

AI-DRIVEN PRODUCTIVITY TRANSFORMATION FOR A COMPETITIVE UNITED KINGDOM ECONOMY

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ABSTRACT

The United Kingdom faces a persistent productivity puzzle that has seen output per hour stagnate since the 2008 financial crisis. This paper investigates the role of Artificial Intelligence (AI) as a general-purpose technology capable of breaking this cycle. By analysing the diffusion of AI across the UK service and manufacturing sectors, the research explores how these technologies transition from mere automation tools to drivers of cognitive augmentation. Let me explain: the core argument posits that the UK's competitive advantage lies not in the raw adoption of AI, but in the institutional and cultural readiness to reorganise business models around these capabilities. Through a critical review of existing economic frameworks and recent UK-specific data, this study demonstrates that effective business decision-making now requires a synthesis of human intuition and algorithmic precision. Here is what matters: without a fundamental shift in management practices and a focused investment in human capital, the productivity gains of the AI era will remain elusive.

KEYWORDS: *Artificial Intelligence, Productivity Puzzle, Cognitive Augmentation, General Purpose Technology, Resource Based View, United Kingdom Economy.*

INTRODUCTION

British economic history is currently defined by a troubling paradox. Despite being a global leader in financial services, creative industries, and higher education, the United Kingdom has struggled to translate its technological prowess into meaningful productivity growth for over fifteen years. Statistics from the Office for National Statistics (2023) suggest that if productivity had followed its pre-2008 trajectory, the average British worker would be significantly wealthier today. This is not just a statistical curiosity; it is a systemic failure that threatens the nation's long-term competitiveness.

The emergence of generative and predictive Artificial Intelligence offers a potential exit ramp from this stagnation. However, we must be careful not to view AI as a simple plug-and-play solution. History shows us that general-purpose technologies, such as electricity or the steam engine, take decades to manifest in national accounts because they require a complete overhaul of how we work (Brynjolfsson, Rock and Syverson, 2021). For the UK, the challenge is twofold. First, we have the technical barrier of integrating complex systems into a landscape dominated by small and medium-sized enterprises. Second, there is a human barrier: the need for a workforce that can collaborate with machines rather than compete with them.

This research aims to dissect the mechanics of this transformation. We are looking at more than just cost-cutting. The bottom line is that AI-driven productivity is about expanding the boundaries of what a firm can achieve. Whether it is a law firm in London using large language models to expedite discovery or a manufacturer in the Midlands employing digital twins to optimise supply

chains, the goal is the same: creating more value with the same or fewer resources. By applying the Resource-Based View (RBV) of the firm and the Productivity J-Curve theory, this paper will evaluate how the UK can leverage its unique economic strengths to become a global hub for AI-driven growth.

Literature Review: The Productivity Puzzle and the AI Solution

The UK Context: A Decade of Stagnation

To understand where we are going, we have to look at where we have been stuck. The UK's productivity gap compared to G7 peers like the United States and Germany is well-documented. Haldane (2018) famously pointed to a long tail of underperforming firms that drag down the national average. While the top 1% of British companies are world-class, the vast majority are slow to adopt even basic digital tools. This diffusion gap is the primary reason why the digital revolution has not yet moved the needle on GDP per capita as expected.

Coyle (2021) argues that our traditional methods of measuring productivity are increasingly unfit for a digital economy. When a business uses AI to improve customer service or speed up research and development, the value added is often intangible. It does not always show up in the same way that producing another ton of steel does. This measurement problem suggests that the UK might be making more progress than the headline figures suggest, but it also highlights a lack of strategic focus on how digital investments are directed.

AI as a General-Purpose Technology (GPT)

The most useful way to think about AI is through the lens of GPT theory. For a technology to be classified as a GPT, it must be pervasive, capable of ongoing improvement, and able to spawn innovations in other sectors (Bresnahan and Trajtenberg, 1995). AI fits this description perfectly. Unlike a specific piece of software designed for a single task, AI is a layer that sits beneath the entire economy.

The concept of the Productivity J-Curve is essential here. Brynjolfsson, Rock and Syverson (2021) explain that when firms invest in a new GPT, productivity often appears to dip initially. This happens because the company is spending time and money on intangible assets, retraining staff, redesigning workflows, and experimenting with new business models, that do not immediately produce output. In the UK, many sectors are currently in the trough of this J-Curve. The investment is happening, but the harvest has not yet begun.

Cognitive Augmentation vs. Simple Automation

Much of the early literature on AI focused on the fear of job displacement. Autor (2015) provided a more nuanced view, suggesting that while machines take over routine tasks, they simultaneously increase the value of the human skills that complement those tasks. For the UK economy, which is 80% services-based, this is the critical lever.

In professional services, for example, the value of a consultant or an accountant is no longer in their ability to process data; the AI does that more accurately and faster. Instead, their value lies in judgment, ethics, and complex problem-solving. This shift requires a move toward what Acemoglu and Restrepo (2019) call task-based displacement and reinstatement. As AI automates old tasks, it creates new, more complex ones that require human oversight. The competitive advantage for the UK will come from how quickly we can transition our labour force into these augmented roles.

Methodology: The Framework of Investigation

To understand a phenomenon as fluid as AI adoption, we cannot rely on a single data point. The methodology for this research employs a multi-dimensional secondary analysis, synthesising

quantitative data from the Office for National Statistics with qualitative insights from industry reports and academic case studies. Let me explain why this matters. A purely statistical approach would capture the number of firms using AI but would fail to explain how that technology changes the internal logic of a business.

The primary tool utilised here is the Resource Based View or RBV. This model allows us to investigate whether AI is being treated as a commodity that any firm can buy, or as a strategic asset that provides a sustainable competitive advantage. For a technology to be a source of long-term productivity, it must be valuable, rare, inimitable, and supported by the organisation (Barney, 1991). We are also applying the Dynamic Capabilities framework (Teece, 2007). This is crucial because the UK economy is highly volatile. The ability of a firm to sense, seize, and transform its operations in response to AI is the true metric of its future success.

The investigation follows a deductive reasoning path. We take the broad theories of General Purpose Technologies and test them against the specific realities of the UK service and manufacturing sectors. By selecting literature from high impact journals such as the Journal of Economic Perspectives and the Strategic Management Journal, the study ensures that the arguments are grounded in rigorous, peer reviewed evidence. Bottom line: the methodology is designed to bridge the gap between abstract economic theory and the grit of daily business operations.

Sectoral Analysis: Where the Rubber Meets the Road

The Service Sector: Beyond Automation to Augmentation

The United Kingdom is a service based superpower. Whether it is the City of London's financial engine or the legal and creative clusters in Manchester and Edinburgh, this sector is the heart of the national economy. However, it is also where the productivity puzzle is most visible. Traditionally, services have been resistant to productivity gains because they rely so heavily on human time. A lawyer can only read so many pages in an hour; a consultant can only attend so many meetings.

AI changes this equation by decoupling output from human hours. In the legal sector, large language models are already being used to perform contract analysis that used to take junior associates days. This is not just about doing the same work faster. It is about allowing those lawyers to focus on high value strategy and client empathy. Susskind (2020) argues that the professions are undergoing a fundamental transformation where the core value is no longer the hoarding of knowledge, but the application of that knowledge through technology.

In financial services, the shift is even more pronounced. Quantitative trading has existed for years, but the new wave of AI is moving into retail banking and insurance. Here, the productivity gain comes from hyper personalisation. By using machine learning to assess risk in real time, banks can offer better products with lower default rates. This is a classic example of how AI supports effective business decision making. Instead of relying on broad, lagging indicators, managers can make choices based on granular, real time data.

Manufacturing: The Industrial Rebirth

While the service sector is the largest part of the UK economy, manufacturing remains vital for exports and regional development. The concept of Industry 4.0 has been discussed for a decade, but AI is the missing link that makes it work. In the automotive and aerospace hubs of the Midlands and the North, the integration of digital twins is a game changer. A digital twin is a virtual replica of a physical asset. By running simulations on the twin, engineers can predict when a part will fail before it actually does.

Predictive maintenance reduces downtime. In a high precision manufacturing environment, an hour of lost production can cost hundreds of thousands of pounds. According to a report by PwC (2023), AI driven manufacturing could add billions to the UK GDP by 2030, provided that the investment is matched by skills. The challenge for British manufacturing is the legacy of underinvestment in physical capital. AI cannot fix a broken machine, but it can make a modern production line significantly more efficient than its competitors in Europe or Asia.

The use of AI in supply chain management also offers a buffer against the shocks the UK has faced in recent years. By using neural networks to predict supply bottlenecks, firms can pivot their sourcing strategies before a crisis hits. This demonstrates the ability to select and effectively utilise tools of investigation within the firm itself. It moves the business from a reactive stance to a proactive one.

Strategic Decision-Making: The Shift from Intuition to Evidence

The most profound impact of AI on the UK economy is not happening on the shop floor or in the call centre; it is happening in the boardroom. For decades, business leadership was often driven by the Highest Paid Person's Opinion, or HiPPO. AI is dismantling this hierarchy by democratising data. When an algorithm can provide a probabilistic forecast of market trends with 90% accuracy, the role of the CEO shifts from being a visionary to being a curator of intelligence.

This transition requires a new set of intellectual skills for leaders. They must understand the limitations of the models they use. This includes being aware of algorithmic bias and the quality of the data being fed into the system. In the UK context, where corporate governance is highly scrutinised, the ethical application of AI is a competitive necessity. Effective business decision making now involves a triad of inputs: data driven insights, ethical considerations, and human intuition (Davenport and Ronanki, 2018).

A firm that adopts AI but keeps its old hierarchical decision making structures will fail to see productivity gains. The technology demands a flatter, more agile way of working. This is where the UK has a potential advantage. The British business culture is generally more flexible than the more rigid structures found in some other major economies. If we can marry this cultural agility with deep technical integration, the productivity transformation will be unstoppable.

Human Capital: The Skills Gap and the Great Re-skilling

The most sophisticated AI system is essentially inert without a workforce capable of directing its power. For the United Kingdom, the human capital challenge is perhaps more daunting than the technical one. We are currently witnessing a shift in the very definition of professional competence. In the previous industrial era, value was derived from specialised, repeatable skills. In the AI era, value is derived from the ability to navigate ambiguity and manage complex systems.

The UK skills gap is a well documented phenomenon. Reports from the Department for Education (2023) suggest that a significant portion of the current workforce lacks the basic digital literacy required to engage with AI tools. This is not just about coding or data science. We are seeing a demand for transversal skills such as critical thinking, ethical reasoning, and emotional intelligence. These are the traits that AI cannot easily replicate.

Li and Hughes (2022) argue that the UK must move toward a model of lifelong learning to avoid a bifurcated labour market. If only a small elite can leverage AI, the national productivity average will remain low. The idea is that the UK needs a radical overhaul of its vocational training and higher education systems. We must move away from the idea that education ends in your early twenties. Instead, we need a flexible system where workers can dip back into training to update their skills as technology evolves.

This brings us to the concept of the Great Re-skilling. This is not merely a policy goal but a business necessity. Companies that invest in their staff's ability to work alongside AI see far higher returns than those that simply replace workers with software. This is because the most productive outcomes occur at the intersection of human intuition and machine speed. For the UK to be competitive, it must encourage an environment where the labour force views AI as a partner rather than a predator.

The Policy Landscape: Navigating Innovation and Regulation

The role of the state in the AI revolution is to provide a stable, predictable environment for investment while protecting the public interest. The UK government has positioned the nation as a global leader in AI safety and regulation, as seen in the 2023 AI Safety Summit at Bletchley Park. However, there is a delicate balance to be struck between safety and speed.

The UK's pro-innovation approach to AI regulation, outlined in the Department for Science, Innovation and Technology (2024) white paper, seeks to avoid the rigid, top-down structures seen in some other jurisdictions. By using existing regulators to oversee AI within their specific sectors, the UK aims to remain agile. This is a strategic choice. This can be done by allowing the Financial Conduct Authority or the Health and Safety Executive to tailor rules to their specific industries, the government avoids a one-size-fits-all approach that could stifle niche innovations.

However, regulation is only one half of the policy equation. The other half is infrastructure. AI requires immense computational power and data storage. For the UK to remain competitive, it must invest in its sovereign data capabilities and energy infrastructure. The high cost of electricity in the UK is a silent killer of AI growth. Data centres are energy intensive, and if the UK cannot provide affordable, green energy, the AI industry will simply migrate to countries with better infrastructure.

Furthermore, the UK must leverage its strengths in research and development. Our universities are global hubs for AI theory, but we often struggle with commercialisation. This is the valley of death where great ideas go to die because they cannot find the venture capital or the scaling support they need within the UK. Policy interventions like the Mansion House Reforms, which aim to unlock pension fund capital for high growth companies, are a step in the right direction. But the bottom line remains that; the UK must become a place where it is as easy to scale a business as it is to start one.

Discussion: Synthesising the UK AI Advantage

We have looked at the technology, the sectors, the people, and the policies. Now we must ask: how do these elements come together to create a competitive advantage? The synthesis of these factors suggests that the UK's path to productivity is unique. Unlike the United States, which leads through sheer scale and capital, or China, which leads through state-directed data integration, the UK must lead through high value specialisation and institutional trust.

The productivity transformation is not a linear process. As we discussed with the J-Curve theory, we should expect a period of disruption before the gains manifest. This is where the intellectual skill of business leaders becomes paramount. They must have the confidence to invest in intangible assets during the trough of the curve. This requires a shift in how we value companies. Traditional accounting often misses the value of a well trained workforce or a custom-built AI workflow, yet these are the very assets that will drive future growth.

The British economy is moving from an era of volume to an era of value. AI allows us to do things that were previously impossible, not just do old things faster. In healthcare, for example, the use of AI in drug discovery could turn the UK life sciences sector into a global powerhouse. This is a productivity gain that saves lives and generates billions in exports. It is the perfect demonstration

of how AI-driven decision making, supported by robust academic research and clear policy, can transform a national economy.

However, we must remain vigilant about the risks of regional inequality. The AI revolution has the potential to further concentrate wealth in London and the South East. For a truly competitive United Kingdom, the benefits of AI-driven productivity must be felt in the manufacturing hubs of the North and the service centres of the Midlands. This requires a decentralised approach to digital infrastructure and a commitment to regional investment that goes beyond slogans.

A Roadmap for the United Kingdom's AI Future

The transition to an AI-driven economy is not an event but a process. For the United Kingdom to translate its current technological potential into sustained competitive advantage, a strategic roadmap is required. This roadmap must focus on three pillars: infrastructure, investment, and inclusivity.

Infrastructure: Beyond Connectivity

Digital infrastructure is often discussed in terms of broadband speeds, but for AI, the requirements are far more complex. We are talking about the massive computational power required to train and run large scale models. Here is what matters: if the UK remains entirely dependent on American or Chinese cloud infrastructure, we lose a degree of economic sovereignty. Developing sovereign AI capabilities is not about isolationism; it is about ensuring that British firms have reliable, affordable access to the "ore" of the new economy—data and compute.

Furthermore, we must address the energy cost crisis. Data centres are the factories of the 21st century. If the UK cannot offer a competitive, green energy grid, the very engines of our productivity growth will be built elsewhere. A roadmap for AI is, by necessity, a roadmap for energy reform.

Investment: Bridging the Commercialisation Gap

The UK has never lacked for brilliant ideas. Our failure has historically been in the scaling of those ideas. To fix this, we need to move beyond the current venture capital model which often forces our most promising AI startups to seek American buyers when they reach a certain size. The roadmap must include mechanisms for institutional investors, such as pension funds, to take a longer-term view of AI growth.

Bottom line: we need to create an environment where a British AI firm can grow from a university spin-out to a global FTSE 100 contender without having to cross the Atlantic for its Series C funding.

Inclusivity: The Regional Imperative

A competitive United Kingdom is a whole United Kingdom. If AI-driven productivity gains are captured solely by the "Golden Triangle" of London, Oxford, and Cambridge, the national productivity figures may rise, but the social fabric will continue to fray. The roadmap must prioritise regional AI hubs. By leveraging the industrial heritage of the North and the Midlands, we can create niche AI applications for manufacturing and logistics that provide high-value jobs outside of the capital. This is how you solve the productivity puzzle at scale.

For a UK-based firm, an audit needs to go beyond a simple "tech checklist" and investigate the institutional readiness that determines whether a company captures the AI dividend or falls into the trough of the J-Curve.

The Opportunity: AI as an Economic Engine

Artificial Intelligence is not just another software update; it is a general-purpose technology

comparable to the steam engine or electricity. Here is what matters: AI allows for the decoupling of economic growth from human hours worked. In a service-dominated economy like the UK, this is the first time we have a tool capable of automating the "un-automatable" cognitive tasks of the professional classes.

Key Strategic Insights:

- **The Productivity J-Curve:** Leaders must prepare for a temporary dip in measured productivity as firms invest in the "intangible assets" required for AI—reorganising workflows and retraining staff. This is a transition, not a failure.
- **Augmentation over Automation:** The greatest gains are not found in replacing humans, but in "cognitive augmentation." By offloading data-heavy tasks to AI, the British workforce can focus on high-value judgment, ethics, and strategy.
- **The Scaling Gap:** The UK remains world-class at AI research but struggles with commercialisation. We need a fundamental shift in how we fund high-growth tech to prevent our best firms from moving to the US for capital.

The Roadmap for Action

To move from potential to prosperity, the briefing identifies three non-negotiable pillars for the UK government and business leaders:

1. **Sovereign Infrastructure:** We must address the high cost of green energy to support the data centres that power AI. Without competitive energy prices, the UK's AI industry will migrate.
2. **The Great Re-skilling:** We need a radical overhaul of vocational training. Digital literacy is no longer enough; the workforce requires transversal skills like algorithmic management and ethical reasoning.
3. **Regional Inclusivity:** AI must be deployed to revitalise the industrial hubs of the North and Midlands through niche applications in manufacturing and logistics, ensuring that growth is not confined to the South East.

The framework: a truly robust audit should look at the **Three Pillars of AI Maturity:** Technical Infrastructure, Human Capital, and Strategic Governance.

Strategic AI Readiness Audit Template

1. Pillar One: Technical & Data Infrastructure

Before a firm can innovate, it must ensure its "digital foundations" are stable.

- **Data Sovereignty & Quality:** Is your data siloed in legacy systems, or is it consolidated in a machine-readable format?
- **Compute Access:** Do you have a strategy for "compute" that balances cost with performance, particularly given the UK's energy price volatility?
- **Tool Interoperability:** Can your proposed AI solutions talk to your existing Enterprise Resource Planning (ERP) systems?

2. Pillar Two: The Human Element (The Augmentation Metric)

As discussed in the paper, productivity comes from people working *with* machines, not being replaced by them.

- **Skills Gap Analysis:** Have you identified the specific "transversal skills" (critical thinking, ethical judgment) your staffs need to oversee AI outputs?

- **The Psychological Safety Quotient:** Does your workforce view AI as a threat or a partner? Low morale is a silent killer of productivity gains.
- **Leadership Literacy:** Does the boardroom understand the difference between predictive and generative AI, or are decisions being made based on "hype" rather than utility?

3. Pillar Three: Strategic Governance & The J-Curve

This measures the firm's ability to withstand the initial dip in productivity while investing in the future.

- **ROI Horizons:** Are you measuring AI success on a quarterly basis (which will fail during the J-Curve) or a multi-year horizon?
- **Ethical Frameworks:** Does the firm have an "AI Ethics Committee" to mitigate algorithmic bias, ensuring compliance with UK regulatory standards?
- **Agility Index:** How quickly can the firm re-allocate resources from a failing AI pilot to a successful one?

Understanding the Productivity J-Curve

To help visualise where a firm might sit during this transition, consider the following progression:

1. **Investment Phase:** High costs, low immediate output (The Trough).
2. **Intangible Accretion:** Training staff and refining data (The Inflection).
3. **The Harvest:** Exponential gains in output per hour (The Rise).

The most UK firms fail because they panic during the "Investment Phase" and pull the plug before reaching the harvest.

The methodology behind this hundred point rubric. We are deliberately weighting the human element heavier than the technical infrastructure. Why? Because as the research demonstrated, technology is merely the lever; human capital is the fulcrum.

Here is the strategic scoring system designed for United Kingdom firms to mathematically assess their position.

Pillar One: Technical and Data Infrastructure (30 Points Maximum)

This section evaluates the digital foundation. A firm cannot augment its workforce if the underlying data architecture is fundamentally broken.

Audit Metric	0 Points (Critical Failure)	5 Points (Developing)	10 Points (World Class)
Data Architecture	Data is entirely siloed in legacy systems and impossible to extract.	Data is partially integrated but requires heavy manual cleaning.	Data is unified in a secure, machine readable architecture.
Compute Access	No dedicated budget or strategy for computational power.	Reactive procurement of cloud services with high cost volatility.	Secure, cost effective access to compute with a clear energy strategy.
System Interoperability	Artificial Intelligence pilots are isolated and cannot speak to existing software.	Limited integration with basic administrative software.	Full compatibility with Enterprise Resource Planning systems.

Pillar Two: The Human Element (40 Points Maximum)

This is where the productivity puzzle is actually solved. Investing in algorithms without investing in the people who manage them is a guaranteed route to capital destruction.

Audit Metric	0 Points (Critical Failure)	Half Points (Developing)	Full Points (World Class)
Skills Gap Strategy (15 pts)	The firm ignores the digital skills gap entirely. (0 pts)	Ad hoc training provided only when new software is installed. (7.5 pts)	Continuous lifelong learning pathways focused on transversal skills. (15 pts)
Psychological Safety (10 pts)	Workforce views the technology with high anxiety and fears job replacement. (0 pts)	Staff exhibit neutral acceptance but lack proactive engagement. (5 pts)	Active enthusiasm where staff collaborate with machines to redesign workflows. (10 pts)
Leadership Literacy (15 pts)	The boardroom fundamentally misunderstands the technology. (0 pts)	Executives possess superficial knowledge driven by media hype. (7.5 pts)	Deep technical and strategic comprehension exists at the highest executive level. (15 pt)

Pillar Three: Strategic Governance (30 Points Maximum)

This final pillar measures the institutional patience required to survive the initial disruption of new technology.

Audit Metric	0 Points (Critical Failure)	5 Points (Developing)	10 Points (World Class)
Investment Horizon	Leadership demands immediate quarterly financial returns on all pilot projects.	Leadership expects clear returns within a single financial year.	Patient capital is deployed with the understanding of a multi year horizon.
Ethical Frameworks	No oversight exists regarding algorithmic bias or data privacy.	Reactive compliance driven only by basic legal requirements.	Proactive ethical auditing and internal bias mitigation boards are established.
Strategic Agility	Rigid hierarchies prevent the rapid reallocation of capital and talent.	Moderate flexibility but delayed by excessive middle management approval.	Flat decision structures allow rapid pivoting away from failing pilot projects.

Diagnosing the Final Score

Once a firm calculates its total score out of one hundred, leadership can identify their exact position on the transformation journey.

0 to 40 Points: The Stagnation Zone

Firms in this bracket are actively contributing to the United Kingdom productivity puzzle. They view technology purely as a mechanism for short term cost cutting. They face a high risk of being outmanoeuvred by more agile competitors.

41 to 70 Points: The Trough of the J Curve

This is the most dangerous but necessary phase. Firms here are spending heavily on infrastructure and training, meaning their measured productivity might actually be dropping. The bottom line is that leadership must hold their nerve, maintain investment, and wait for the intangible assets to mature.

71 to 100 Points: The Augmentation Vanguard

These organisations have successfully reorganised their business models. They are no longer automating old tasks; they are doing entirely new things. They represent the benchmark for a highly competitive British economy.

Conclusion: Breaking the Stagnation

The United Kingdom stands at a crossroads. The productivity stagnation of the last fifteen years has been a heavy anchor on the nation's aspirations. However, as this research has demonstrated, Artificial Intelligence offers a unique lever to break this cycle. By treating AI as a General Purpose Technology rather than a mere tool for automation, we can reimagine the very nature of the British economy.

Our investigation has shown that the path to competitiveness lies in the successful synthesis of human and machine intelligence. In our dominant service sectors, this means moving toward cognitive augmentation, where professionals are freed from routine tasks to focus on high-value judgment. In manufacturing, it means using predictive technologies to overcome legacy investment gaps.

But technology alone is not a panacea. The ultimate success of this transformation depends on our ability to adapt our institutions, our schools, and our management cultures. We must embrace the Productivity J-Curve, accepting that the necessary investments in intangible assets, people and processes, may not show immediate returns but are the only way to ensure long-term prosperity.

The UK's competitive advantage will not be built on out-competing other nations in raw data or silicon. It will be built on our ability to apply AI ethically, creatively, and across every sector of our diverse economy. If we can do that, the productivity puzzle will not just be solved; it will be rendered obsolete.

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