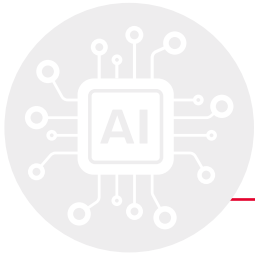


FROM WASTE TO FUEL: TAKE DATA-DRIVEN DECISIONS WITH AI AND MACHINE LEARNING





INTRODUCTION

If someone asks you what the most valuable and future-proof resource is today, what would you answer?

Similar to charging an e-bike and eating food for your body to function, data can be treated as a type of fuel. It's an incredibly powerful resource in the age of information we live in, driving businesses forward by providing us with customer insights, behaviour patterns, consumption habits, character traits and product quality to name a few. But data analysis is also important to monitor compliance. **Data can tell what's happening in an organisation, and if managed well, why.**

However, many companies are struggling to manage this increasing volume of data, let alone extract actionable insights from them. As a result, they leave money on the table as they need to address their roadmap to manage this complex journey. To compete long-term, companies are required to dive deeper into the richness data can offer and learn how to use it to their advantage to make insight-driven decisions.

This journey begins with **enhancing data management and data analytics maturity**. It starts with seeing data as a raw material instead of simply a by-product, knowing how and where to gather these data from, and of course, verifying which data is correct and of good quality. Improved data management skills will ultimately create added value for every stakeholder involved.

“Similar to charging an e-bike and eating food to live, data can be treated as a type of fuel to drive your business forward.”

Data maturity, Data analytics and AI

The human brain is neural and cognitive, meaning it can solve even the most complex problems, draw connections from past experiences to new circumstances and recognise patterns or emotions behind someone's eyes.

Artificial Intelligence, or AI for short, acts in a similar way. That's why it's not a product or an outcome. Rather, it's a **synthetic reproduction of human cognition with the intriguing ability to take over decision-making in every aspect of a business.**

Andrew Mooren, Former-Dean of the School of Computer Science at Carnegie Mellon University, describes it as “the science and engineering of making computers behave in ways that, until recently, we thought required human intelligence.”¹

Within AI sits **Machine Learning (ML)**, through which algorithms can learn from the historic data they mine, without explicit programming, applying their newfound knowledge to improve performances. ML relies on working with small to large datasets by examining and comparing the data to find common patterns and explore nuances¹. It's the kind of technology widely known platforms such as Spotify and Netflix use to recommend more of the same music and movies you like.

AI and ML are both incredibly powerful technologies, developing day by day. In order to apply AI in your business, good quality and in-depth data is a prerequisite to assure accuracy.

To assist organisations pinpoint their data analytics maturity—and the incremental steps they can take to level up—we have drafted this white paper, explaining how to turn data from waste into fuel.

¹ <https://pub.towardsai.net/differences-between-ai-and-machine-learning-and-why-it-matters-1255b182fc6>



NOW IS THE TIME TO START TAKING DATA-DRIVEN DECISIONS

In order to become a truly data-driven company, **good data management is the starting point**. But what exactly does that mean? And why is it worth it to put in the effort?

Data management includes the set-up, execution and continuous improvement of processes, technology, skills and knowledge that are needed to govern and enhance the value of data collected and produced by an organisation. It covers all the technological, business, people, risk and privacy aspects. **Having these processes under control, next to having proper and good quality data, is key when taking the next steps in your data analytics journey.** Ignoring this condition will lead to (more) operational issues in the long term - we speak from experience. Quality over quantity, always!

Effectively managed data will enable you to make better decisions for your company in the long term as they are based on **facts instead of mere intuition**, instincts or perceptions, resulting in less bias.

Moreover, data can serve as a benchmark for your business results. Performances can be tracked, measured and expressed in EUR, allowing managers, employees and stakeholders to see how well the organisation is doing and where its strengths and weaknesses lie. Data truly is and will be the driving force in your business' future.

Data analytics prove to be incredibly powerful. By spotting patterns, you gain insight into why something is happening and foresight in what may happen. AI technologies complemented with Robotic Process Automation (RPA) assist in running tasks more

efficiently with less human intervention, resulting in less errors and faster throughput. New services can be created, and business processes can be optimised. Even new business models can be designed and put in place. The ultimate scenario is that every business process – from core operational processes like customer acquisition, to management processes like risk management and support processes like accounting – is data-driven, with analytics embedded throughout.

“Once you start seeing and using the power of data and AI, you’ll soon find yourself wanting to dive deeper into the world of AI.”

Think big, start small and scale according to your capabilities. Many success stories start small, with simple dashboards and reports to gain insight into different aspects of the business and available data. In a next step, more sophisticated tools for data management, analytics and visualisation are added to kick-start a true transformation.

The journey of a data-driven company is a process of experiments, assessments and refinement with several steps and successes and failures along the way. The good news is that data management expertise domains are interconnected, so once you start seeing and using the power of data to your advantage, you’ll soon find yourself diving deeper into its world.



KEY ELEMENTS OF DATA MANAGEMENT

Technology

Embedding the right technology is a prerequisite to embrace the power of data. It may not be easy to pick the best digital solution right away - and the market only keeps expanding! - but fortunately, that's not necessary either. A starting recipe from our practice:

- a cloud data warehousing solution for storing data,
- data integration tools to combine data from different sources into a single, cohesive set,
- data insight and intelligence tools to analyse and transform these data sets.

Organisation & People

Employees are the driving force in your organisation, so it's essential to get your people aboard of your digital journey. Changes in businesses processes will disrupt current ways of working and could evoke resistance out of fear for the unknown. Take the time to guide employees through the new way of working, indicating the benefits for themselves and the organisation.

“In businesses, there is no way AI or data analytics would function independently from humans,” says Maarten Vanhoof, a big data expert and founder of Himawari, a company that helps organisations understand their data better. *“After all, the role data can play in your organisation needs to be defined, and constantly re-evaluated, by the domain experts, managers, and executive workforce who make your organisation tick”.*

The importance of data governance cannot be underestimated. Policies and procedures are to be put in place to ensure the data used and management are compliant to regulations (GDPR and alike) and bring the expected value.

Risk

Everything digital comes with its own challenges and risks, and data management is no exception to that. According to a BDO survey, one third of companies surveyed, particularly in the retail, tech and manufacturing industry, are concerned about cybersecurity threats.

Raising cyber awareness and increasing knowledge on privacy regulations such as the **General Data Protection Regulation (GDPR)** is absolutely essential. Robust controls and threat-based data protection practices are to be put in place to protect the company data from cyberattacks and threats.

Data driven businesses can only be effective if data quality is under control. Contaminated, outdated and incorrect data will lead to ineffective and even counterproductive data models. Taking the time to put and keep the data in good order is the right approach in every step of the journey.

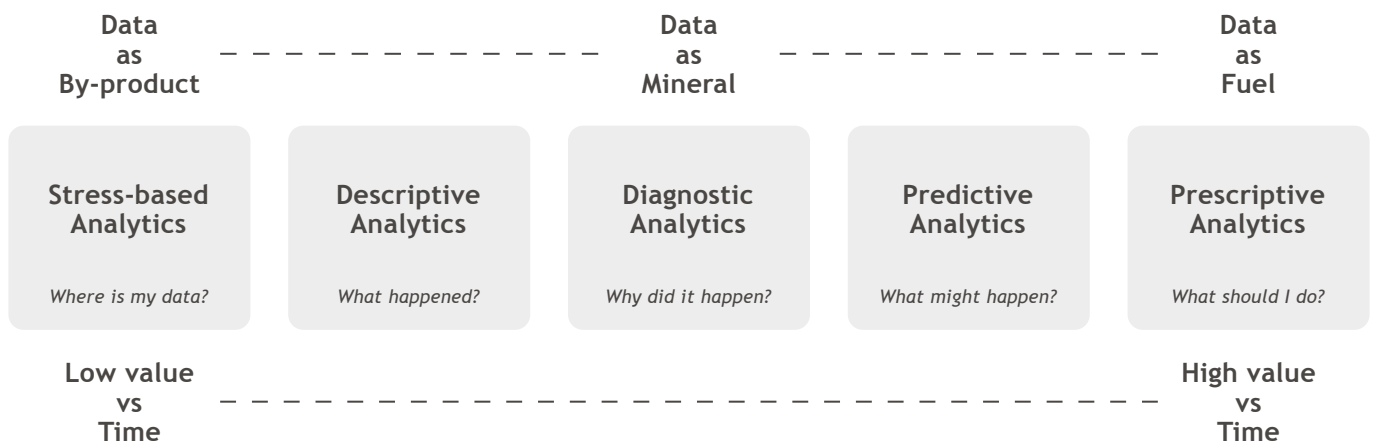




HOW TO INCREASE YOUR DATA ANALYTICS MATURITY: INSIGHT IN MATURITY LEVELS AND ACTION POINTS

Becoming a data-driven company means growing your data analytics maturity. This doesn't happen overnight. It's a process of controlled experimentation and continuous learning and an experience based on best practices.

We roughly distinguish three maturity levels with each a specific set of action points to address before moving onto the next: **data as by-product**, **data as mineral** and **data as fuel**. Throughout each phase, the value of data increases in line with analytical levels, but similar to creating a diamond ring from a simple piece of charcoal, the process requires time, patience and skills.



1 Data as by-product: report the past
Your organisation has invested in the digitisation of your processes and as a result, data is being gathered on a regular basis from one or more sources. However, the data available in your operational systems aren't actively being valorised. Descriptive or diagnostic reports may be produced on an ad-hoc basis, but are not always trusted by the management. Your organisation may or may not be aware of the great amount of valuable information in its hands, but doesn't know where to start in order to drive the company forward.

Required steps to move to the next level

The first step is to gather and prepare data on your data source to gain insights from them through analysis and reports later on.

1. Start by **centralising data** in a (cloud) data warehouse. This is a sort of 'store' that saves structured data pulled together from different operational systems.
2. Take time to **correctly model your data**, taking into account historisation and auditability.
3. **Gain insight** into your data and support business decisions by **creating reports and dashboards**.
4. Start **setting up data governance processes** to improve control over your data:
 - a. Make sure to document (meta)data in a data catalogue.
 - b. Invest in data lineage to be able to explain the results in reports and dashboards.
 - c. Set up processes to keep track of and improve data quality.
 - d. Don't forget about processes protecting data privacy and security!

Technologies worth investing in during this phase

- Cloud data warehouse
- Data ingestion/transformation
- Data warehouse automation
- Reporting/BI

You should now have a clear and structured overview of all the data gathered in the past. It's time to move on to the next phase.

2 Data as mineral: learn from the past and predict the future

This is a phase many companies find themselves in today. When basic reporting needs are met, an experimental phase starts where data science exercises help you acknowledge and gather value from your data. A shift occurs from descriptively reporting on data towards learning from the data and perhaps starting to predict future outcomes of processes. This phase is all about testing, experimenting with different methodologies and ways of working to go forward. Businesses are now aware that data is a useful mineral that needs to be mined and processed correctly in order to extract value from it.

Required actions to move to the next level

1. **Gain as much experience with data science** as possible and **map the gaps** to indicate where additional data is needed, either externally or internally. Now, the importance of data quality is even higher than in the first phase, as increasingly more decisions will be based on the data available.
2. **Experiment with several proof of concepts** and types of platforms to customise your data and to extract the maximum value from it.
3. **Make timelines** to follow up on your experiments. Doing - or outsourcing - this in a controlled way may save your organisation existential amounts of time and money.

Technologies worth investing in during this phase

- Data analysis, e.g. process mining
- ML API's
- ML models
- Data lake(house)

The insights gathered in this phase and the intelligence added to it allow for proper access, analysis and improvement of data.

What is GDPR and how does it protect us?

There's a tricky duality in this phase.

In order to spot trends and patterns, client's data must be processed. Enough technological freedom is needed to do so, but to avoid misuse or even worse, breaches, Europe has put strict laws and legislation in place, such as the widely known General Data Protection Regulation (GDPR). This legislation is aimed at **enhancing individuals' control and rights over their personal data and simplifying the regulatory environment for international business**. In practice, this means **organisations are not allowed to save or analyse data that is considered sensitive without the client's explicit consent**. Moreover, it's not allowed to save or process just any data. Sensitive information such as someone's ethnical background or religious beliefs should be excluded.

While these rules and laws are crucial to protect us, it also means that **each step forward is a step back**. Despite innovation and digital possibilities, each technological addition brings along a new rule, (partly) hindering progress, as opposed to other non-European countries that may have far less strict data legislation, allowing them to experiment more freely technologically, but putting both the organisation and customers at risk.

The duality between legislation and technological improvements makes for a complicated case that poses restrictions and limitations on either side. Data encryption, anonymisation and pseudonymisation are techniques that can help safeguard privacy while still being able to gain valuable insights from data.

3 Data as fuel: influence the future

Data is seen as valuable and insightful information that is analysed, processed and combined into algorithms. This process is modelled for acceptable use and works autonomously afterwards. Periodically revisiting its effectiveness is a common practice. The outcomes of ML and other analytical models directly impact company processes, which can be achieved by the adoption of digital workers/software robots. The ambition is to augment the work of human workers and the overall efficiency of the organisation as there will be too much data in the future to be handled by humans alone. In this phase, data is not only used to predict the future but to make (and automatically act on) data-driven decisions as well.

Required actions to move to the next level

To achieve this phase, a significant amount of high-quality data is needed in order to build trustworthy algorithms. This includes:

- training and maintaining machine learning models
- building data structures and data transformation scripts
- keeping track of the performance of each model
- knowing when to put each model into production and when to retrain it
- putting the right processes into place
- appointing data officers and defining their tasks
- exploring new business models to use data in a more clever way
- ...

Besides processing sensitive data, the resulting AI models need to be evaluated on its ethical implications. Are the models put into place truly unbiased (*see box on p. 7*)?

Technologies worth investing in during this phase

- ML Operations (Ops)

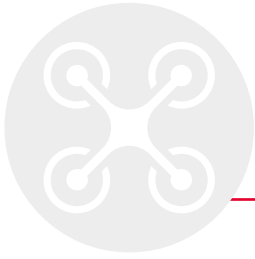
Is AI ethical?

Machine ethics or 'ethical AI' is a frequently debated topic. To what extent are robots and computers responsible for their actions? To what extent are these computer-made decisions transparent, trustworthy, and unbiased? Often, they are black box decisions, and the why behind them is almost never unequivocal with so many parameters into play.

To prevent algorithms from creating biased patterns, they must be monitored for their outcome. A best practice is to set up different scenarios and use a variety of input techniques to feed your algorithm data in different ways. Check whether it alters its decisions based on sensitive parameters such as gender, race, ethnicity or nationality. This is far from easy to do and certainly not a one-time action. It's likely that this ethical issue will become more significant as technology spreads to critical areas such as law and medicine.

Final thoughts

These levels don't imply that organisations move from one phase to another as a whole. Rather, **processes or domains can be - and preferably are - situated in different phases at the same time.** By experimenting with a (part of a) pioneer domain first, lessons learned can be applied to other domains, accelerating the process of improving data maturity.



CLIENT CASE

For a warehouse operations improvement project, we collaborated on a reference warehouse management data analytics project using drone (UAS Unmanned (autonomous) Aerial System) and AGV (autonomous guided vehicle) technology.

Challenge

The stock indicated in the warehouse management system doesn't always mirror the reality in the warehouse. Goods may not be stored in the right place, the labeling of the goods is damaged/faulty or periodic stock-taking errors may happen.

The client needed accurate and factual awareness of the real location of goods, permanent knowledge of the empty spaces in the racks and early warnings on the 'state' of the goods (damaged packaging, possibly faulty labelled goods leading to wrong volume indication, etc.). Having top quality data (accurate, timely) in the warehouse/logistics management systems certainly has its business value.



Approach

Different technologies and techniques were tested to evaluate the best result at the lowest effort (cost). Eventually, we targeted an innovative new digital approach using computer vision technology from the pictures made by the drone(s) and turned the pictures into logistics and SKU state information.

To do so, BDO partnered with a drone supplier. Technically, the drones fly autonomously through the warehouse during a window of 7 hours at night. They follow a predefined path while taking high resolution pictures of all layers of all racks.

BDO took care of the business case, project management and the image processing of the images (on average 220,000 every night). After every 20 minute flight, the drone/AGV combination transmits the pictures to a data storage while recharging for the next flight on the next warehouse spot.

We trained image processing models using AI and ML technologies that now provide daily stock information data besides other warehouse operations insights.

Value

A couple of outcomes to name a few:

- Daily verification of the warehouse management data providing an accurate (Floor to List) overview.
- Saving time and the costs for periodic stock verification procedures.
- New data insights are provided with 'alarms' for missing labels.
- Indication of empty bin locations.

Business Model Opportunities

The image processing capabilities are now ready to serve a wide range of warehouse management set-ups of clients. They're also available for BDO Audit related stock verification missions.



CONCLUSION

Data volumes are growing at a speed and accuracy that humans are unable to process. It's up to us to learn what technology can provide us and how to master the data and technologies to create more efficiency and value that can be expressed in money, in quality of work and ultimately, in quality of life.

Start with getting a hold on the right and accurate data. Centralise these data before proceeding to the next steps. Make sure to verify and, if necessary, improve the quality. Repeat this process in every action. High-quality data are an absolute prerequisite for analytics and AI to provide workable outcomes.

Depending on the business case, model your data by taking into account historisation and auditability. Derive (initial) insights through data mining and visual analytics.

Clean up (reformat) where indicated, anonymise or pseudonymise sensitive data before storing, tag data for removal upon request (GDPR requirement), and validate business outcomes with reference reports and data quality/volume dashboards. When valuable insights emerge, incorporate them into your company processes.

Not all dimensions, actions and tasks can be addressed from the start. Capabilities and capacity of staff, the current technologies used and the selection of new technologies and the time to adopt them may be a couple of reasons why. Rather, we recommend you to start small and learn from each step along the way. Experiment in different domains, and dare to make mistakes. After all, the lessons learned will help you acquire the knowledge and experience you need to eventually move to a truly data-driven company.





This is how BDO can help you

BDO Advisory holds 5 groups of experts: Financial Advisory, Risk Advisory, Strategy & Transformation, Digital and Flexible Resources. We actively manage data, provide additional value, and help to create new business models. We act as a sounding board for your organisation, providing you with practical and executable advice we put into practice together to create more value for your business. We can help you with:

Technologies

- Cloud data warehousing
- Data analytics (incl. Machine Learning), visualisation/reporting, data modeling
- Process Mining and Data mining for compliance and performance with check-up and improvement focus
- Machine Learning operations

Risk

- Data governance assessment
- Data privacy assessment

Organisation & People

- Data Management maturity assessment
- Change management

Interested?

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