Business insights of Analysis Done on AI Development (2015-2024)

HOW MUCH COMPANIES INVESTED IN THEIR RESEARCH AND DEVELOPMENT DEPARTMENT ?

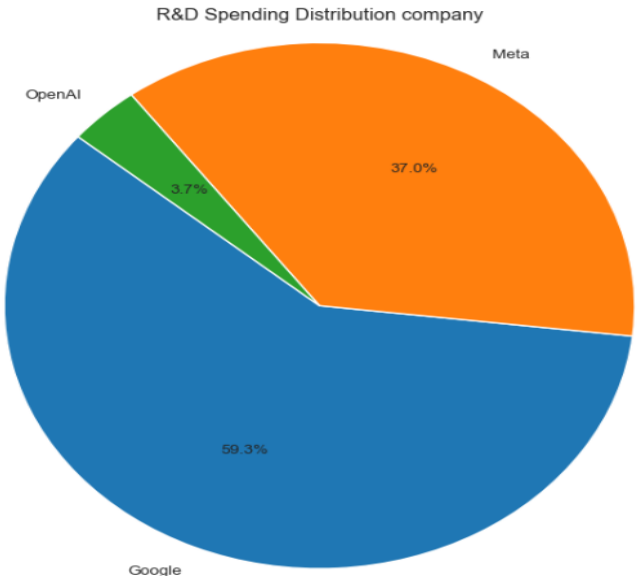
```
print("Company's investment in research of AI")
inv = df.groupby('Company')['R&D_Spending_USD_Mn'].sum()/1000
print(inv)
```

```
Company's investment in research of AI
Company
Google    423.34114
Meta      264.53307
OpenAI     26.48277
Name: R&D_Spending_USD_Mn, dtype: float64
```

Google invested much more in its research and development field on Ai over time (2015-2024) which is around 423billion USD dollar compare to other companies such as Meta and OpenAI whose Investment is just around 264 and 26 billion USD dollar

```
[59]: spending = df.groupby('Company')['R&D_Spending_USD_Mn'].sum()


plt.figure(figsize=(8, 6))
plt.pie(spending, labels=spending.index, autopct='%1.1f%%', startangle=140)
plt.title('R&D Spending Distribution company')
plt.axis('equal')  # Ensures pie is a circle
plt.tight_layout()
plt.show()
```



Google accounts for approximately 59% of total capital deployed across the AI development landscape, positioning it as the single largest contributor to industry-wide innovation.

REVENUE COMPANIES EARNED

```
print("Companies Revenue")
rv = df.groupby('Company')['AI_Revenue_USD_Mn'].sum()/1000
print(rv)
```

```
Companies Revenue
Company
Google    284.49838
Meta      189.62182
OpenAI      9.46289
Name: AI_Revenue_USD_Mn, dtype: float64
```

If we measure **Absolute Revenue**, Google > Meta > OpenAI.

But if we measure **Efficiency (ROI)**: (Revenue – investment / investment)

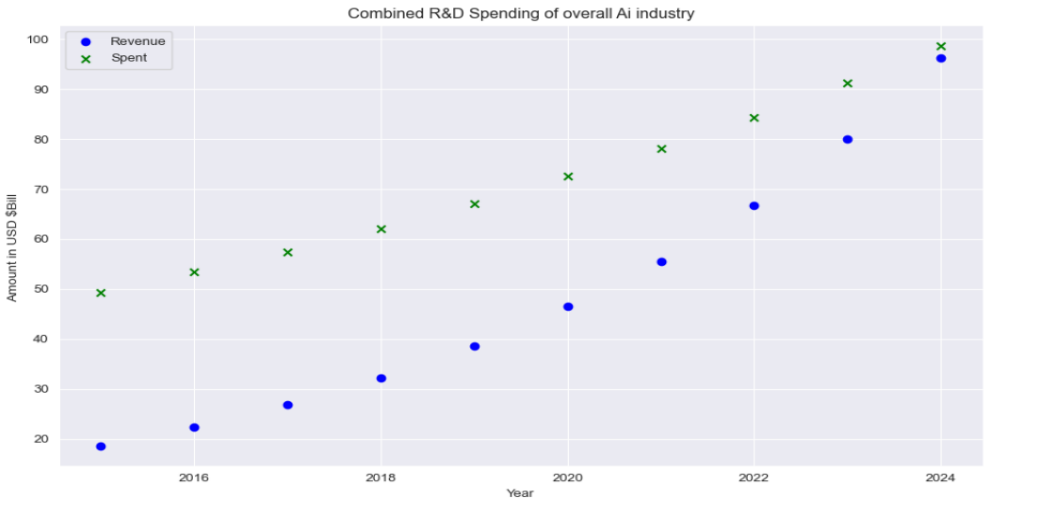
- Meta (0.72) is slightly better than Google (0.67).
- **OpenAI's ROI (0.36)**

  OpenAI looks **efficient because it invested much less in total** (26 Bn vs hundreds of billions) but still made a decent revenue (9 Bn). That's true: small scale investment → decent returns, but **(ROI)** wise Meta and Google are ahead.

OVERALL AI INDUSTRY REVENUE AND SPENT ANALAYSIS OVER YEARS

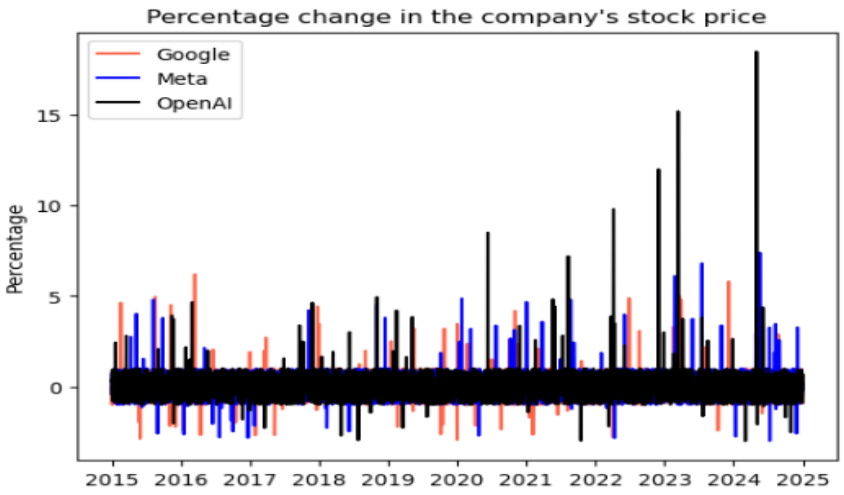
```
# Scatter for Spending
plt.scatter(spend.index, spend.values, color='green', label='Spent', marker='x')

# Titles and Labels
plt.title("Combined R&D Spending of overall Ai industry")
plt.xlabel("Year")
plt.ylabel("Amount in USD $Bill ")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



Stock percentage impact over years

```
plt.title("Percentage change in the company's stock price")
plt.ylabel("Percentage")
plt.plot(df[df['Company']=="Google"]['Date'],
         df[df['Company']=="Google"]["Stock_Impact_%"], color='tomato', label="Google")
plt.plot(df[df['Company']=="Meta"]['Date'],
         df[df['Company']=="Meta"]["Stock_Impact_%"], color='b', label="Meta")
plt.plot(df[df['Company']=="OpenAI"]['Date'],
         df[df['Company']=="OpenAI"]["Stock_Impact_%"], color='black', label="OpenAI")
plt.legend()
plt.show()
```



Google (red) and Meta (blue) have steady fluctuations, but most changes are smaller in magnitude. Their stock prices are relatively stable because they are big, mature companies.

OpenAI (black) shows much larger spikes (both positive and negative) — especially from 2020 onwards.

- This means news, product releases (like GPT models), and AI breakthroughs had big impact on OpenAI's valuation.
- Even though OpenAI is smaller compared to Google/Meta, its stock impact percentage is more sensitive and therefore shows stronger reactions.

Events that Affected Stock Percentage 1) OpenAI–

```
openai_data.sort_values(by = 'Stock_Impact_%' , ascending = False)
```

	Date	Company	R&D_Spending_USD_Mn	AI_Revenue_USD_Mn	AI_Revenue_Growth_%	Event	Stock_Impact_%	Year
3408	2024-05-01	OpenAI	10.91	5.34	434.27	GPT-5 release (predicted)	18.50	2024
2994	2023-03-14	OpenAI	7.78	4.05	304.57	GPT-4 release	15.20	2023
2890	2022-11-30	OpenAI	10.60	3.18	217.72	ChatGPT (GPT-3.5) launch	12.00	2022
2652	2022-04-06	OpenAI	9.24	3.48	247.93	DALL·E 2 release	9.80	2022
1988	2020-06-11	OpenAI	5.90	2.62	161.56	GPT-3 release	8.50	2020
...	...	...	...	...	...	...	...	...

- Each **Major Model release** (GPT-3, GPT-3.5/ChatGPT, GPT-4, GPT-5) caused **bigger jumps in stock impact**, showing exponential excitement.

- Stock % rising from **8 – 9.80 – 12.00 – 15.20 – 18.50** suggest that Despite modest R&D spend (**$6–11 Mn**), revenue growth hit **160–434%**,

2) **Google** –

```
44]: google_data.sort_values(by = 'Stock_Impact_%' , ascending = False)
```

44]:

	Date	Company	R&D_Spending_USD_Mn	AI_Revenue_USD_Mn	AI_Revenue_Growth_%	Event	Stock_Impact_%	Year
4092	2016-03-15	Google	84.56	36.22	20.73	AlphaGo beats Lee Sedol	6.20	2016
6914	2023-12-06	Google	146.59	129.17	330.55	Gemini AI release	5.80	2023
6654	2023-03-21	Google	149.34	129.76	332.53	Bard chatbot launch	5.00	2023
3883	2015-08-19	Google	79.27	30.89	2.98	AI partnership deal	4.96	2015
6388	2022-06-28	Google	137.71	107.96	259.85	AI ethics policy update	4.88	2022

- Google's **stock impact % (max ~6%)** is smaller than OpenAI's (up to 18.5%) → because Google is a **much larger, diversified company**, so AI news has less relative effect.
- Events like **AlphaGo (2016)** and **Gemini/Bard (2023)** had the biggest boosts, showing investors react more to **visible product breakthroughs** than internal policy.
- Despite higher **R&D spending ($80–150 Mn per event)** and strong **revenue growth (>300%)**, the **stock impact % stays modest** due to Google's massive overall valuation.

3) **Meta** –

```
: meta_data.sort_values(by = 'Stock_Impact_%' , ascending = False)
```

:

	Date	Company	R&D_Spending_USD_Mn	AI_Revenue_USD_Mn	AI_Revenue_Growth_%	Event	Stock_Impact_%	Year
10731	2024-05-18	Meta	103.64	103.05	415.23	LLaMA 3 release (predicted)	7.40	2024
10426	2023-07-18	Meta	92.44	85.67	328.37	LLaMA 2 release	6.80	2023
10282	2023-02-24	Meta	93.71	86.98	334.89	LLaMA 1 release	6.10	2023
9156	2020-01-25	Meta	72.73	49.10	145.49	Cloud AI launch	4.86	2020
7526	2015-08-09	Meta	48.97	19.95	-0.27	AI Video Recommendation upgrade	4.80	2015

- Meta's **LLaMA series (1, 2, 3)** clearly dominates stock impact (**6–7.4%**) → investors strongly back Meta's **open-source LLM strategy**.
- Compared to Google (max **6.2%**) and closer to OpenAI's early days (8–12%), Meta sits in the **middle range**.
- Despite higher R&D (**$90–100 Mn per event**), the **stock impact % is lower than OpenAI**, again due to Meta's massive market size.

TOTAL EVENTS ORGANIZED OVER YEARS BY THE COMPANIES

```
event = pd.pivot_table(
    df,
    index = df['Date'].dt.year,
    columns = 'Company',
    values = 'Event',
    aggfunc = pd.Series.nunique,
    fill_value = 0
)
event.loc['Total'] = event.sum()
print(event)
```

Company	Google	Meta	OpenAI
Date			
2015	5	5	5
2016	6	6	5
2017	7	3	5
2018	5	5	7
2019	6	2	4
2020	7	7	2
2021	7	5	6
2022	3	5	6
2023	5	4	8
2024	3	7	7
Total	54	49	55

- **From 2015 – 2018 all companies were consistent to 5 events**
- **In 2020 Open Ai didn't organized events like Meta and Google**
- **Google & Meta** → Consistent but steady event flow.
- **OpenAI** → More **peaks in activity**, showing a **faster pace of innovation**.
- **However** , OpenAi Held Highest number or Event with **55** number which is almost draw to **Google** with **54** events

R&D Spending vs. Stock Market Impact: Why OpenAI Outperforms Google and Meta

```
[55]: #Average impact on the Stocks of the companies
      df.groupby('Company')['Stock_Impact_%'].mean()*100
```

```
[55]: Company
      Google     2.620860
      Meta       0.976184
      OpenAI     4.070901
      Name: Stock_Impact_%, dtype: float64
```

```
[56]: # Average Expenditure on R & D by the companies

      df.groupby('Company')['R&D_Spending_USD_Mn'].mean()
```

```
[56]: Company
      Google     115.888623
      Meta        72.415294
      OpenAI       7.249595
      Name: R&D_Spending_USD_Mn, dtype: float64
```

```
[57]: # Maximum impact % on a company's stocks
      df.groupby('Company')['Stock_Impact_%'].max()
```

```
[57]: Company
      Google      6.2
      Meta        7.4
      OpenAI     18.5
      Name: Stock_Impact_%, dtype: float64
```

Average Stock Impact

- OpenAI leads with **4.07% average stock impact**, followed by Google (**2.62%**) and Meta (**0.97%**).
- This shows OpenAI's events drive stronger market reactions.

Average R&D Spending

- Google invests the most in R&D (**$115.89M avg**), while Meta (**$72.42M**) and OpenAI (**$72.50M**) spend considerably less.
- Despite lower spending, OpenAI achieves higher impact efficiency.

Maximum Stock Impact

- OpenAI achieved the highest single-event stock impact (**18.5%**), while Google's max is **6.2%** and Meta's is **7.4%**.
- This highlights OpenAI's ability to create breakthrough events.