AI ENERGIZER

LINKING STRATEGY AND MACHINES

THE WHITEPAPER

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How Major Energy Company Increased Profitability up to 20% using Robot Trader

A Practical Application to Artificial Intelligence in Energy Trading

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White Paper

How Major Energy Company Increased Profitability up to 20% using Robot Trader

A Practical Application to Artificial Intelligence in Energy Trading

#Artificial intelligence
#Machine learning
#Data Engineering
#Data Science
#Robot Trader

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AI Energizer a Joint Venture by Maycroft and River Commodity

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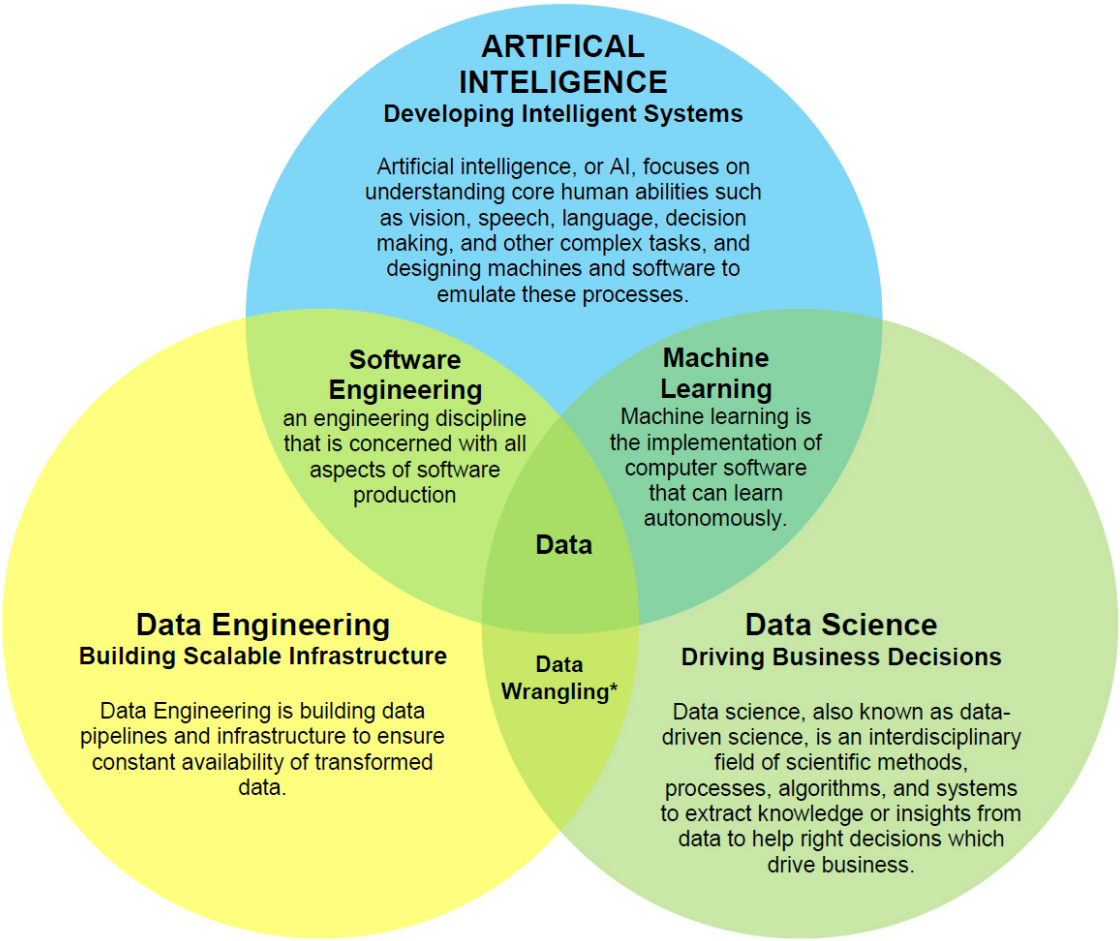
WHAT IS ARTIFICIAL INTELLIGENCE?



Data wrangling is the process of transforming and mapping data from one "raw" data form into another format with the intent of making it more appropriate and valuable for analytics.

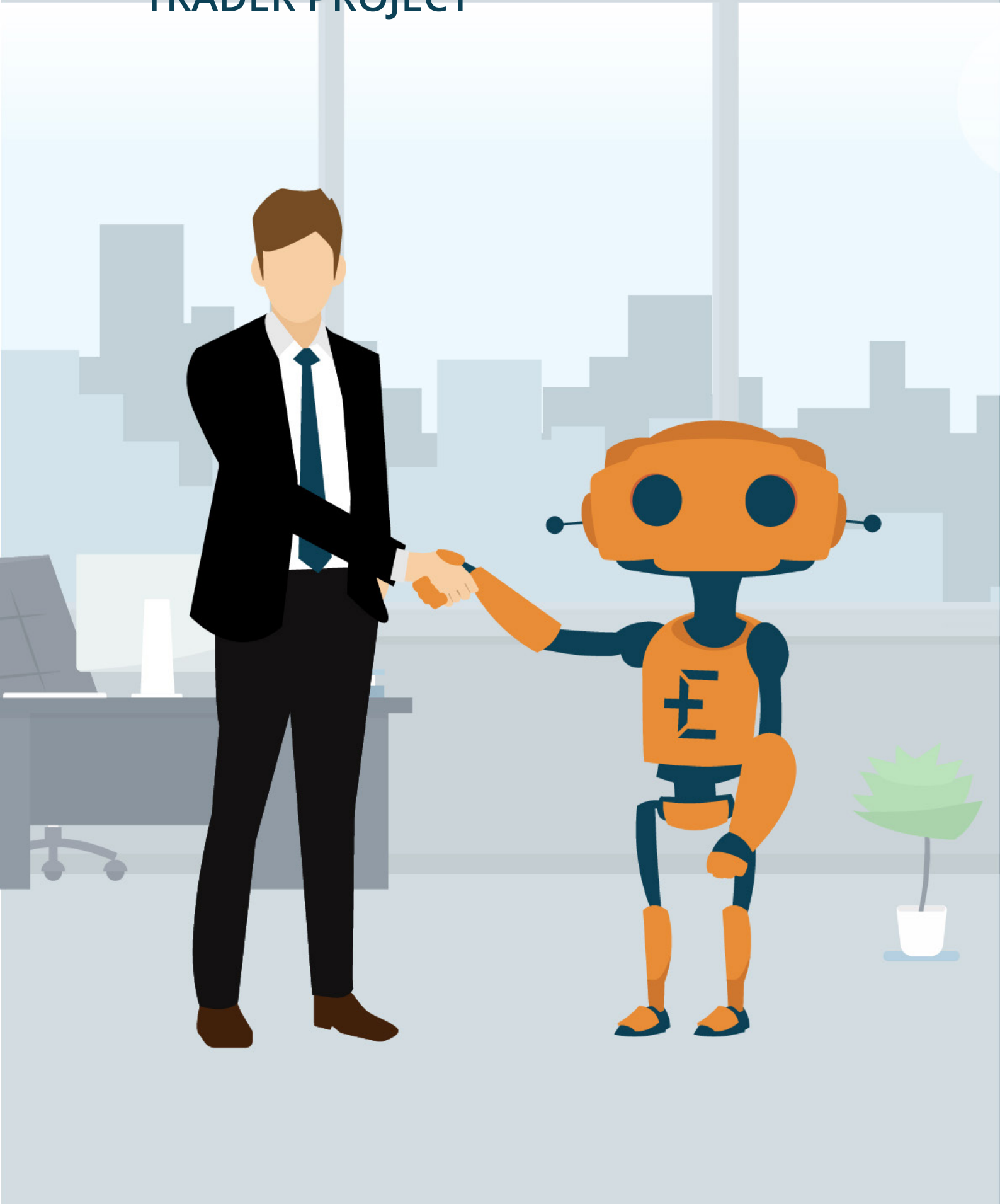
We used the following sources for this infographic:

Software Engineering – Ch 1 Flashcards, Quizlet March 22, 2018 - https://quizlet.com/144249506/software-engineering-chapter-1-flash-cards/

Data wrangling – Wikipedia, March 22, 2018 - https://en.wikipedia.org/wiki/Data_wrangling

How AI Careers Fit into the Data Landscape – Medium, Insight Data, Jeremy Karnowski, Nov 7, 2016 - https://blog.insightdatascience.com/how-emerging-ai-roles-fit-in-the-data-landscape-d4cd922c389b

THE PRIMARY AIM OF THE ROBOT TRADER PROJECT



One of the key firms in the energy sector engaged AI Energizer from a business and operational effectiveness perspective. We designed and developed a new artificial intelligence trading system for the Energy Trading departments. We involved other departments in the project, such as Risk Control and Compliance.

The primary aim of the robot trader development project was to provide such an artificial intelligence system that would increase the efficiency of trading decisions, including the follow up why and how the traders decided in decision-making situations as they did.

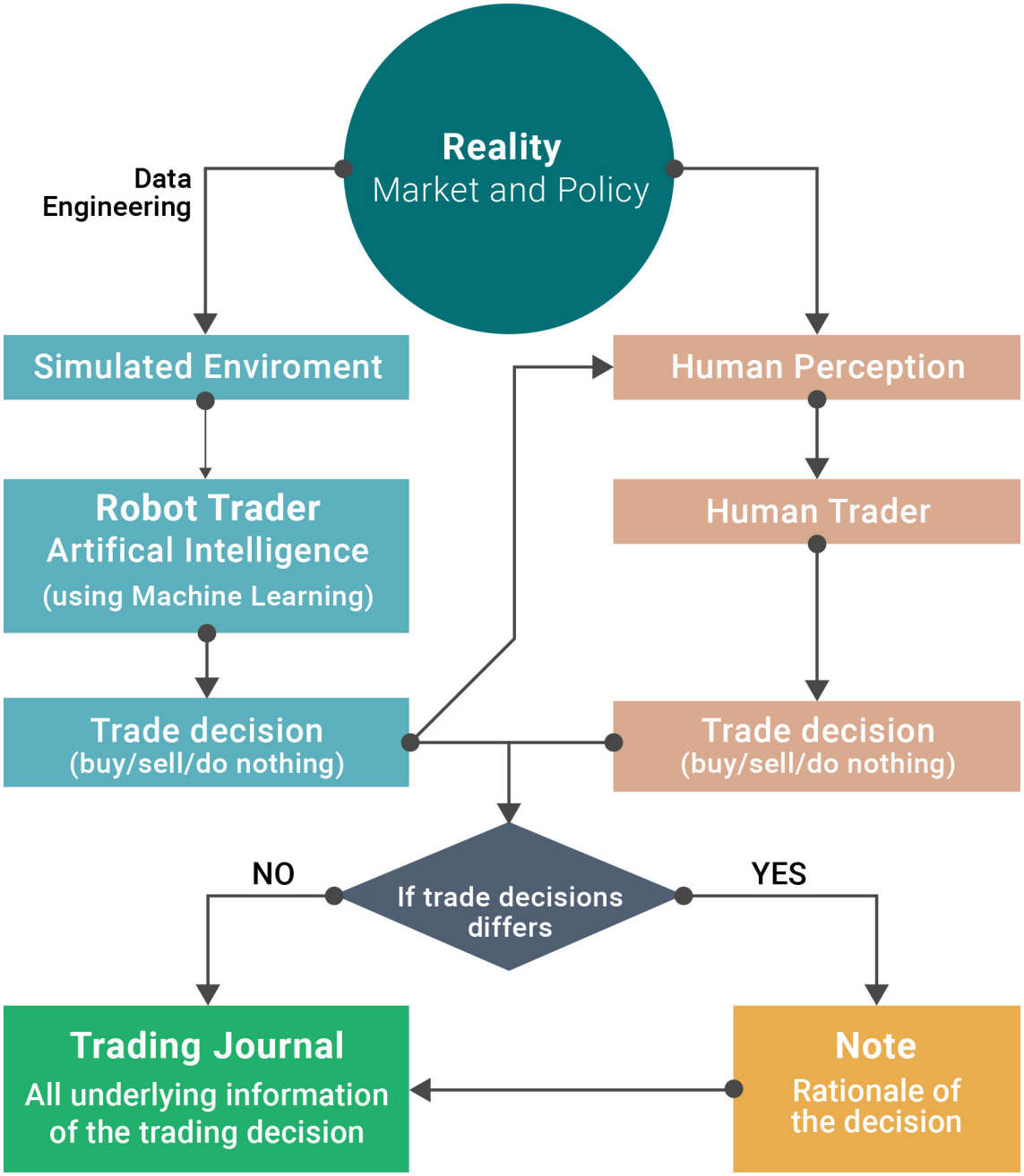
AI Energizer team members brainstormed and integrated ideas for the new artificial intelligence trading system and delivered:

- A second opinion concept, what defines the roles of humans and machines.
- A simulation environment, what ensures trading decisions practicability in real market conditions and corporate trading rules.
- A Robot trader an artificial intelligence system for making human-independent trade decisions.
- A Trade journal for benchmarking, monitoring and analysis of trade decisions.

Robot Trader

A computer program based on a set of trading signals that helps determine whether to buy or sell. Depending on the automation level it should make the trade decision and transaction without human support. **Robot traders are designed to remove the psychological element of trading.**

After we had chosen the promising models and settings for the robot trader, we connected them to the simulation environment. We selected the final models in a simulation if real market conditions. After we had a working system and all the documents together, we ran workshops with the company management and traders. Based on the excellent results, the Board decided to integrate this new system into its integrated corporate IT system.



APPROACH, SCOPE, AND RESULTS

Objectives

One of the most significant energy companies in Europe engaged AI Energizer from a business and operational effectiveness perspective. Specifically, our goals for the engagement were to:

- Assess the design of the trading process in the context of our experience with other energy trading companies and current data science practices.
- Design the critical components of a new trading process and trade benchmarking approach.
- Design and develop new artificial intelligence trading system for the Energy Trading department.
- Provide recommendations for further improving the energy trading.

Approach

We conducted the review and the development of the company's trade decision-making over a 14 week period from the beginning of September to the end of December. Our work included:

- Interviews with over 20 stakeholders including leaders and team members from various functions;
- Policy assessment of more than 50 documents including policies, management reports, risk register, training materials, KPIs, and documentation of the trading process
- Systems analysis to evaluate trade decision-making and monitoring tools;
- Analysis of sample transactions used in the decision making and

monitoring tools to assess them;

- **Second opinion concept,** which defines the roles of humans and machines;
- A **simulation environment,** which ensures trade decisions are practicability in real market conditions and corporate trading rules;
- **Robot trader** an artificial intelligence system for making human-independent trade decisions;
- The **trade journal**, a tool for benchmarking, monitoring and analysis of trade decisions;
- Proposal document for the implementation of the second opinion concept to policies and procedures;
- Plan for the decision automation;
- Documentation and training for all stakeholders.

Scope

- We kicked off the project with the second opinion concept. This idea defines the roles of humans and machines. The machine is not a substitute and does not even compete with people directly. It only gives a second opinion before every decision.
- By involving the traders and experts from the company in the project, we expected that the staff would be more accepting of the new technology. It turned out to be the case.
- We agreed that we would deliver a prototype software and that the company will finalize it in an interim project.
- A phased approach to implementation, it helps overcome resistance to change.

- The model should consist of a series of simple steps, and it should not forecast energy prices. A human can follow up its calculations with pen and paper, that's why the software should not be a black box model. It should be simple and easy to understand.

Project timeline

The overall project itself took place during a one-and-a-half-year period, and it had three parts.

- The first was our part; the design and prototype development of the artificial intelligence trading system over a 14 week period;
- The second was when the company implemented, tested and finalized the prototype with our continuous support;
- The last part was the integration of the new system with our support to the company-integrated IT system.

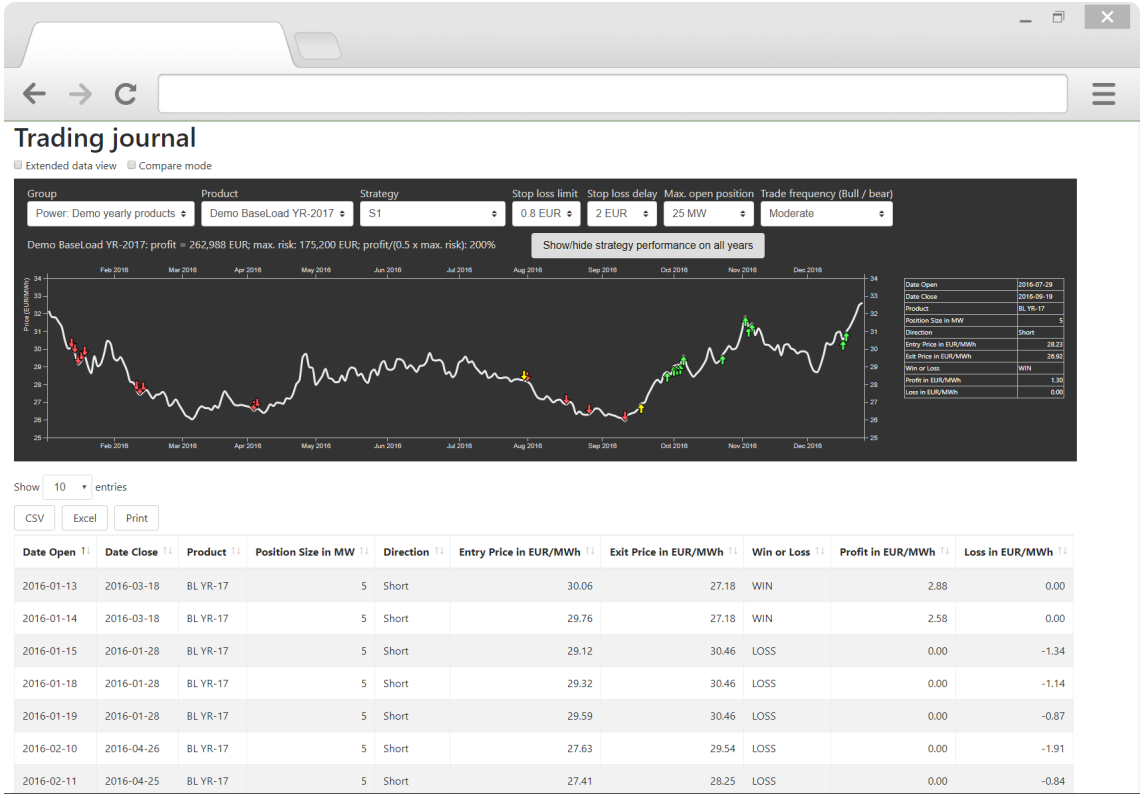
Overall Results

- The **Second opinion concept** ensures that there will be no significant changes in the company's trade decision-making process, helping the traders accepting the new technology. It also leaves the human traders with the final decisions so that they can filter out machine errors during the phased implementation of artificial intelligence.
- With the **Simulation environment,** we managed to simulate the reality of market conditions and corporate trading rules. This environment made it possible to develop an artificial intelligence Robot Trader instead of a simple decision support system;
- The **robot trader** system showed a stable performance on

standard and volatile market conditions with low-risk appetite;

- The **trade journal** proved to be a useful tool in analyzing the rationale behind the decision, and it enables analysts, risk controllers, compliance officers to have a real-time follow up;
- Practical documentation, workshops, and training made the project very much alive in the company, with much brainstorming which resulted in excellent ideas.

Based on our analytics of the robot trader performance, the company launched the interim development. We gave the company continuous management consulting support. Based on the excellent results of the interim development, the company decided that it would integrate this new system into its integrated corporate IT system. A third-party IT vendor company managed this.



Date Open	Date Close	Product	Position Size in MW	Direction	Entry Price in EUR/MWh	Exit Price in EUR/MWh	Win or Loss	Profit in EUR/MWh	Loss in EUR/MWh
2016-01-13	2016-03-18	BL YR-17	5	Short	30.06	27.18	WIN	2.88	0.00
2016-01-14	2016-03-18	BL YR-17	5	Short	29.76	27.18	WIN	2.58	0.00
2016-01-15	2016-01-28	BL YR-17	5	Short	29.12	30.46	LOSS	0.00	-1.34
2016-01-18	2016-01-28	BL YR-17	5	Short	29.32	30.46	LOSS	0.00	-1.14
2016-01-19	2016-01-28	BL YR-17	5	Short	29.59	30.46	LOSS	0.00	-0.87
2016-02-10	2016-04-26	BL YR-17	5	Short	27.63	29.54	LOSS	0.00	-1.91
2016-02-11	2016-04-25	BL YR-17	5	Short	27.41	28.25	LOSS	0.00	-0.84

Recommendations

In the following five components we have made suggestions for greater operational effectiveness. Our recommendations to improve and strengthen trade decisions efficiency, for management's consideration, are as follows:

Simulation Environment

1. For all changes to market and company policy rules, the company should examine whether it is required to bring it into the environment.

Robot Trader

2. Further developments should take place in the system, using more complex machine-learning technologies.

Trade Journal

3. Ongoing monitoring and further analysis of the newly collected data about trade decisions.

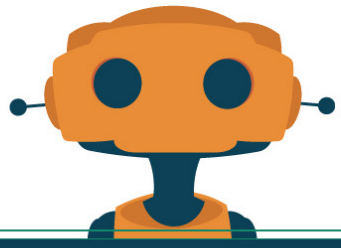
Incentive program

4. After a test phase, the management should change the incentive programs and should introduce new benchmarks and rules.

Training

5. Cross-train current staff personnel in areas beyond their ongoing responsibility to contribute to a succession of artificial intelligence application in business processes.

HOW TO EVALUATE A TRADER'S DECISIONS?



Machine Strength	Human Strength
Displaying Information	Flexible/Adaptable
Data Management	Creativity
Simple Repetitive Decisions	Visual Perception
Performing Calculations	Emotion Learning From Experience
Combinatorial Problems	Complex Communication
Continuous Availability	Conceptualization
Fast Computational Parallel Reasoning	Symbolic or Spatial Reasoning
Speed Accuracy Predictability	Pattern Recognition
Low Cost	Hedging Against Uncertainty
Risky Situations	Narrowing Search Space
	Management of Computational Effort
	Strategic Assessment
	Understanding the "Big Picture"

Is human intuition sufficient enough to make trading decisions?

In complex situations, energy companies prefer human decision-making. The traders make economic decisions that rely on human intuition. Although there are many advantages to utilizing human decision-making, there are a lot of downsides to it compared to applying computer technology. Consequently, it is a good practice to pay attention to deciding who is going to make a specific decision and how.

Several human strengths are relevant in decision-making, such as decisiveness, flexibility, managing complex problems, and being able to apply a rule of thumb. The brain utilizes diverse forms of information to analyze a problem. When a human has to decide in a new situation, the brain can rewrite any existing decision-making rules. This flexibility of the brain is significantly different compared to the way machines work. By formulating the right questions, the brain can break down a complicated problem into smaller pieces. This virtue helps humans to understand which questions will lead to a solution to a problem. As a result, humans can put together the big picture very efficiently and can then manage complex problems. The human brain has excellent problem-solving capabilities, but it has its downsides in repeated decision-making tasks and - compared to machines - in analyzing a large amount of information.

Machines have excellent strengths in decision-making like accuracy, speed, and memory. Nevertheless, there is still no computer technology capable of solving a problem without human-driven preparation. Human support should define the input parameters, the decision-making technology, and the required outcome. Once

a machine is in operation, the characteristics of its processes are different from how humans work: it is endlessly accurate, stress-tolerant, and motivated. Its operation can be automated and monitored. Another advantage is that a computer can store all data and calculations, what enables us to examine how it analyzed a problem in the past. It is also a key aspect that even advanced decision-making engines can run on a simple personal computer. A PC can take millions of data segments and attempt to analyze a problem. In the past ten years, computational power has grown continuously, so today's data scientists can run sophisticated algorithms to solve problems. Artificial intelligence technologies make it possible for computers to analyze more and more business cases in an increasingly faster way. Historically, decision automation started with simple administrative tasks; however, nowadays, computers are frequently involved in solving complex business situations.

Energy companies are struggling to keep up with the rapid speed of technology development. According to our experience, most companies have not started to implement and exploit these new technologies to their full potential. The energy sector still prefers human decision making, and as a tendency, it puts its trust in human capabilities. We have found in our professional practice that the limitations of human performance make it necessary for businesses to start utilizing artificial intelligence in trading decision making, since they offer a huge competitive advantage. There is no question anymore that a higher volume of human performance is needed to prove the importance of human participation in trading decision making.

How can we evaluate a trader's decisions?

Making the optimal trading decisions is challenging for traders. Energy traders are continuously monitoring every relevant piece of news on the market. Ideally, they receive professional market analysis every day. After analyzing this data, the trader puts together the big picture and makes trading decisions. Since traders are working under psychological traction, companies should review how they are controlling trading. The trader has certain dedicated positions to manage. There are two determinative types of trade. The trader has to buy if the company sells energy to a consumer. The other type is when the trader has to sell if the production facilities produce energy. For energy companies, it is crucial to closing the positions as soon as possible. Based on the size of the positions, the traders have individual volume- and value-based limits. Limits are responsible for keeping the financial risks of the company on a predefined level. Only some high-level committees have the right to hold open positions above the defined limits. It is almost impossible to make what-if analyses in the past because most of the underlying information of the trading decision is missing. There are not enough human resources or motivation to check thousands of deals in the past.

With the current technology, it is possible to operate robot traders. A Robot Trader is useful for benchmarking decisions. In this kind of application, the computers compete with every trader separately.

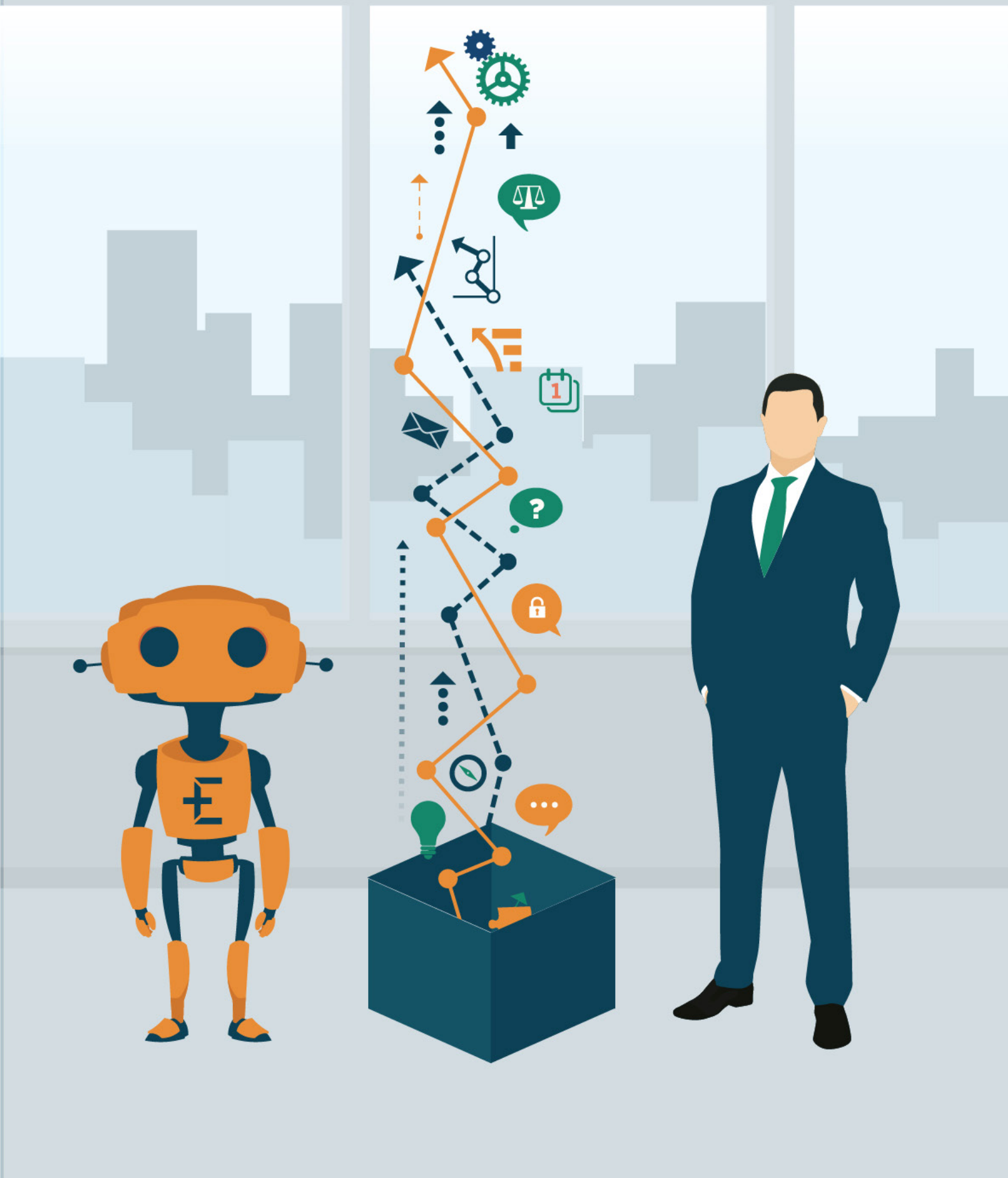
HOW WE DESIGNED THE PROJECT AFTER PRESENTING THE FIRST TEST RESULTS?

After we presented our research results on trading decisions, the Board decided that changing the decision-making process and implementing up-to-date computer technology was essential.
We also agreed that we would use a phase-wise implementation. Based on several interviews with the senior management and the traders, we found self-knowledge protection and resistance among traders to automatized decision-making. Our unwritten target was making as minimal a relapse as possible in the trader's motivation during and after the project. By involving the traders and experts from the company in the project, we expected that the staff would be more accepting of the new technology. To improve their skills, we agreed that we would deliver a prototype software and the company would finalize it in an interim project. For the prototype's development, knowing the trading strategy of the company was not necessary. That's why they let us work in a short time with the most information-sensitive departments. Our professional team had two primary tasks:

1. Implementing a new process
2. Developing the prototype software

The project itself took place during a one-and-a-half-year period, and it had three parts. The first was the design and prototype development of the artificial intelligence trading system. The second was when the company tailored, tested and finalized the prototype. The last part was the integration of the new system to the company-integrated IT system.

ARTIFICAL INTELLIGENCE TRADING SYSTEM DEVELOPMENT



In this paper, we are focusing on the robot trader system development as these entail the overwhelming majority of new technologies and new business approaches. In the following discourse, we offer an overview of this part of the project.

Second opinion concept

We launched the project with the second opinion concept. This idea defines the roles of humans and machines. The machine is not a substitute and does not even compete with people directly. It only gives a second opinion before every trading decision. This opinion is available for the traders so that they can agree or disagree with the machine. **If the trader does not agree with the machine's opinion, the trader can make a short note in the system why he/she decided otherwise.** The next step was writing a proposal for the implementation of the second opinion concept to policies. Fitting this concept within the company policies was easy.

Robot trader concept

In this stage of the project, we defined the fundamental principles of the system. A human should follow up calculations with pen and paper, that's why the software should not be a black box model. It should be simple and easy to understand. The model should consist of a series of simple steps, and it should not forecast energy prices.

System technical design

In the next step, we defined the main technical characteristic of the system. We developed the prototype in Excel and VBA. We coded the visualization parts in JavaScript, HTML5, and CSS3. With this technology, the visualization is running in any web browser.

We developed the machine learning engine in Python programing language.
After we had our concept and system design, we did several interviews with the management and the traders. After some refinements, we got a green light for the development.

Robot trader development

At the beginning of the project, we created a simulation environment of real trading activity. It included all the details of the tradable energy products and the energy exchange operations. These details are, for example, costs, deadlines, bid-ask spread, minimum trading size, and liquidity. This environment guaranteed that a robot trader would be feasible in the real market. The simulations can run different trading-strategies and evaluate them. The following phase was the development of the robot trader. Like the simulation environment, the robot trader also represents real market operations. It works with information that was available on the market on a specific momentum. It means that, for example, the daily closing market price is used only for the next day's decisions.

The trading strategy development started with a consultation with the Board and senior management. With a questionnaire, we found out which trading techniques are the most reliable for them. The implementation of the selected rules to the system was not self-explanatory because energy prices are very volatile. The market price works as a mirror, and it represents every piece of information on the market. When somebody starts some action based on new information, it builds into the market price very quickly. Energy price reacts to changes in politics, market sentiment, weather, and economic and physical conditions. It is very challenging to judge

whether they are going up or down. We used a trend analysis to detect the market trends. In the energy industry, there is a physical system with power plants, transmission systems, mines, and wells. These facilities have a lot of fixed costs that can change slowly over the years. This structure of the energy market ensures that the market price is reverting to its balanced state like a long-term moving average. In the shorter term, the prices are fluctuating around this slowly changing balance.

Based on our experience in the energy industry, we defined the models that can simulate this behavior of market prices. The models have a lot of possible parameters to optimize. We chose two ways to find the most promising ones. First, our colleagues tried to find them based on their experience and some mathematical and statistical calculations. Second, we used artificial intelligence (machine-learning) technology for the same problem. The machine learning also found the same parameters that our expert did and a lot more. After we had chosen the promising models and settings, we connected them with the simulation environment. By simulating real market conditions, we selected the final settings.

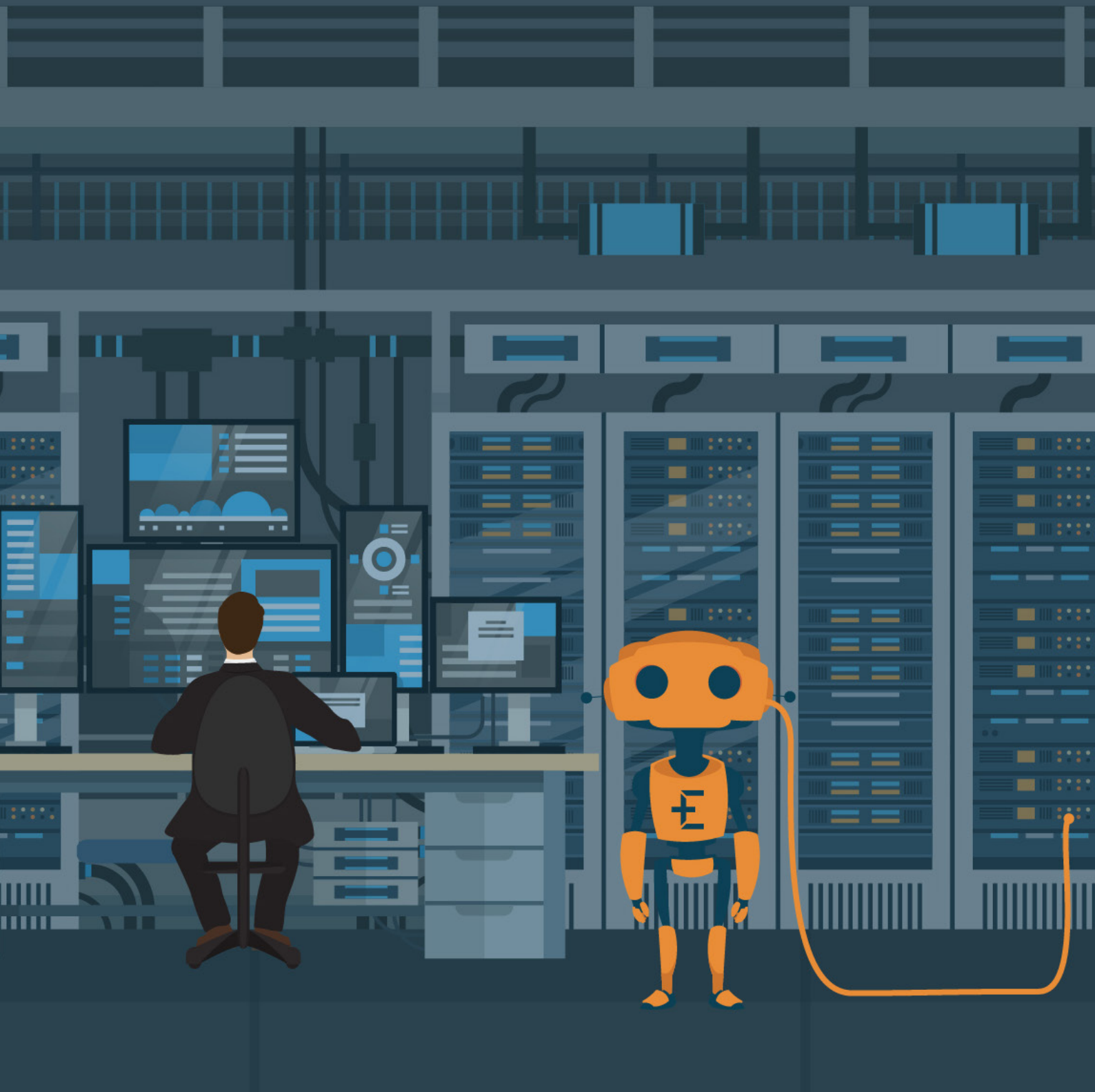
Trading journal

Once we had a working artificial intelligence system, we made the visualization and the user interface. Its most important part is the trading journal. This trading journal is a user interface where traders can access the rationale behind the trade decision, and an efficient tool in visualization and analyzation of the trading activity.

Delivery

The decision automation plan was the next step of the project. In this plan, we gave recommendations as to which part of the system was worthy of automatization. We suggested data collection, report generation, and data analysis. We recommended the Python programming language and ecosystem aim for this problem because the Python ecosystem contains excellent machine learning tools. After we had a working prototype system and all the documents together, we did workshops with the company management and traders. The Python programming language was so practical for this problem that we ultimately proposed the whole system should be in Python.

IMPLEMENTATION, TEST, AND RESULTS



During the implementation and test phase the management has identified the following benefits of the robot trader software:

- The Second opinion concept provides that there is no significant change in the company's trade decision-making process which helped the traders accepting the new technology. It also leaves the human traders to make de final decisions so that they can filter out machine errors during the phased implementation of artificial intelligence;
- With the Simulation environment, we managed to simulate the reality of market conditions and corporate trading rules. This environment made possible to develop an artificial intelligence Robot Trader instead of a simple decision support system;
- The robot trader system had stable performance on standard and volatile market conditions with low-risk appetite;
- Trade journal proved to be a useful tool in analyzing the rationale behind the decision, and it enables analysts, risk controllers; compliance officers to have a real-time follow up;
- Practical documentation, workshops, and training make the project very alive in the company, with much brainstorming which results in excellent ideas.

Based on the excellent results, the company decided that it would integrate this new system into its integrated corporate IT system. This last part was managed by a third-party IT vendor company, given that it had the experience of working with big corporate IT systems. The project structure itself helped the counterparties to have enough time to design, test and understand the system. We gave procurement support in this phase.

ROBOT TRADER DEVELOPMENT ROADMAP

Week 1-4

Interviews with over 20 stakeholders including leaders and team members from various functions.

Study of more than 50 documents including policies, management reports, risk register, training materials, KPIs, and documentation of the trading process.

Systems analysis to evaluate trade decision-making and monitoring tools.

Analysis of sample transactions used in the decision making and monitoring tools to assess them.

Week 5-6

Second opinion concept, what defines the roles of humans and machines.

A simulation environment, what ensures trade decisions practicability in real market conditions and corporate trading rules.

Week 7-10

Robot trader an artificial intelligence system for making human-independent trade decisions.

Trade journal for benchmarking, monitoring and analysis of trade decisions.

Week 11-12

Proposal document for the implementation of the second opinion concept to policies and procedures.

Plan for the decision automation.

Week 13-14

Documentation and training for all stakeholders.

ABOUT AI ENERGIZER

AI Energizer

Maycroft joined forces with River Commodity to offer artificial intelligence services. Together we have launched a new joint venture. We are going to provide support to (energy) companies about artificial intelligence. Through artificial intelligence, companies can save costs, increase profitability and offer tailored solutions to their clients and much more. Through workshops, educational programs and by providing advisory services we will support you in preparing yourself and your company to be ready for the digital revolution that is happening right now.

Advisory team

Kasper Walet, László Siller, and Gergely Szerovay are the project leaders. Together we have the unique, practical and academic knowledge and experience about the energy sector and artificial intelligence (artificial intelligence, data science, and data engineering). Recently we executed Artificial Intelligence Projects for major energy companies in Europe.

The short bios of the project leaders are:

Kasper Walet (Maycroft)

Skilled and accomplished professional with over 25 years of extensive of C-level board level experience in the energy markets worldwide. Kasper has strong expertise in all the aspects of energy commodity trading markets, international sales, derivatives trading, staff training, risk management and regulatory compliance within dynamic and high-pressure environments.

László Siller (River Commodity)

An energy commodity full supply chain professional with over ten years of experience in Risk Management, Risk Controlling, and Portfolio Management, ranging from Mining and Oil and Gas to Power and Renewables. Member of different high-level Decision-Making Committees with a role and competence of Investments, Portfolio Management and Risk Management. Laszlo has further experience developing intelligent systems with Artificial Intelligence as well as training for different levels of the organization and interdisciplinary project management.

Gergely Szerovay (River Commodity)

20 years of experience in Software Development, Data Engineering, and Data science, with significant experience in power and natural gas projects. He has also over ten years of experience in natural gas supply chain management related IT projects, as well as power-trading algorithms and modeling.

About AI Energizer

Maycroft joined forces with River Commodity to offer artificial intelligence services. Together we have launched a new joint venture. We are going to offer support to (energy) companies about artificial intelligence. Through artificial intelligence companies can save costs, increase profitability and offer tailored solutions to their clients and much more. Through workshops, educational programs and by offering advisory services we will support you in preparing yourself and your company to be ready for the digital revolution that is happening right now.

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