Letter to the Editor-in-Chief of the journal Technological Forecasting and Social Change

Serendipity and the Limits of Output-Based Research Evaluation

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Abstract

This letter responds to Park and Suh article, published in the journal Technological Forecasting and Social Change,, which investigates the emergence of use-inspired researchers within a South Korean public research institute using Stokes' Pasteur's Quadrant framework. While the study provides valuable empirical insights into the institutional dynamics of use-inspired research, two key issues warrant further discussion. First, the article does not consider the role of serendipity in scientific discovery. A growing body of literature in the sociology and philosophy of science emphasizes that many major breakthroughs arise from unexpected observations and exploratory inquiry rather than from narrowly defined research objectives. Contemporary research governance systems that prioritize predictable impact and measurable outputs may therefore overlook important mechanisms of scientific creativity. Second, the study relies heavily on patent counts as indicators of technological contribution. However, existing research suggests that patent statistics often provide an incomplete and potentially misleading representation of innovation.

Keywords: Pasteur's Quadrant; Research Metrics; Use-Inspired Research; Serendipity, Patents

1.The missing role of serendipity

The article *How are 'Pasteur researchers' formed and what contributions do they make? A case study of a research institute in Korea* by Yeonsoo Park and Dukrok Suh, published in the journal Technological Forecasting and Social Change, offers an interesting empirical exploration of the emergence and institutional role of "Pasteur-type researchers" within a public research institute in

South Korea. By applying the quadrant framework proposed by Donald E. Stokes in Pasteur's Quadrant: Basic Science and Technological Innovation, the authors attempt to understand how researchers who combine fundamental inquiry with practical application contribute to institutional scientific and technological performance. While the paper presents valuable empirical insights into the dynamics of use-inspired research, several conceptual and methodological issues deserve further discussion. A first point concerns the absence of any consideration of serendipity in scientific discovery. The study categorizes researchers according to citation impact and patent output, thereby associating "Pasteur researchers" with a combination of scientific productivity and technological application. However, the paper does not address the role of serendipity, a phenomenon widely recognized in the history and sociology of science as a key driver of major breakthroughs. Many landmark scientific discoveries illustrate the important role of unexpected observations in advancing knowledge. For example, Wilhelm Conrad Röntgen was not attempting to discover X-rays when he observed them while experimenting with cathode rays, and Alexander Fleming was not searching for a cure for bacterial infections when the accidental contamination of a Petri dish led to the discovery of penicillin. Research in the sociology and philosophy of science has increasingly emphasized that scientific discovery often results from the interaction between prepared minds and unforeseen circumstances, rather than from strictly goal-oriented research trajectories. In recent years, this insight has contributed to the emergence of a "science of serendipity," which seeks to systematically understand how unexpected discoveries arise and how environments can be structured to facilitate them (Copeland et al., 2023). Similarly, studies on creativity in research argue that serendipitous encounters with data, ideas, or collaborators can play a significant role in stimulating innovative thinking and enabling researchers to pursue novel lines of inquiry that were not initially anticipated (Kennedy et al., 2022). A growing body of literature further conceptualizes serendipity as a process involving the interaction between chance events and a researcher's cognitive preparedness, suggesting that unexpected findings become meaningful only when interpreted by individuals capable of recognizing their potential significance (Busch, 2024). The neglect of serendipity is particularly relevant in the context of contemporary research governance. As argued by Horta (2022), current research evaluation systems increasingly require scholars to predict the societal impact of their work even before research begins. In his words, "*academics are now, even at the start of research projects, asked to describe the ways in which their research will be impactful. This is not aligned with the notion of serendipity in science or the fact that many innovations leading to products used today were conceived without foreseen applications*." Horta further argues that this situation reflects a shift in the governance of science away from academic autonomy toward managerial and policy-driven priorities emphasizing measurable impact and application. According to this perspective, such conditions may even hinder scientific breakthroughs, since they privilege predictable and short-term outcomes over exploratory and curiosity-driven research. As Horta notes, this misalignment suggests that "academic research is to a large extent no longer governed by academics and that the idea of science that is dominant today overemphasises application and impact. In this context, the analytical framework adopted in the article by Park and Suh may inadvertently reflect the same emphasis on measurable outputs and application-oriented research. By classifying researchers according to citation impact and patent production, the study implicitly assumes that scientific activities can be neatly categorized according to their orientation toward knowledge generation or practical use. Yet the history of science suggests that breakthroughs frequently emerge from exploratory inquiry and unexpected findings that cannot easily be anticipated or planned. One might therefore question whether the authors implicitly treat the "Bohr" quadrant in Stokes' taxonomy as a proxy for serendipity-driven discovery, although such an interpretation is not explicitly discussed. A deeper engagement with the literature on serendipitous discovery and the changing governance of academic research could have enriched the theoretical framing of the study and offered a more nuanced understanding of how different research styles—and different modes of discovery—contribute to scientific progress.

2. The limits of patent-based innovation metrics

A second issue concerns the strong emphasis placed on patents as an indicator of technological contribution. In the article, patent counts are used as a primary measure of applied research output and serve as a central variable for distinguishing researchers categorized as belonging to the Pasteur quadrant. While patents are frequently employed as indicators of innovation and technological productivity, the relationship between patenting activity and broader economic or societal impact remains a subject of considerable debate within the literature. Several scholars have questioned whether the number of patents produced by researchers or institutions provides a reliable proxy for meaningful innovation or technological advancement. For example, research by Sweet and Eterovic (2019) has shown that increases in patenting activity do not necessarily translate into measurable economic growth. Their findings suggest that higher patent counts may reflect institutional incentives or strategic behavior rather than genuine technological breakthroughs with tangible economic benefits. Similarly, critical analyses have pointed out that a substantial proportion of the millions of patents granted globally have limited practical or economic value. Concerns about the limited real-world utility of many patents have also been highlighted in analyses of large patent datasets. An article in *The Economist* noted that although roughly 50 million patents have been granted globally—an impressive testament to human inventiveness—the overall collection often resembles an “intellectual junkyard,” containing plausible ideas that never attracted commercial interest, concepts that ultimately failed, and even outright absurdities. When the list is restricted to patents that remain legally in force, meaning those for which renewal fees continue to be paid, the number falls to approximately 16 million. The same analysis discussed efforts to estimate the economic value of patents, including the approach developed by the startup PatentVector. Using artificial intelligence to examine approximately 132 million patent documents held by the European Patent Office in Munich, PatentVector evaluates both the frequency with which a patent is cited and the influence of the patents that cite it in order to approximate its relative importance. (Pacheco-Torgal, 2022). Against this broader backdrop, specific cases further illustrate the limitations of equating patent activity with genuine technological advancement. In this regard, the question raised by Pacheco-Torgal (2022a)—*"among the vast multitude of patents granted thus far, how many share the same dubious 'quality' as those associated with Theranos?"*—is particularly revealing. The notorious case of the Theranos "unicorn"—once valued at approximately 10 billion dollars and supported by a portfolio of more than one hundred patents—illustrates the limitations of equating patent activity with genuine technological advancement. Despite this impressive patent portfolio and the substantial financial valuation attributed to the company, the underlying technologies were ultimately shown to lack robust scientific validation. In retrospect, many of these patents were built upon claims that were not supported by credible empirical evidence and therefore failed to generate meaningful technological or societal value. Further evidence questioning the reliability of patents as indicators of innovation is provided by the work of Taalbi (2025). Drawing on an extensive dataset of 4,460 innovations spanning several decades, the study reveals that the vast majority of these innovations were never patented at all. Even in cases where patents were filed, they captured only a relatively small fraction of the underlying innovation activity—approximately 15% of the overall innovation signal—leaving a substantial share of innovative efforts unreflected in patent records. This finding suggests that patents provide only a partial and potentially misleading representation of technological change, as a large proportion of innovation occurs through channels that are not formally protected by intellectual property rights. Consequently, relying exclusively on patent statistics risks overlooking significant forms of technological development, incremental improvement, and creative problem-solving that take place outside the patent system. Related concerns have also been raised in policy discussions within Europe. For instance, a commentary addressing debates within the European policy community noted that some officials from the European Commission have warned that innovation policy may be suffering from an "unhealthy obsession with patents." According to these critics, excessive reliance on patent metrics risks narrowing the understanding of innovation by prioritizing easily quantifiable indicators over more complex forms of knowledge creation and societal value generation (Pacheco-Torgal, 2022a). From this perspective, patents represent only one dimension of technological contribution and should be interpreted cautiously when used as a measure of the broader impact of scientific research. In this context, the heavy reliance on patent counts as a proxy for meaningful technological contribution may lead to questionable conclusions about the actual impact of researchers classified within the Pasteur quadrant. Patent statistics may capture certain forms of commercially oriented activity, but they do not necessarily reflect the depth, originality, or transformative potential of scientific discoveries. Consequently, the use of patent counts as a central evaluative metric may oversimplify the complex pathways through which scientific knowledge contributes to technological and societal progress.

Conclusion

The article by Park and Suh provides useful empirical insights into the emergence and institutional role of "Pasteur-type researchers." However, two issues deserve further consideration. First, the analysis does not address the role of serendipity in scientific discovery, despite substantial evidence that many major breakthroughs arise from unexpected observations and exploratory research rather than from predefined objectives. This omission is noteworthy because the history of science repeatedly demonstrates that unanticipated findings can open entirely new research directions and play a crucial role in shaping major scientific advances. Second, the strong reliance on patent counts as indicators of technological contribution may offer only a partial and potentially misleading representation of innovation. Empirical studies suggest that many patents have limited practical value, while a large share of innovation occurs outside the patent system. Innovation frequently emerges through informal knowledge exchange, cumulative experimentation, and incremental improvements that remain invisible in patent statistics.

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