HARVARD UNDERGRADUATE CBE

AI in ESG Reporting

CBE | Spring 2024

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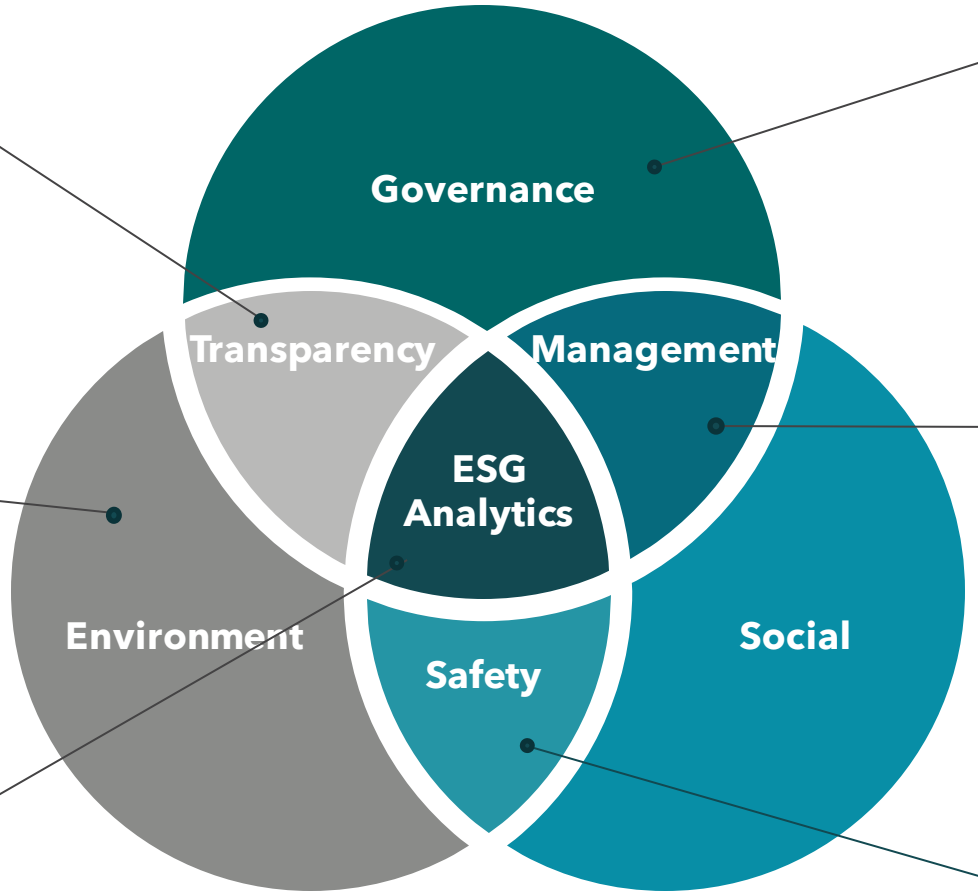
ESG Analytics Overview

ESG, or Environmental Social Governance, is a business practice that focuses on improving companies' social impact. Artificial intelligence is used to optimize actions and ensure company commitment to their goals.

TRANSPARENCY
AI can **aid companies in drafting reports** and summarizing changes in stakeholder sentiment and **provides natural language search functions to rapidly access insights**. It can streamline preparation and ensure that all the information is correct and up to date.

ENVIRONMENT
Used for environmental management and reporting, AI can **perform climate change modeling, monitor deforestation through satellite imagery analysis, conduct energy management** reports, and capture greenhouse gas emissions. After capturing this data, AI can then use analytics to recommend actions that the company could take in order to lower their impact.

ESG ANALYTICS
ESG affects all industries, with **38% of CEOs say that they prioritize sustainability** issues when making capital allocation decisions. To do this, **88% of CEOs report existing or planned capital investments to AI-driven products**.



GOVERNANCE
By training AI to read a certain type of conversation and analyzing the tone, **companies can identify the parts of the conversation** where ESG related topics are addressed and infer how committed a company appears to be about promoting ESG decisions.

MANAGEMENT
AI can help financial institutions design and promote instruments that **cater to green projects, including green bonds and green loads**. It can provide information on transition financing that supports companies in the interim period to **gradually shift from "brown" to "green" practices** and can allow for **divestment or reduction from "brown" practices** which are often plagued by high transition costs.

SAFETY
Businesses can train an AI-based solutions to help **detect anomalies such as breached in data centers or cyberattacks**. They can also create fraud detection systems that can can **accurately pinpoint suspicious activities** using comprehensive customer profiles.

EY, SP Global

AI's Use in Aiding ESG Stakeholders

AI tools such as data analytics and NLP has rapidly become the primarily method through which investment companies can communicate ESG data and comparative framework standings to stakeholders.

ESG Standards
In order to claim that their investments are ESG certified, investment companies **must abide by a variety of reporting frameworks** that are constantly evolving. A recent study examined 250 sustainability reports from S&P 500 companies and identified that **SASB and TCFD** dominated the disclosure frameworks, followed by **GRI and the UN's SDGs.**

AI for Identifying ESG Standards
Benchmarking allows **companies to compare their performance against industry standards and frameworks**. AI-driven tools can automate the process of benchmarking and provide executives and board members with deep insights into their company's relative standing in terms of sustainability preference. Predictive analytics can also **anticipate future ESG trends and frameworks** to abide by.

AI in Sentiment Trading
AI can be used as Natural Language Processing (NLP) sentiment trading to make enhanced decisions based on processing vast amounts of real-time data. By **analyzing articles, papers, and reports**, AI can provide more accurate insights into market sentiment compared to traditional methods and ensure that **investment decisions align with sustainability trends**.

Future of AI and ESG
Global ESG assets reached $480 bil in 2023 and is only expected to increase. AI has already been used to aid investment strategies and is becoming increasingly used in ESG strategies. Methods such as **NLP, data processing, and comparative standards** can ensure that investment companies are keeping up to date with the most recent sustainability trends, particularly as **standards constantly evolve.**

Katalis.App, ESG Today

AI & ESG Reporting

AI is gradually becoming an instrumental part of ESG reporting among virtually all industries and companies due to its accuracy, as well as ability to sift through vast amounts of ESG related information.

Current State

- AI is already used in ESG context for **automating data collection processes** and providing data analysis.
- ESG goals are similarly important **across all industries** and AI technologies that are used for enhancing ESG reporting **do not differ significantly** among industries or companies' sizes.
- MSCI, S&P Global, Refinitiv/LSEG, and **many other large corporations** are already using AI to crawl ESG reports.

Future

- In the future, with more enhanced AI and machine learning, companies will be able to **pull ESG data in real time**, identify anomalies in the data through pattern detection, and **pinpoint findings** that need to be reviewed and audited more immediately and **accurately**.
- Once the **ESG standards are clarified**, generative AI will provide a strong pathway for ESG reporting to be **truly integrated with financial reporting**.

Benefits

- Main benefit of integrating AI in ESG reporting is **avoiding errors** that human analysts might overlook.
- AI specifically facilitates sifting through **vast amounts of information**, from emissions reports to time sheets, **identifying** data trends, risks, and other opportunities **to bolster company's sustainability**.

Limitations

- For investors, the main challenge **is getting sufficient data** to understand how companies are utilizing generative AI to **enhance their ESG reporting**.
- Experts warn that accuracy rate of GenAI tools fluctuates.
- As a result, companies using GenAI for ESG purposes should either **verify output from public-facing tools**, or **use proprietary tools** that only use data from smaller, verifiable data sets.

Reuters, *KEY ESG*

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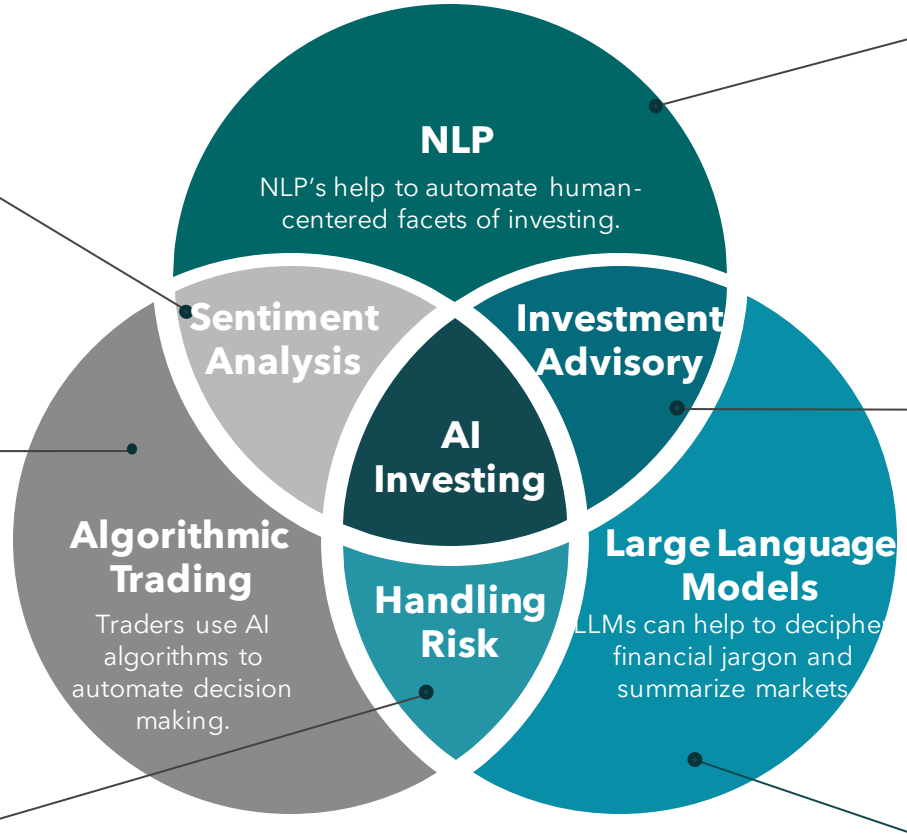
The State of Artificial Intelligence in the Investment Industry

AI is being quickly integrated into the investment industry from trading and client services to operational optimization and content creation, all helping companies and investors to augment their ESG goals, reporting, and impacts.

Market Sentiment Analysis with AI
AI is used to **gauge market sentiment** towards specific securities, industries, and catalysts. Trades are automated based on NLP conclusions. One caveat is **"Black Box Risk"** where the conclusions of an NLP can be unknown and hard to acclimatize to more nuanced investment strategies.

Algorithmic Trading
The global market size was valued at **USD 15.55 billion in 2021** and is expected to expand at a **12.2% CAGR** from 2022 to 2030. AIEQ is an ETF which **uses IBM Watson** for machine learning, sentiment analysis and NLP to trade securities for the EquBot index. In this way, it **democratizes technology** that, for a long time, has only been accessible to institutional investors. Their algorithm analyzes 6 million data points daily and **consistently outperform the S&P500.**

Managing Risk and Human Error with AI
AI is most used for non-linear relationship discovery. These **nonlinear machine learning algorithms**, which use LLM's to **quantify human actions**, have proven better than regression models at identifying **relationships between risk factors** and trading variables.



Natural Language Processors and Investing
Investment banks are utilizing NLPs to streamline their client services and augment productivity. Morgan Stanley is the first major to utilize a bespoke solution based on GPT-4. ***AI @ Morgan Stanley Assistant*** gives professionals **instant access to 100,000 documents.**

AI & Wealth Management
Investment banks have recently begun to use AI to **automate advisory and management services**. In 2023, JPMorgan trademarked *IndexGPT* which **offers investment advice to customers.** This functionality lies at the intersection of NLPs which **analyze customer inputs** and LLMs which provide tailored advice based on customer profiles. Studies suggest that the use of **generative AI can boost productivity** for front-office employees by as much as **27%–35% by 2026.**

Applications of Large Language Models in Investing
A study at the Chicago Booth School of Business used **LLMs to analyze MD&As** of publicly traded companies. Using an artificial neural network, they **quantified how important company statements** were for projecting earnings, valuations, and backdated equity performance.

Deloitte, Forbes, Chicago Booth, Morgan Stanley

Artificial Intelligence for Investment Risk Management

Artificial intelligence has key applications in the financial risk management space. These tools not only help investors, but they also streamline corporate responsibility, fraud deterrence, and regulatory bodies like the SEC.

Fraud Detection
Machine learning algorithms have been trained to identify fraudulent card transactions. These un-supervised ML algorithms are more efficient than traditional regression models.

Viability and Credit Modeling
AI-based decision tree techniques have been used by private and commercial lenders to assess debtors' probability of default based on their historical credit activity and financial profile.

Trader Behavior Monitoring
In a similar application to those above, the SEC uses machine learning to identify nonlinear trading patterns and detect insider trading, rogue trading, and market manipulation.

Sentiment Analysis
Natural Language Processors are being used by investment banks to synthesize news cycles and 10Ks into investment recommendations

KPMG, CFA Institute

COMMON APPLICATIONS OF AI FOR INVESTMENT RISK MANAGMENT

KEY ADVANTAGES OF AI OVER ALTERNATIVE METHODS

Increased Prediction Accuracy
Conventional regression models do not capture correlations between market factors and stock prices nearly as well as machine learning algorithms.

Augmented Variable Selection Ability
The primary time drain for investment decision making models is selecting relevant variables and compiling actionably large datasets. ML models with Big Data capabilities help streamline impact investing.

Optimized Data Segmentation
Distance and density-based approaches to outcome clustering are only possible through AI and ML. This granularity is critical in crafting ESG conscious portfolios.

Nonlinear Pattern Discovery
Across the board, from credit risk to trader behavior, the ability of ML algorithms to perceive nonlinear correlations between factors and outcomes helps ESG investors narrow their scope.

AI & ESG Data in the Investment Industry

AI has proven to be a double-edged sword at the intersection of investing and ESG. It can help streamline impact investing and ensure corporate responsibility, but it is highly resource-intensive, susceptible to biases, and not yet comprehensive.

AI for ESG Data Collection

- AI is **helping impact investors make decisions** based on actionable company ESG activity. Although AI-compiled **databases are widely used**, clearer parameters are needed to **quantify risk and "meaningful" action.**
  - **TruValue Labs**, a software-focused equity research firm, uses AI to compile ESG information on over 16,000 securities. A **one-year analysis** they conducted on the **completion rate of ESG** goals in the automotive industry **saved five years of human analyst work.**
  - Their analysis aims to omit **greenwashing,** or baseless ESG claims by firms.

Exacerbation of Inequities

- In two-fold, AI is susceptible to embellishment by established companies, undervaluing the ESG potential of smaller firms, and exacerbating biases in society.
  - The CEO of TruValue says that **"companies can report whatever they want"** and acknowledges that the majority of positive climate and cultural contributions are not yet quantified. **AI can't overcome what it can't see.**
  - **AI is very susceptible to biases in existing data sets** like vernacular, translation, and sample misrepresentation. This can **facilitate inequitable ESG data reporting of minority-owned, international, and community-based companies.**

Methods for Data Collection

- The primary method of AI ESG data collection is **sentiment analysis.** While powerful in data funneling, **current methods can be too broad in scope.**
  - On one hand, there is **no current standardization for reporting ESG data** and AI helps to sift. NN Group NV, a Dutch asset manager, screens earnings calls for ESG data and **reduces scores when a CEO says "but"** or "however" suggesting doubt.
  - Negatives are much easier to quantify, inserting confirmation bias. AI can see when a company misses ESG targets **but can't yet evaluate the future impact of initiatives,** creating a one-sided and **pessimistic picture.**

Environmental Impact of AI Applications

- The application of AI for **ESG quantification can quickly become zero-sum** because of the resource-intensive nature of AI training and operation.
  - A UMass Amherst study showed that training an **AI model contributes 5x the lifetime emissions of an average car.**
  - In the short run, it appears that AI applications to ESG investing will cause more harm in its development than good in shifting corporate culture.
  - Solution-wise, **standardized ESG reporting regulations** can not only reduce companies' emissions, but it can also make AI analysis more streamlined and efficient, thus improving impact investing and snowballing change.

InTechOpen, S&P Global, TruValue Labs, WSJ

AI & Predictive Analytics

For a long time, predictive analytics have been used to optimize business decisions – now they can be significantly enhanced by predictive AI capabilities that can also facilitate ESG reporting by forecasting company's future trends.

Technologies

- **Artificial Neural Networks** is a sophisticated technology modeled on **the networks of neurons** in the brain that uses layers of neurons between the **input** data and **output** result.
- **Machine Learning** technologies are commonly used for predictions: the training phase uses **pre-existing data** to build an analytic model that best reflects **the patterns** hidden in the data and then **the inference phase** uses the trained model with new data to generate the **needed predictions**.

> AI is expected to grow to a **$309 billion industry** by 2026, and **44%** of executives report **decreased operational costs** as a direct result of implementing AI.
>
> **Forbes**

Benefits	AI-enhanced predictive analytics uses **statistical algorithms** combined with **internal and external data** to forecast future trends, which enables businesses to **optimize** inventory, **improve** delivery times, **increase** sales and ultimately, **reduce** operational costs in a **more accurate and timely** manner compared to predictive analytics alone.
Supply Chain	AI-enhanced predictive analytics are **especially relevant** in the industries that have **large supply chains** such as **healthcare, consumer retail, and transportation**. For example, in case of unexpected **shortage or demand**, AI system could **proactively flag** such events, resulting in **more informed decision-making** within the supply chain.
Inventory & Delivery	AI algorithms are now capable to predict the **best times** for deliveries, potential delays, other transportation and delivery factors, as well as **optimize routes**. Meanwhile, monitoring technologies like IoT devices in the warehouse provide **real-time alerts** for low inventory so **one can restock** products **before they go out of stock**.
Limitations	Most US-based business owners **have identified several challenging aspects** in implementing AI within their businesses. These include but are not limited to data **accessibility**, adaptation and **scaling**, **finding talent** that would be able to use AI technology, and **general knowledge** of accessible models and tools.

Key Takeaway

While combining AI with predictive analytics is instrumental in ensuring accurate and timely forecasting, it is important to consider limitations such as scaling or accessibility and strike balance in the two areas.

Forbes, *McKinsey*, *MIT*

Supply Chain, ESG & AI

Companies within the supply chain industry might heavily benefit from using AI algorithms in their ESG reporting, especially by addressing the intricate nature of supply chain companies as well as their used complex data.

Current State

- European Sustainability Reporting Standards (ESRS) **recently established guidance** for corporations on **how to comply** with the European Union's Corporate Sustainability Reporting Directive (CSRD).
- There is still an **absence of ESG-related frameworks** related to consistent **data**, **assurance**, and comparability.
- As a result of that, **many companies**, such as Unilever, are often facing **accusations for greenwashing**.

AI Capabilities

- AI can process information in **multiple languages** and provide **translation**, enabling organizations to analyze data from **various sources around the world**.
- Companies employing diverse ESG standards can benefit from AI's **ability to detect anomalies**, **data gaps**, and predict relevant metrics based on a **custom** set of inputs.
- AI interaction enables **easy customization** of automated **alerts** to monitor various changes related to ESG factors.

Challenges

- **Collecting** ESG data has posed **challenges** for companies operating globally, especially given their **complex network** of **multiple tiers** of suppliers.
- The **absence of adequate oversight** and visibility within the supply chain represents **reputational risk** for the reporting companies.
- The **intricate nature** of global supply chain activities, complicates **the standardization** of environmental impact **assessment methodologies**.

Recommendations

- Identify **relevant ESG areas** that are most pertinent to the **company's operations** and industry.
- Outline **functional requirements** and understand how the technology **addresses** those requirements.
- Perform a **cost-benefit analysis** of the chosen solutions to **quantify** the long-term **return of investment**.
- Conduct **pilot tests** to understand **effectiveness** and **challenges**; provide **necessary training** to key stakeholders on the **broader context** of ESG reporting.

Thomson Reuters

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AI, Predictions & Climate-Related Decision Making

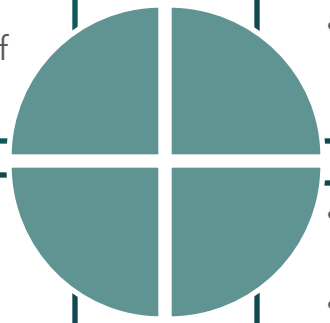
AI can boost the speed of environmental predictions tremendously, thus, allowing companies, governments, and communities to adapt the necessary decisions while bearing in mind the limitations of AI.

AI vs. Traditional

- While accuracy of **AI** and **traditional climate modeling** is relatively similar, it is estimated that AI can accomplish **the same environmental prediction** around 1,000,000 times **faster** compared to **traditional methods**.
- For climate modeling, **machine learning** algorithms are used to achieve the **most optimal outputs**, however, **hybrid models** such as those incorporating elements of physics-based models are also used.

Decision Making

- AI can **significantly improve decision making process** due to its **effectiveness** at forecasting various objectives.
- For instance, AI can determine **which facilities** are likely to be **violating environmental regulations**, thus, making them get **inspected**.
- Alternatively, companies can improve **detection** of water **pollution violators** by 600% by using machine learning algorithms which **helps making appropriate decisions**.



Limitations

- For AI, running, managing and interpreting **multi-dimensional datasets** ranging from energy use to waste production introduces a lot of **complexity**.
- AI models need **continuous periodic updates**, fine-tuning to adapt to new data or conditions, and even **complete overhauls** to incorporate new standards
- Machine learning algorithms demand **considerable energy**, elevating the project's environmental impact through **extensive computational power**.

Recommendation

- Establish **well-defined sustainability objectives**: carbon **neutrality**, waste **reduction**, or social benefits.
- Centralize data and use **data lakes** to store sustainability markers: **energy** usage, **emissions**, or waste generation.
- Customize algorithms as projects may have challenges that **generic algorithms** can't **address effectively**.
- Opt for a **phased implementation** approach, gradually incorporating the algorithm into different aspects of the project **while monitoring performance** metrics closely.

Harvard Business Review, *Nature*, *UPenn*

Ethical Implications of AI for ESG Reporting

AI is an imperfect tool which, in pursuit of widespread applications, requires stringent ethical guardrails, government regulation, and standardized frameworks of use across users and companies.

Data Privacy

Prior to the late 2023 release of GPT Enterprise, companies including J.P. Morgan and **Amazon banned the internal use of OpenAI technologies** citing security & privacy concerns. This **is bad in the short-term for ESG-AI reporting tools** on the frontier.

Algorithmic Bias

AI models trained on historical data can inherit historical biases. A 2024 matched guise probing study from Cornell found that GPT is more likely to "sentence someone to death" when they speak AAVE. This has **bad implications for Human Resources** applications.

Transparency

Contemporary with more stringent ESG guidelines from bodies like the SEC, **AI has the potential to be the force that standardizes** reporting. NASDAQ ESG Solutions has risen to the top, not only as an AI tool to collect data internally, but a **standard metric on which to judge a company's** ESG data.

Zou et. Al 2023, *NASDAQ ESG*, *Euronews*

Regulations of AI use in ESG Reporting

ESG reporting, with or without the use of AI, is a loosely regulated space with a series of governing bodies, standards, and motivation which create inconsistency, but also serve as the foundation for increased ESG reporting.

Early 2024 SEC Regulation

- In March 2024, the SEC released its first guidelines and **requirements on ESG reporting for publicly traded companies**.
- These were closely **modeled after TCFD and GHG** regulations which been fairly widely adopted internationally, in an attempt to enable comparisons with foreign companies.
- Some included requirements are:
  - **Disclosure of Scope 1 & 2 GHG Emissions**
  - Disclosure of any **climate-related goals** that may affect a company's capital allocation.
  - Disclosure of scenario related analyses related to climate events or warming.

Standardization

- These SEC requirements may seem common sense but the struggle to standardize ESG reporting has taken years for many reasons:
  - **ESG Materiality** is highly subject to industry, location, and revenue model.
  - **Subjective definitions** of scope, attributability, make it difficult to compare ESG reports from company to company.
- One possibly impactful framework comes from the **Sustainability Accounting Standards Board (SASB),** an organization closely parallel to TCFD. Their recent release includes **77 different ESG reporting standards, by industry.**

Artificial Intelligence

- Artificial intelligence, in its current applications, can serve as the glue that adheres this **seemingly unorganized space.**
- Josh Friedman, an ESG strategy expert, cites that AI assistants are already **helping ESG reporters ascribe their data to preexisting standards and frameworks**, effectively serving the role of a risk agent.
- That being said, there are **no currently widely used ESG reporting frameworks** (SEC, TCFD, GIR, etc**.) that mention artificial intelligence** for data collection in their standards.

Bloomberg Law, TCFD, HLS, SEC Guidelines

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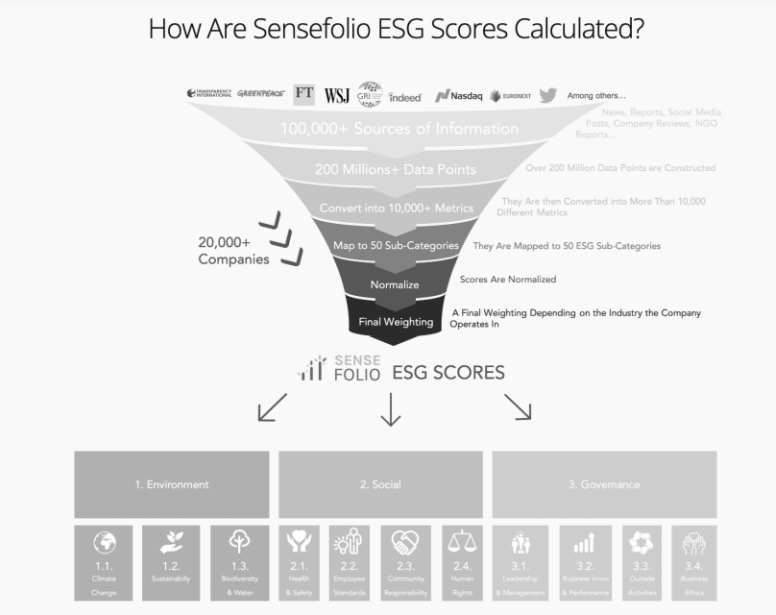
Sensefolio

Sensefolio is a machine learning/NLP company allowing other companies to view ESG scores and estimate their own ESG ratings, using a variety of real-time sources and updates that allow for greater accuracy than their competitors.

SENSEFOLIO

- Sensefolio is a **machine learning and natural language processing (NLP) company** started in 2013 that provides **accurate ESG scores** to companies to aid them in their impact investing strategies.



Sensefolio Hub	With a singular platform, Sensefolio Hub **provides companies with real-time ESG updates,** news, report and millions of company reviews, and machine learning and natural learning processing systems. Its **easy-to-use browser, ESG/sustainability/CSR reports, and social media posts & company reviews** provide many forms of aid.
Consumer Base	Sensefolio provides solutions to **30,000 companies** including **asset & investment managers, endowment funds, quantitative managers, and more**. This includes 20,000+ listed companies and 11,000 private companies. They work across **80+ countries**, including China and Japan.
Process	Sensefolio ESG scores are calculated by compiling over **100,000 sources of information** with **200 millions+ data points into 50 sub-categories** that are normalized before producing a final weighting. The final result is separated into **Environment, Social, and Governance values.**
Competitive Edge	Primarily distinguishing themselves with their **real-time updates**, Sensefolio scans the Internet for **a variety of sources, including NASDAQ, Financial Times, and MarketWatch**, to input into their model. This allows them to provide the most accurate ESG scores that are weighted to reflect the future circumstances.

Key Takeaway

Sensefolio is an example of a company which had first mover advantage in the ESG scoring market, using machine learning to increase accuracy and provide real-time updates.

BlackRock Investing

BlackRock is an industry leader investment company that has recently implemented ESG investment strategies into Aladdin, its flagship AI solutions system that aids investment decisions across industries.

1 – TACTICS
BlackRock adds machine learning algorithms to **Aladdin, its electronic investment solutions system**, to analyze diverse data sources, such as company disclosures, news articles, and social media, to **extract insights regarding companies' ESG performance** and risks.

2 – RECENT NEWS
Recently, Blackrock announced the expansion of Aladdin to **further incorporate ESG data**, allowing investors to assess ESG risks and opportunities alongside traditional financial metrics. For example, they **employ Natural Language Processing** techniques to process data to identify patterns.

3 – BENEFITS
Using AI enables BlackRock to deliver accurate and timely ESG datasets to investors to facilitate informed decision-making and alignment with ESG objectives. AI's main selling point is its **efficiency to identify patterns and make market predictions**

4 – PARTNERS
In 2021, BlackRock announced **an investment in Clarity AI,** a data science software provider with a focus on **sustainability analytics, ESG, and social impact investing** with a plan to integrate Clarity AI into BlackRock's Aladdin platform.

5 – INVESTMENTS
BlackRock has **partnered with MioTech**, a Hong Kong-based AI startup to develop ESG data solutions. MioTech uses AI to **analyze news articles, company reports, and other data sources** to identify ESG risks and opportunities.

Harvard CBE – Industry Report
AI in ESG Reporting
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