

# Scientific foundations of the MARE TechPark

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## New Ideas are getting harder to find

The growth in productivity in industrialized countries has significantly slowed down since the 1970s, with a particularly noteworthy deceleration since the early 2000s. In the EU, the annual productivity growth rate fell from 1.6% (1995-2007) to just 0.9% (since 2008), while in the US, it halved from 2.1% to 1.1% over the same period.<sup>1</sup>

In Germany, the hourly productivity growth rate declined from an average of 2% in the 1990s to only 0.8% in the 2010s. This phenomenon is often referred to as the "productivity paradox" because it occurs despite ongoing technological innovations and digital advancements.<sup>2,3</sup>

A research paper from the National Bureau of Economic Research, published in the *American Economic Review* magazine, titled "Are Ideas Getting Harder to Find?" captures this issue well:

"In many growth models, economic growth arises from people creating ideas, and the long-run growth rate is the product of two terms: the effective number of researchers and their research productivity. We present a wide range of evidence from various industries, products, and firms showing that research effort is rising substantially while research productivity is declining sharply. A good example is Moore's Law. The number of researchers required today to achieve the famous doubling every two years of the density of computer chips is more than 18 times larger than the number required in the early 1970s. Across a broad range of case studies at various levels of (dis)aggregation, we find that ideas — and in particular the exponential growth they imply — are getting harder and harder to find. Exponential growth results from the large increases in research effort that offset its declining productivity."<sup>4</sup>

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<sup>1</sup> <https://www.wirtschaftsdienst.eu/inhalt/jahr/2017/heft/2/beitrag/schwaches-produktivitaetswachstum-zyklisches-oder-strukturelles-phaenomen.html>

<sup>2</sup>Karl Brenke, "Produktivitätswachstum sinkt trotz steigendem Qualifikationsniveau der Erwerbstätigen", Detusches Institut für Wirtschaftsforschung, Wochenbericht 33/2019;

<sup>3</sup> <https://www.derstandard.at/story/2000055396451/produktivitaet-innovative-ideen-ohne-wirkung>

<sup>4</sup> Bloom, N., Jones, C. I., Van Reenen, J. & Webb, M. Are ideas getting harder to find? *Am. Econ. Rev.* **110**, 1104–1144 (2020)

## The AI implementation Gap

One would think that in the age of AI, this problem could be easily overcome, due to the vast potential of this new technology. However, especially in the field of AI there turn out to be significant implementation problems, so that the term “AI implementation gap” was coined.

The implementation gap in artificial intelligence (AI) represents a significant challenge for organizations seeking to translate AI innovations into practical applications. As reported by Harvard School of Public Health, this gap is particularly visible in clinical practices, highlighting the broader struggle across industries to effectively deploy AI technologies despite their potential benefits.<sup>5</sup>

## Data Quality and Knowledge Transfer

Among many others, two barriers for faster AI implementation are Data Quality and knowledge transfer:

Data quality emerges as a critical obstacle in AI implementation, often undermining the effectiveness of AI systems. Poor data quality can lead to inaccurate predictions, flawed decision-making, and diminished trust in AI technologies.<sup>6</sup>

Organizations frequently grapple with inconsistent, incomplete, or erroneous data, which can result in unreliable AI models and misleading outputs. A recent study by AvePoint, in collaboration with the Association for Intelligent Information Management (AIIM) and the Centre for Information Policy Leadership (CIPL), highlights that data quality is a significant barrier to the adoption of generative AI technologies. Key findings from the report include:<sup>7</sup>

- **Data Quality Challenges:** 95% of organizations encounter obstacles during AI implementation, with data quality being the most prevalent issue.

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<sup>5</sup> <https://hsph.harvard.edu/exec-ed/news/implementation-gap-artificial-intelligence-help-patients-clinical-practices/>;

<sup>6</sup> <https://research.aimultiple.com/data-quality-ai/>

<sup>7</sup> <https://campustechnology.com/articles/2024/04/10/report-ai-adoption-hindered-by-data-quality.aspx>

- Perceived vs. Actual Data Readiness: While 80% of organizations believe their data is prepared for AI, over half (52%) face challenges related to data quality and categorization during implementation, indicating a gap between perception and reality.
- Information Management Maturity: Organizations with mature information management strategies are 1.5 times more likely to realize AI benefits compared to those with less developed strategies.
- Lack of Governance: More than half (53%) of organizations use public AI tools without an AI Acceptable Use Policy, posing risks such as loss of intellectual property and competitive disadvantage.
- Data Volume Management: 64% of organizations manage at least 1 petabyte of data, and 41% handle at least 500 petabytes, underscoring the need for effective information management strategies to handle growing data volumes.

Effective knowledge transfer is another crucial factor for successful AI implementation, yet organizations often face significant barriers in this area. The lack of cooperation between departments and stakeholders can hinder the adoption of AI technologies, creating silos that impede the flow of critical information and expertise.<sup>8</sup>

This challenge is compounded by:

- Limited understanding of AI concepts among non-technical staff, leading to resistance or misalignment with organizational goals
- Insufficient communication between technical teams and business units, resulting in AI projects that fail to address real-world needs
- Difficulties in translating complex AI concepts into practical applications that non-experts can understand and utilize
- The need for better collaboration between academia, industry, and government to bridge the gap between AI research and implementation

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<sup>8</sup> Averill Campion, Mila Gasco-Hernandez et al.; “Overcoming the Challenges of Collaboratively Adopting Artificial Intelligence in the Public Sector”, *Social Science Computer Review*, Volume 40 Issue 2, April 2022

## The need for more physical cooperation in research

Recent studies have highlighted the importance of physical proximity for fostering innovative and productive research environments. The lack of physical proximity in research settings is an underestimated problem that can significantly impact the efficiency and effectiveness of scientific collaboration. This is not a new finding, but in the age after Covid 19, home office, videoconferences and reduced research productivity, its relevance is increasing.

### The Allan Curve

The research of Thomas J. Allen, a former MIT Professor, on physical proximity and its relationship to communication and innovation is foundational in understanding how spatial arrangements impact organizational performance. His studies, particularly those from the 1970s, gave rise to the concept of the “Allen Curve”, which illustrates how communication frequency between individuals decreases exponentially as physical distance increases.

Allan's demonstrated in his book “Managing the Flow of Technology”, that individuals seated within 10 meters of each other are in an “optimal communication zone,” where interaction is most frequent. Beyond 25 meters, communication drops significantly, and at distances over 50 meters, it becomes rare.<sup>9</sup>

Interestingly, this effect holds true across various forms of communication—including face-to-face, telephone, and email—indicating that physical proximity fosters not just direct interaction but also engagement through other mediums.<sup>10</sup>

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<sup>9</sup> Thomas J Allen, „Managing the flow of technology: technology transfer and the dissemination of technological information within the R&D organization”; 1977

<sup>10</sup> Thomas Allen, Gunter Henn, „The Organization and Architecture of Innovation”, London 2006

## Spatial proximity matters in research and innovation

Allans findings have been confirmed by various scientists in recent years. A study published in *Management Science* in December 2024 reveals significant insights into the impact of physical proximity on startup innovation within coworking spaces.<sup>11</sup>

The research, conducted by Harvard Business School assistant professor Maria Roche and her colleagues, offers valuable findings for organizations balancing in-person and remote work strategies. The study found that physical closeness plays a crucial role in knowledge sharing among startups. The most significant influence occurs within a 20-meter (65-foot) radius, with the probability of technology adoption increasing by 3 percentage points for startups within this range. Beyond the 20-meter threshold, the impact of proximity diminishes quickly. Doubling the distance between firms reduces the likelihood of technology adoption by 1.7 percent. Startups located more than 20 meters apart behave as if they are on entirely different floors. Knowledge spillovers are most pronounced between startups that differ in product markets and socio-demographic features. The rate of peer technology adoption increased by 3.7 percent when involving companies in different markets. The study revealed that social interactions among startup employees enhance knowledge sharing. When startups share common areas like kitchens, the "distance of influence" increases, allowing knowledge to spread to startups located farther apart. Startups in moderately diverse environments (within 20 meters) that engage in knowledge sharing and participate in coworking social events are more likely to receive at least \$1 million in seed funding. This research underscores the importance of fostering physical proximity and social interactions in coworking spaces to enhance knowledge spillovers and increase the likelihood of startup success.<sup>1213</sup>

Another study titled "Spatial proximity matters: A study on collaboration" by Salazar Miranda and Claudel examines the impact of physical proximity on collaborative

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<sup>11</sup> Maria Roche et al.; „Proximate (Co-)Working: Knowledge Spillovers and Social Interactions”, *Management Science* 2024;

<sup>12</sup> Maria Roche et al.; „Proximate (Co-)Working: Knowledge Spillovers and Social Interactions”, *Management Science* 2024;

<sup>13</sup> <https://www.library.hbs.edu/working-knowledge/how-much-does-proximity-influence-startup-innovation>

activities among researchers at the Massachusetts Institute of Technology (MIT) from 2005 to 2015. The authors leverage a natural experiment created by building renovations that relocated faculty members to assess how these changes in spatial proximity influenced co-authorship rates.<sup>14</sup>

The study found that moving researchers into the same building significantly increases their likelihood of collaboration. Specifically, researchers who co-locate in the same building increase their collaboration rate by an average of 1.85 additional papers per hundred pairs five years after the move. The peak effect occurs three years post-move, where the collaboration rate can increase by up to 2.7 papers per hundred pairs. The authors explain that the increase in collaboration does not occur immediately but follows a typical academic publication cycle, where it takes time for new collaborations to materialize into published work. The findings suggest that buildings hosting researchers from similar or related fields and multiple departments enhance collaboration rates even further. This indicates that not just proximity, but the organizational composition of a building plays a crucial role in fostering collaborative efforts. Importantly, the study found no evidence that researchers who were relocated to the same building were collaborating prior to their move, reinforcing the argument that physical proximity itself is a significant factor in enhancing collaboration.<sup>15</sup>

### “Remote collaboration fuses fewer breakthrough ideas”

The study “Remote collaboration fuses fewer breakthrough ideas”, published in *Nature* on November 29, 2023, investigated the impact of remote collaboration on scientific and technological innovation. The researchers analyzed 20 million research articles and 4 million patent applications from the past half-century to examine how geographical distance between team members affects the production of breakthrough ideas.<sup>16</sup>

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<sup>14</sup> Salazar Miranda and Claude, „Spatial proximity matters: A study on collaboration”; 2021

<sup>15</sup> Salazar Miranda and Claude, „Spatial proximity matters: A study on collaboration”; 2021

<sup>16</sup> Lin, Frey and Wu, „Remote collaboration fuses fewer breakthrough ideas”, *Nature* 2023

Over the past 50 years, there has been a significant increase in remote collaboration across cities in both scientific research and patent applications. The average distance between team members has grown from 100 km to nearly 1,000 km for papers and from 250 km to 750 km for patents. However, despite this increase, distributed teams are consistently less likely to produce breakthrough discoveries compared to their on-site counterparts. The probability of disruption (a measure of breakthrough innovation) falls from 28% to 22% for papers and from 67% to 55% for patents as collaboration distance increases from 0 km to more than 600 km. This suggests that while remote collaboration expands access to diverse expertise, it also introduces barriers to high-impact innovation. One of the key reasons behind this trend is the nature of tasks performed by remote versus on-site teams. Remote teams tend to focus more on late-stage, technical tasks involving codified knowledge, whereas on-site teams are more likely to engage in early-stage conceptual tasks such as conceiving new ideas and designing research. Notably, the same scientists exhibit different behaviors depending on their work setting: they are more likely to contribute to conceiving research and writing papers when on-site, while tending to carry out experiments and analyze data when working remotely. This distinction highlights the importance of physical presence in fostering creative and ideation-driven processes.<sup>17</sup>

Moreover, on-site teams are more likely to involve less established researchers in conceptual work, whereas remote teams tend to assign them technical tasks. This difference affects the opportunities for idea generation among emerging scholars, potentially limiting their long-term development and contribution to disruptive innovations. While remote collaboration allows for more combinations of knowledge, it also makes it harder for teams to integrate diverse ideas effectively. This challenge may explain why increased connectivity has not led to the surge in innovation predicted by recombinant growth theory. Despite advancements in digital technology, physical proximity remains crucial for fusing breakthrough ideas. Face-to-face interactions continue to play a critical role in conceptual tasks and early-stage idea development, reinforcing the persistent value of proximity. As a result, while remote work may favor incremental innovation, it often does so at the expense of disruptive discoveries. This

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<sup>17</sup> Lin, Frey and Wu, „Remote collaboration fuses fewer breakthrough ideas”, Nature 2023



trade-off has significant implications for both short-term exploitation of existing ideas and long-term progress driven by groundbreaking research.<sup>18</sup>

The reduced involvement of emerging researchers in conceptual tasks within remote teams may also impact the development of future innovative talent. Given these findings, policymakers and managers should carefully consider the trade-offs between remote and on-site work when aiming to foster innovation. Investments in physical infrastructure to reduce travel costs and improve housing affordability in knowledge industry clusters may be just as important as digital infrastructure development in ensuring that in-person collaboration remains feasible and beneficial. In conclusion, this study highlights the continued importance of in-person interaction for generating breakthrough ideas in science and technology, even in the age of advanced remote work technologies. Rather than favoring one approach over the other, a balanced strategy that integrates both remote and on-site collaboration may be necessary to optimize innovation outcomes and ensure sustained progress in scientific and technological fields.<sup>19</sup>

## MARE is bridging the AI implementation gap – from Venice to the world

The MARE TechPark is built on scientific principles emphasizing physical proximity and collaboration as key drivers of innovation and productivity. By fostering knowledge exchange in a dynamic ecosystem, it directly addresses the AI implementation gap and removes barriers to practical applications.

Its design is informed by the Allen Curve, ensuring workspaces and communal areas are within an optimal radius to enhance collaboration. The park's campus system connects research institutions, companies, and startups, promoting interdisciplinary cooperation and breakthrough innovations.

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<sup>18</sup> Lin, Frey and Wu, „Remote collaboration fuses fewer breakthrough ideas”, Nature 2023

<sup>19</sup> Lin, Frey and Wu, „Remote collaboration fuses fewer breakthrough ideas”, Nature 2023

A balanced mix of remote work and personal interactions enhances creativity, while communal spaces like cafeterias and lounges facilitate informal networking. High-quality living and working conditions help attract and retain top talent, ensuring a vibrant innovation environment.

By integrating diverse expertise and supporting young researchers, the MARE TechPark fosters pioneering AI advancements. This holistic approach leverages the benefits of physical proximity and modern technology, creating the ideal conditions for transformative progress.

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