POLITECNICO MILANO 1863 SCHOOL OF MANAGEMENT

osservatori.net digital innovation

13.10.23

Quantum Computing & Communication Observatory

An engaging research model for the Quantum ecosystem in Italy: where we are

Quantum Computing & Simulation Workshop

Marina Natalucci
marina.natalucci@polimi.it

Promote sustainable and conscious use of digital innovation

Create, disseminate and make accessible an original body of knowledge on digital innovation in order to promote its **sustainable development and conscious use**, involving all the main actors (research, companies, PA, people, politics and institutions) in the process.

Research model: Engaging Research

Innovative model of research design and orchestration in academia

Enable actor engagement within the ecosystem
of Digital Innovation & Transformation

through a **structured portfolio of initiatives,** characterized by different levels of engagement

Different from classic research concepts basic and applied, typical of models of traditional **university-business collaboration**

The different **levels of engagement** proposed allow the companies involved to evolve from an initial state of **"awareness" of trends**, scenarios and application solutions related to Digital Innovation, up to an **increasing degree of "action"** within the Digital Open Innovation ecosystem

Internal benefits
(benchmarking, budgeting, training, new services development, ...)

External benefits
(new collaborations, startups development ...)

Fattori distintivi

Empirical base

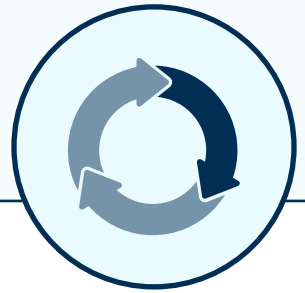
Research that combines models and theories with solid evidence supported empirics robust methods of investigation and Exploring the reality

Open and inclusive research

Constructed research through comparison spaces independent pre-competitive and stable

Continuity over time

Prospettiva longitudinale nel tempo, sviluppata attraverso cicli annuali di Ricerca



Large dissemination

Conoscenza autentica, accessibile a tutti, a supporto delle decisioni

Interpretative and predictive models

Model development interpretative of ongoing phenomena and analysis predictive on future adoption of solutions technological

Support to new ideas development

Research oriented to generate the fertile soil for birth of new ideas and startups

The history of the Quantum Computing & Communication Observatory

Meeting
13.10.23

2020

First explorative reflections in interested Observatories

- Exploratory meeting on HPC and Quantum with **30 representatives**
- Identification of some **use cases and start-ups**
- Exploring **interest in companies** belonging to Observatory communities (Cloud, Cybersecurity, Blockchain, AI)

2021

Creation of the Quantum Technologies **round table**

- **11 Companies** supported the research
- Establishment of an **Advisory Board** of experts
- **2 research themes** and **5 thematic events**
- **1 public event** with **>750 participants**

2022

First edition **Quantum Computing & Communication Observatory**

- **16 companies** supported the research
- Continuation of an **Advisory Board** of experts
- **5 research themes** and **first italian survey**
- **5 research events** and **ecosystem creation**
- **1** final dissemination **conference**

2023

Second edition **Quantum Computing & Communication Observatory**

- **19 companies, agencies and institutions** supported the research
- Extension of the **Advisory Board** of experts (+2 members)
- Continuously **expanding research**
- **5 ecosystem events** and **1 outdoor experience**
- **Outreach activities** at external **institutional and corporate events**
- **1** final dissemination **conference**

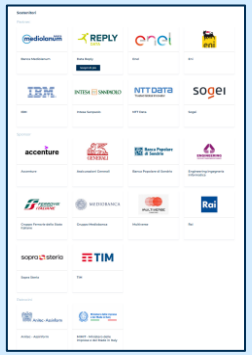
Il ruolo del Polimi e dell'Osservatorio nell'ecosistema del Quantum Computing in Italia

Quantum Computing & Communication Observatory

Pre-competitive working group and market research

Companies

Politecnico di Milano
Managerial and Technical perspective



National and international experts

Dissemination of research results

Il ruolo dell'Osservatorio nell'ecosistema Quantum

HPC, Big Data and QC National Center

Support to the **coordination** of the Quantum Computing Spoke 10 for **Politecnico di Milano**

Network between research centers, universities and companies to promote basic and applied research

Research partner of the Supercomputing Trends & Applications Observatory of the ICSC Foundation promoted by IFAB

Analysis of the impact of the Centre's activities on the country, monitoring **trends, dissemination of knowledge and support for policy making**

The actors involved in the Observatory in 2023

Meeting
13.10.23

POLIMI RESEARCH TEAM

Management perspective of the Department of Management Engineering and **technological perspective** of the Department of Electronics, Information and Bioengineering

COMPANIES

PARTNER

SPONSOR

PATROCINI

EXPERT ADVISORY BOARD

Tommaso Calarco, Director of the Institute for Quantum Control of the Peter Grünberg Institute at Forschungszentrum Jülich

Gabriele Compostella
Quantum Computing Lead at Volkswagen AG

Chiara Decaroli Quantum Innovation Sector Lead – National Quantum Computing Centre (NQCC) – UK.

Annarita Giani, Senior Complex System Scientist Quantum Computing Applications, General Electric

Sabrina Maniscalco, Professor of Quantum Information and Logic at the University of Helsinki

Enrico Prati, Professore Associato, Università degli Studi di Milano

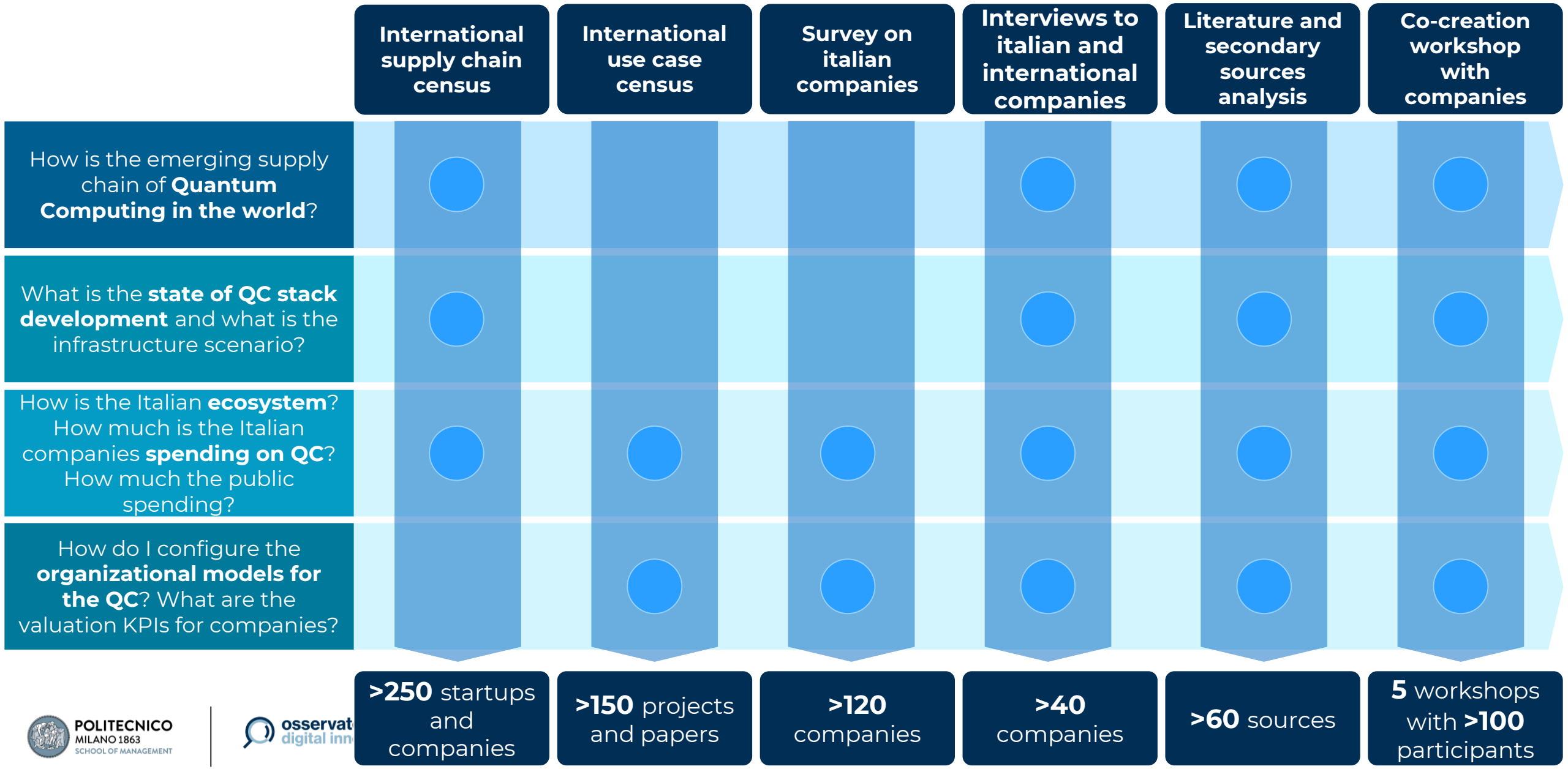
Davide Venturelli, Associate Director, Quantum Computing, USRA, Senior Scientist NASA Quantum AI Laboratory

POLITECNICO MILANO 1863 SCHOOL OF MANAGEMENT

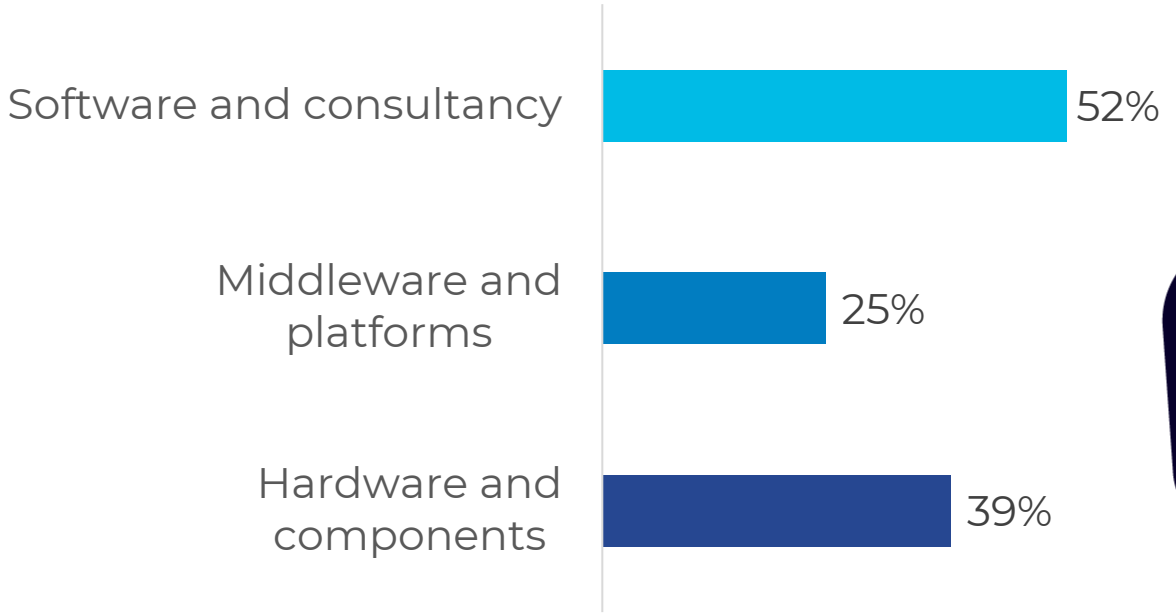
osservatori.net digital innovation

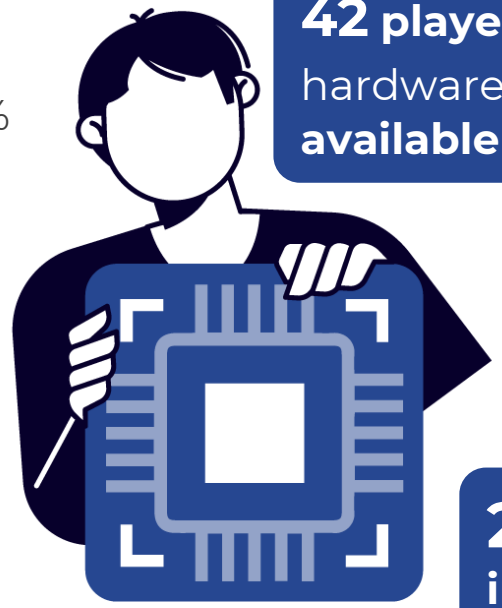
La ricerca 2023 dell'Osservatorio

Meeting
13.10.23



Il mercato infrastrutturale e lo sviluppo sinergico di hardware e software





42 players developing quantum hardware, **19 with prototypes available** in the Cloud in the short term

7 different types of qubits in R&D

2 architectural approaches implemented: general and special purpose

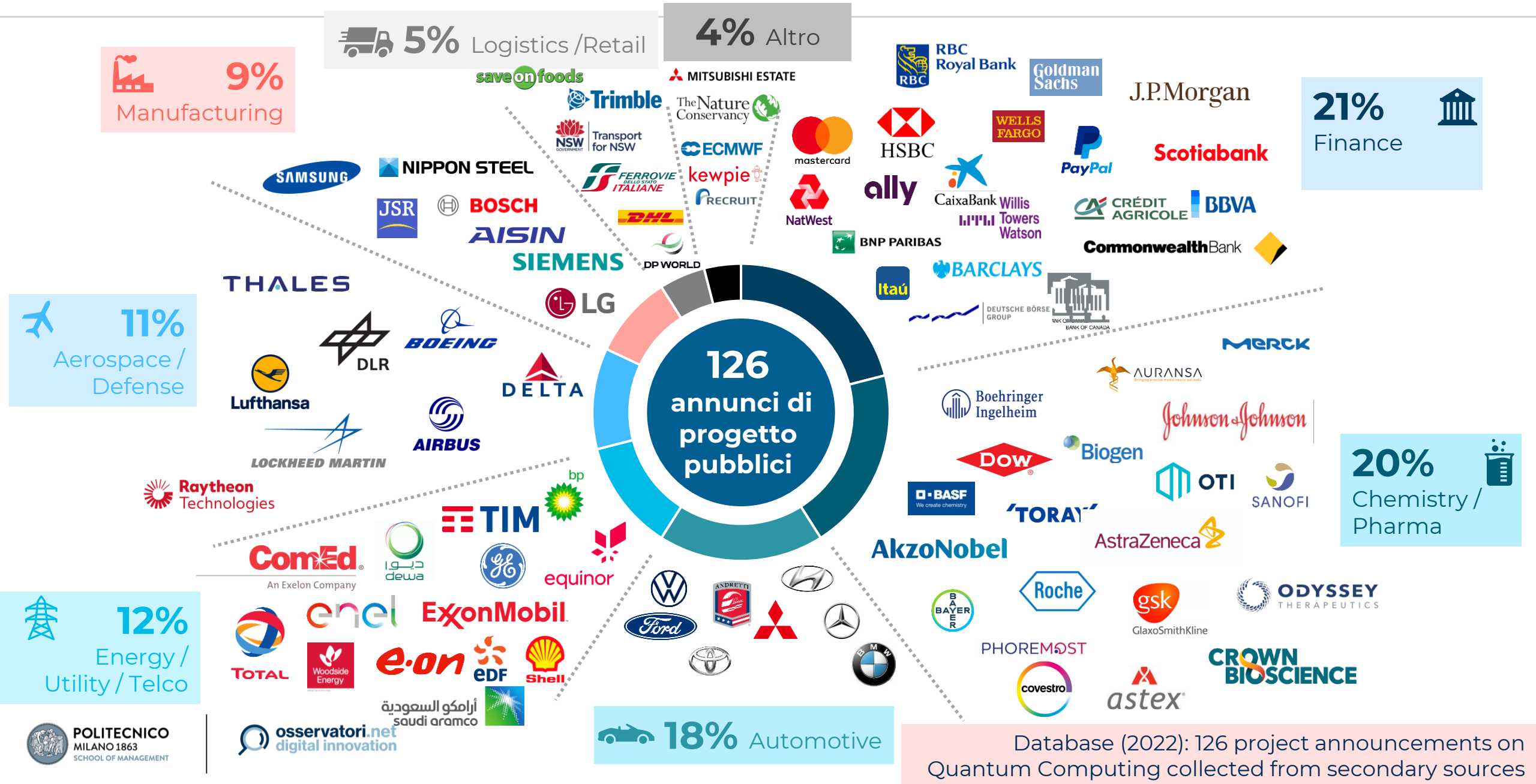
Complex and constantly evolving scenario: there are no comparison standards and it is not possible to know which of the tested approach will win. **Companies need to monitor to dynamically adapt strategies**.

Need to develop all the Quantum Computing stack: the ecosystem is already working on different levels. Fundamental collaboration between research and industry.

Base dati: 179 attori dell'offerta di Quantum Computing identificati all'interno di un censimento da fonti secondarie (aggiornato a Maggio 2022)

Il censimento dei progetti annunciati pubblicamente dalle grandi aziende nel mondo

Workshop
13.10.23



POLITECNICO MILANO 1863 SCHOOL OF MANAGEMENT

osservatori.net digital innovation

Database (2022): 126 project announcements on Quantum Computing collected from secondary sources

Purpose of Quantum Computing projects

Feasibility and scalability analysis	Benchmark with classical algorithm	Benchmarking between different technologies
Assessing whether it is possible to formulate the problem in quantum form, the scalability of the problem and the quantum resources required	Assessing what the advantage is over the classical case and for what size of problem	Comparing different types of quantum architecture

Know-How development	Acquiring know-how for when the technology will actually be available

Output

- Publication of a scientific paper
- Production-ready algorithm and state-of-the-art maintenance
- Quantum-inspired algorithm in production on classical hardware

KPIs for the PoC

Technical KPIs in quantum hardware development

- #Logical Qubit
- #Shots
- Run time
- % of success (for known results)
- …

Evaluation of results and potential

Benchmark with classical agorithm:

- Quality of solution
- Potential speed-up
- …

Industrialization perspective

- Time to industry-relevant applications:
  1. Quantum inspired
  2. Hybrid
  3. Full Quantum
- Solution sustainability
- …

Strategic KPIs for the company

Impact on company

- Brand reputation
- Know-how
- Talent induction/retention
- …

Reputation and scientific relevance

- Published papers
- Impact factor of the journal
- Numero di citations
- Scientific conferences
- …

Results based on analysis of 29 papers on quantum computing PoCs and company interviews

Save the date!

Public Conference to present 2023 research results

23 Novembre 2023
9:30-13:00

Polimi (Bovisa Campus) o online streaming

Link to register