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THE ROLE OF ARTIFICIAL INTELLIGENCE IN SUPPORTING INTELLIGENCE DECISION

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Abstract: *Decision intelligence is the application of AI and machine learning technologies, along with data fusion, data visualization and collaboration tools, to augment and improve decision making. In this context, AI is not the decision maker, but rather a pillar which supports a more informed decision. This paper presents in a scientifically argued manner the method of using AI tools in the decision-making process by means of scientific arguments, but also some praxeological ones, related to the dynamics of the business environment marked by the acceleration of digital transformation.*
Key words: *artificial- intelligence, decision-intelligence, technology, decision-making*

1. INTRODUCTION

Decision intelligence is the use of artificial intelligence and machine learning technology, as well as data fusion, visualization, and collaboration tools, to supplement and improve decision-making. The objective is not to replace humans, but rather to enable them to make more accurate and timely judgments.

The paper has to offer the answers for the following questions: what is decision intelligence and what role does AI play in the decision intelligence context?

2. DECISION INTELLIGENCE

2.1. General overview

Decision intelligence is a new field focused on transforming knowledge into improved actions at any size. This is accomplished by combining data science, social science, and management science. According to a Gartner forecast from 2020 [1] more than 30% of major enterprises will have decision intelligence analysts. Decision intelligence is a framework that may be used to help with the design, composition, modelling, alignment, execution, monitoring, and tweaking of decision models and processes in the context of business results and behaviour.

The term "Decision Intelligence" was popularized in 2019, the year in which Lorien Pratt launch the book "*How Decision Intelligence Connects Data, Actions, and Outcomes for a Better World*" and it was identified as one of the most impactful technical trends by Gartner analysts [1]. Google was one of the first organizations adopting this paradigm in 2018 when they announced their decision intelligence department in 2018 (as supported by Google chief decision officer Cassie Kozyrkov: https://www.fastcompany.com/90203073/why-google-defined-a-new-discipline-to-help-humans-make-decisions).

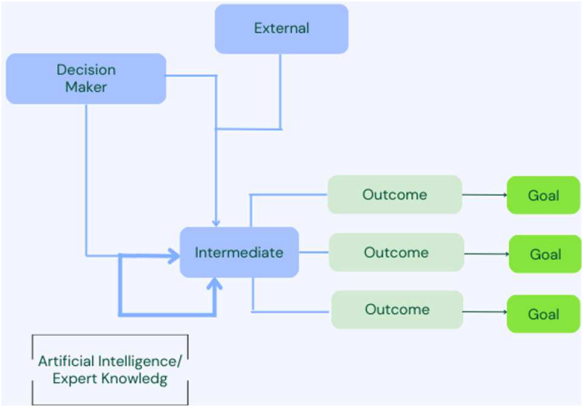

Fig. 1. Decision Intelligence blocks (authors own development).

Decision intelligence is bridging the gap between decision science, which studies the psychology, neurology, and economics of how humans make decisions, and automated decision making.

2.2. Decision Intelligence Engineering

AI and machine learning are data-driven and may provide insights. These insights, however, are frequently divorced from decision implementation and results. Furthermore, they are task-focused and can automate activities and make processes more efficient, but they can only execute what they have been designed to perform and hence have a limited impact on decision-making efficacy. Decision intelligence attempts to integrate these technologies with human input to develop insights based on data, then utilize those insights to generate decisions, execute those actions, and assess the efficacy and success of those decisions, resulting in better decisions in the long term.

In many cases, data scientists feel that the decision-maker is aware of what they require, so they construct the queries accordingly, but this is not always the case. Taking as an example Google`s framework (according to the recent position of the Google chief decision officer, https://www.fastcompany.com/90203073/why-google-defined-a-new-discipline-to-help-humans-make-decisions) for decision intelligence, this process can be separated into three steps:

- How will the decision-maker make a choice if there is no more information?
- Determine how the decision-maker will respond if they have access to any information they require - which criteria will be more balanced.
- The decision-maker should analyze if he/ she has access to the ideal type and amount of data; in the actual world, this is not always the case, thus the decision-maker should determine which errors he or she is willing to accept.

As the Google representative suggests, in the industry decision makers most of the time believe that putting together "a bunch of mathematics" is the key, but they don`t have a clear prioritization of the factors or what would they decide if not all the needed information is available. The better the flow of decision-making process is established in an organization, the more chances there are to have successful outcomes on the long run. An example of a decision-making flow is illustrated in Figure 2.

In her book, Lorien Pratt [2] stresses the importance of using a Causal Decision Diagram (CDD) which is ultimately showcasing the question: given the situation faced today, how can the paths form the decision to the outcome be better understood? Or in other words, it is a" decision map showing the important connections between actions and outcomes in an organization" [2].

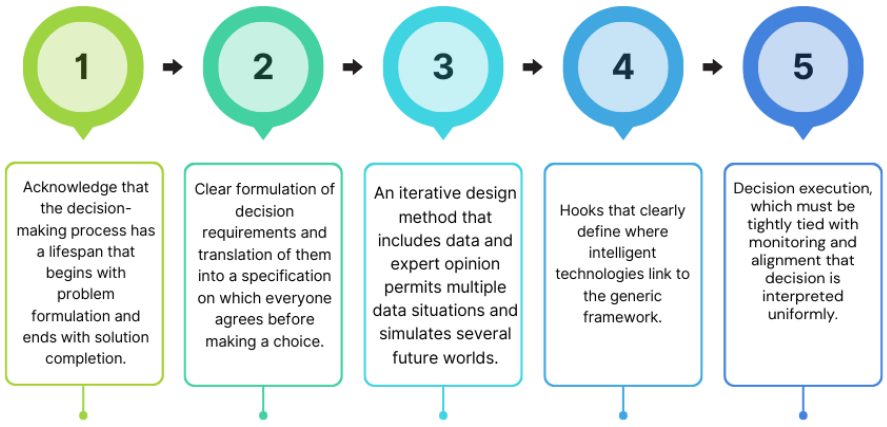

Fig. 2. Decision making flow based on Lorien Pratt interpretation (authors own development).

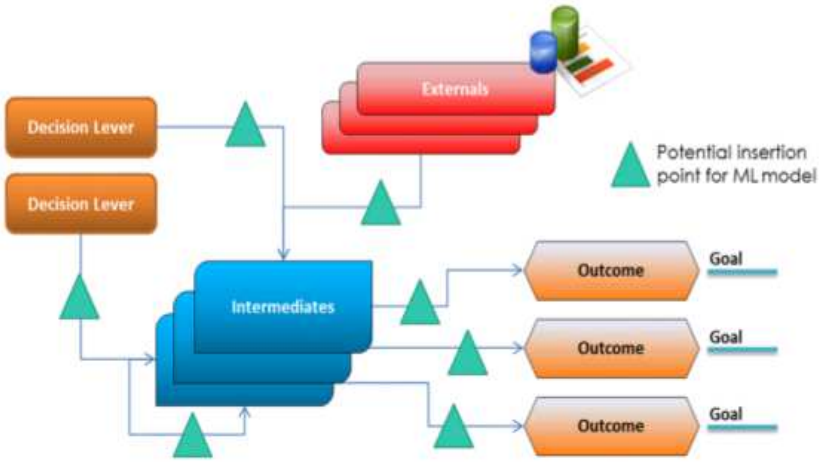

Fig. 3. The role of AI/ML in a CDD [2].

Using a visible diagram instead of empty words, such as a CDD, it serves as a basis for integrating predictions, ML, data or human expertise, offering a better understanding of where and when this should be considered in the process of decision making. It is important however that this model exists before data, so that the cause effect is already established and the data model is created in accordance with the need. The benefits of using a CDD in DI is that the CDD has value on its own at the beginning, and over time it gains more information and becomes more powerful. In addition, before delving into data, technology, and AI, enterprises should be aware of the collaboration model they require in the decision-making process, preventing a situation in which resources are squandered. It is no secret that data management may be costly, and the cost can be difficult to forecast. Using a CDA enables enterprises to avoid spending resources in data management where they are unnecessary, allowing them to benefit sooner and with fewer risks.

Furthermore, decision making is an engineering discipline, and a CDD is an artifact like many other built and manufactured items that may be handled. Decision intelligence is a technology that bridges the AI theory-to-practice split. It employs artificial intelligence, data, human knowledge, and other technology to assist companies in reasoning through complicated cause-and-effect chains ranging from policies and acts to commercial consequences [2]. Decision intelligence can be thought of as the next natural extension of AI: it fills important gaps in how we currently use AI and ML. Although there is much interest from academia and there is a lack of research regarding the decision intelligence paradigm, the consulting companies started looking into this topic more seriously. Forbes suggested that technologies such as AI and Big Data have a new meaning in the context of decision intelligence. They become intermediaries between data and decisions, actions, and consequences. Organization can develop insights from data, apply those insights to make decisions, carry those decisions through, and assist the feedback process by assessing their efficacy and success (according to the Forbes experts' debates, https://www.forbes.com/sites/forbestechcouncil/2022/05/25/is-decision-intelligence-the-new-ai/?sh=43537634e425). A Deloitte study [3] underlined that "technology can accelerate decision-making, but can`t replace human ambition"; "company's decision intelligence is only as smart as its employees at all levels". To that end, high-performing firms give their workers with the necessary tools, data, and a secure environment in which to make better decisions. One more finding of the study suggests that "technology, for all its strengths, cannot emulate what people bring to the table: values like empathy, courage, and compassion".

Technology and data may improve decision quality by shedding light on the issue and

freeing up the mental capacity for individuals to make judgments by moving through enormous volumes of data on their behalf, quantifying risks, and decreasing ambiguity. Technology and data may improve decision quality by filtering through massive volumes of data on individual's behalf, identifying risks, and reducing ambiguity. This simplifies the issue and frees up mental capacity for people to make the necessary decisions to attain their objectives. An example given by Deloitte in their research [3] refers to self-driving cars: "while they can relieve passengers of the task of navigation and provide a safer, more efficient path, they cannot define the destination of their passengers". The same principle applies to decision-making: humans and technology should collaborate to bring their unique capabilities to the table.

To build the mental muscle for decision making, the study conducted by the Deloitte consulting company [3] found four factors are needed:

- **Decision integrity** - being honest with yourself and others when making decisions;
- **Decision framing** - establishing, up front, the decision details, the why, what, when, where, how, and who;
- **Decision rigor** - bringing clarity, structure, and precision to the decision-making process;
- **Decision basis** - Objectively relying on data and evidence to inform decisions.

High-quality judgments are not made on the golf course; rather, they are produced in a unique environment in which people's decision-making abilities take precedence over hierarchy and power connections. Another feature emphasized by the findings of this paper is that high performing companies know that each choice (including seemingly little ones) deserves to be pressure tested, and effective organizations construct guardrails to retain agility and momentum.

The research conclusion also implies that higher-capability businesses enable their decision-makers to approach decisions without ego by allowing them to take calculated risks and "fail forward" without consequences, embracing "a researcher mindset: the perspective that views each decision as a hypothesis to be tested, a journey to be undertaken". In addition, competent decision-makers may not only focus on the decision at hand, but also identify how it fits into the framework of other decisions. In other words, high-performing businesses are more likely to view decisions as "moments in time" because they approach each decision in its own unique context. The study brings into discussion three levels of developing decision intelligence maturity as shown in Table 1.

Table 1

The maturity levels of the organization (authors own development).

Maturity Level	Characteristics
Underdeveloped	Early in the decision maturity process, decisions tend to be made reactively, based largely on first-order concerns like political considerations rather than broader context and evidence. Few, if any, tools exist to aid decision-making. When decisions are made, they're over and done with, with little thought given to the process and context that drove the decision in the first place
Developing	Organizations with developing maturity recognize the importance of decision-making as a necessary capability. Standardized processes and tools have made their way into leaders' hands, although the skills necessary to be effective are still underdeveloped in some leaders. Decision-makers understand that decision quality is better judged by process and context over results. Inclusion of voices and debate are encouraged, but cultural conditions have not evolved to make it the norm.
Well-developed	High DI maturity is marked by transparent and iterative decision-making, facilitated by healthy and inclusive debate. Leaders, at all levels, have a collective understanding of effective decision-making and take accountability for anticipating future decisions that will need to be made. They can focus on the forest and the trees, giving each choice its due attention in the context of achieving broader goals. The organization supports their efforts to improve their decision-making capabilities through environment, learning opportunities, tools, and technology.

The research found eight core drivers of decision intelligence maturity. These drivers are what separate leading organizations from their competitors in terms of their decision-making ability. Not only that, but leading organizations also (those with high decision intelligence maturity) demonstrated a range of tangible business, workforce, and societal results.

3. THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DECISION PROCESS

3.1. The potential of AI

In its most basic form, an AI model is a tool or algorithm that is trained on a certain data set and can decide without the involvement of a person. AI models are becoming increasingly important in most businesses due to their ability to execute a wide range of problem-solving activities. What is a learning model and how does it vary from an artificial intelligence model.

One approach of differentiating AI branches. These branches allude to how AI is applied to real-world situations and may include the following techniques (Table 2).

The AI market is expected to grow at a rapid rate to US $1.2 trillion world-wide fueled by initiatives like The US Defense Advanced Research Projects Agency (DARPA)`s US $2 billon" AI Next" initiative and US$1 trillion investment and it is well on the road to mass adoption (see the 2015 article from practitioners, https://www.lorienpratt.com/machine-learning-is-poised-for-mass-adoption/), for better or worse.

Fig. 4. Decision Intelligence maturity levels based on Deloitte research (authors own development)

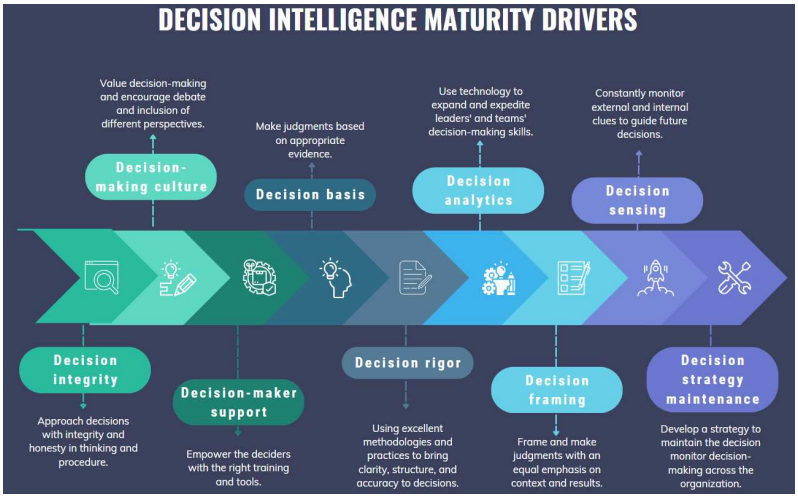

Fig. 5. Decision Intelligence maturity drivers based on Deloitte research (authors own development)

Table 2

AI Branches

AI Branch	Characteristics
Machine Learning	The science of teaching machines to interpret, process, and analyse data.
Deep Learning	Make use of Neural Networks to gain insights and form solutions from high-dimensional data.
Natural Language Processing (NLP)	The science of extracting meaning from natural human language to communicate with machines.
Robotics	AI robots are artificial agents that act in the real world to produce results through accountable actions.
Fuzzy logic	Computing approach based on "degrees of truth".
Expert system	Employ if-then logical notations to solve problems.
Cognitive Computing	An attempt to simulate the functioning of the human brain on computers.
Computer vision	Enables computers and systems to extract useful information from digital photos, videos, and other visual inputs.

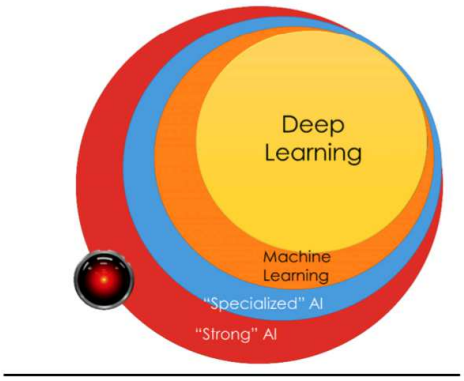

Fig.6. DI maturity drivers based on Deloitte research [2]

Although used already for some time as form of support in the decision-making process in breast cancer screening and credit card fraud detection, it took until 2010 for the technology to advance sufficiently and gain the trust of the big players in technology.

AI models can only be as good as their training. A Machine Learning model that determines if a photograph is male or female might activate actions accordingly: if it is male, proceed with action A, if it is female, proceed with action B. This action can be repeated by the model without the need for human intervention. If the human training the algorithm sometimes classifies the guy as female, the program will make wrong conclusions just as quickly as it does good ones. As AI systems get more complex, the potential for humans to add errors into the findings grows.

We can take as an example GPT-4, the new hot trend which is able to provide answers to a variety of questions/problems, but due to in`s lack of context understanding it gives half true answers or even wrong ones. One example could be a medical chatbot based on Open AI`s GPT-3 large language model recommended that a researcher acting as a patient commit suicide (as supported by the information provided at: https://www.aiaaic.org/).

Several changes occurred in AI throughout this lengthy gestation period. Early studies were on systems that captured intelligence through logic. The core elements here were rules and facts like "All elephants are gray" and "Harold is an elephant" that led to conclusions like "Harold is gray". Until recently, a second camp garnered less attention, but it has been the most effective to yet. The idea behind "sub symbolic" AI was to employ a simplified representation of a brain cell (a neuron) as the core basis around which AI systems would be developed. This paradigm is used by most of the AI systems today, and most of them are ML systems.

Working from the outside in, *strong* AI is also known as "artificial general intelligence" and is represented in film characters such as Hal from 2001: A Space Odyssey and the AI love interest in Her. Although powerful AI is useful in science fiction, most professional AI researchers feel that it is a long way off. The risk of strong AI, or GI, is the diversion it poses from the serious, difficult challenges that AI can assist us in solving now by collaborating with human professionals.

Most AI today is "specialized", which means it handles a specific issue. The bulk of those systems are ML solutions, with deep learning approaches being the most effective, accounting for the majority of deployed systems today.

AI as a decision support tool can be used in different applications. For example, [4] explored the disruptive technologies of AI on agricultural

operations. [5] found that data and AI determine where new oil and electricity are needed in various area of the operations management, such as manufacturing, product/service development and supply chain. Another research [6] suggest that many AI techniques can be applied to supply chain management. Other authors [7] investigate the strategic alignment between marketing and information technology strategies and provide a model which helps improving operations. In addition, [8] look at the ways AI is being used in decision making in human resources management.

3.2. AI in the context of CDD

Data plays numerous functions in the context of decision intelligence and scenarios in which the organization uses a causal decision diagram in their decision-making process:

1) As a source of training data for determining how each connection works. This might include:

- Training data for a machine learning model;
- Data to be used to generate a statistic that captures an important causality or connection;
- Data from a randomized control experiment;
- Data to feed another type of model, such as an agent-based, game theory, or analytic hierarchy process;
- Qualitative data that helps to inform "soft" links.

2) As a source of knowledge regarding externals: those things outside our control that interact with our decisions to produce results. Externals are classified into two types:

- Those that remain constant across the decision model's time span, such as the earth's diameter;
- Predictions about things we cannot change.

The data may originate from within or beyond the company. The capacity to represent complicated dynamics at work when the organization interacts with the outside environment and vice versa becomes more practicable as decision modeling grows more advanced.

In many respects, data may be seen as humanity's "seventh sense". However, there is a widening gap between firms' willingness to embrace Big Data and their capacity to operationalize it, and expertise and best practices for converting data into value are severely missing. Furthermore, many systems today are designed to collect data about the present and the past but have not been mined to understand the cause-and-effect relationships that may assist support future decisions.

The most significant sort of data is cause-and-effect links: linkages that connect one occurrence to another. All data is not created equal; managing fewer valuable data fields is a massive waste of effort. Furthermore, the intensity of the signal compared to noise is more important than the number of rows or columns in the data collection.

While the concept of harnessing data to make better and more informed decisions is not new, the capacity to make smarter, data-driven decisions has never been more important, given the more sophisticated capabilities of bad actors and the limitations of continually expanding technology in difficult and unpredictable situations, law enforcement, national security, and other government professionals must make vital judgments. In the face of information overload, it is nearly hard to fuse and make sense of all available data points in order to adequately analyze potential dangers and battle threats.

Decision intelligence technology is a hybrid of current technologies, such as AI and process automation, which can perform more than either of them alone. AI and machine learning are data-driven; they may provide insights but are frequently separated from decision execution and consequences.

Furthermore, business process applications (such as robotic process automation, process mining, and process discovery) are task oriented. They can automate jobs and make them more efficient, but they can only do what they've been programmed to do and have little influence on decision-making efficacy.

4. CONCLUSION

Decision intelligence is the use of artificial intelligence and machine learning technology, as well as data fusion, visualization, and

collaboration tools, to supplement and improve decision-making. The objective is not to replace humans, but rather to enable them to make more accurate and timely judgments. Ai, in this context of decision intelligence, is only a pillar that can be used as an information resource but which cannot see the bigger picture, as should be the case for the decision-maker. High performing organizations, as the Deloitte study also enhances, they know AI can be used as a knowledge input but will not take the decision itself.

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5. REFERENCES

[1] Gartner, "Top Strategic Technology Trends 2023."

[2] Lorien Prrat, How Decision Intelligence Connects Data, Actions, and Outcomes for Better World. 2019.

[3] Deloitte, "Decision intelligence: The human discipline of high-quality choices," 2023.

[4] K. Spanaki, U. Sivarajah, M. Fakhimi, S. Despoudi, and Z. Irani, "Disruptive technologies in agricultural operations: a systematic review of AI-driven AgriTech research," Annals of Operations Research, vol. 308, no. 1–2. Springer, pp. 491–524, Jan. 01, 2022. doi: 10.1007/s10479-020-03922-z.

[5] P. Grover, A. K. Kar, and Y. K. Dwivedi, "Understanding artificial intelligence adoption in operations management: insights from the review of academic literature and social media discussions," Ann Oper Res, vol. 308, no. 1, pp. 177–213, 2022, doi: 10.1007/s10479-020-03683-9.

[6] R. Toorajipour, V. Sohrabpour, A. Nazarpour, P. Oghazi, and M. Fischl, "Artificial intelligence in supply chain management: A systematic literature review," *J Bus Res*, vol. 122, pp. 502–517, Jan. 2021, doi: 10.1016/j.jbusres.2020.09.009.

[7] A. Al-Surmi, M. Bashiri, and I. Koliousis, "AI based decision making: combining strategies to improve operational performance," *Int J Prod Res*, vol. 60, no. 14, pp. 4464–4486, 2022, doi: 10.1080/00207543.2021.1966540.

[8] W. Rodgers, J. M. Murray, A. Stefanidis, W. Y. Degbey, and S. Y. Tarba, "An artificial intelligence algorithmic approach to ethical decision-making in human resource management processes," *Human Resource Management Review*, vol. 33, no. 1, Mar. 2023, doi: 10.1016/j.hrmr.2022.100925.

Rolul inteligenței artificiale în oferirea suportului pentru decizii inteligente

Inteligența decizională costă în aplicarea tehnologiilor de inteligență artificială (AI) și de învățare automată, împreună cu instrumentele de fuziune, vizualizare și colaborare a datelor, pentru a spori și îmbunătăți procesul decizional. În acest context, AI nu este factorul de decizie, ci mai degrabă un pilon care sprijină o decizie mai informată. Prin lucrarea de față se prezintă într-o manieră științific argumentată modalitatea de utilizare a mijloacelor AI în proesul de luare a deciziei prin intermediul unor argumente științifice, dar și a unora praxiologice, legate de dinamica mediului de afaceri actual, puternic marcat de accelerarea transformării digitale.

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