

Digitizing Knowledge, Democratizing Innovation

Jung H. Kwon (University of Denver)

Shu Deng (University of Mississippi)

Haemin Dennis Park (University of Texas at Dallas)

KEYWORDS: Strategic Entrepreneurship Journal, Digitization, Google Patents, Life Sciences, Startup Innovation.

Startups in remote locations can now leverage digitized knowledge to compete on more equal footing with companies in established innovation hubs.

EDITOR'S NOTE: This article was produced in partnership with Strategic Entrepreneurship Journal, a leading academic journal, as part of our effort to highlight actionable, cutting-edge research on entrepreneurship. [Click here \(https://eiexchange.com/content/bringing-research-based-insights-to-a-wider-audience-our-partner\)](https://eiexchange.com/content/bringing-research-based-insights-to-a-wider-audience-our-partner) to read other insights from SEJ.

Today, the Internet's ocean of knowledge is only a few clicks away. However, throughout history, access to the knowledge necessary for innovation has often been severely limited by geography, institutional barriers, wealth, and other constraints. Only in the last 20 years or so have these barriers begun to break down meaningfully with the rise of open innovation and digital technologies. This shift has been nothing short of transformative for an entire generation of inventors.

Digitization has upended how entrepreneurs discover and develop ideas, turning the vast hoard of online knowledge into a gold mine for startups pursuing innovation. A prime example of the shift was the rapid digitization of inventive records, highlighted by the advent of Google Patents in 2006. While it seems clear that this type of online platform has democratized access to knowledge, bridging long-standing gaps in innovation potential among organizations, questions remain about who benefits, how much they benefit, and what remains to be done. What, then, are the

implications of digitizing knowledge for the democratization of innovation?

We examined this question in an article published in the *Strategic Entrepreneurship Journal*. As we will see, unpacking just how digitization has transformed innovation in the startup world provides practical insights for entrepreneurs, investors, and policymakers seeking to cultivate equitable and dynamic innovation ecosystems across diverse landscapes.

Pre-Digitization Challenges and How They've Changed

For many startups, innovation demands not only time and money, but also domain expertise that may be in short supply. Bottlenecks in the flow of expert knowledge can be particularly challenging for startups in technology-intensive industries.

Before digitization in the US, inventors seeking access to inventive records ran up against barriers in both geography and logistics. Access to critical knowledge about inventions and scientific discoveries (e.g., patents and scientific articles) was previously limited to individuals who could physically visit knowledge repositories, such as the United States Patent and Trademark Office (USPTO) archives, where the relevant files were stored. This situation disproportionately benefited startups near a USPTO archive, typically located in major metropolitan areas or at major universities, while leaving those in rural areas at a disadvantage.

The launch of Google Patents in December 2006 was a transformative milestone. By digitizing inventive records and offering user-friendly search functions, Google Patents reshaped startups' ability to access, identify, analyze, and utilize intellectual resources.



Think back to the early versions of search engines in the 1990s—with clunky interfaces, limited functionalities, and overwhelming amounts of unstructured data. Navigating these archival systems was anything but easy; even trained professionals found them confusing and time-consuming. In those days, the process of searching for relevant prior art was often slow, error-prone, and incomplete due to the sheer volume of unstructured data and less advanced search tools.

Google Patents changed the game. Users could now perform keyword-based searches, track citations, and browse inventor and assignee profiles, making navigation of complex datasets much easier. Making knowledge accessible, usable, and disseminable online was particularly transformative for startups in remote regions. These far-flung startups could now compete on a more level playing field with their big-city counterparts. That is the big picture, but interested stakeholders will still want to know: How exactly has digitizing knowledge democratized innovation?

Insights from our study: How digitization affects innovation

Using the 2006 advent of Google Patents as our research context, we examined the universe of startup innovation in the US life sciences industry from 2003 to 2010. Our findings indicate that the digitization of inventive records has enhanced the quantity and quality of patent applications for all startups, particularly for those located further away from the nearest USPTO archive. Moreover, digitizing knowledge has done more than simply open the door to inventions; it has also improved search effectiveness through digital search functionalities that help startups identify emerging technological trends, analyze competitors' innovation strategies as well as recent inventions, and uncover interdisciplinary opportunities for innovative endeavors.

For instance, a life sciences startup could utilize Google Patents to scan oncology patents, monitor the inventors and organizational owners behind them, and explore potential collaboration or licensing opportunities -- all without leaving their own office or lab. Over time, as logistical friction fell, the innovation trajectory for previously marginalized startups began to rise, unlocking breakthrough opportunities that once seemed out of reach.

We saw that digitization has supercharged entrepreneurial innovation in two main ways:

Search Efficiency: As digitization has dismantled the logistical barriers that previously restricted access to patent records, scientific articles, and other foundational knowledge, the process has become far more efficient. With Google Patents, startups can conduct comprehensive and in-depth searches remotely from their premises with just a few clicks, eliminating the need for physical travel and the associated expenses. This improvement is most noticeable for startups located far from the USPTO archives. For instance, a biotech startup in a small town in Montana can now instantly retrieve relevant records without spending days or even weeks searching through physical repositories, such as the Rocky Mountain Regional Office in Denver, Colorado, allowing its inventors to concentrate on research and development (R&D). This shift not only streamlines operations but also accelerates the pace of innovation by slashing the lag time between acquiring knowledge and deploying it.

Search Effectiveness: Digitization does not just make searches faster—it also makes them smarter. Features like keyword-based filters, citation tracking, and profiling of inventors and company owners enable startups to pick out precisely those tidbits needed to identify innovation opportunities from the vast ocean of knowledge. For instance, a biotech startup might utilize Google Patents to track forward and backward citations of a key patent and a scientific article to better understand its technological lineage and potential applications. Armed with a comprehensive map of the innovation terrain, a startup leveraging digitized knowledge can traverse a new technology development zone with greater confidence and reduced risk, such as of infringing on existing inventions or inadvertently duplicating inventions. No longer does physical distance equate to distant dreams; today, online search functionality puts inventors and their ideas in the same knowledge village, where innovations can freely cross-fertilize.



Figure 1. Digital Search Process in Startup Innovation

Key Findings

We find that digitization promotes extensive and in-depth knowledge searches, improving startups’ capacity to integrate new and scientific insights. Thus, this enhances the quantity, quality, novelty, and technological applicability of startup inventions. More importantly, these effects are most pronounced for startups located outside traditional innovation hubs, highlighting how digitization democratizes access to and use of innovation inputs, bridges gaps in expertise and geographic disparities, and provides more equitable opportunities for innovation.

To see just how much digitization has fueled a knowledge revolution in the American hinterlands, just take a look at the following chart visualizing our findings. The results show that for every 100-mile increase in distance from the nearest physical knowledge repository, digitization has enabled the number of scientific references quoted at a startup to grow by more than a quarter; input quantity and novelty to grow by about a third; and input quality to increase by nearly half, compared to the pre-digitization situation.

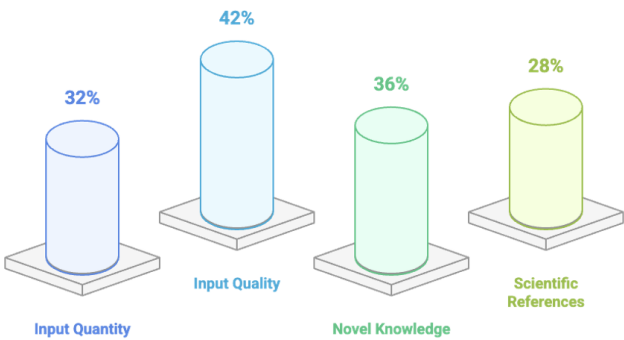


Figure 2-1. Innovation Inputs in the Digital Age

Digitization also transforms innovation outputs. After digitization, for every 100-mile increase in distance, startups experience significant jumps in patent application counts, invention applicability, and new technology entries, as well as a massive leap in application quality.

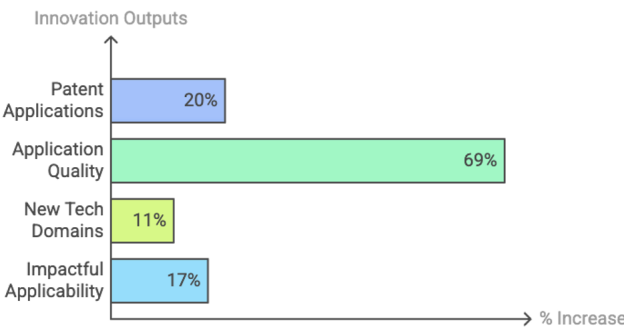


Figure 2-2. Innovation Outputs in the Digital Age

These findings emphasize the importance of digitizing knowledge as an economic equalizer for traditionally underprivileged startups, with potential for greater innovation. Indeed, we did *not* observe the same effects of digitization on the innovation of already established tech giants, including S&P 500 companies.

Implications for Entrepreneurs

A democratically broadened program of digitization extends beyond mere convenience in ways that could potentially modernize many startups’ strategies for future innovation. Harnessing these advantages, however, hinges on entrepreneurs choosing targeted orchestration that aligns with available opportunities. Successfully deploying these maneuvers in the battlefield of competition depends on a few key

principles of grand innovation strategy:

1. Integrate Digital Tools into R&D Workflows

Integrating digital archive search tools such as Google Patents into R&D workflows is crucial for conducting comprehensive analyses of prior art, identifying technological gaps, and tracking emerging trends. For instance, conducting assignee-based searches can help startups understand their competitors' technology portfolios, enabling them to position their innovations strategically within the market. Similarly, inventor-based searches can identify potential collaborators with the expertise needed for a planned project. Partner matching in this way has the potential not only to accelerate product development but also to build mutually beneficial relationships with talent or contractors.

2. Embrace Interdisciplinary Approaches

Because digitization reduces the barriers to accessing knowledge across diverse technology fields and industries, making it easy to integrate insights beyond one's domain expertise, entrepreneurs should actively seek interdisciplinary knowledge to drive innovation. For instance, a biotech startup might leverage advances in artificial intelligence (AI) to create predictive models for drug discovery, developing innovative solutions that set new industry standards.

3. Cultivate a Workforce

Startups can fully reap the benefits of digitization only when their workforce possesses the skills to navigate these new platforms effectively. It's crucial to invest in training to enhance employees' digital literacy. For instance, employees trained in advanced invention search functionalities can discover valuable insights that might otherwise go unnoticed, leading to more informed decision-making in R&D and technology strategy. Hiring for complementary skills is also crucial. Attracting experts in data analytics, machine learning, and intellectual property (IP) management could act as a force multiplier for digitization's revolutionary powers.

Policymakers' Role in Fostering Inclusive Innovation

For policymakers keen to realize the latent societal benefits of digitization by fostering an environment that supports startup growth, the following initiatives would assist in achieving this goal:

1. Expand Digital Infrastructure

While digitization has democratized access to knowledge, its benefits remain contingent on robust digital infrastructure. Policymakers should prioritize increasing investments in high-speed broadband and public search stations, especially in rural and underserved communities. Ensuring equitable access to digital platforms and AI (such as ChatGPT) will enable startups in these regions to compete on an equal footing with their urban or university-town counterparts.

2. Incentivize Knowledge Sharing and Collaboration

Policymakers can promote collaborative innovation by offering tax credits, grants, and subsidies to incentivize cross-disciplinary research or public-private partnerships. Such deliberately cultivated synergies have the potential to accelerate groundbreaking solutions and foster a culture of openness and shared progress within innovation ecosystems.

3. Support Skills Development and Capacity Building

State governments should invest in education and training programs to equip both entrepreneurs and employees with the skills needed to fully leverage big data and digitization. By forming partnerships with local universities and industry groups, neglected areas can develop a talent pipeline and link it to entrepreneurial innovations.

Looking Ahead

These implications carry particular weight in rapidly growing industries such as AI, robotics, and quantum computing. These fields have undergone rapid evolution, roiled by high uncertainty as new technologies have branched off from older ones, or even upended entire industries. Here, there is no substitute for the ability to quickly identify which inventive records might be relevant, detect emerging trends, and reposition oneself in dynamic IP landscapes. As new algorithms, applications, and architectures constantly emerge, the pace and breadth of innovation make timely access to up-to-date knowledge ever more critical. For instance, an AI startup developing a novel machine learning model must navigate an increasingly complicated IP thicket crowded with overlapping claims. Amid this confusion, digitizing knowledge enables startups to assess the novelty of their ideas, benchmark against prior art, and flag potential infringements before they escalate into legal disputes.

Moreover, digital search tools can further enhance the utility of entrepreneurial inventions when integrated with machine learning and natural language processing. Powered by digitally searchable data, predictive analytics can identify areas for improvement in existing innovation processes or assist in the commercialization of new innovations. These insights help startups improve their likelihood of survival and growth by focusing on technological specialization that aligns with the evolving technological frontiers. In fields like AI, where the rapid recombination of existing knowledge components catalyzes a competitive advantage, digitized knowledge databases have become an indispensable source of training data for even more discovery. For instance, a startup specializing in AI for healthcare diagnostics might bridge two traditionally siloed disciplines by examining inventive records across medical imaging and deep learning.

Beyond the level of individual startups, digitization appears poised to reshape entire innovation ecosystems. By leveling the playing field, digitization has challenged traditional notions of geographic clustering and agglomeration economies such as California's Silicon Valley, Massachusetts's Kendall Square, North Carolina's Research Triangle, and Texas's Silicon Prairie. Increasingly, startups in previously underserved small towns can leverage digitization to compete on more equal footing with companies in established innovation hubs, potentially fostering a more inclusive entrepreneurial landscape. Yet, even as digitization has unlocked significant opportunities, it also presents new challenges.

As the saying goes, "too much of a good thing" can become a liability. Beyond a certain point, overreliance on digital tools may hinder creativity, particularly in industries that require high levels of discretion and originality. Likewise, the sudden influx of external knowledge brought about by digitization can overwhelm the decision-making process at less experienced startups, potentially leading to paralysis by analysis. To mitigate these issues, startups must strike a balance between leveraging digital resources and nurturing the human intelligence that fuels transformative innovation. Policymakers, meanwhile, should prioritize establishing regulatory frameworks that promote the ethical and equitable use of digital tools. These considerations will only grow in importance as emerging technologies like quantum computing continue to reshape the innovation landscape, presenting new opportunities while raising

critical questions about accountability, inclusivity, security, and IP rights.

Explore the Research

Kwon, J. H., Deng, S., & Park, H. D. (2025). [Startup Innovation in the Digital Era](https://sms.onlinelibrary.wiley.com/doi/10.1002/sej.1537). (https://sms.onlinelibrary.wiley.com/doi/10.1002/sej.1537) *Strategic Entrepreneurship Journal*.