research*. MIT Press and John Wiley & Sons, 1951.

[19] See, for example, Lakatos, Imre. *Proofs and Refutations*, Cambridge University Press (1976), §1-2. Hodgson, Geoffrey M. *How Economics Forgot History: The Problem of Historical Specificity in Social Science* Routledge (2001), and Mirowski, Philip. "Cyborg Agonistes: Economics Meets Operations Research in Mid-Century". *Social Studies of Science* 29(5):685-718, 1999.

[20] See Merkle (1980) and Tsutsui (1998) referenced above.

[21] See especially Braverman (1974).

[22] Quoted in Alford, Leon Pratt. *Henry Laurence Gantt, Leader in Industry*. Harper & Brothers (1934), page 264.

[23] See Veblen, Thorstein. *The Engineers and the Price System*, New York: B. W. Huebsch (1921).

[24] See Chapter 2 in Elsner Jr, Henry. *The Technocrats: Prophets of Automation* Syracuse University Press (1967).

> It was important in order to maintain objectivity and neutrality that the operations research scientists not make the decisions - they were doing 'science in collaboration with and on behalf of executives'.[25]

After World War II ended, and the Cold War emerged, associating with a movement with any historical designs for political power through claims of technical elitism would have drawn suspicion. As historians Fortun and Schweber describe it:

> In the wartime setting, the decisions could simply have been made unilaterally by the military: OR became valued because it produced valuable results. But in a postwar setting, in the democratic and presumed egalitarian setting of the paradigms of twentieth-century liberal societies, Great Britain and the United States, unilateral decisions would lack credibility. So OR was mobilized to provide quantitative evidence on the basis of which decisions were to be made.[26]

To maintain objectivity and credibility, OR had to stay neutral, offering insights without taking control. It collaborated, never dictated. Whether this was a lesson from the travails of Scientific Management or simply the constraints of working within a strict military heirarchy, OR learned to stay away from the politics of actual decision-making. This, undoubtedly, has contributed to its longevity.

In the 2010s, I taught OM as "applied OR," none the wiser. I now feel the sting of that ignorance. Was it laziness—or comfort in a story that cast my tribe as greater pioneers than maybe they were? History, they say, is written by the victors. OR wrote this one. How it won—well, that's a story for a future essay.

[25] Blackett, P.M.S. *Studies of War, Nuclear and Conventional*. Hill & Wang, (1962), page 201.

[26] Fortun and Schweber (1983), pages 628–629.