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Monitoring Construction and Civil Engineering Innovation Metrics

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Abstract

The review presents and breaks down development measurements in development and structural designing, spaces which are found to linger behind different areas of science and innovation as far as advancement yield. In both academia and industry, research and development (R&D) receives particular attention. Eighteen of the field's oldest peer-reviewed journals, which have published more than a hundred thousand articles in the past fifty years, are used in the analysis of scientific production. The four verticals of new materials and systems (hardware), digitalization, environmental impact and novelty/efficiency are the focus of the study. The analysis reveals distinct rates of innovation for each vertical, some of which slow as innovation becomes standardized and commonplace, while others peak as a result of advancements in other scientific fields. The S-curve technology maturity framework, which takes into account development effort and time, as well as the widely used scale of technology readiness levels, is used to evaluate the results. In addition, a patent search of twelve key inventors and various technology areas is used to examine corporate innovation.

Keywords: Digitalization • Environmental impact • S-curve technology

Introduction

The current work aims to provide a comprehensive monitoring of the progress in the field that reflects capital, time and effort put together toward advancing propositions for future research. Despite the fact that there is no straightforward approach to present innovation metrics without taking into consideration the broader socio-political and economic context, Innovation reflects efforts to achieve competitive advantages and improve products and systems' overall techno-economic and environmental efficiency in times of crisis and prosperity. It is essential to first provide critical background on the breakdown of innovation by sector, territory and to distinguish between academic research and corporate innovation in order to comprehend the motivation behind the current work. The pace at which new ideas are developed and adopted varies across technological fields. When available data on innovation output by field is taken into consideration, the aforementioned preliminary gap that was discovered between publicly funded and corporate R&D becomes even more pronounced. The top two thousand R&D spenders were responsible for filing sixty percent of the world's the European Patent Office, the Japan Patent Office, the Korean Intellectual Property Office and the National Intellectual Property Administration in China). On the other hand, only 3% of all scientific articles published during the same time period were created by the same inventors. This reveals a significant initial gap between the two metrics, which are scientific output and patents. A comprehensive industrial R&D investment scoreboard reveals that only 61 of the world's 2500 largest R&D investors or 2.44 percent are construction and materials businesses, while the proportion of relevant investors among Europe's top thousand is comparable, at 3.5%.

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Description

It should be noted that, on the same scoreboard, chemicals, industrial metals, mining, or real estate investment and services are distinct categories. In addition, construction falls in the bottom quartile for intermediate ICT services, robot use, online sales revenue and ICT specialists in the taxonomy of sectors by quartile of digital intensity. Construction is in the second quartile for software investment, the third quartile for ICT tangible investment and the fourth quartile for intermediate ICT goods. The above further approve that development falls a long ways behind as far as Research and development and development with the chance for shutting the area's efficiency hole adding up to about $1.6 trillion. Despite the field's lack of innovation, one should keep in mind that construction-related spending makes up 13% of the world's GDP and that the building and construction industries are responsible for 39% of the world's emissions of greenhouse gases. Taking into account the above scene, the work introduced in this plans to lay out a thorough observing of development yield in the worldwide field of development with a particular spotlight on four verticals which are addressing essential support points to motivate, drive and develop advancements [1,2]. These are the verticals digitalization, the impact on the environment, new materials and systems (hardware) and overall novelty and efficiency. The current study keeps an eye on changes in construction and civil engineering-related scientific literature to see how far forward, mature and successful innovative ideas and methods have come in the past fifty years. By analysing and comparing patent output and scientific articles in relation to four key categories that inspire, drive and grow innovation, insight is provided into the distinction between academic research and corporate innovation. Based on this study's findings patent output, which is the result of corporate R&D and scientific literature, which is the result of academic research, are suggested as the two primary indicators that can be used to measure innovation in the field [3].

As a metric, the S-curve framework on technological maturity is used to evaluate the outcomes of the various studied verticals. The term "plateauing," which refers to an increase in technology maturity, varies by industry, but it generally begins between 15 and 20 years after first appearing in literature. Digitalization tools exhibit plateauing more clearly than physical systems or materials (hardware). Once a first innovation cycle has been established, it appears that certain terms produce a double S-curve, indicating an increasing interest in new developments. Equipment development shows more slow development rates when contrasted with computerized development, which approves a more drawn out status and reception cycle for actual items/

frameworks. Digitalization terms outperform the average growth rate of literature output, while hardware innovation generally performs below the overall growth rate. The research on nanomaterial is the most successful of the analyzed hardware vertical themes, with 1000 publications in for studies focusing on pre-cast materials and systems, reaching the same milestone took 45 years. Compared to the studied hardware and digital innovation, the environment-related focus is the newest trend, but it has grown steadily over the past few years and shows no signs of slowing down. About 10% of the total analyzed publications, or more than 10,000 articles per term, are found to address efficiency/optimization and novelty issues. Despite its predominant role in economic and social development, construction is not a patent-intensive industry and several indicators suggest it lags behind other industries in innovation adoption and R&D spending [4,5].

Conclusion

Individual patent strategies among the stakeholders analyzed appear to have a significant impact on both corporate innovation and patent output. However, when cement/minerals companies and other materials specialists' output is compared, distinct trends emerge. When viewed in terms of the socioeconomic landscape as a whole, these trends are found to be a reflection of the expansion of the sector as a whole. Both the number of patents issued and the number of scientific publications appear to reflect similar trends in particular areas, such as machine learning, which sees a peak in both indicators around 2012. This suggests that recent advancements in various scientific fields have led to growing interest in the field, resulting in a double S-curve of maturity. Published data covering more than fifty years shed light on the evolution of the innovation potential, revealing the aforementioned findings. The traction of innovations that filled gaps in previous research is examined. Their analysis suggests that opportunities for future research to fill current and future knowledge gaps are likely to follow the growing patterns captured for older and now well-established technologies in an effort to eventually address the $1.6 trillion productivity gap.

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Conflict of interest

No potential conflict of interest was reported by the authors.

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