Portugal, AI and the Future

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Portugal and, increasingly, most countries face a structural transition that is deeper than a technological shift. It is a transition in the foundations of national development and sovereignty. For two centuries, countries measured their strength through territory, industrial capacity, transportation systems, energy, finance and military power. In the coming decades, an equally decisive factor will emerge: the ability to create, structure, simulate and control knowledge and world models.

In that context, the development of a country can be understood through four interconnected dimensions.

First, education. A nation develops when it fosters human capability at scale. The challenge is not only to teach fundamentals, but to expose students to the adversarial layer of knowledge. This is the layer where contradictions, edge cases, uncertainty and deep understanding reside. In many systems, including Portugal's, that layer is frequently used as a filtering mechanism: students are evaluated against it without being properly trained to navigate it. The result is often fear of complexity rather than mastery of it. In leading innovation ecosystems, by contrast, the adversarial layer becomes a creativity engine. It is where students learn to challenge assumptions, combine disciplines, identify gaps in existing systems and generate disruptive ideas. In the AI era, education systems must evolve from knowledge transmission filtering systems into those that are capable of developing creators, explorers and model-builders.

Second, knowledge creation. Portugal has significantly improved its scientific and technological output over the past decades. However, the global knowledge economy contains a growing asymmetry. Publicly funded research is often transferred into publishing systems that concentrate intellectual property and data ownership outside the countries that generate the underlying knowledge. Those knowledge repositories are increasingly used to train large AI systems that later sell intelligence back to the original researchers, institutions and societies. This creates a structural dependency loop. Countries therefore need sovereign knowledge infrastructures capable not only of producing knowledge, but also of structuring, connecting, simulating and preserving it as strategic national capability. The emergence of large language models is only one layer of this transformation. The deeper issue is who owns and orchestrates the cognitive infrastructures of the future.

Third, entrepreneurship and wealth generation. Many European economies, including Portugal's, became highly competent at optimization, compliance and incremental improvement. But the coming AI wave will increasingly absorb layers of intermediary logic, particularly in service and software sectors based on repetitive analytical processes. This creates the risk of wiping out economies specializing in optimization while losing the ability to generate frontier industries. To avoid that outcome, countries must foster creator-entrepreneurs capable of transforming scientific and engineering knowledge into new products, industries and platforms. This requires educational models that bridge technology, creativity, simulation, design and entrepreneurship from an early stage. It also requires ecosystems where experimentation and calculated risk are culturally accepted rather than institutionally discouraged.

Fourth, sovereignty. Until recently, sovereignty was associated primarily with control of land, resources and institutions. In the future, sovereignty will increasingly depend on the control of digital representations of reality itself. Maps evolved into platforms; platforms evolved into AI systems; AI systems are now evolving into world models capable of representing, simulating and influencing physical, economic and social systems in real time. Countries that do not participate in the creation of these infrastructures risk becoming dependent on external cognitive systems for decision-making, natural resource management, economic optimization and even cultural interpretation.

This challenge goes beyond artificial intelligence in a narrow sense. The decisive layer is the convergence of AI with simulation systems, multimodal interfaces, spatial computing, information structures, augmented and virtual reality, robotics and real-time digital twins. The countries and organizations capable of integrating these dimensions will possess not only technological advantages, but also strategic autonomy.

Portugal has, paradoxically, several conditions to participate in this transition. It has world-class scientists, engineers, designers, creative talent and a global cultural identity. It has experience in geographic information systems, ocean sciences, renewable energy, telecommunications and digital experimentation. Historically, Portugal helped map the physical world during the Age of Discoveries. The next challenge may be whether countries like Portugal can help map, simulate and understand the emerging digital world before becoming permanently dependent on infrastructures designed elsewhere.

This is therefore not merely an economic or technological issue. It is fundamentally a civilizational and sovereignty question. The debate is not about resisting globalization or technological evolution. It is about ensuring that countries retain the ability to educate creators instead of filters, transform knowledge into strategic capability, generate new industries instead of merely optimizing old ones, and participate actively

in the construction of the world models that will increasingly mediate human interaction with reality itself.