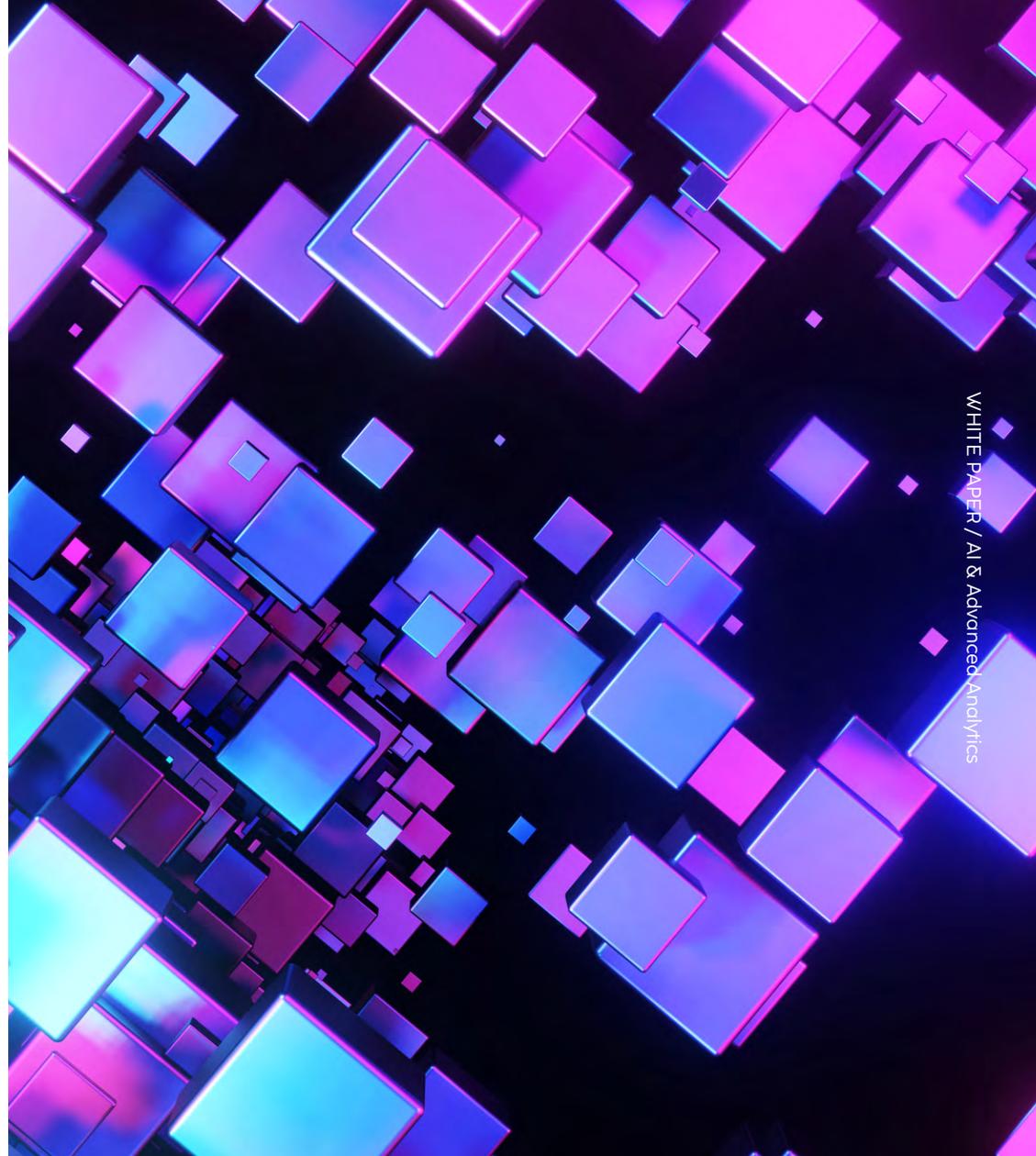




WHITE PAPER **AI & Advanced Analytics**

The impact of AI in creating new value from data to drive the business of the future.





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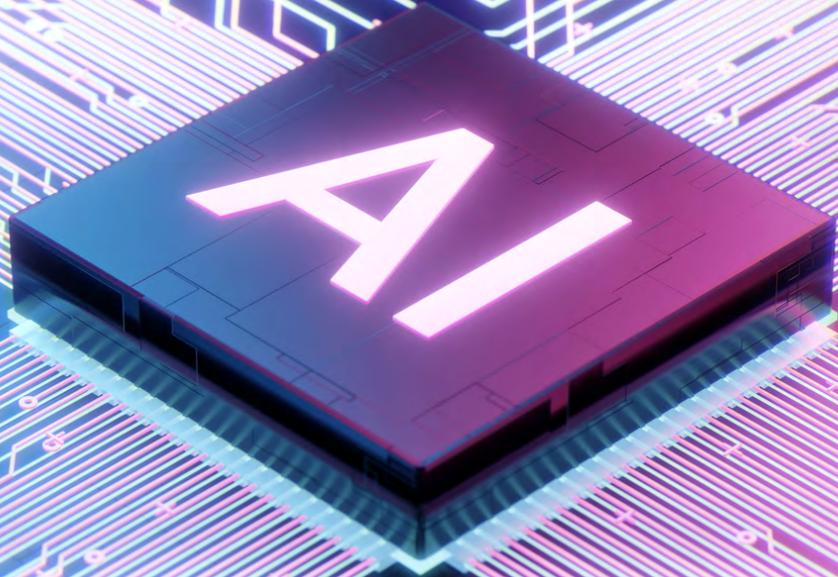


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Data is talking



01

Data is talking

DIGITAL TRANSFORMATION IS ENABLED BY A VARIETY OF TOOLS, SUCH AS CLOUD INFRASTRUCTURE AND DIGITAL PLATFORMS, WHICH ALLOW ORGANIZATIONS TO RAPIDLY ADAPT TO MARKET CHALLENGES AND EMERGING OPPORTUNITIES.

AT THE HEART OF THIS PROCESS IS THE DATA-DRIVEN APPROACH, WHICH, THROUGH IN-DEPTH DATA ANALYSIS, PROVIDES A CLEAR AND INFORMED VIEW TO SUPPORT STRATEGIC BUSINESS DECISIONS.



In the last decade, the combination of availability and access to large amounts of data, a significant increase in computing power, the usability of powerful libraries, and important developments on a theoretical level, have greatly expanded the capabilities to which Artificial Intelligence (AI) and Advanced Analytics can provide access.

Making data talk, in a modern sense, requires the use of modular architectures composed of elements of Analytics & Business Intelligence and Advanced Analytics/ AI, supporting the entire value chain from descriptive to predictive and prescriptive aspects, leveraging all the variety and breadth of available sources.

Enabling "self-service" mode, that is, the ability of users to access and analyze data independently, also allows **democratizing and simplifying access to valuable information**. AI and Advanced Analytics thus allow companies to gain a significant competitive advantage by attributing to digitalization a broader meaning than simple automation or mere process improvement.

Although the evolution of these technologies is only at the beginning, several AI applications have already generated

new lines of business and sparked considerable interest. For example, **text-oriented Generative AI** represents a significant step forward in information management, as it uses AI to create text in response to specific inputs. This capability, achieved through training on a wide range of data, often far surpasses human capability in terms of depth and quality of the language produced. This example highlights the potential of AI technologies to revolutionize how we express ourselves and interact with information in the digital age.

However, the power and pervasiveness of AI-based solutions entail various implications related to the so-called **"Responsible AI"**. It is necessary, in fact, to have a deep understanding behind these "intelligent systems" to appropriately address issues related to reliability, fairness, bias, ethics, risk, and compliance with laws protecting individuals and their privacy.

In this paper, we explore the most recent trends and challenges in the field of AI and Advanced Analytics. We will also showcase specific cases where we have successfully leveraged the potential of AI to develop increasingly innovative solutions



Data is talking



Q2 Advanced analytics empowering human capabilities

Analytics can be seen as a journey that begins with observing and describing past events, aiming to identify their roots and causes. Subsequently, the analysis moves towards the future, attempting to formulate predictions and identify the most appropriate responses to the challenges ahead. This process is not merely theoretical but materializes through the automation of decision-making processes, allowing the gathered information to be translated into concrete and timely actions.

In this journey, along with traditional data analysis methodologies, we are witnessing the emergence of innovative approaches that embrace the latest technologies such as **Machine Learning (ML)**, **Deep Learning (DL)**, and **Artificial Intelligence (AI)**. These technologies enable a deeper and more predictive understanding of data,

significantly expanding analytical capabilities and value extraction. By combining fundamental aspects of human experience with cutting-edge technologies such as **Natural Language Processing** and techniques of **Advanced Analytics** in general, it is possible to develop AI applications for a wide range of purposes.

For example, one can create a virtual assistant capable of handling basic user support within a system, allowing human operators to focus on more complex and strategic tasks.

The ability to learn from data and simulate nature-inspired behaviors, coupled with advanced models and algorithms, represents the change and evolution that position AI and Advanced Analytics among today's most essential enabling technologies.



Key Trends

\$2 trillion

AI GLOBAL MARKET SIZE BY 2030 WITH A CAGR OF 37% (2023-2030)

\$45 bn

GLOBAL GENERATIVE AI MARKET IN 2023 WITH A CAGR OF 24% BY 2030

\$650 bn

GLOBAL BIG DATA MARKET GROWTH BY 2030

\$41,45 bn

THE GLOBAL PREDICTIVE ANALYTICS SOFTWARE MARKET BY 2028

180 ZB

OF DATA/INFORMATION IN THE WORLD ESTIMATED IN 2025

+700 m

USERS OF AI APPLICATIONS BY 2030

€570 bn

AI ADOPTION'S IMPACT ON ITALIAN ECONOMY REVENUES BY 2030

The main challenges come from:

Ethics, Data Robustness, Security and Privacy

TOP 3 BUSINESS BENEFITS

Efficient and effective process management

Proactive decision-making

Increased productivity

The holistic approach to AI & Advanced Analytics supports business in managing complex scenarios

Data displayed represents our elaboration of data coming from multiple sources



A constantly evolving scenario

Generative AI, Synthetic Data, Composability, and new trends like Quantum Computing are already realities and, at the same time, promises for the future.

Synthetic data, meaning data artificially generated to simulate characteristics and distributions of real data, are an excellent tool to meet informational needs while protecting sensitive data and **privacy**, reducing biases. The use of synthetic data offers advantages in many sectors such as healthcare, where patient confidentiality

is of primary importance: these data allow healthcare professionals to conduct research and analysis without compromising the privacy of individuals. Furthermore, in the field of scientific research, the use of synthetic data can help **overcome limitations** related to access to real data, allowing researchers to explore new hypotheses, simulate situations not easily replicable in reality, and thus develop more accurate models.

Lastly, the generation of synthetic data can help reduce biases present in the data, with the goal of **increasing the fairness** of algorithms for a more ethical and responsible use of AI. AI systems, in fact, must be able to consider all individuals and their respective data fairly under equal conditions, regardless of specifics such as ethnicity or geographical origin.

In recent years, the paradigm of large general-purpose models has been increasingly established, with tens if not hundreds of billions of parameters, capable of solving a large number of different tasks without being specifically trained for them: **Large Language Models (LLMs)** are one of the main examples, as well as **Diffusion Models**, capable of generating any type of image, or **Automatic Speech**

Recognition Models capable of transcribing any type of language. For the training of these models, it becomes crucial, on the hardware side, to be increasingly efficient: techniques such as **Quantum Computing**, which has already demonstrated significant computational gains compared to current technology, are thought to offer the performance leap that today's and tomorrow's models will need.

Finally, innovative themes such as synthetic data, generative AI, and quantum computing are far from being segregated from each other and express their full potential when combined with more traditional but equally fundamental technologies such as data visualization and data management: all in a total perspective of **composability**.

By composability, we mean the possibility of integrating different analytical components to allow the creation of new and more complex applications or solutions, improving their agility, scalability, and adaptability.

Combining, for example, a conversational AI assistant with advanced data extraction techniques, we can enable instant insights for which until recently would have required time, resources, and multiple different skills.

GENERATIVE AI

[Generative AI](#), at its core, is a groundbreaking fusion of Artificial Intelligence and creative content generation. It harnesses the power of advanced Machine Learning models to craft incredibly lifelike content across various mediums, including text, images, code, audio, and video.

While more traditional AI systems rely on programming at their core to enable tasks to be performed, Generative AI learns from **extensive data sets** and with that knowledge creates content starting from **prompts** expressed in natural language.

Generative AI models undergo extensive training with large amounts of data to understand patterns, structures, and features. Once trained, these models can generate new content that closely resembles the patterns and characteristics of the original data.

They can generate content that is similar to what they have learned, but with variations and creativity. Generative AI utilizes deep learning techniques, such as **Transformers** based on Attention mechanism, Diffusion Models, **Generative Adversarial Networks (GANs)** and **Variational Auto-Encoders (VAEs)**, to generate content.

The significance of Generative AI lies in its integration into our daily lives in a way that AI hadn't achieved before.

While AI, algorithms, and data-driven decision-making have become commonplace, Generative AI has struck a chord with us on a profound level, sparking discussions about the impact of technology. This phenomenon can be attributed to Generative AI's ability to tap into areas closely linked to **human creativity**.

Truth be told, currently GenAI does not create anything, but it composes various pieces of content in a statistically correct manner (thus delivering "realistic" outputs).

Generative AI is currently viewed as both a tremendous opportunity and a potential challenge to the status quo, and by extension, our livelihoods. Ultimately, it has the potential to revolutionize the way we live and work, enhancing both our productivity and creativity.





The place where the "data-driven" concept becomes reality

The place where the "data-driven" concept becomes reality

Within the Technology Business Line 'Data & Analytics', we develop end-to-end solutions for organizations with a holistic approach that allows managing the entire data chain and turning data into a competitive advantage. We are involved in the design and configuration of **data platforms** through cloud, on-premise, or hybrid solutions, managing data lakes, data hubs, or lake houses and leveraging approaches such as data mesh or data river. We apply **Data Management techniques** to structured and unstructured data, centralizing them in a repository or using federated architectures to create a reliable foundation to support exploration, deductions, insights, and visualizations. Using data, we develop **Artificial Intelligence** techniques that create value and provide the best answer to specific business questions. We cover the entire spectrum of **Advanced Analytics** techniques, from Machine Learning, Deep Learning, AI to Generative AI, and have developed models in the main areas of Analytics application such as for instance:

- creation of virtual assistants,
- definition of optimal resource utilization (e.g., what-if & simulation, predictive maintenance, traffic flow, logistics planning, etc.),
- sound analysis (from voice recognition to voice feature detection, sentiment analysis),
- document analysis and understanding through text recognition (keyword extraction, entity extraction, summaries generation, construction of semantic maps

and graphs of knowledge),

- image/video analysis including, for example, face recognition and detection of emotional characteristics, age estimation, including artificial modifications,
- semantic-based image search,
- detection of defects for maintenance purposes and pathologies for healthcare purposes,
- motion detection to manage situations containing moving backgrounds and gradual lighting variations,
- time series analysis with applications spanning almost all business areas, such as predictive analysis of time series on sensor data, industrial machinery, energy, household, human behavior, economic variables, etc.

Finally, we facilitate data understanding in a simple and immediate way. We provide users with access to the information they need, whenever they want it, in a self-service mode, blending various data sources with mash-up techniques that ensure a mix of meaningful information and free explorations in visual form.

In a world that moves fast, dominated by visual messages, the representation of analysis results must not only respect form and functionality but also pay attention to the user experience. Our **Data Visualization** team fully understands these needs and knows how to provide solutions that meet users' expectations.



Engineering's **Data & Analytics** / At a Glance



○ OFFICES
● PROJECTS

Exploiting the value of data with **Data-driven tools & methodologies.**

Our holistic Data Analytics approach enables our partners to design high performance Data Platforms that manage complex AI use cases while guaranteeing a strong UX.

We cover the whole Data Analysis lifecycle, from collection and data management, to quality, governance and visualization.

380+
Professionals

100+
R&D Professionals

20+
Partnerships and Academic Collaborations

50+
Projects/year

300+
Certifications

100+
AI certifications

ADVISORY

TECHNOLOGY & IMPLEMENTATION



The place where the "data-driven" concept becomes reality



A holistic approach to innovation

In the world of Artificial Intelligence and Advanced Analytics, it is necessary to adopt a scientific approach towards data and problems in order to **provide tailored solutions**: there is no single solution that fits all cases. With our approach, we intervene to overcome this complexity by identifying and processing the relevant components with the most fitting tools to ensure an engaging, complete and effective user experience.

Design Thinking, Lean Startup, and Agile methodologies converge to form a holistic approach to innovation and project management.

Design Thinking prioritizes empathy, ideation, and prototyping to solve complex problems by placing the user at the center of the design process. This user-centric approach aligns seamlessly with the **Lean Startup** methodology, which advocates for rapid experimentation,

the creation of **Minimum Viable Products (MVPs)**, and continuous iteration based on customer feedback. **Agile methodologies**, on the other hand, embrace flexibility, collaboration, and **iterative development** to respond quickly to changing requirements. When integrated with **DevOps**, these methodologies contribute to a culture of continuous integration, delivery, and operations, promoting seamless collaboration between development and IT teams.

In the field of **MLOps**, these principles extend to the end-to-end management of machine learning lifecycles, emphasizing **rapid deployment, continuous monitoring, and adaptive development of models**.

Engineering has a **multidisciplinary team**: Data Scientists, Data Engineers and Data Analysts with engineering, computer science, mathematical, physical or statistical skills. Additionally, we include linguists specialized in understanding semantics and syntax for natural language analysis, as well as professionals with psychological expertise and, above all, experience in neuroscience. There is no one person who embraces all disciplines, but a hub and spoke model that allows each client to make the most of the expertise available on the market.



Data & Analytics drives innovation in AI, Gen AI and data architecture & management by implementing highly customized solutions to enable data-driven decision making.

DATA & ANALYTICS

Data Architecture & Management

Empower customer success through seamless data management and analytics insights

Data Strategy & Governance

Mainstream Data Platforms

Advanced Data Platforms

Data Insights & Storytelling

Artificial Intelligence

The digital fuel to transform data into value and competitive advantage

Generative AI

Data Science & Advanced Analytics



06

The increasingly human side of AI

The increasingly human side of AI



In the years to come, various trends and challenges seem destined to take center stage in the landscape of AI and Advanced Analytics.

Generative AI, merging AI and data-driven content generation, has opened the doors to previously unimaginable possibilities and is ushering in a new era of efficiency and creativity. The continuous improvement of advanced **Virtual Assistants** enables increasingly natural interactions between machines and humans, both through text and voice. These systems not only understand user requests but are also capable of generating rich and coherent responses to the context. **Companion/co-pilot AIs** are designed to assist users in a variety of work activities, ranging from drafting documents to creating presentations and managing emails.

The trend towards greater portable processing power is leading to the execution of algorithms directly on devices, with low-latency responses. This is reflected in the widespread use of smartphones and larger "devices" such as cars for autonomous or assisted driving.

This evolution enables **real-time edge analysis**, providing support to sales & marketing professionals in crafting more targeted proposals.

As for language models, we are witnessing interesting developments with Small Language Models and Large Language Models Store. Language Models are Artificial Intelligence models capable of understanding natural language in its complexities. Within Generative AI, they are often constituted by large-scale Neural Networks called Transformers, which aim to predict the next word in a text based on the preceding ones.

Small Language Models are designed to be more efficient and faster than their larger counterparts. They find utility in various applications, including automatic word correction, translation, and text generation.

The **Large Language Models Store**, on the other hand, represents a repository of Large Language Models specialized in specific themes.

An interesting step towards the future is also represented by the growth of the **"Bring-Your-Own AI"** approach, allowing users within the company to use personalized artificial intelligence systems to meet specific organizational needs. The adoption of personal AI tools is not without

challenges, especially in managing Shadow AI (unauthorized or ad hoc use of Generative AI within an organization outside of IT governance) with potential regulatory compliance and data protection issues.

Growing attention will need to be paid to ensure transparency in decision-making systems and investing in AI Ethics education, with increasing emphasis on ethical considerations in research and development.

This theme is central throughout the data lifecycle: from raw data collection and management to algorithm writing and training on selected data, as well as the actual use of information derived from AI-powered systems by companies, healthcare personnel, and public administration.



The creation of **modern and robust data infrastructures** will remain essential to facilitate integration, standardization, and efficient information analysis.

This will be an essential foundation for accurate management and an ethical approach to data analysis.

AI will increasingly play a role in Cybersecurity, responding to the growing threat of cyber-attacks.

Machine Learning algorithms will become increasingly proficient in detecting and countering threats, including those posed by other AI applications, ensuring advanced data protection and contributing to more efficient management.

Finally, the adoption of a comprehensive strategy to seamlessly integrate AI into existing processes and services not only responds to business opportunity logics but also brings with it the potential to make **positive impacts** on our way of living and working, significantly contributing to addressing major **global challenges**.



07

Our projects

Our projects



USE CASE / DIGITAL DEFENSE

AI-generated identikits for forensic activity

We leverage techniques of Generative AI, specifically GANs (Generative Adversarial Network) applied to images, to support the work of forensic artists. Traditionally, forensic artists rely on verbal descriptions to create stylized drawings of subjects based on witness accounts.

We enhance this process using machine learning (ML/DL) and Generative AI. By training the model on large sets of real images, it learns the characteristics of facial evolution, including as the effects of aging, changes in appearance and surgical modifications. When applied to images of subjects under investigation, the GenAI model generates more realistic and accurate representations, closely resembling reality. These generated images can be reproduced as photographs, making them more easily recognizable and usable for identification and matching purposes. The project not only benefits forensic artists but also provides a tool for users without artistic skills to create photorealistic identikit.



CASE STUDY / DIGITAL FINANCE

GenAI-based Virtual Assistant for customer care

We adopted Generative AI, particularly ChatGPT with services of Azure platform, to improve customer service of a bank. Our aim is to develop a more effective system for interaction and classification of customer requests compared the as-is condition. By leveraging ChatGPT's natural language processing capabilities, our solution can interact with customers in a human-like manner, understand the content of conversations, derive intents, and classify requests based on the bank's domain-specific information. Our solution enhances conversation quality, problem-solving abilities, routing accuracy and response quality of existing bots. As a result, the deflection rate (reduction in the need for human operators) increases, sentiment scores for customer assistance improves, and the availability of 24/7 support contributes to higher Net Promoter Scores (NPS) and improved app ratings for the bank. Generative AI empowers the virtual assistant to provide personalized and efficient customer care, enhancing the overall customer experience.



CASE STUDY / SMART GOVERNMENT

Generative AI supporting business analysis

We built a digital platform for worldwide consultation of geographic, demographic, economic, sociocultural, environmental, and institutional indicators of various countries, for broad strategic objectives related to the Agenda 2030.

The multitude of data from many different sources can be quickly and effectively accessed through interaction in natural language with a conversational agent. Leveraging generative AI, this agent understands the request for specific data, directly identifies it in the database, interprets the results, and provides the user with the correct response, also in the form of charts.

This agent represents a new and natural mode of self-service data consumption, allowing for direct consultation and analysis from complex databases without relying on Excel files, reports, or dashboards, thus reducing the time required for report production and the training needed for analysts.





CASE STUDY / E-HEALTH

Synthetic data generation for Telemedicine

For the National Telemedicine Platform, we developed proprietary internal models based on advanced simulations and statistical algorithms that consider various factors of interest, such as co-morbidity, interaction effects, seasonality, anomalies in service delivery, regional heterogeneity, and the terminology of the National Health System. A complete simulation was conducted to generate synthetic and realistic data as close as possible to conceivable scenarios. New samples of this data can be generated as needed based on user analytical requirements. The availability of synthetic data, for which anonymization is not required in compliance with the GDPR (General Data Protection Regulation), has reduced the time to market of the solution.

The simulation models and modular, flexible, and parameterizable services, adaptable to different geographical and clinical contexts, have also facilitated maintenance operations of the overall system.



CASE STUDY / SMART ENERGY & UTILITIES

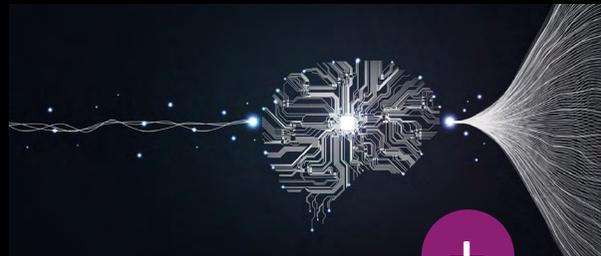
Advanced Analytics for gas transportation

For an Italian Energy Infrastructure Company, we developed a new approach to manage Unaccounted for Gas (UFG), which is the amount of residual gas from the balance between gas input and gas returned to end users, net of variations.

We used advanced analysis techniques to identify the causes of UFG losses. By examining data from meters, such as daily or hourly volumes, we also calculated UFG caused by measurement errors. Additionally, we considered UFG in relation to gas quality, meter age, and different geographical areas.

The enabling technologies used include supervised and unsupervised machine learning algorithms, run daily across the entire Italian gas network.

This project has improved the quality of data analysis, reduced unaccounted for gas, and led to improvements in the entire system.



CASE STUDY / SMART ENERGY & UTILITIES

Distributed generation through AI

We implemented a system capable of predicting how much electricity renewable energy plants such as solar panels, wind turbines, and others produce.

We improved data collection and used statistical techniques to identify informational gaps. Associative algorithms allowed us to relate different plants to each other, optimization algorithms led to the identification of the actual load state of the power grid. Through simulation algorithms, we evaluated the performance trends and the optimal number and position of sentinel plants from which to extract real data to optimize the load forecast of the grid. The system thus developed can predict with extreme precision the amount of renewable energy produced by each type of plant, in every area of the grid, with updates every 15 minutes.

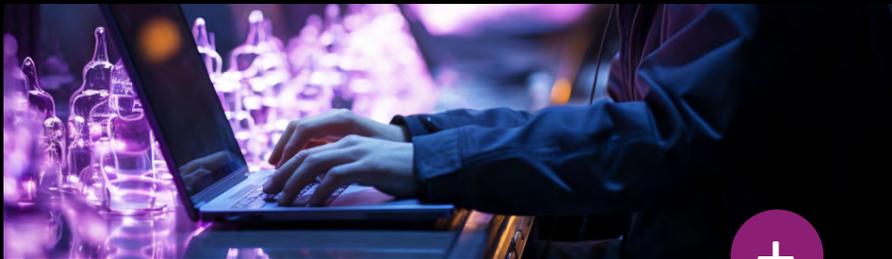
Finally, we identified an effective solution to balance renewable energy with traditional one, seeking to cause the least possible impact on plants and locations.



EngGPT: our AI-driven assistant for your business

EngGPT is a large language model (LLM) developed in-house by ENG. It constitutes the core of the generative AI solutions we develop for our clients and is built using techniques that currently represent the state of the art for Generative AI, such as Transformer architectures, RLHF (Reinforcement Learning Human Feedback), and DPO (Direct Preference Optimization). EngGPT offers reasoning, logic, and language comprehension performance that falls within the comparability range of ChatGPT (GPT3.5-turbo), while addressing concerns about data privacy according to the principle of Private Generative AI; EngGPT can indeed be fully installed on-premise on dedicated client hardware, ensuring that their data never leaves the corporate perimeter.

EngGPT can be customized to client data through the RAG approach (Retrieval Augmented Generation), as well as through fine-tuning, which involves retraining the engine exclusively for the client. Additionally, EngGPT has multimodal capabilities and, within an architecture composed of various AI modules, can perform a vast array of different tasks including: text content generation, natural language data analysis, data quality assessment, customer support, image analysis, and many more, all with the aim of providing our clients with a powerful, versatile, and customizable Generative AI solution.



Focus on



08

Key takeaways

Key takeaways



key take

Key takeaways

1

Giving voice to data requires the creation of modular architectures

with components of Analytics & Business Intelligence and Advanced Analytics/ AI that ensure smooth support along the entire value chain, covering descriptive, predictive, and prescriptive aspects, while ensuring easy access to information.

2

The ability to learn from data and simulate "nature-inspired" behaviors

combined with traditional models of intelligence and algorithms represent a turning point in the evolution of Analytics.

3

Current AI applications allow for the generation of highly realistic and complex data, content, and services

but they require the construction of a solid database foundation, new approaches to algorithm learning paradigms, and advancements in hardware power.

4

The composable approach to analysis enables the creation of highly flexible solutions

ensuring agility, scalability, and maximum adaptability to the various needs within the analytical framework.



Key takeaways

5

In the landscape of AI & Advanced Analytics, it is necessary to adopt a scientific method

towards data and problems to develop tailored solutions. A holistic approach and the involvement of a multidisciplinary team are equally critical factors for the development of innovative AI solutions.

6

The comprehensibility of analytical models, clarity in decision-making processes, and ethical training

in the field of AI are central aspects both in the research phase and in the development of AI-based solutions.

7

AI will increasingly play a role in Cybersecurity:

Machine Learning algorithms will be able to identify patterns, relationships, and anomalies in data, responding to the growing threat of cyber-attacks, ensuring an advanced level of data security.



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