

Banking Innovation with AI

Optimizing Processes, Enhancing Productivity and Real-World Applications

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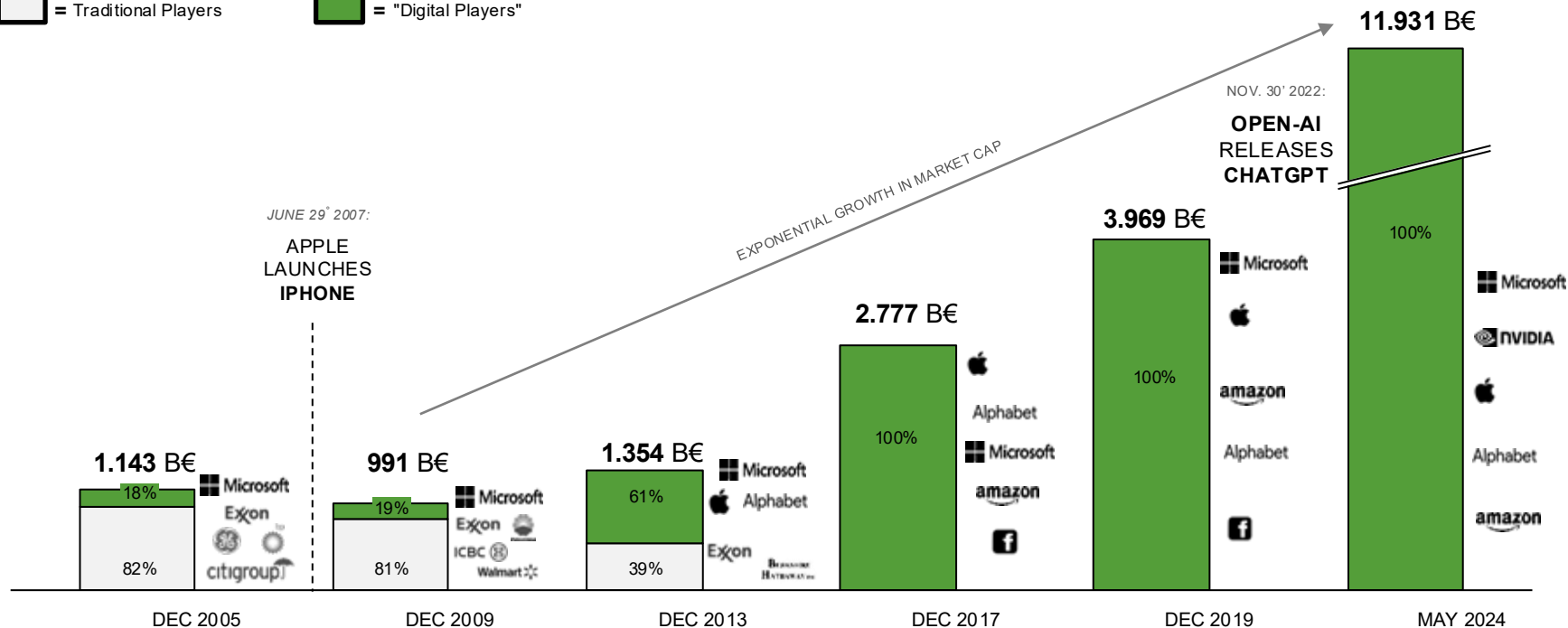
The Digital Transformation Revolution

The value generated by the digital revolution has so far been captured mainly by digital players

TOP 5 COMPANIES FOR MARKET CAP

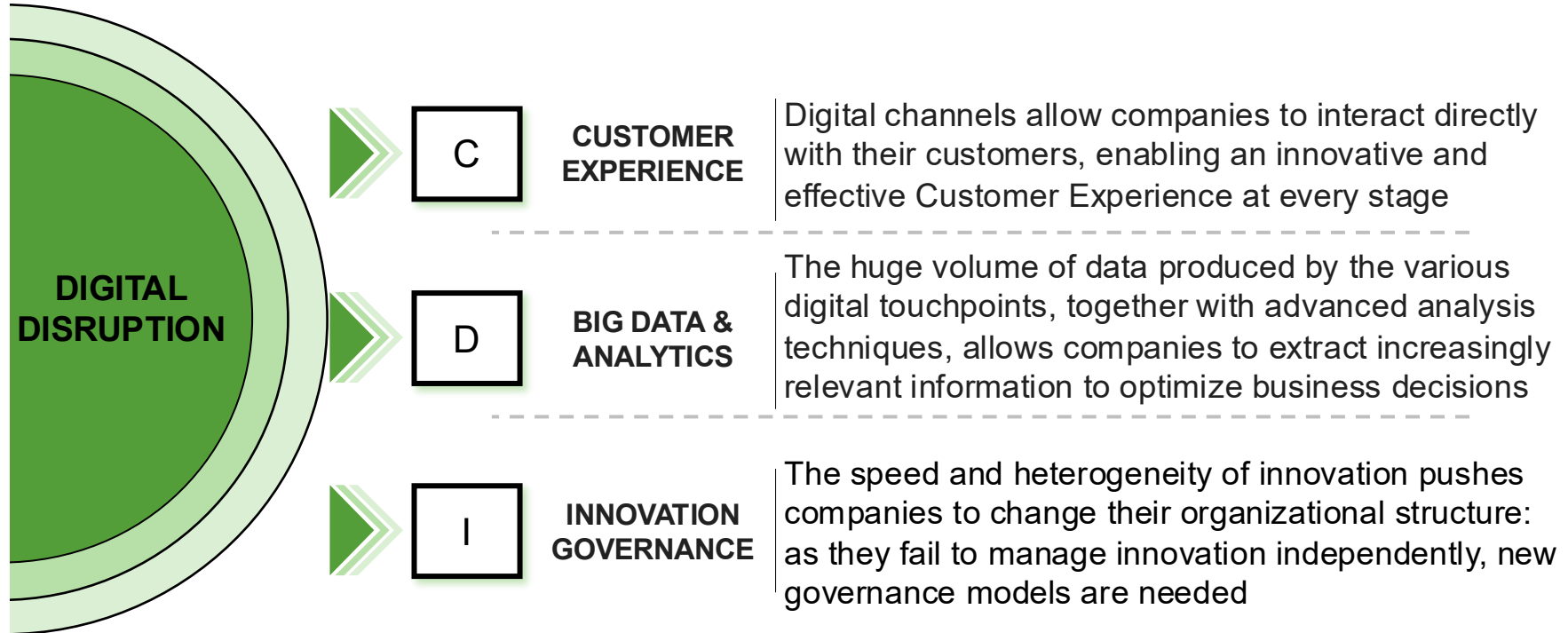
☐ = Traditional Players

■ = "Digital Players"



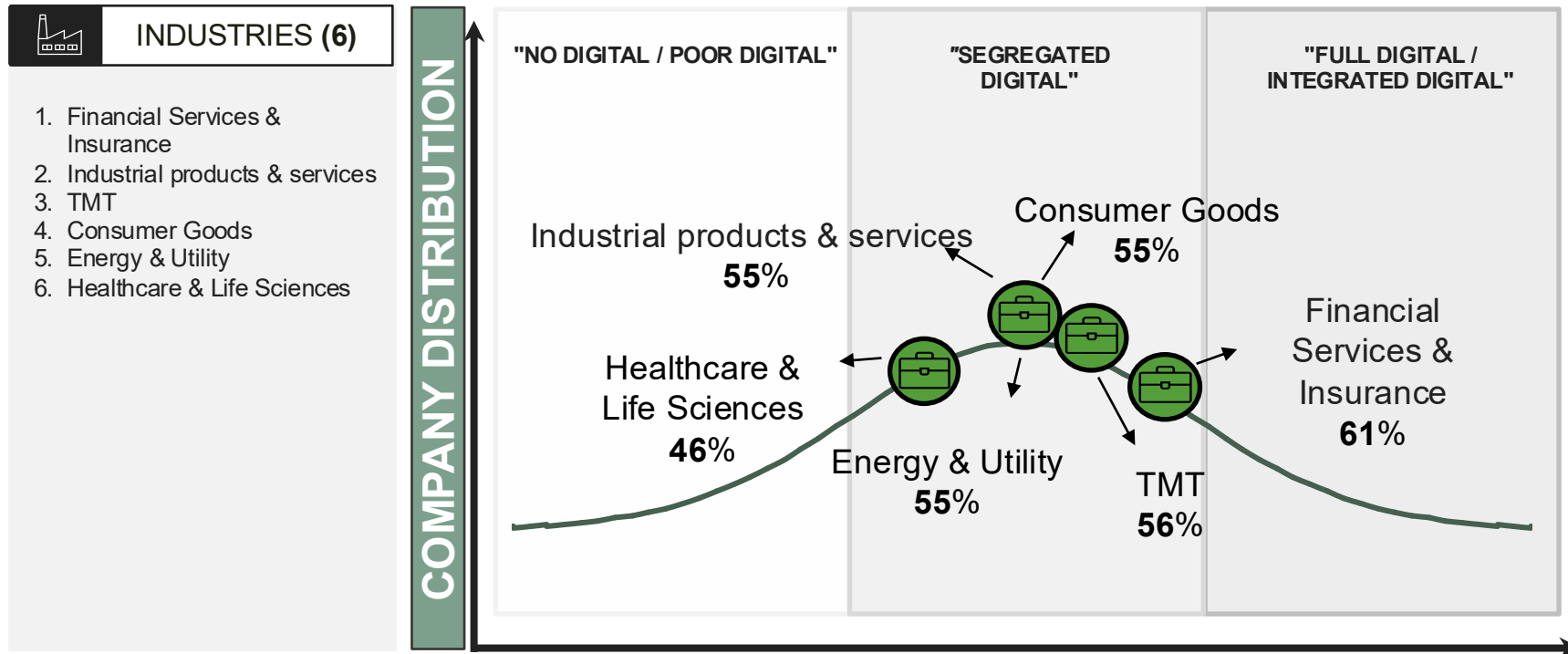
The Digital Transformation Revolution

For traditional players capturing business value generated by digitization, means completely rethinking their business model





















Digital Transformation Index

Digital maturity changes substantially across industries



Digital Transformation Index

The top 20 companies*

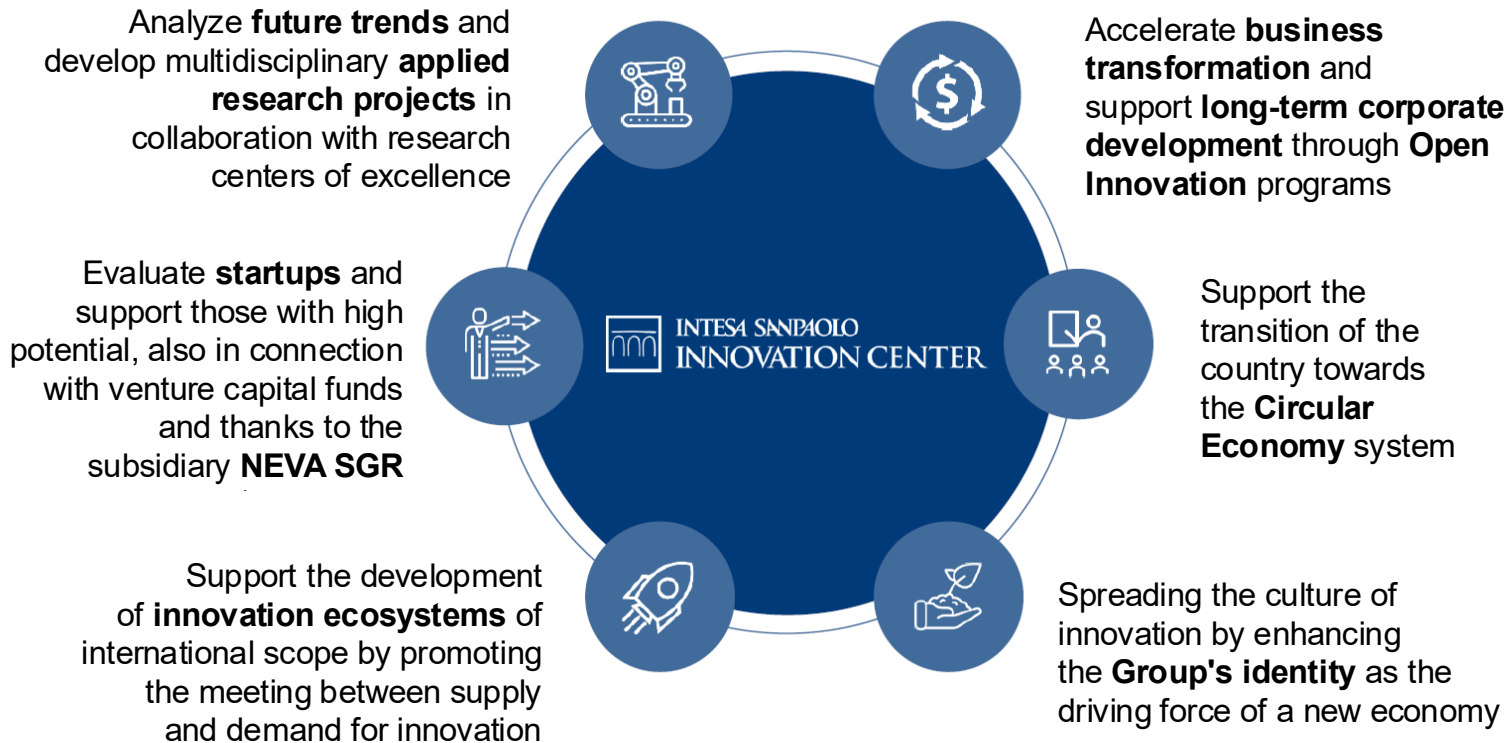
RANKING	COMPANY	INDUSTRY	RANKING	COMPANY	INDUSTRY
1	 Prysmian Group	Industrial	11	 Sesa	TMT
2	 TIM	TMT	12	 LEONARDO	Industrial
3	 nexi	FSI	13	 DeLonghi	Consumer Goods
4	 brembo	Industrial	14	BRUNELLO CUCINELLI	Consumer Goods
5	 FINECO	FSI	15	 Posteitaliane	FSI
6	 TECHNOGYM	Consumer Goods	16	 UniCredit	FSI
7	 BANCA GENERALI	FSI	17	 TOD'S	FSI
8	 INTESA SANPAOLO	FSI	18	 amplifon	HLS
9	 WIIT <small>THE PREMIUM CLOUD</small>	TMT	19	 GENERALI	FSI
10	 UnipolSai <small>ASSICURAZIONI</small>	FSI	20	 DiaSorin	HSL



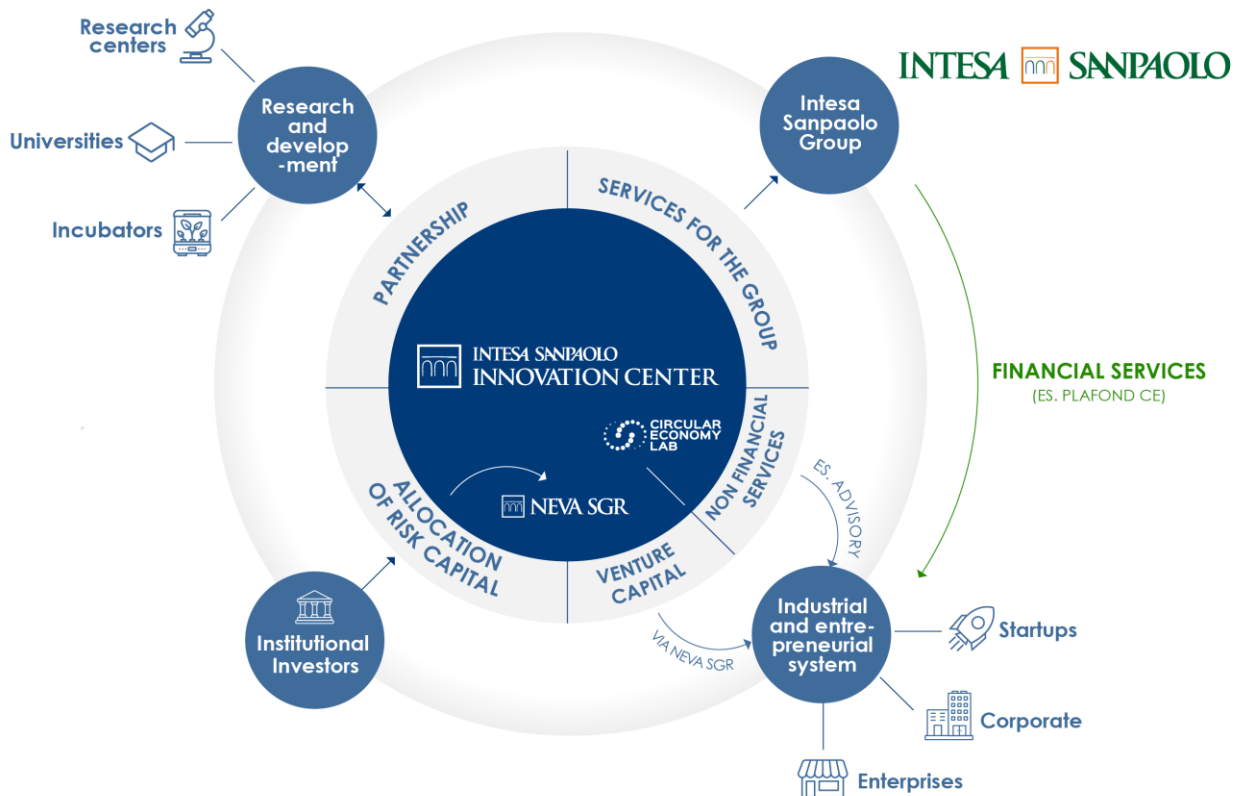
Innovation Center at Intesa Sanpaolo

Luigi Rugggerone





Areas Of Activity



Our Business Model



Our Offer

Knowledge 	Discovery 	Journey 	Challenge 
<p>Knowledge of emerging technologies and sector/market trends</p>	<p>Search for new technologies for industrial application or as investment or partnership opportunities</p>	<p>Research and contact with innovative companies in the field of international ecosystems</p>	<p>Experimenting new business process management models and development of technological applications and prototypes in the laboratory</p>
<p>INNOVATION NEWS: dissemination to client companies of the analyzes and information reviews periodically compiled by the internal Competence Center</p> <p>INDUSTRY TREND REPORTS: production by specialized partners of the Innovation Center of analyses, studies and surveys on specific topics requested by client companies</p>	<p>WHITE LABEL STARTUP INITIATIVES: A program dedicated to search and acceleration of technological startups, on behalf of one or more corporate clients</p> <p>TECH SCOUTING: tailor-made service for on demand tech scouting based on specific requirements shared by the company/corporate client, carried out in-house or with the help of specialised partners outside the group and through on-site journeys at the client's premises</p> <p>TECH MATCHING: business development service supporting startups seeking opportunities for business, capital and industrial partnerships.</p>	<p>TECH TOUR: a supporting program for international ecosystems undergoing rapid growth in terms of innovation aimed at generating new business and investment opportunities for corporate customer and prospects of the ISP Group with the clear aim of internationalization and technological development.</p>	<p>TECH LAB: development of projects to resolve challenges on specific topics within the competence of laboratories (Artificial Intelligence, Neuroscience) through mixed teams of laboratory experts, scientific partners and customer resources</p> <p>CIRCULAR ECONOMY LAB: innovative technology research and new business model advisory in support of corporate transition from a linear economic model to a circular one</p>



DEFINITION OF THE APPLIED RESEARCH PROJECT

Collection and definition of the research request with the client, internal or external, and **definition of the scientific brief** together with the scientific partner



PROJECT ACTIVATION

Definition of the vertical skills and **selection of the research group, protocol validation** following the authorization procedure (privacy, ethical committee,...) and definition of the **contractual framework**



PROJECT REALISATION

Creation and development of advanced and innovative solutions by the research group for complex problems in synergy with domain experts of the Group business units or the company clients



SUPPORT FOR PUTTING INTO PRODUCTION

Support for the integration of the identified solution in the business context of reference and development of the product also using third party partners

Innovation Intelligence & Applied Research

Innovation Intelligence

Identification and interpretation of **innovative trends**

Development of **instruments and services** to **anticipate new evolutionary scenarios** (reports, publications and multimedia content) with a multidisciplinary approach

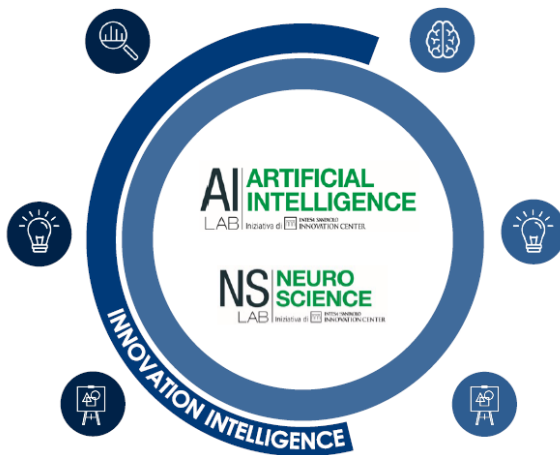
Research, analysis and monitoring of cross industry technologies

Methodological Frameworks

New data-driven methodologies and processes for Innovation Trend Analysis
Regional and sectorial indicators of innovation

Knowledge sharing services

- **Industry trend reports**
- **Monographs dedicated** to relevant trends
- Innovation Ecosystem **Observatories**
- **Regional and sectorial innovation report**
- **Innovation News**



Applied Research Projects

- Resolution of **complex needs** of the Group and external customers through a multidisciplinary approach
- Examples of output generated: **Models and algorithms, technical reports, neuroscientific surveys** validated, **intervention strategies, guidelines**

Enhancement and Protection

Patenting analysis of the created assets
Business impact analysis
 Drafting of **scientific publications**

Development of New Skills

Acquiring **new competences** within the research group
 Organizing **technical and informative seminars**

Artificial Intelligence Lab: Risk Overlay

Tail risk hedging

RISK OVERLAY – INTERNAL COMMITMENT

A research line focused on developing solutions to support analysts in managing financial hedging strategies for investment portfolios (of the Bank and the Financial Institutions to which the service is sold).

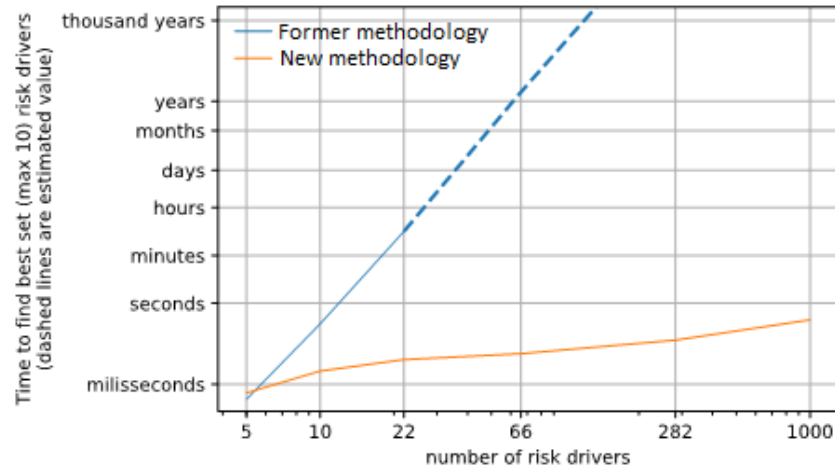
The various phases have brought **efficiency** in terms of **time** and **performance throughout the entire process: in defining risk drivers, in generating a hedging portfolio from scratch, and in dynamically managing it**, increasing by an order of magnitude the options for hedging management. This has made it possible to **explore scenarios that previously could not even be considered**.

PROTECTION

The innovative elements developed in this project **have enabled the Intesa Sanpaolo Group to obtain the grant of 2 patents for the Italian market (ID 102019000024535 and ID 102021000031970) and to file 2 more.

PRODUCTION

The algorithms have been deployed and are currently available on the IMI-CIB and ISP Vita platforms



Reduced computation time by orders of magnitude: years versus seconds for large sets of risk factors (~300).

Risk Overlay – Replicating Portfolio

Goal: design the best hedging portfolio to protect the target portfolio against tail events



1

Risk Monitoring

Risk analysis of the portfolio, where the **main sources of risk in the portfolio are identified** and analysed.

2

Risk Management

The potential hedging strategies are compared among themselves, the **hedging portfolio is built**, and the **risks are actively managed**.

Contribution of our research

Phase 1

Replicating portfolio: given a target portfolio, identify the sources of risk and the events of stress (tail events)

Phase 2

Hedging portfolio (static): building the optimal hedging portfolio from scratch

Phase 3

Dynamic portfolio management: dynamically manage the existing hedging portfolio

Benefits

Speeding up, perfecting and extending the investment process

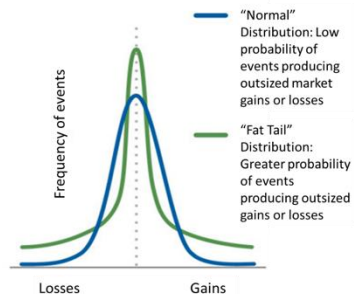
Risk Overlay

How to protect an equity portfolio with an overlay strategy in a market drawdowns

Over the last two decades, extreme market drawdowns have become more frequent.

The latest has occurred over the COVID-19 crisis.

Dynamic risk management strategies (risk overlays) can be useful for investors.



FAT Tail The last decade has clearly shown that financial markets are far from being immune to stress events. In fact, the frequency and the magnitude of “risk-off” events show that the financial world is not “normal”, as the distribution of returns in financial markets is fat-tailed.

<https://www.prometeia.it/anteo/equity-risk-overlay-approcci-tradizionali-approcci-innovativi>

<https://www.livewiremarkets.com/wires/it-s-a-fat-tailed-world-after-all>

Hedging Portfolio Static & Ptf Management

The instruments in the **hedging portfolio** will be selected from among those given in a list of financial instruments (put options, call options and futures for several major stock indices).

The hedging portfolio attempts to **mimic a synthetic time series** called the target put, **which represents an ideal risk management/cost behavior of the hedging portfolio based on the projected performance of the target portfolio during past tail scenarios.**

At the same time, the **hedging portfolio needs to satisfy a number of financial constraints** relative to those instruments: for example, a financial constraint may limit the exposure of the hedging portfolio to instantaneous movements in some specific index.



Goal: we seek a hedging strategy that

- › Accurately **matches the target put**
- › **Allows us to bound the number of instruments** in the hedging portfolio
- › Is **computationally efficient**
- › Is **stable for small changes** in market data

Input

- › Daily **Target Put returns**
- › Daily **returns of financial instruments**
- › **Additional data** about the instruments (e.g., delta, vega, expiry date,...)
- › **Other parameters:** upper bound on the number of instruments, etc..

Methodology

- › Suitable for **dynamic portfolio management**

Output

- › **Hedging portfolio allocation**
(set of instruments and weights)



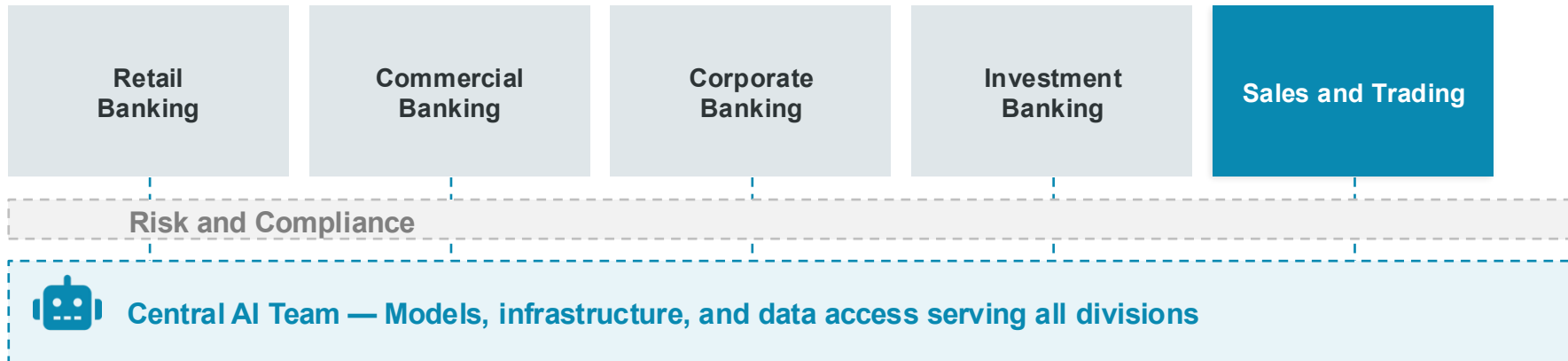
AI in Sales and Trading

Edoardo Vittori

What is the Sales and Trading Division of a Bank

Schematic overview of a bank's structure

Bank Structure



AI Team Integration

Central AI teams provide models and tooling, business units define use cases and domain logic

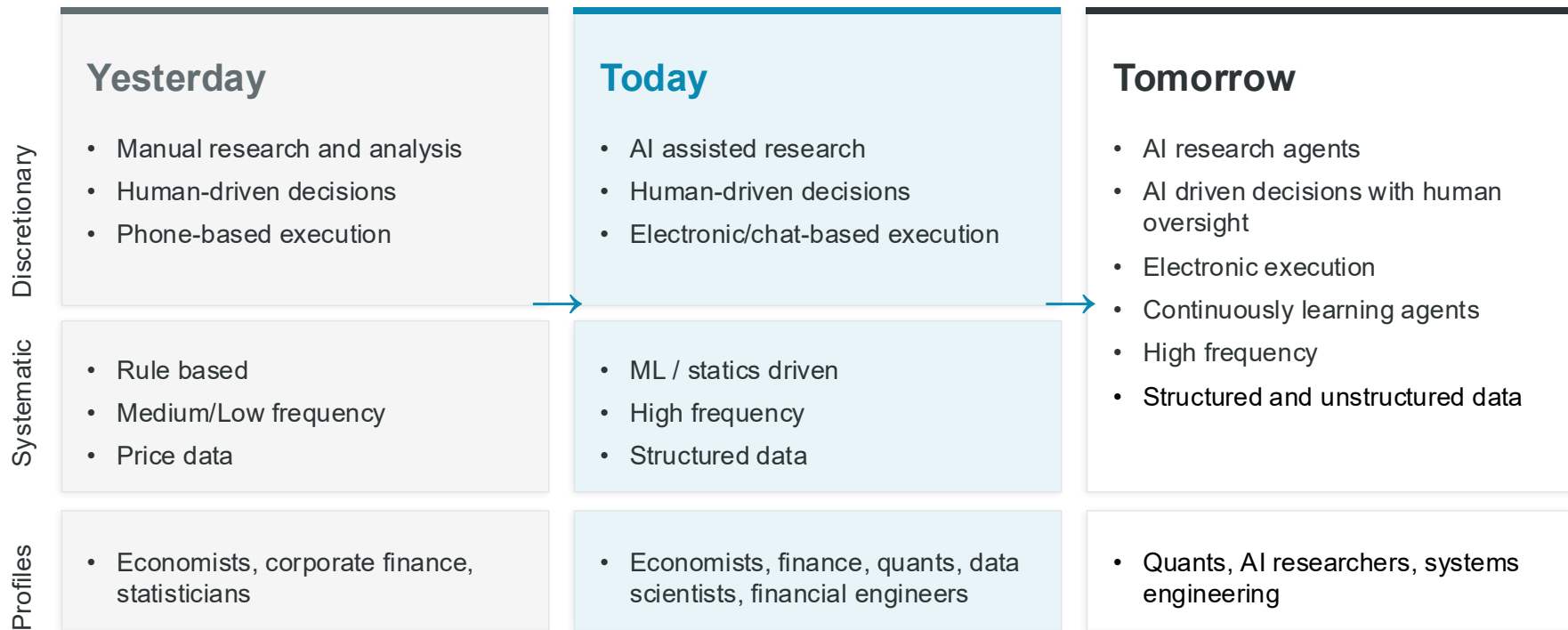


Sales & Trading

Sales advises clients, trading provides liquidity and invests capital

From Human Trading to AI Augmented Markets

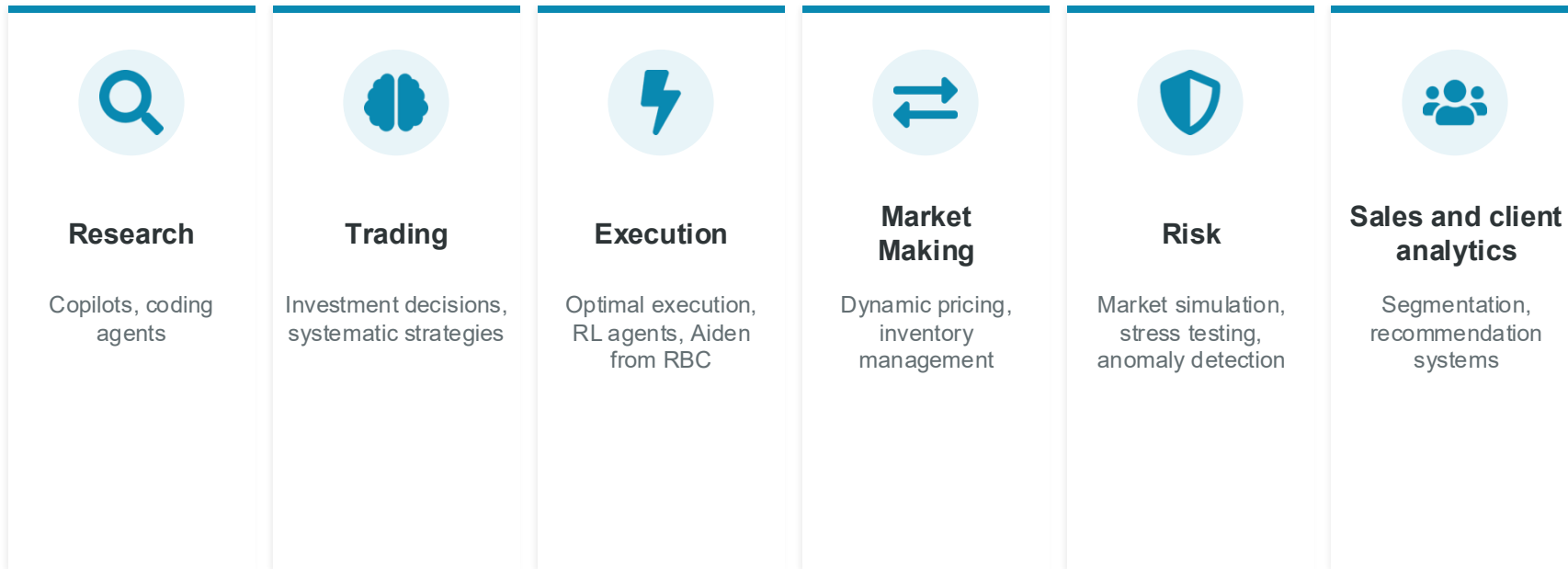
The evolution of decision-making on trading floors



The skillset shift: from economics and finance backgrounds to AI, and systems engineering

Where AI Creates Value

AI spans the entire sales and trading value chain



Each of these areas represents a distinct AI use case — we will deep-dive into the key ones

What It Takes to Build an AI-Driven Capability

Four pillars of AI infrastructure in sales and trading



AI Models

- Research copilots
- Coding copilots
- Enterprise license vs self-host open model



Data

- Historical market data
- Real-time feeds
- Alternative / unstructured
- Internal client flow



Compute

- CPUs and GPUs
- Cloud vs on-premise



Governance

- Model risk controls
- Compliance policies
- Ethical AI guidelines

AI Operating Models in Banks

How banks organize AI capabilities — from centralized to federated

Centralized

Single AI team owns all development, deployment, and governance across the organization

- ✓ Consistency, quality control, efficiency
- ✗ Slow, distant from business needs

More Control

Hybrid

Business units propose or lead AI projects, with central team providing infrastructure, tooling, and standards

- ✓ Balance of relevance and quality
- ✗ Requires strong coordination

Federated

Each business unit builds its own AI capability independently with full autonomy

- ✓ Maximum speed and ownership
- ✗ Duplication, governance gaps

More Speed

The "AI Trading Desk": A Real-World Case Study

Challenges of building a decentralized AI capability inside a large bank



Key takeaway: AI transformation in banking is as much an organizational challenge as a technological one. Success requires navigating internal politics, building cross-functional alliances, and proving value incrementally.

Key Takeaways



AI is transforming every stage of the sales and trading value chain, from research to execution to risk



The shift requires new skills: AI researchers, and systems engineering



Success depends on four pillars: models, data, compute, and governance



Operating model matters: centralized vs federated AI determines speed and quality



AI transformation is both a technology and an organizational challenge

From Human Trading to AI Augmented Markets

The evolution of decision-making on trading floors

Yesterday

- Manual research and analysis
- Human-driven decisions
- Phone-based execution
- Economists and corporate finance experts

Today

- AI assisted research
- Human-driven decisions
- Electronic/chat-based execution
- Quants and financial engineers

Tomorrow

- AI research agents
- AI driven decisions with human oversight
- Electronic execution
- Quants, AI researchers, systems engineering

The skillset shift: from economics and finance backgrounds to AI, and systems engineering

The Economics of AI: CAPEX vs OPEX

How AI projects are funded and the trade-offs involved

CAPEX

Capital Expenditure

- GPU hardware and on-premise servers
- Data acquisition and licensing
- Talent hiring and team buildout
- Initial platform development

OPEX

Operational Expenditure

- Cloud compute (AWS, Azure, GCP)
- API usage (LLM providers, data feeds)
- Model monitoring and maintenance
- Ongoing data subscriptions

Key Trade-offs

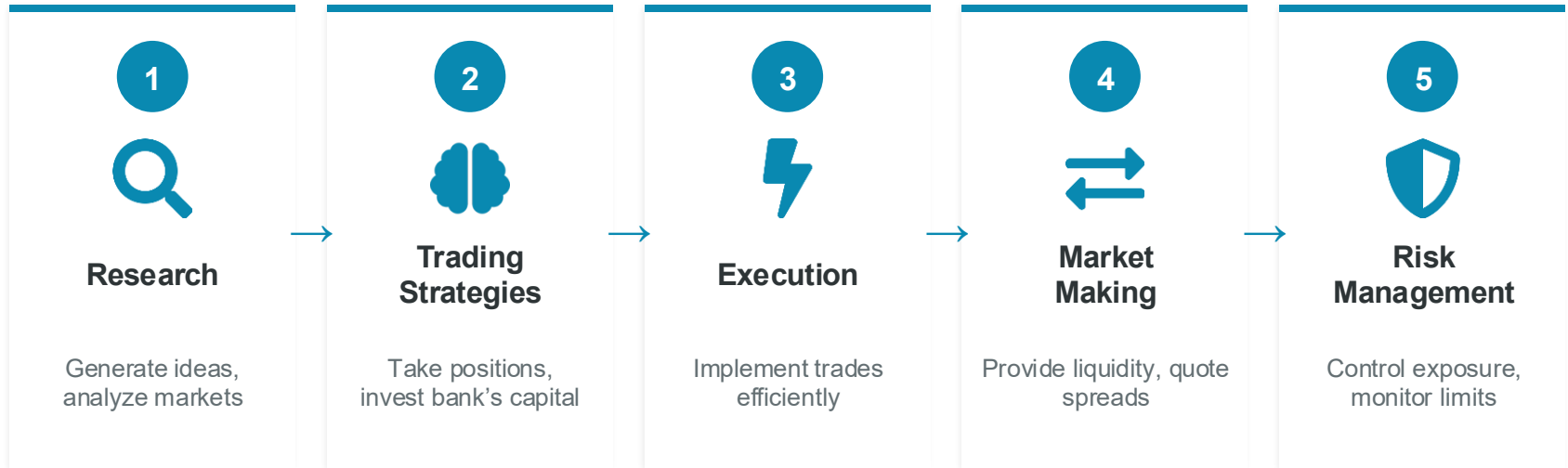
Flexibility ↔ **Control**

Scalability ↔ **Cost**

Speed to market ↔ **Customization**

The Capital Markets Value Chain

Five interconnected functions that drive the business

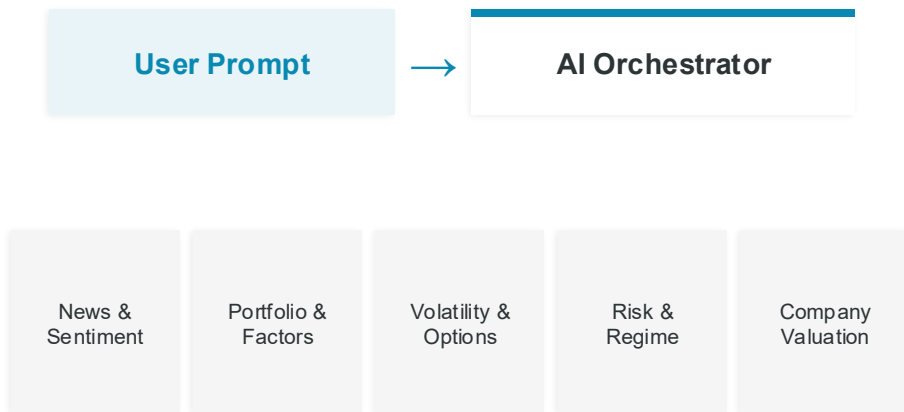


AI is creating value at every stage of this chain — from research copilots to autonomous execution agents






AI for Research Copilots

Augmenting human analysts with AI-powered intelligence tools

How a Trading Copilot Works

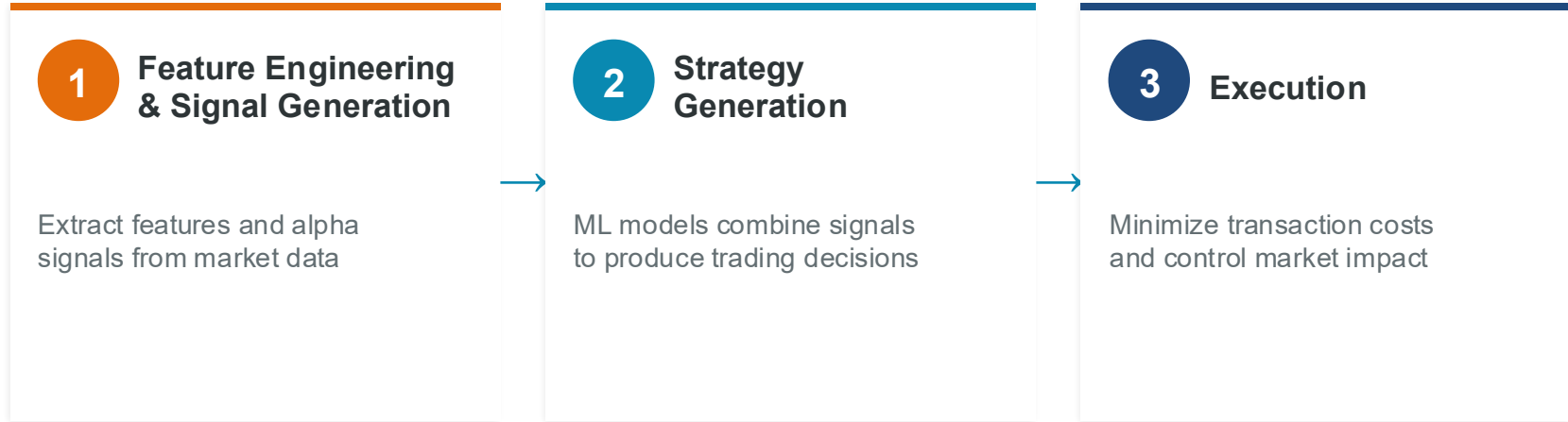


Key Capabilities


-  Summarize news, earnings calls, and filings in seconds
-  Extract signals from structured and unstructured data
-  Detect emerging themes across markets and sectors
-  Regime detection: identify macro shifts in real time
-  Code advanced trading models

Trading with Machine Learning


End-to-end workflow to build an AI-driven trading strategy



Data Inputs

 Real-time data

 Historical data

 Current portfolio

Key insight: Modern trading algorithms learn continuously from market feedback. The execution component feeds outcomes back into strategy generation, creating an adaptive loop.

AI for Execution

Reinforcement learning agents that optimize every trade

How AI Transforms Execution



Optimize vs TWAP/VWAP benchmarks



Adaptive strategies based on real-time market conditions



Order book prediction and microstructure analysis



Minimize market impact and transaction costs



RL agents that learn from every execution

Case Study: Aiden

Reinforcement Learning for Optimal Execution

- RL agent optimizing order slicing, timing, and venue selection
- In production since 2020, processing 32M+ calculations per order
- Learns continuously from real-time market feedback
- Predicts short-term price movements to reduce market impact
- 300+ data inputs including historical, real-time, and self-awareness signals

Source: Borealis AI / RBC Capital Markets

AI for Market Making

Real-time pricing engines that manage risk and provide liquidity



Dynamic Pricing

AI adjusts bid-ask spreads in real time based on volatility, flow, and inventory position



Inventory Management

Inventory-aware quoting that balances risk exposure against revenue opportunity



Adverse Selection

Detect informed flow and adjust pricing to protect against toxic order flow



Real-Time Decisions

Sub-millisecond decision systems that continuously re-optimize quotes across instruments

AI for Risk Management

From reactive monitoring to predictive, real-time risk intelligence



Risk Forecasting

ML models predict VaR, CVaR, and tail risk with higher accuracy than traditional parametric methods



Stress Testing

Automated scenario generation and simulation across thousands of market conditions



Anomaly Detection

Real-time identification of unusual trading patterns, rogue activity, and limit breaches



Exposure Monitoring

Portfolio-level risk aggregation with early warning systems for concentration and liquidity risk

AI for Client Intelligence

Turning client data into actionable insights and personalized engagement



Client Segmentation

Behavioral profiling and clustering to identify client types, preferences, and trading patterns



Recommendation Systems

AI-driven product suggestions, trade ideas, and research tailored to each client segment



Flow Prediction

Anticipate client trading needs and flow patterns to proactively position and engage



Engagement Scoring

Churn risk identification, relationship health monitoring, and personalized commentary generation

Artificial Intelligence Lab: Risk Overlay

Metodi per la gestione dei rischi di coda

FASE 1

Creation of replication portfolio:

- Performance improvement (calculation time)
- By analyzing a greater number of risk factors (x10), we achieve higher accuracy and identify "unexpected" risk factors that make the "replicating portfolio" more aligned with the desired one
- Better identification of tail events (91% accuracy, lower error)
- No need for manual preselection (reduction of operational risk)
- Potential for full automation within the current framework

FASE 2

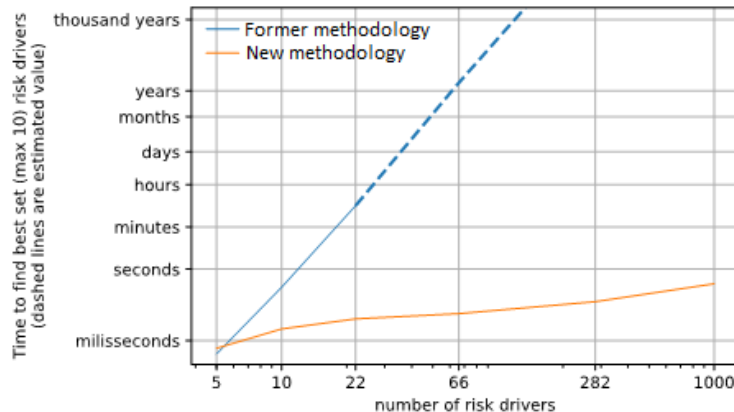
Creation of a "static" hedging portfolio:

- Improved accuracy of the "static" hedging portfolio (which and how many assets)
- Enhanced computational efficiency
- Stability against small variations in market data (minimizing transaction costs)
- The model proved suitable for managing the "dynamic" portfolio

FASE 3

Dynamic Portfolio Optimization:

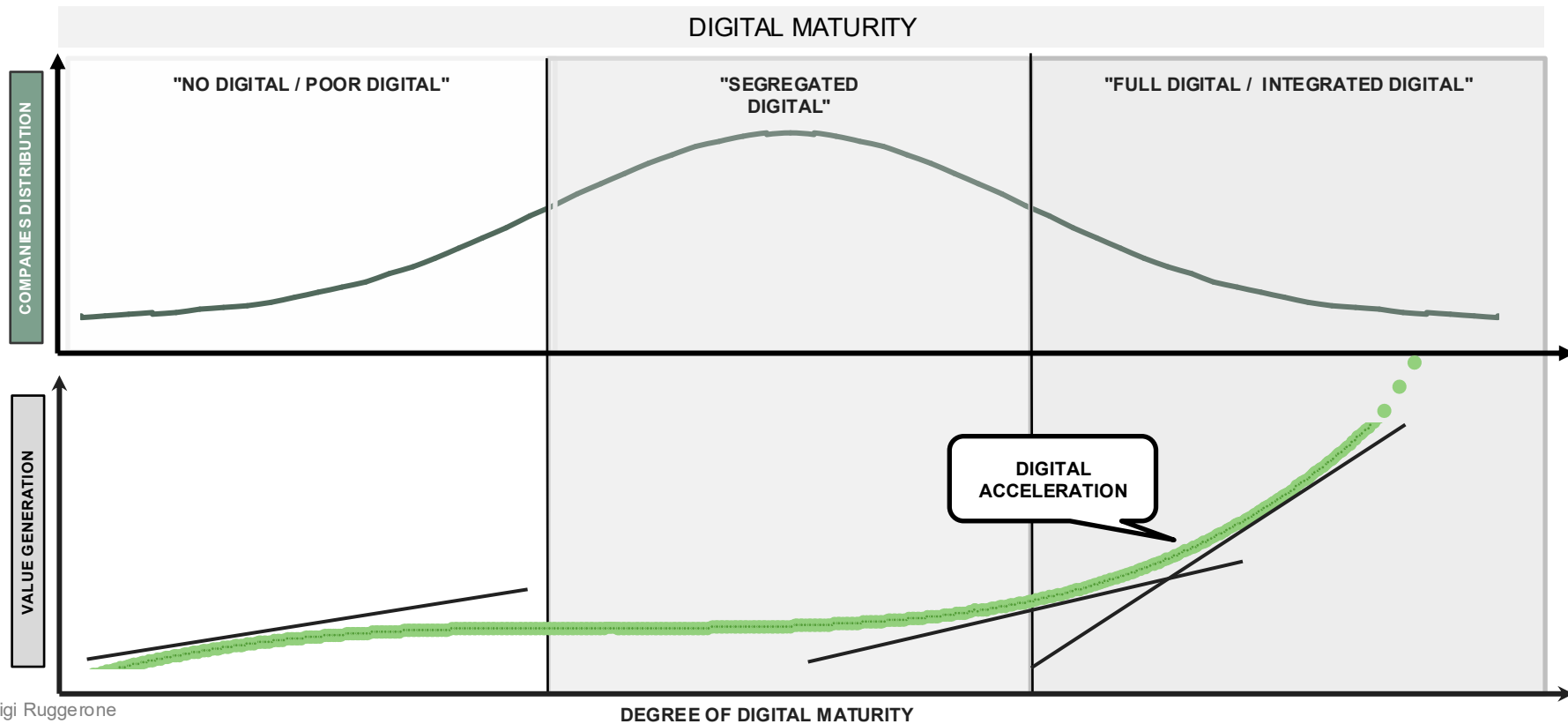
- Reduction of the number of changes (or costs) required to maintain a good approximation, while allowing the system to withstand small fluctuations



Tempo di calcolo ridotto di ordini di grandezza: anni contro secondi per insiemi di fattori di rischio di grandi dimensioni (~300).

The Digital Transformation Revolution

Companies create value with digital only when digital becomes a real enabler of the whole business



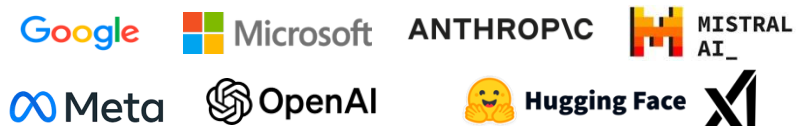
I Key Enabler dell'AI

Le università, i tech company, le conferenze AI, il software open source

Università



Tech company



Open-source software

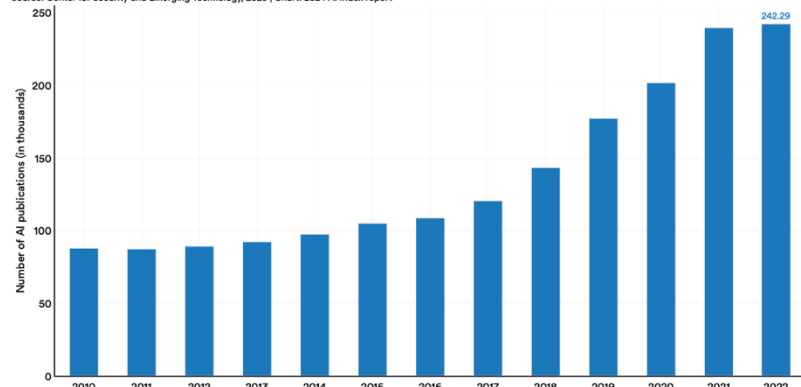


AI Conferences



Number of AI publications in the world, 2010-22

Source: Center for Security and Emerging Technology, 2023 | Chart: 2024 AI Index report



I Paradigmi dell'AI

Tecnologie AI usate per percepire, comunicare, generare contenuti e prendere decisioni

	Percezione	Linguaggio	Generazione contenuti	Decision making
Definizione	Interpretare dati sensoriali come immagini, video, suoni	Comprendere e processare il linguaggio naturale	Generare nuovi contenuti	Imparare dei processi sequenziali, decisionali
Tecnologia	Audio <ul style="list-style-type: none"> • Recurrent Neural Networks • Transformers Immagini <ul style="list-style-type: none"> • Convolutional Neural Networks • Vision Transformers 	<ul style="list-style-type: none"> • Recurrent Neural Networks • Transformers (e.g. BERT, GPT) • Large Language Models (LLMs) 	<ul style="list-style-type: none"> • Large Language Models • Generative Adversarial Networks • Variational Auto Encoders 	Reinforcement Learning: <ul style="list-style-type: none"> • PPO • TRPO • DQN
Applicazione	Audio <ul style="list-style-type: none"> • Audio recognition • Voice recognition • Speech to text Immagini <ul style="list-style-type: none"> • Image recognition • Video recognition 	<ul style="list-style-type: none"> • Sentiment analysis • Translation • Summarization • Question answering 	<ul style="list-style-type: none"> • Generate text, audio, images, videos • Story generation • Chatbots • Deepfakes 	<ul style="list-style-type: none"> • Robotic control • Strategy games • Trading • Resource management

Machine Learning nel banking

Le stesse tecnologie usate per l'AI possono essere usate per imparare task specifici

Retail							
Application	Fraud detection	Customer service	Credit Scoring	Identity verification	Loan Processing	Product recommendation	Anti-money laundering
ML Tecnology	<ul style="list-style-type: none"> • Neural networks 	<ul style="list-style-type: none"> • NLP • LLM 	<ul style="list-style-type: none"> • Neural networks • Random forests 	<ul style="list-style-type: none"> • CNNs 	<ul style="list-style-type: none"> • Neural networks • Random forests 	<ul style="list-style-type: none"> • Neural networks • Bandits • KNN 	<ul style="list-style-type: none"> • Random forests • RNNs

Capital Markets							
Application	Algorithmic Trading	Market making	Portfolio management	Sentiment analysis	Due diligence	Credit ratings	Automatic RFQ management
ML Tecnology	<ul style="list-style-type: none"> • Reinforcement learning • Deep learning 	<ul style="list-style-type: none"> • Reinforcement learning • Deep learning 	<ul style="list-style-type: none"> • Reinforcement learning • Graph NN 	<ul style="list-style-type: none"> • NLP • LLM 	<ul style="list-style-type: none"> • LLM 	<ul style="list-style-type: none"> • Neural networks • Random forests 	<ul style="list-style-type: none"> • NLP

AI Team

900+

Datascientists

600+

ML Engineers

200+

AI researchers

Teresa Heitsenrether
new position Chief Data &
Analytics Officer

Business impact and future directions

>\$1.5Bn

AI driven business impact
(2023)

GenAI

reshaping entire business
workflows

Explainable AI

Costruire modelli spiegabili agli
utenti

Responsible AI

Assicurarsi che i modelli
rispettino le guideline etiche

General bank use case

- ML è usato in più di 400 use case in produzione negli ambiti del **marketing**, **antifrode** e **risk**.
- **IndexGPT**: un applicativo basato su GPT-4 che può creare indici tematici
- AI è usato per la **validazione** real-time dei **pagamenti**

Capital markets use case

- **ABIDES**: agent-based exchange simulator
- **Phantom**: RL driven multi agent framework to model complex systems
- **Deep Hedging**: Deep Learning for derivatives hedging
- **DNA**: Deep Neural Algo for execution



AI Team

500+

Datascientists

430+

Patent applications

50+

AI researchers @ Notch

Prem Natarajan

Chief Scientist & Head of
Enterprise AI

Main AI pillars



Graph ML



Anomaly detection



Explainable AI



Data and privacy

Customer experience use case

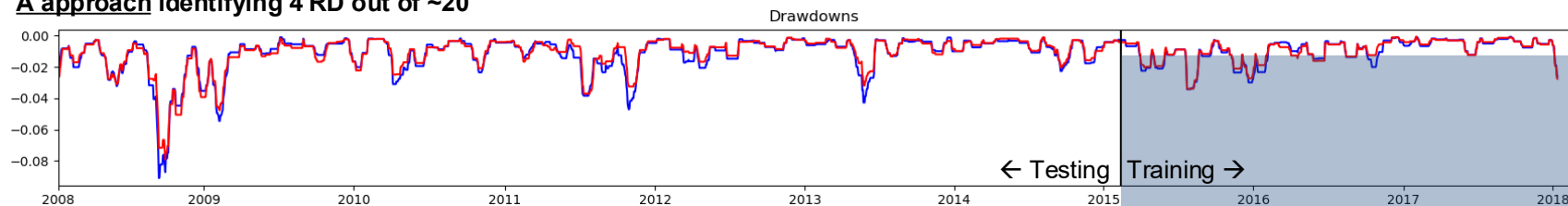
- **Eno browser extension:** tramite ML at the edge, capital one è in grado di identificare le pagine di pagamento e compilarle con una carta virtuale unica generate ah hoc per ridurre i rischi
- **Auto Navigator:** Un applicativo ML per la clientela retail che è in grado di emettere il finanziamento per un auto in una frazione di secondo

Fraud detection and operational efficiency

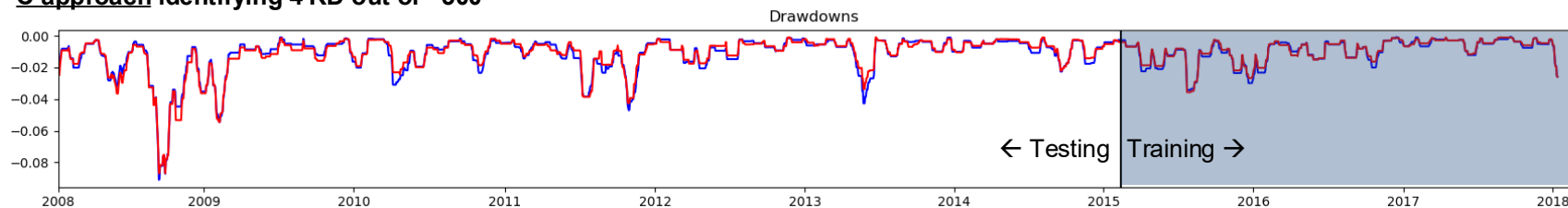
- **Fraud detection:** applicativo di ML che è in grado di identificare potenziali transazioni fraudolente in real-time e notificare il cliente
- **Mobile App Diagnostics:** un tool ML interno che permette di identificare le problematiche nelle mobile banking apps in real time, minimizzando il down time per la clientela

Given a target portfolio, identify the sources of risk and the events of stress (tail events)

A approach identifying 4 RD out of ~20
























C approach identifying 4 RD out of ~300



	R^2	DD_{err}
A approach	0.91	1.92
C approach	0.91	0.94

In regression, the R^2 coefficient of determination is a statistical measure of how well the regression predictions approximate the real data points

Results: First phase

	A approach	B approach	C approach
High Interpretability	 Yes	 Yes	 Yes
Accuracy (R ² and DD)			
Number of RD that can be evaluated	 ~ 20	 ~ 20	 ~ 1000
"Stable" set of identified RD	 No	 No	 Yes
Automatic model selection	 No	 No	 Yes
Computational Time	 Exp.	 Exp.	 Polyn.
Customised loss function	 No	 No	 Yes



Explanatory power is preserved



Drawdown error is significantly reduced