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INFORMS JOURNAL ON APPLIED ANALYTICS
Vol. 00, No. 0, Xxxxx 0000, pp. 000–000
Submitted to *INFORMS Journal on Applied Analytics*
ISSN 2644-0865, EISSN 2644-0873

Fifth Column — What was new in Operations Research?

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Abstract. This essay investigates what differentiated Operations Research (OR) from its historical predecessors. This offers insight into how OR might respond today to the development of newer fields that cover similar intellectual and practical ground to OR.

Funding: This research was supported by the Social Sciences and Humanities Research Council of Canada Insight Development Grant (AWD-029333).

Key words: History of operations research, philosophy of science and engineering, scientific managmenet, artificial intelligence

Many of us who were trained in academic Operations Research (OR) that find ourselves teaching at business schools have our first real encounter with operations management (OM) when we are assigned to teach it in the classroom. This strange proposition feels a bit more natural if we hold that operations management is applied OR. After all, the concepts that we teach to young professional business students seem almost watered-down rules-of-thumb of the abstract and rigorous mathematics in our novel research. When introducing the first-year operations course at business school, it is not uncommon to have a slide briefly noting the history of operations, and we, as operations researchers, may default to a point of pride, proclaiming that "the field of operations began in World War II with Operations Research".

After all, if OM is applied OR, then OR must have come first, right? It makes perfect sense, but this is not true. OR did not come first and OM isn't its footnote. Think of the material covered in business schools across North America: process flows, quality control, waitline theory and inventory theory. None of these topics began with OR.

Process theory has its roots in the early 20th century, with two fundamental concepts — process flows (Gilbreth and Gilbreth 1921) and Gantt charts (1903) (Gantt 1903) — first formally developed by Frank and Lilian Gilbreth and Henry Gantt, respectively. A scientific approach to quality control dates to Walter Shewhart (Shewhart 1924). Waitline theory can be traced to 1917 and the work of Erlang (Erlang 1917). Ford Harris introduced the Economic Order Quantity (EOQ) model in 1913 (Harris et al. 1913). The newsvendor model was discussed by Edgeworth in 1888 (Edgeworth 1888).

Yet none of these names (besides maybe Gantt's) or dates feature prominently in materials for OM classes.

Was it because these theories were random discoveries by isolated thinkers? Is it at least accurate to claim that the early practitioners of OR during and after World War II were the ones responsible for organizing these ideas into a coherent movement?

A largely agreed-upon definition of OR in the early post-World War II period was given by Kittel:

> . . . a scientific method for providing executive departments with a quantitative basis for decisions. (Kittel 1947)

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 heyday—that came to prominence long before World War II (and in fact, even before World War I): ”Scientific Management.”

The vanguard of Scientific Management was Frederick Winslow Taylor and his acolytes (including the Gilbreths and Gantt), pioneering 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 (Taylor 1912).

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

It is difficult to capture the full breadth of Taylor's life and influence, but 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 books and papers chart his influence; this sketch will be brief.[1]

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.

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. This approach transformed into a true movement not from mere application of experiments to work practices – something that had been done for centuries – but from the introduction of the role of engineers in the workplace, acting as trained professionals to improve industry's efficiency.

Taylor was uniquely suited for the role of prophet in this nascent movement. Born into inherited wealth, Taylor witnessed firsthand the decline of the whale oil industry – the basis of his family's fortune – as new technologies took sway. 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, which chafed against his instilled Quaker values. He set out to address these vices of industry 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 proffered a solution, what we called a "mental revolution". Planners, trained to identify inefficiencies, would serve as optimizers of operations. With the promise of greater efficiency, the perennially feuding parties of labor and capital would mutually benefit and acquiesce.

Taylor's ideas gained widespread acclaim 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. In a set of hearings before the Interstate Commerce Commission, Taylor and his acolytes gave testimony, proselytizing the simple idea of "efficiency". Taylor's ideas found a home in early business academia, where his writings formed a basis for curricula at places like the, then fledgling, Harvard Business School and Tuck Business School at Dartmouth, where Taylor himself taught (Stevens Institute of Technology 2025).

Given this rich history, a natural question arises: if both OR and Scientific Management 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 OR? Why, in other words, was there a need for a new movement?

We are not the first to ask this; in fact, there were efforts in the early days of OR to differentiate itself from Scientific Management (Morse and Kimball 1951, Kittel 1947, Blackett 1950, Smiddy and Naum 1954). Some have argued that the most significant difference is one that lies close to the surface (Fortun and Schweber 1993). Taylorism believed in a deterministic and mechanistic world. It aimed for the "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 OR do not differ. Operations research just adds mathematical sophistication and tools that didn't exist previously. (Whitehouse and Wechsler 1976, p. 1)

This seems to suggest that Taylor was averse to using mathematical methods to improve decisions. There is little evidence of this, and Taylor and his acolytes often prized mathematization when feasible.[2] Applied mathematical tools were under rapid development in the intervening years, so why should the inclusion of more sophisticated tools of mathematics alone change the nature of the movement? Couldn't we have just added them and kept the name "Scientific Management"?

The sharper divide was not so much technical but social. While Scientific Management was primarily initiated by engineers and consultants embedded in industry, OR was started by scientists – physicists, chemists, biologists, mathematicians – who were mobilized in interdisciplinary teams during the war effort to enter the 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 (Mirowski 1999). For example, the RAND Corporation – a hotbed for post-war innovation in our field – was initially a partnership between the Douglas Aircraft Company and the United States Air Force (Abella 2008).

As sociologists of science have forcefully pointed out (Latour 1987), 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, OR) 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 (Flood 1956).

While Taylor started a movement of engineers, who applied science to the work of organizational decision-making, OR began as a scientific movement conducted by scientists themselves.

Another key distinction lies in the human side of the story. Lilian Gilbreth, a prominent industrial psychologist and disciple of Taylor, played a significant role in the development of Scientific Management and its evolving focus on the human side of the equation. However, in the postwar period, OR, emphasizing 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 even use the word "human" in its nearly two-hundred pages, with the word "people" appearing only once in passing (Morse and Kimball 1951). OR did evolve into areas with more "human" or "social science" flavors, although these topics areas typically did not become subfields of academic OR proper, but took on more parallel development either in academia or in practice. The relationship between academic OM and academic OR provides an example of such an evolution.

Despite their differences, there can be little doubt that the overarching goal of both Scientific Management and OR was remarkably similar: to improve decision-making through scientific methods. But this raises an even more poignant question: how has the name of Frederick Winslow Taylor escaped the education of many in our own field? How could our field have a prominent academic journal called "Management Science" while many who read and publish there are unaware of even the name "Scientific Management"? Inverting the words "Scientific Management" to "Management Science"—and having the history of the former largely obscured—is a circumstance that would make even George Orwell blush.

An answer may lie in the general ahistoricity of technical fields.[3] 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 distance oneself from Scientific Management. One may be its association with totalitarian regimes – including Soviet Russia, Imperial Japan, Fascist Italy and Nazi Germany (Merkle 1980, Tsutsui 1998). The history of Scientific Management in the

United States also had its dark moments, with some citing it as an accelerant of labor unrest and accusing it of dehumanization.[4] But a possibly more ominous current in the American context 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.[5]

Gantt's movement caught the attention of noted economist Thorstein Veblen, who wrote a book that presaged an era where a "Soviet of Engineers" would take political power in the United States (Veblen 1921). Inspired by this message, the social movement (and eventual political party) "Technocracy, Inc." tried to do exactly this in the 1930s and 1940s (Elsner 1967, Chapter 2).

Emerging from the military context, OR understood the importance of maintaining the hierarchical structure of decision-making, distancing itself from political aspirations. As Blackett wrote:

> 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' (Blackett 1962, p. 201).

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 (Fortun and Schweber 1993, p. 628-9).

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.

Lessons for the future

The historical trajectory of OR provides a framework for understanding its current institutional position amidst the rise of data science, machine learning, and artificial intelligence in the 21st century. Today, OR occupies a position analogous to that of Scientific Management in the post-war era: it functions as the venerable, established tradition facing a wave of modernizing newcomers that claim the mantle of contemporary decision-making. Just as OR consciously shed the moniker of Scientific Management to decouple itself from historical baggage and institutional inertia, modern fields like data science have established independent identities rather than subsuming themselves under the banner of OR. By the late 1970s and 1980s, academic OR had accumulated its own disciplinary baggage, facing sharp criticism from within the community for becoming overly preoccupied with mathematical abstraction at the expense of managerial relevance and real-world implementation (see, for instance, (Ackoff 1979, Corbett and Van Wassenhove 1993)). Consequently, when the modern demand for data-driven optimization accelerated, the market sought a clean break from the perceived insularity of traditional academic OR, offering up new names like "analytics" to describe the outline of the field and expand its scope Davenport (2006), Saxena (2010).

However, attempting to delineate OR from these newer domains through technical differences—such as contrasting the mathematically puritan ethos of mathematical programming with the roughshod reputation of artificial intelligence—underplays the profound structural and social divides that govern the evolution of these disciplines. Data science, machine learning, and artificial intelligence emerged in prominence from different structural arenas: namely, decentralized industrial tech companies and the emergent computer science community (Breiman 2001, Donoho 2017). The society-altering development of the Internet, structurally associated with computer engineering rather than mathematical optimization, bestowed societal status and cultural currency upon computer scientists entering the twenty-first century (Abbate 1999, Ensmenger 2010). This occurred despite the historical reality that foundational Internet architectures, routing protocols, and network flow dynamics relied directly on theoretical breakthroughs pioneered by operations researchers (Baran 1964, Kleinrock 1964, 2002, Bellman 1958).

While professional societies have recognized this shifting landscape—evident in INFORMS' attempts to adopt the term "analytics" through the creation of the Certified Analytics Professional accreditation and the rebranding of this very journal from *Interfaces* to *The INFORMS Journal of Applied Analytics*—the underlying social and cultural divide remains pronounced. Those trained in the traditions of computer science and technical entrepreneurship maintain a distinct professional identity that resists assimilation into the INFORMS fold.

Crucially, what makes OR a distinct and vital discipline can certainly not be boiled down to technique. OR has its own developed philosophical outlook, distinct social group, and broad practical successes that are well documented in the pages of this journal and other INFORMS journals. Reduced to a collection of algorithms and mathematical techniques, we are quite susceptible to being subsumed into someone else's, even more comprehensive, algorithms.

We believe we can look to the early foundation of OR as a guide to our successful future. As detailed in this column, there are two essential currents. First is the grounding of OR in *science*: the pursuit of verified knowledge itself by those trained in the ethos and discipline of discovery. In particular, we find inspiration in Kittel's definition of OR as a scientific method to uncover truths in service of making hard and consequential decisions, as opposed to a suite of tools aimed at automating decision-making.

Second is our society's championing of the social role of the operations researcher as an *advisor* to decision-makers, deliberately eschewing the technocratic vision of Scientific Management for an elite of engineer-decision-makers—an impulse that undoubtedly lies nascent in the AI-fueled technological hype of our era.

If OR inherited Taylor's method while renouncing his ambition, AI may prove the truer heir of the ambition itself. Taylor's program was, at bottom, the substitution of systematized knowledge for individual judgment "in all matters relating to the work done in the establishment." The contemporary aspiration to build systems that *decide*, rather than merely inform and offer a platform for collaboration, recapitulates the promise of the New Machine, now rendered in silicon rather than stopwatches. Even the "mental revolution" has returned: just as Taylor promised that efficiency would dissolve the antagonism of labor and capital, today's champions of AI promise an abundance that will reconcile displacement with prosperity (Altman 2021, Amodei 2024, Brynjolfsson and McAfee 2014). OR, having watched this movie once, must again decline a starring role. That refusal — Blackett's insistence on science on behalf of executives rather than in place of them (quoted above) — was not a failure of nerve but a considered position on the politics of expertise.

Fortun and Schweber's observation (quoted above) also bears repeating for today. OR earned its postwar credibility by producing advice based on models that a skeptical executive, regulator, or citizen could interrogate and whose assumptions were stated, clear, and contestable. A "learned" system whose reasoning is not transparent cannot play this legitimating role, however impressive its predictive accuracy. If the demand for decisions that can be justified, and not merely made, persists in liberal societies — and there is every indication it is intensifying[6] — then the OR mode of transparent, contestable modeling is not a quaint predecessor to artificial intelligence but a civic complement to it.

We believe these two founding ideas of OR—a grounding in the ethos of scientific discovery and a wariness of the technocratic impulse—provide powerful principles for reinvigoration. Both ideas call for a re-introduction of the "human", a fascination that we believe should be recovered from the annals of Scientific Management, which OR may have been too hasty in discarding. After all, how do we advise a human decision-maker we do not ourselves understand, a point made explicit long ago in (Churchman and Schainblatt 1965)? We submit these topics for robust discussion in the cultural outlets of our field, including the pages of "Fifth Column" in this journal, and the influential "OR Forum" column in *Operations Research*, as well as panels and conversations in our conferences and online forums.

Notes

[1]The three biographies of Taylor's life include: Kanigel (2005), Nelson (1980), Copley (1923). Five other books we recommend as enlightening reading on Taylor and Scientific Management include the influential Marxist critique of Scientific Management in (Braverman 1974), details of how Scientific Management spread beyond the United States to Europe in Merkle (1980) and Japan in Tsutsui (1998), and how Scientific Management interacted with the progressive political movement in the United States Haber (1964).

[2]See, for example, the formulas given on page 109 of (Taylor 1911). See also the paper that introduced "Taylor's Equation" for tool life: (Taylor 1906).

[3]See, for example, discussion in (Lakatos 1976, Hodgson 2001, Mirowski 1999).

[4]This viewpoint is most forcefully captured in (Braverman 1974).

[5]Quoted in Alford (1934), page 264.

[6]This demand is increasingly codified — and contested — in law. In 2025 alone, thirty-eight U.S. states enacted roughly one hundred AI-related measures (National Conference of State Legislatures 2025); the European Union's AI Act phases in transparency and oversight obligations for high-risk automated decisions through 2026 (European Union 2024). Notably, even amid a deregulatory turn in U.S. federal policy (Executive Office of the President 2025) and Colorado's repeal of its comprehensive AI statute, the replacement regime retained disclosure and appeal rights for individuals subject to consequential automated decisions (Colorado General Assembly 2026) — suggesting that the requirement of justification, if not the surrounding compliance apparatus, is the durable core of the emerging settlement.

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