

Executive Summary

In the matter of digital sovereignty, France and furthermore Europe, seem to have already lost some battles (even though Europe hosts some global leaders, in the field telecommunication for example): the main social networks are American (or Chinese), the most critical electronic components are manufactured in China or in Taiwan, the most significant Operating Systems are American. But there are still two major domains where France (together with Europe) has a few trump cards to play to maintain, or maybe rebuild, its sovereignty: the development of quantum computers, and the farming of ethics in Artificial Intelligence.

Both those topics have been the focus of our research. This report proposes a consolidation of recommendations to support their development and allow for their success.

Quantum computer, what is at stake, what are the challenges, and the opportunities:

Our report starts by defining, in a few simple terms, this technology.

A quantum computer utilizes the quantum properties of matter to perform operations on data. To the difference of a classic computer, based on transistors and working on binary data (coded in bytes, with a value of 0 or 1), the quantum computer uses qubits which quantum state can possess several values, or more precisely a quantum state holding several possible values simultaneously. Quantum computers have the ability to revolutionize calculations. This technology brings the ability to solve, in a few minutes only, complex calculations that couldn't be solved previously with the current calculation capabilities.

Several technologies have emerged and choices will have to be made to achieve the emergence of true champions, and tomorrow an industry of quantum computing.

Applications are concrete and numerous. To only cite a few:

- In digital security, with all current codes being exposed, if they are not based on quantum technologies.
- Some usages in metrology are already being developed, whether in military applications or civil ones.
- In medicine and in chemistry main applications will be to help understand better the way diseases operate and support the development of new molecules and new chemical compounds. The calculation powers of quantum allowing to work at a molecular level.
- In logistics, quantum computing will allow the solve numerous complex problems.
- An improvement in AI systems is also expected, for example in machine-learning tools.

Many countries have understood the criticality of this technology for the future of States' sovereignty. The United States and China, in the first instance, are rivalling in the scale of their investments. France is not far behind on this topic and possesses some real assets. Non-the-less, our analysis and the interviews we performed with key stakeholders of this sector has allowed us to identify 7 recommendations that should allow to consolidate our development and to give us

a chance to position ourselves in the future of quantum computing, each one of them associated to some a risk we identified during our research:

Risk of sub-financing	Recommendation 1	Focus financings on the industrialization phases of quantum technologies that are the closets to manufacturing stages by selecting a few champions
	Recommendation 2	Do not spread the financing and focus the industrial approach on quantum technologies closest to production
Risk of lack or loss of talents	Recommendation 3	Define right away an HR strategy for quantum computing
	Recommendation 4	Support the back and forth between public and private laboratories for researchers
Risk of late appropriation by companies of the technology	Recommendation 5	Prepare companies to the quantic revolution
	Recommendation 6	Allow companies to possess infrastructures to support the development of quantum computing
	Recommendation 7	Set-up the right conditions for industrialization of the technology

All these recommandations are detailed in the body of this report and will allow our readers to go deeper into these topics that our study have allowed us to identify.

Artificial Intelligence and Ethical Issues:

Our report also focuses on artificial intelligence as one of the disruptive technologies arising in recent years that can have a major impact on the sovereignty of states. The subject is not new, but the reflections engaged today around the framework of AI have pushed us to further explore this theme.

In this case also our report proposes a succinct definition of AI:

Artificial intelligence (AI) is a field of technology that aims to make machines capable of performing tasks that usually require human intelligence, such as understanding language, solving problems or learning on their own.

There are many ways in which machines can learn. One of the most common is called "machine learning", another important concept is "deep learning", where the machine uses neural networks to perform complex tasks.

There are many ways to use AI technology today:

- Voice and Facial Recognition, which makes it a useful tool for security systems in particular.
- Transportation: AI is used to optimize driving routes, and for autonomous cars.
- E-commerce: AI is used to recommend products online; to personalize shopping experiences.
- Health: AI is used to design drugs, diagnose diseases, and recommend treatments.
- Finance: AI is used to perform complex and secure financial transactions and recommend investments.
- Marketing and Retail: AI is used to personalize marketing campaigns, predict consumer trends, and recommend marketing actions.
- Education: In personalizing study plans, detecting learning difficulties, and assessing student performance.

Governments have identified the issue and have proposed, notably in Europe with the "AI Act", a regulatory framework to try to mitigate some of the risks AI could represent for sovereignty. Beyond this framework, our report proposes recommendations to remedy certain risks and help maintain state sovereignty in the context of accelerated AI deployment.

Lack of trust risk	Recommendation 8	Define and deploy an OpenSource strategy
Data risk	Recommendation 9	Create a multidisciplinary AI ethics committee Risk of over-regulation
Risk related to the lack of skills and development of future "AI workers" in companies	Recommendation 10	Start continuous training on quantum technology and AI in companies

- ➔ Our report is not intended to be exhaustive, but we hope its conclusions can support the regulators and legislators in advancing the absolutely critical development of a competitive quantum computer industry in France, and even inspire companies to invest the development and supervision of the AI industry.