THE IMPACT OF DATA, ANALYTICS AND AI

On REVOLUT

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About Revolut

Overview

The past few years have witnessed an increase in the number of "challenger banks", which are rapidly changing the financial landscape by providing an alternative to traditional banks. Revolut is a London- based fintech firm, founded in 2015 which offers banking services (Appendix 1) through an all-in-one mobile app to best serve the growing needs of its customers.

Key Objectives[1][2]

1. Encourage customers to use Revolut for daily spending and not just as a travel card
2. Provide seamless customer experience and adapt to their growing demands
3. Increase revenue
4. Offer differentiated services and products versus its competitors
5. Expand into more countries
6. Acquire one Billion customers worldwide
7. Increase transaction Volumes

Key Challenges

1. Further monetization and generation of profits while complying to low rates as promised.
2. Existence of strict regulations which hinder expansion into countries like the United States, coupled with different consumer preferences (Appendix 1)
3. Bouncing back from the negative publicity surrounding fraud, money laundering loopholes, and unfair practices.
4. Adapting a profitable business model in light of COVID-19 due to lack of economic response initiatives by the government and decrease in cross-border transactions volumes.

[1] (An open letter from our CEO | Revolut, 2020)
[2] (Cook, 2020)

Understanding Data Analytics and AI

Data

Simply put, data refers to information, generally facts or numbers, which have been collected over a period of time. Nowadays, the words 'big data' are growing in popularity. Big data refers to datasets whose size is beyond the ability of typical software tools to capture, store, manage, and analyze.[3]

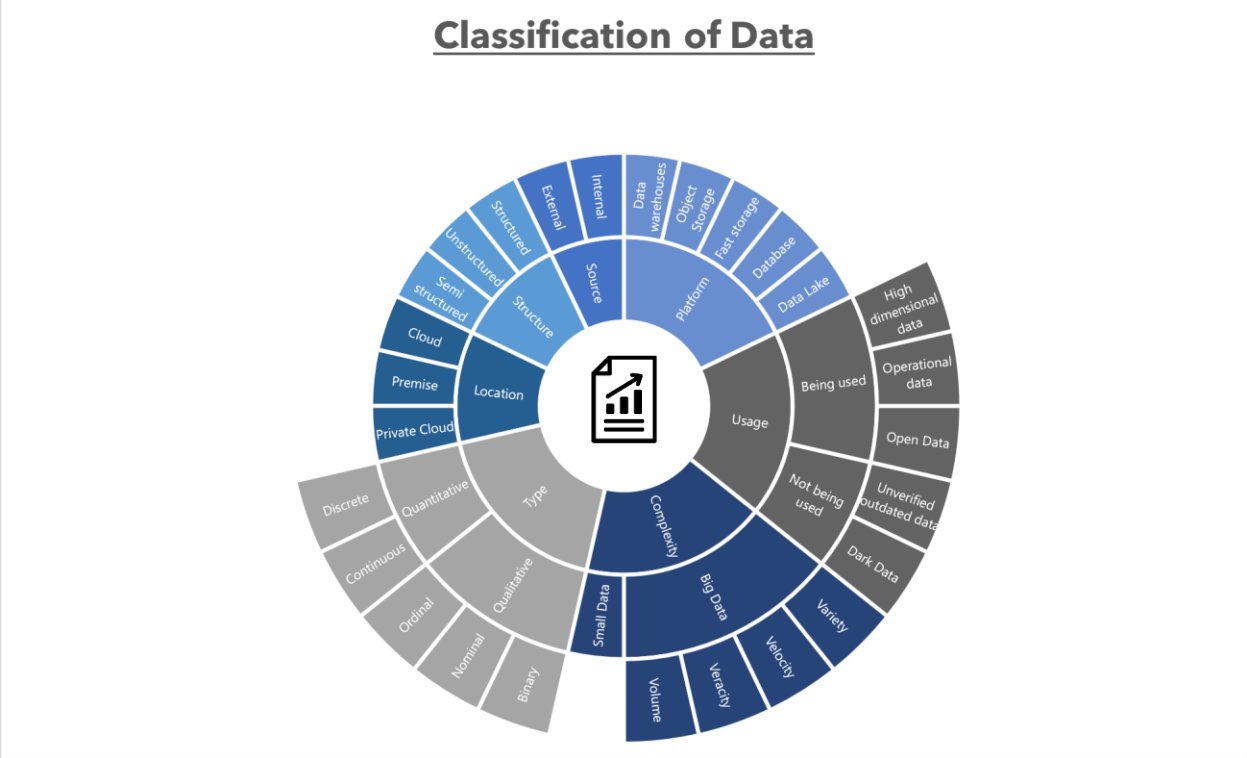


Figure 1: Classification of "Data" [4][5][6]

Analytics

Data analytics is the process of transforming a raw dataset into useful knowledge.[7]

Artificial Intelligence

AI refers to machines that can learn, reason, and act for themselves.[8] AI is most often used to recognize patterns, make predictions, and derive insights out of available data.

Machine learning is a form of artificial intelligence that uses algorithms to enable a system to learn from data rather than through explicit programming.[9] It involves preparing the data,

[3](MGI_big_data_exec_summary, 2020)
[4](Data Types in Statistics, 2020)
[5] (Bridgwater, 2020)
[6] (Editor, 2020)
[7] (Artificial intelligence for data analytics (AIDA), 2020)
[8] (What is AI? We drew you a flowchart to work it out, 2020)
[9] (What is machine learning? , 2020)

training an algorithm on it and generating a model (for example, regression models), and then predicting on a new set of data based on this model.

Deep learning is a subset of machine learning concerned with algorithms inspired by the structure and function of the brain (neurons) called **artificial neural networks**.[10] [11]Neural Networks have the advantage of performing even better when more amount of complex data is available, and hence predict outcomes with a greater accuracy.

Natural Language Processing (NLP) is a branch of artificial intelligence that helps computers understand, interpret and manipulate human language.[12]

The three technologies complement each other. The relationship between them is shown in the chart below.

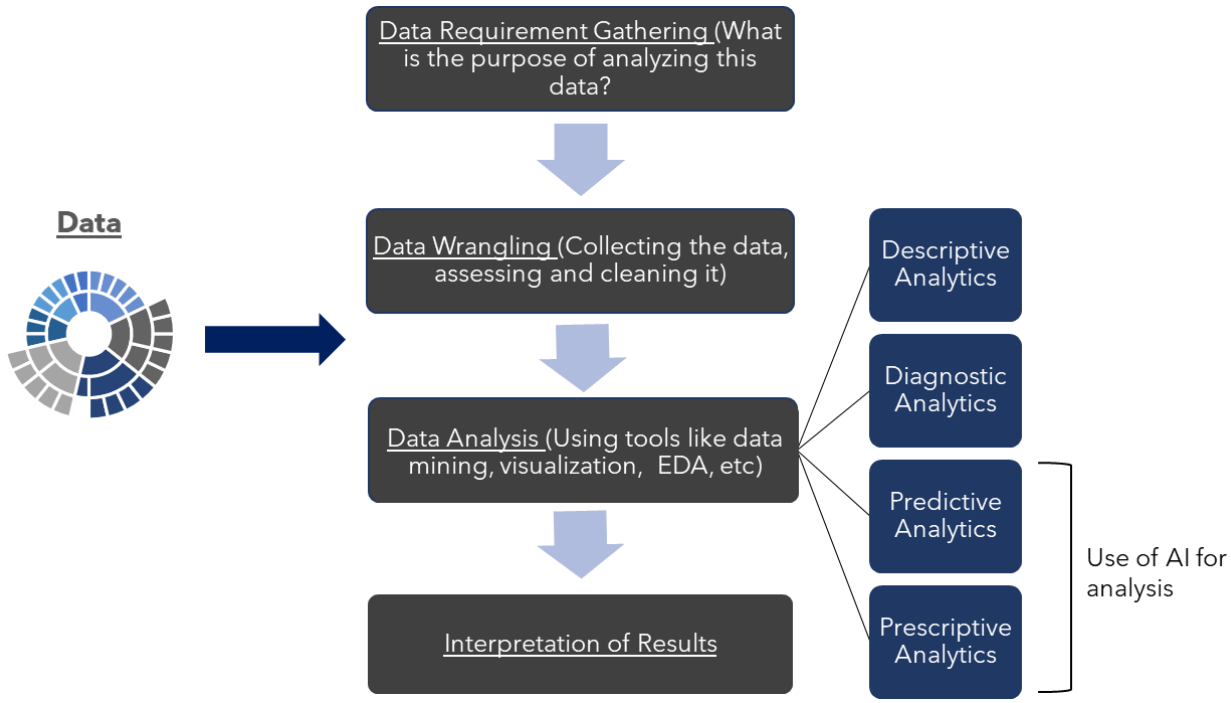


Figure 2: The relationship between Data, Analytics and AI[13] [14] [15]

[10] (Brownlee, 2020)
[11] (Marr, 2020)
[12] (Insights, Processing? and Insights, 2020)
[13] (Smith, 2020)
[14] (The 5 Steps of the Data Analysis Process, 2020)
[15] (Jeevan and Jeevan, 2020)

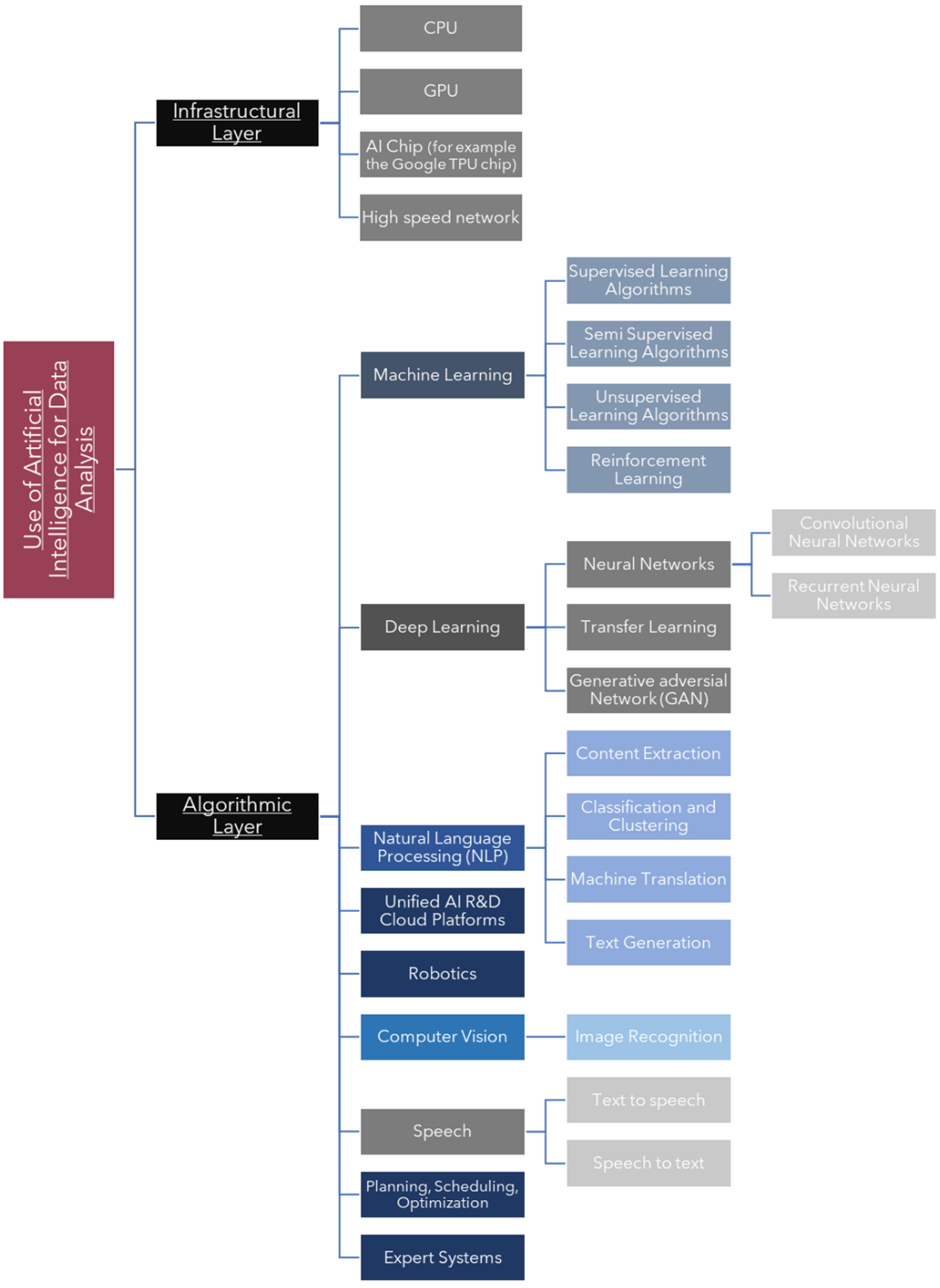
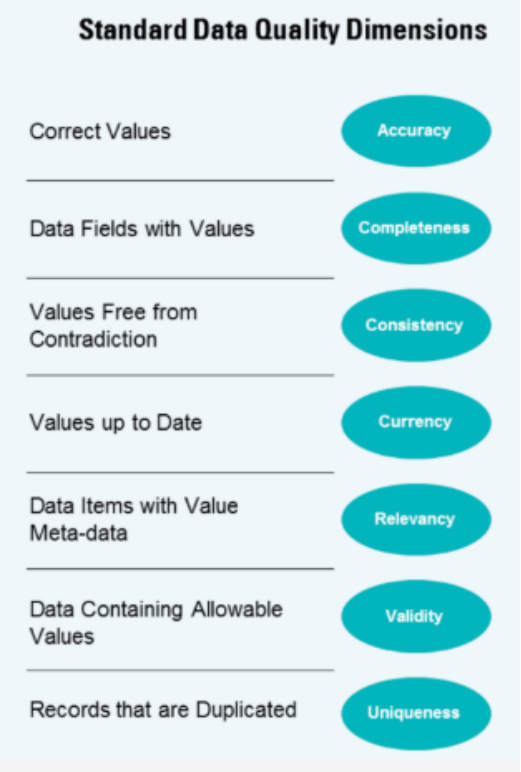


Figure 3: Technology Components of AI [16] [17] [18] [19]

[16](An-executives-guide-to-AI, 2020)
[17] (Yeung, 2020)
[18] (TouchTechLabs, 2020)
[19] (Kainth, 2019)

Key Performance Characteristics

System	Component	Key Performance Characteristics
Data Analytics and Artificial Intelligence	Data	 [20]
	Infrastructural Layer	Calculations per second (FLOPS) Cost
	Algorithmic Layer	Classification Accuracy Logarithmic Loss Confusion Matrix Area under Curve F1 Score Mean Absolute Error Mean Squared Error[21] Ability to transfer learn - Can a model trained on one task be repurposed for a second task?

(Refer Appendix 2 for details)

[20] (KPMG, InsideSherpa,2020)
[21] (Mishra, 2020)

Application Landscape

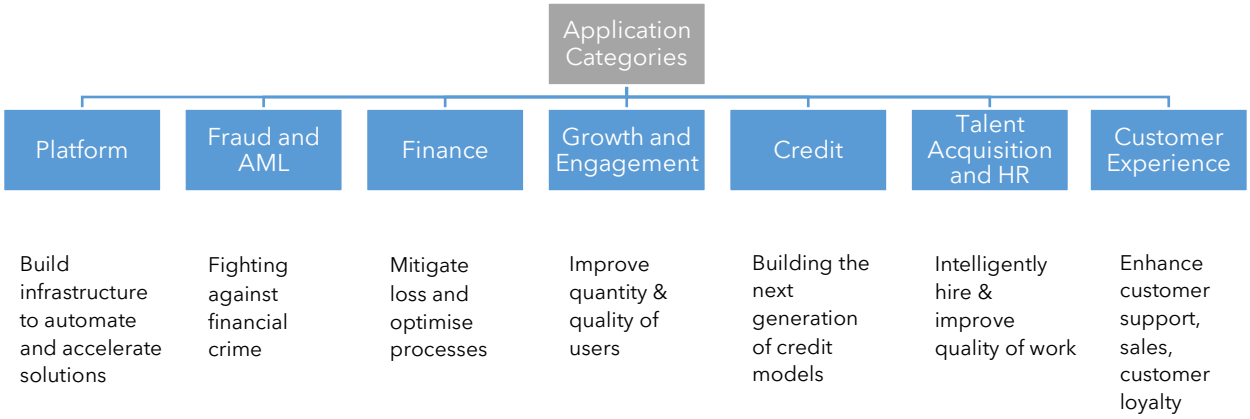
Application Areas for Data, Analytics and AI

After analyzing the primary processes and decisions to be made by Revolut, the following application map has been drawn to understand the application areas for further automation.

For the scope of this study, two burning areas have been shortlisted based on the feedback of the customers, risk associated with Revolut's business and press coverage of the brand that can benefit from the power of data analytics and AI.

1. Optimize Chatbot Functionality

2. Enhance AML and Fraud Detection Capabilities



Application 1: Chatbot Optimization

A chatbot is a program, powered by rules and AI, which simulates a real interaction with users via a chat interface.[22] It helps provide faster, 24x7 customer service and save time and costs.

In 2017, Revolut introduced Rita (**R**evolut's **I**ntelligent **T**roubleshooting **A**ssistant), its chatbot. Rita is powered by artificial intelligence and she can recognize normal human language and will get smarter as she learns from conversations with our customers overtime. At the moment Rita can resolve "common questions" such as "how can I unblock my PIN?" and "what are your current exchange rates?"

The need for optimization

- The current bot answering customers is not very optimized and too many customers are being redirected to manual agents. The customer sends the bot a message saying, "live agent". This further leads to customer support being overloaded with messages and blurs their focus from only tackling complex issues.
- Rita solves 20% [23]of customer queries (from an average of 7500 customer queries per day, as suggested by the pilot[24]) per day. While this may be a good start, Accenture reports that it has seen more than 80% of chat sessions being resolved by a chatbot.[25]
- Moreover, sometimes queries need to be in a rigid format, for example, for finding out exchange rates.[26]
- Revolut needs to accomplish its promise of providing a more personalized experience like Rita helping customers track their finances. It could further aim to provide Investment recommendations based on the savings bank balance and risk profile of a customer.

Proposed Solution: Kore.ai

Problem type	**ML/other analytics**	**Use case**
Customer Service	Deep learning and neural networks, natural language processing	Chatbot with higher efficiency

By using the texts that customers send to manual agents and analyzing the answer of the manual agent with some machine learning models, a better automated system can be developed. Advanced speech, natural language processing techniques, sentiment, and analytics can be used to offer solutions that are correctly customized to the customer and the

[22] (DigitalDoughnut, 2017)
[23] (Hey, I'm RITA |Revolut,2020)
[24] (FintechFutres, 2020)
[25] Accenture

general context of the conversation. Furthermore, it may be worth looking into possible integration with other upcoming technology, like IoT.

Since Revolut already has a dedicated technology team (Appendix 2), they could improve these services in-house or partner with a third party and use their technology instead (For list of technology providers, refer Appendix 3)

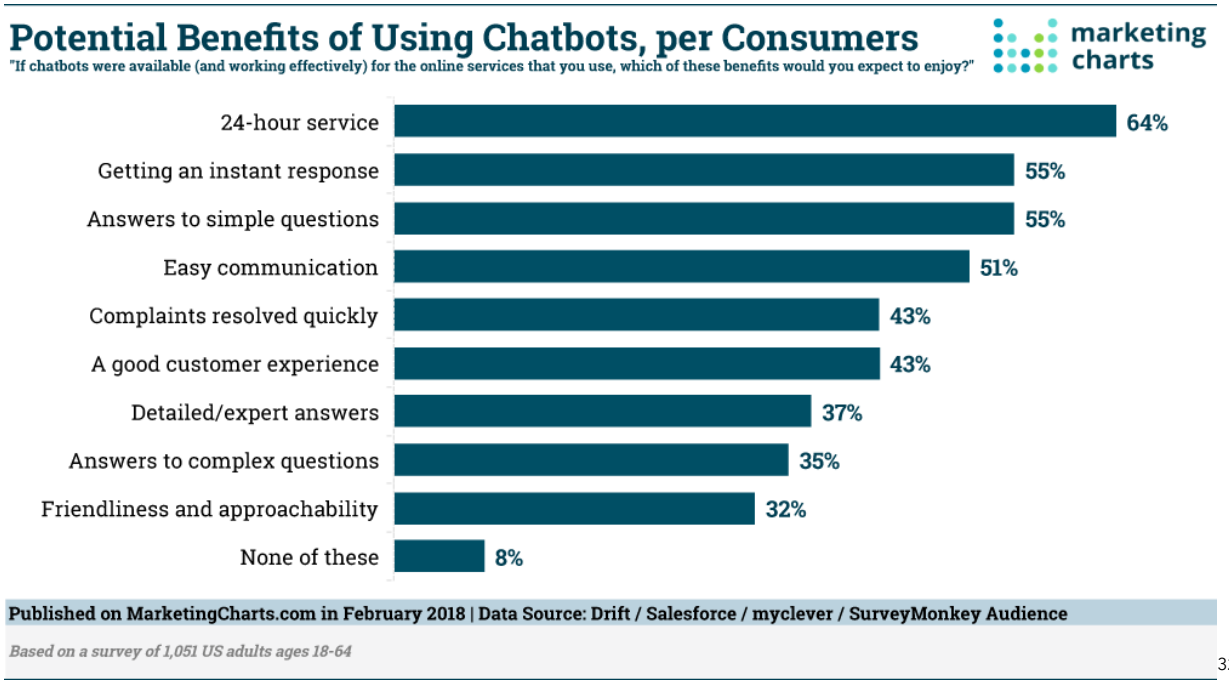
Data Footprint – 4 Vs of Big Data [27]

Vol	The volume of data refers to the size of the data sets that need to be analyzed and processed, which are now frequently larger than terabytes and petabytes. Big Data is increasing tremendously, and experts believed that by 2020, we will be dealing with 35 zettabytes of data[28] Nina, the chatbot deployed by the Bank of Sweden, which averaged 30,000 chats per month.[29]	Variety is guaranteed by the variety of queries and terms used by users. Each client who engages in a conversation with the bot is looking for a different piece of information and asks for it in entirely different ways. [30] The data required may be unstructured, semi-structured, or structured. Moreover, both internal and external data is required (details given below)	Velocity refers to the speed with which data is generated. Velocity is provided by the extreme speed at which queries are processed and categorized by these robot agents. Stored data is used to train the model, but the bot can learn from its experiences through interactions and mistakes. So, data is being generated continuously.	Veracity refers to the quality of the data that is being analyzed. Data should[31] be in line with the Data Quality Metrics as described in the 'Technology' Section. For a full list of quality metrics of chatbot, refer Appendix 3

[27] Big Data Framework©, « The Four V's of Big Data | Big Data Framework© »
[28] (Tedson, 2019)
[29] (Brooke, 2017)
[30] (Marius, 2018)
[31] (Bridged.co, 2020)

Characteristics of a good chatbot

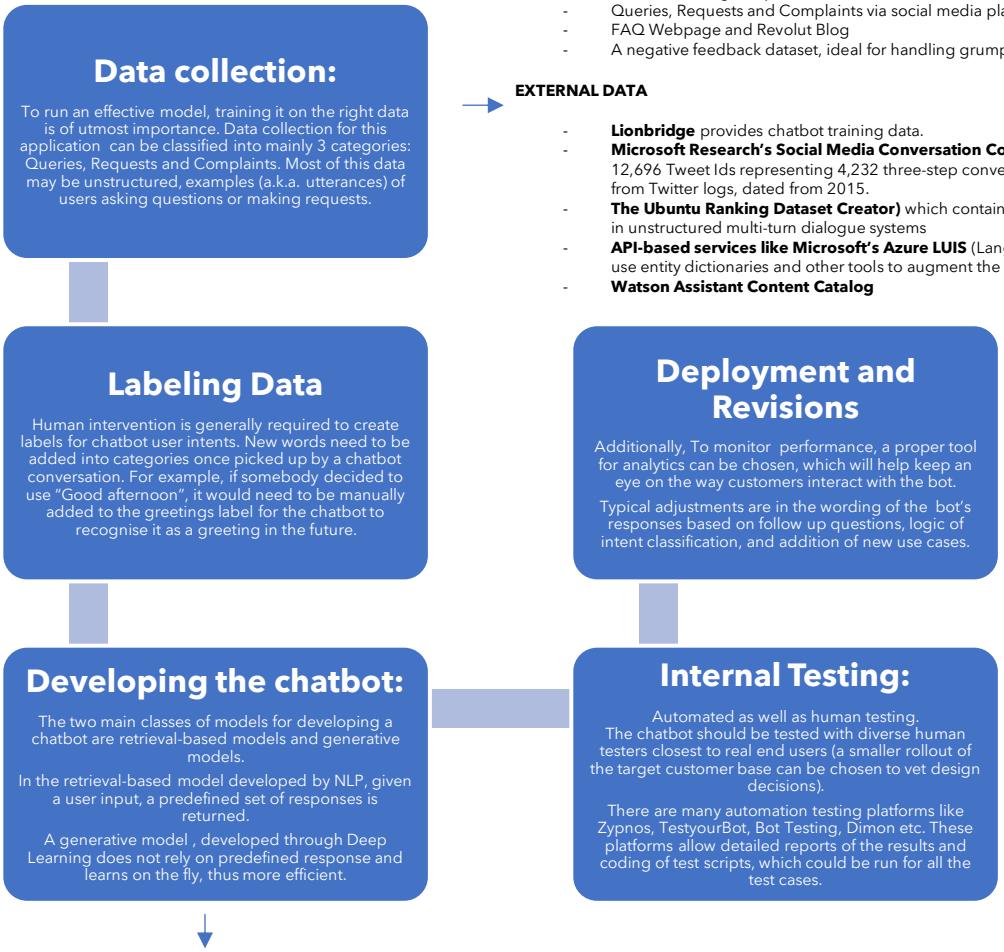
1. Multiple Languages
2. Learn from its mistakes
3. Help cut down on operational costs
4. Keeping up with the trends: Integration with multiple platforms
5. Keeping up with the trends: IVR, UI
6. Complies w privacy and security regulations
7. Initiates conversation
8. Good personality and human touch, humor
9. Try to understand problem by asking the right questions
10. Provide a personalized experience to customers



[32]

[32] (Marketing charts.com, nd)

Process of Implementation, Components of system [33] [34] [35] [36] [37] [38] [39] [40] [41] [42]



INTERNAL DATA

- Texts sent to manual agents, and their responses
- Email or message requests
- Queries, Requests and Complaints via social media platforms like Twitter
- FAQ Webpage and Revolut Blog
- A negative feedback dataset, ideal for handling grumpy customers

EXTERNAL DATA

- **Lionbridge** provides chatbot training data.
- **Microsoft Research's Social Media Conversation Corpus** – A collection of 12,696 Tweet Ids representing 4,232 three-step conversational snippets extracted from Twitter logs, dated from 2015.
- **The Ubuntu Ranking Dataset Creator)** which contains a large dataset for research in unstructured multi-turn dialogue systems
- **API-based services like Microsoft's Azure LUIS** (Language Understanding) which use entity dictionaries and other tools to augment the need for training.
- **Watson Assistant Content Catalog**

Things to keep in mind while developing the chatbot:

1. (Intent Detection) How to figure out what the user says to the bot. i.e relating a query/request/complaint to the plethora of actions Revolut app can perform
2. (Entity Detection) How to extract information required to perform an action on the application.
3. (Entity Validation) How to validate information provided by the user. Ex: Date, Currency, number, items etc
4. (Channel Integration) How to integrate this bot with Facebook or Alexa or Google Assistant etc?
5. How seasonal events may influence the scope and frequency of certain topics. If candidate training examples are harvested from a particular point in time, some topics may be under-represented or over-represented.
6. Do outside factors such as holidays, tax season, open enrollments, year-end processing, etc. impact the kinds of questions users may have?
7. How to handle interruption from the user while performing an action.
8. How to analyze failed conversation with the users?
9. How to authenticate the user?
10. How can it conditionally control the conversation? i.e if the user provides an invalid number of toppings, how to inform him and ask for a different preferred topping?
11. How to make it work for multiple languages?
12. Onboarding process should be easy, potentially with a "Get Started" button
13. How does the bot respond to confusion or spelling errors?

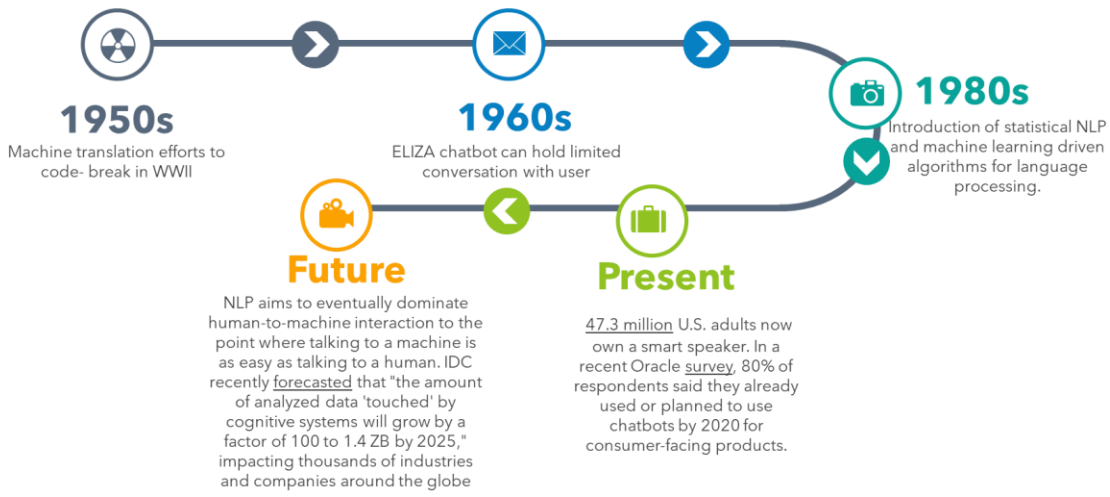
[33] https://developer.kore.ai/docs/bots/nlp/user-utterances/
[34] https://kore.ai/platform/design-and-develop/training/
[35] https://lionbridge.ai/services/chatbot-training-data/
[36] https://aichat.com/2019/06/27/data-is-the-key-to-develop-a-truly-conversational-chatbot/
[37] (Nekkanti, 2020)
[38] (Knight, 2020)
[39] https://www.microsoft.com/en-us/download/details.aspx?id=52375&from=http%3A%2F%2Fresearch.microsoft.com%2Fen-us%2Fdownloads%2F6096d3da-0c3b-42fa-a480-646929aa06f1%2F
[40] (Lazarevich, 2019)
[41] (Burton, 2019)
[42] https://www.aspect.com/globalassets/microsite/nlu-lab/images/10-Steps-to-Chatbot-Creation.pdf

Feasibility and Challenges of AI Implementation [43] [44] [45] [46] [47] [48] [49]

Technological:

If Revolut decides to use third party platforms for its chatbot, the solution will likely be implemented much sooner than if they develop their chatbot independently. Moreover, the technology is proven and successfully used by other prime institutions. Integration with Revolut's own system should be seamless. The chatbot's output can be measured adequately though performance indicators (Appendix 3). Moreover, Kore.ai covers a large variety of languages, and can thus cater to a large proportion of audience.

Natural language processing is not yet entirely accurate, however, pursuant to the below timeframe, NLP is making progress in analyzing unstructured data which could be useful in potentially develop more efficient chatbots.



[50]

Challenges which need to be overcome in this regard are:

[43] https://ppp-certification.com/ppp-certification-guide/7-assessing-technical-feasibility
[44] (Bilyk, 2018)
[45] https://theappsolutions.com/blog/development/challenges-of-chatbots-for-business/
[46] (Alpana, 2017)
[47] (McDougall, 2020)
[48] https://aglowiditsolutions.com/blog/chatbots-in-enterprises-challenges-benefits-applications/
[49] (Ghanchi, 2019)
[50] Based on an article by (Zhang, 2018)

1. **Message Interpretation**: Interpreting the messages and understanding the user intention. Revolut has a wide range of services, some of which may overlap, and the chatbot should understand which services exactly the customers are referring to.
2. **Uncertainty of User Conversation:** The current state of natural language Processing is not that advanced to tackle everything. The synonyms, extraction of entities has been taken care of but what about mixing of local language, the words and slang being added to the vocabulary at high speed. While efforts are being made and the landscape is evolving, it takes large amounts of time and practice.
3. **Lack of Robust testing Strategies:** When the Chatbot is out of the development lab, it needs to be tested prior to the implementation. Chatbot testing requires going through some complexities. As natural language processing (NLP) capability is increasingly getting better, Chatbots are now frequently updated. The testing mechanism should always be used for every update to check the effects of each value addition
4. **Chatbot Security:** Privacy and Security regulations place limits on the kind of questions that can be asked. Moreover, the chatbot should be able to securely transmit and store data and be in compliance with data protection regulations.

Other Parameters:

Individual implementation of elements of chatbots costs approximately $35,000. But third party platforms and incubation projects help build a chatbot at a twice cheaper price and 16 times more accelerating speeds depending upon the solution to be employed. Artificial Intelligence flight in the chatbots has been rapid and to build an AI supported chatbot starts from $40,000 and can go up to $100,000. These kinds of chatbots are built to enable customers with more of a personalized and customized experience along with a complete business-enabled solution.[51] Revolut would need to determine if such a comprehensive solution will be more cost efficient.

Challenges which need to be overcome in this regard are:

1. **Challenging perception:** There is an idea that people would always rather talk to a human than a machine, although in a recent survey by HubSpot, 55% of consumers said they were interested in using a chatbot to interact with a business. However, 47% of adult internet users in the US felt that chatbots had too many unhelpful responses.[52] [53] Such unsatisfying experiences with a chatbot may cause customer to revert to this ideology.
2. **Legal Issues and Risks[54]:**

[51] https://blog.sitm.ac.in/feasibility-and-success-rate-of-chatbots-on-websites-with-reference-to-their-customer-association/
[52]https://www.intellectyx.com/blog/chatbot-statstics-2019/
[53] Statista, 2018
[54] (Dreyfus, 2017)

a. Terms & Conditions: Users should be aware if a certain activity is being carried out by a chatbot. This is especially important if chatbots are being used to facilitate online transactions or provide any type of advice
b. Disclaimers and compliance to regulated activities: The introduction of chatbots in highly regulated industries such as financial, medical or legal services highlights a range of potential issues relating to liability.
c. Infringement of third-party rights: Chatbots are susceptible of infringing copyright protected rights or using third party trademarks. Appropriate safeguards must be put in place to prevent such infringements.
d. Prevention of rogue chatbots: Companies should be cautious about potential detrimental, abusive and incorrect responses that a chatbot may give and bear in mind the effect a chatbot can have on a company's image and profile[55]

Advantages of Deploying a Chatbot [56]

1. Cost savings- According to Chatbots Magazine, implementing virtual agents or chatbots can help businesses to save up to 30%. [57] Juniper Research claimed that the cost savings from using chatbots in the Banking Industry is estimated at $209 M in 2019 and it will reach $7.3 B globally by 2023.[58]
    a. Implementing a full functioning chatbot, is much cheaper and faster than creating a cross platform app or hiring employees for each task.
    b. Because customers can easily access chatbots within seconds and start interaction immediately, user acquisition is also associated with lower cost.
2. Improved Customer Service- Bots can be leveraged to increase customer engagement with timely tips and offers. They help the customer find what he is looking for and evaluate different suggestions. According to a research by Gartner, customer service is the most important factor to success.
    a. Extensive Customer Assistance
    b. Always Available Customer Support
    c. Proactive Customer Interaction [59]
3. Increased Customer Engagement and Loyalty
4. Track purchasing patterns and consumer behaviors by monitoring user data : According to Forbes, chatbots help a company to decide “which products to market differently, which to market more and which to redevelop for relaunch”.
5. Reduces burden on customer support and saves their time so they can focus on complex tasks.
6. Providing recommendations and stimulating sales: Chatbots can recommend products to customers, who are always searching. So, it’s no surprise that 37% of all consumers—and 48% of millennials—are open to receiving recommendations or

[55] https://spectrum.ieee.org/tech-talk/artificial-intelligence/machine-learning/in-2016-microsofts-racist-chatbot-revealed-the-dangers-of-online-conversation
[56] (Digital Doughtnut, n.d)
[57] (Techlabs, 2018)
[58] (Juniper Research, n.d)
[59] (Spixiii, n.d)

advice from chatbots. They also sell, developing to such a degree that they can now hold payment options. More than 1 in 3 Americans would be willing to buy through a chatbot, making them an influential buying channel. For example, Sephora has implemented a chatbot in partnership with Kik messaging application. Customers get in touch with Sephora through their chatbot and ask for recommendations for makeup or request product reviews based on their needs. The chatbot recommends selected products and sends them videos.[60]

Impact

Traditional banks spend on an average GBP 150 per customer per year to maintain each customer account, but by using chatbot technology, it may be possible to reduce it to as low as GBP 15 per account.[61] To meet the needs of millennial customers, Revolut needs to up the ante on convenience, trust, and personalization, applying the latest technology to attract and retain this growing customer segment. Potentially Revolut can save between 25 to 40% cost on customer support services and free up the bandwidth of human support to render further value add services to its customers. Using technology to pre-empt questions, Monzo reduced the number of customers that needed to get in touch with its contact centre by 33 per cent in three months.[62] [63]

If Revolut were to develop their own chatbot, they would need a team of 12 people team comprising a project manager, a business analyst, 2 technical architects, 5 software developers and 3 software testing resources

The development phase takes typically 6 months and costs around 200K GBP depending on the cost of staff and maintenance costs.

You can save most of these expenses by using an external chatbot, such as Kore.ai. This would cost 60K GBP and some additional cost of custom code.

[60] (Acquire.io, n.d.)
[61](FinanceDerviative, n.d.)
[62] (Fintech Futures, 2018)
[63](CNBC, 2020)

Application 2: Anti Money Laundering (Compliance)

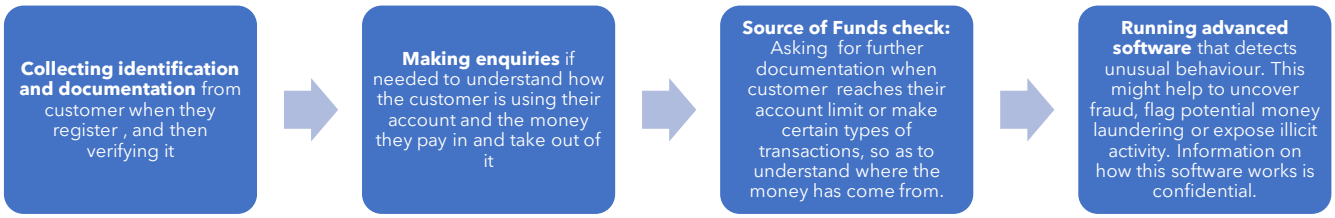
What is Anti Money Laundering?

The practice of making illicit funds seem legitimate by disguising the ultimate disposition of the funds or eliminating audit trails is known as money laundering and preventing criminals from laundering money is known as Anti-Money Laundering or AML. Ultimately, laundered money flows into global financial systems where it could undermine national economies and currencies (Refer Appendix 4 for detailed process). The estimated amount of money laundered globally in one year is 2 - 5% of global GDP, or $800 billion - $2 trillion.[64] Money laundering erodes the integrity of a nation's financial system by reducing tax revenues through underground economies, restricting fair competition with legitimate businesses, and disrupting economic development.

Lately, three factors have heightened the risk banks face when combating financial crime. The growth in volume of cross-border transactions and greater integration of the world's economies have made banks inherently more vulnerable. Moreover, regulators are continually revising rules as their focus expands from organized crime to terrorism. Finally, governments have expanded their use of economic sanctions, targeting individual countries and even specific entities as part of their foreign policies.[65]

Money laundering is not only a law enforcement problem but poses a serious national and international security threat as well. It goes hand-in-hand with illicit activities like tax evasion, drug dealing, human trafficking, and terrorist financing (Appendix 4). So, there is an important social and ethical reason for stopping money laundering, not just regulations or fear of losing business.

Revolut's current AML system[66] (Appendix 4)



The need for better automation

1. The **source of funds process can be better automated**. SOF represents the check when someone tops up a large amount into his/her account and a manual agent needs to check whether the money is legitimate. This could be better automated by looking at what we look for in a "legitimate" document, which could be done using computer vision (Appendix 2) to check if the document is legitimate or not and textual data to see if the source makes sense or not.

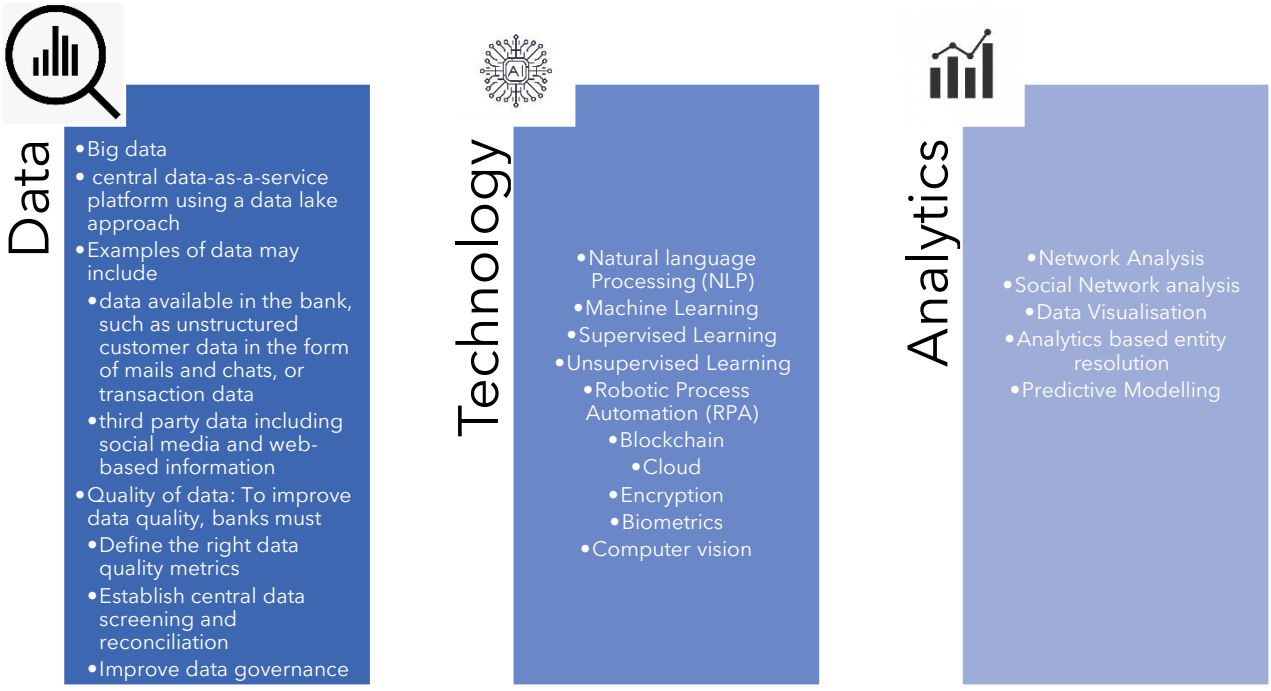
[64] (UNODC, n.d.)
[65] (McKinsey and Company, n.d.)
[66] (What is money Laundering?|Revolut)

2. **Bad press** surrounding Revolut's compliance.
3. Analytical approaches for customer risk scoring and transaction monitoring suffer from **high rates of false positives**, resulting in significant resources focused on investigating low-risk accounts and transactions. Adding new calibration tools and thresholds often leads to another spike in the number of false alerts.
4. Poor-quality data, nonstandard data structures, and fragmented sources make **data aggregation** by legal entities, subsidiaries, and vendors difficult. For example, many banks are still making tens of thousands of costly customers calls every month to refresh KYC documents, updating information that is incorrect or missing in their databases.
5. **Inconsistent standards in processes** such as customer identification, enhanced due diligence, and account monitoring and screening mean that businesses do not agree on what constitutes risk and violation of compliance requirements.
6. Similarly, **inconsistency in the reporting of suspicious activities** and currency transactions means banks sometimes produce too many reports, and sometimes too few, exposing them to the twin dangers of regulatory sanctions and excessive cost.
7. **Fragmented systems and platforms** limit the ability to automate transaction monitoring and due diligence. Instead, compliance teams spend the bulk of their time collecting data, and then on "stare and compare" sessions, instead of investigative work.
8. Reliable **quantitative metrics** to assess risk across products, geographies, and processes are often not available.
9. Ever-faster **launches of new products and services**, as well as instant fund transfers and mobile payments, add complexity to real-time detection and prevention. For example, "intelligent" ATMs allowing customers to anonymously deposit and transfer cash even when banks are closed certainly offer convenience but lack adequate KYC and AML safeguards.
10. **New Criminal Topologies:** Financial institutions are struggling with legacy systems even as fraudsters take advantage of new technology to hide their crimes. Crime topologies are changing as are the channels through which crime is being committed, e.g. automated teller machine (ATM), mobile platforms and crypto-currency. These trends need to be understood and channels secured to mitigate potential risk to business.
11. **Evolving Financial Landscape:** The combination of new threats, high transaction volumes and increased regulation places a premium on a financial institution's ability to streamline operations and maintain appropriate levels of control.

Proposed Solution- NICE Actimize for AML (Used by Deutsche Bank and Barclays)

Technology in AML

A report by Accenture[67] identifies the following technology components as instrumental to the prevention, detection, and management of financial crime (Appendix 3):



Use cases in AML

The role of Data, analytics and AI in AML can be broadly classified into 3 categories: Transaction Monitoring, Know Your Customer (KYC), and Sanctions Screening.

Transaction Monitoring

Use of machine learning models can enrich transaction monitoring alerts and boost Suspicious Activity Report (SAR) conversion rates – predicting AML scenarios before they occur.

Enrichment adds potentially significant details about the customers, accounts or beneficiaries associated with the alert such as existing scoring processes that assess the risk of a transaction, series of transactions, customers or accounts and external information such as law enforcement inquiries, subpoenas or negative news

Know your Customer (KYC)

Mandatory process of identifying and verifying the identity of the client when opening an account and periodically over time.

By augmenting human activity with machine learning techniques, it is possible to achieve a more holistic view of the customer, enhance the data used to conduct due diligence, and provide a more contextual basis for determining customer risk and detecting suspicious activity.

Analytics can also enable customer segmentation and profiling for various business purposes, including compliance and marketing.

Sanctions Screening

Tuning the matching and filtering performance of the screening engine requires the data to be complete and of high quality, completeness, and accuracy, ultimately resulting in a boost in true positives detection rates and operational efficiency.

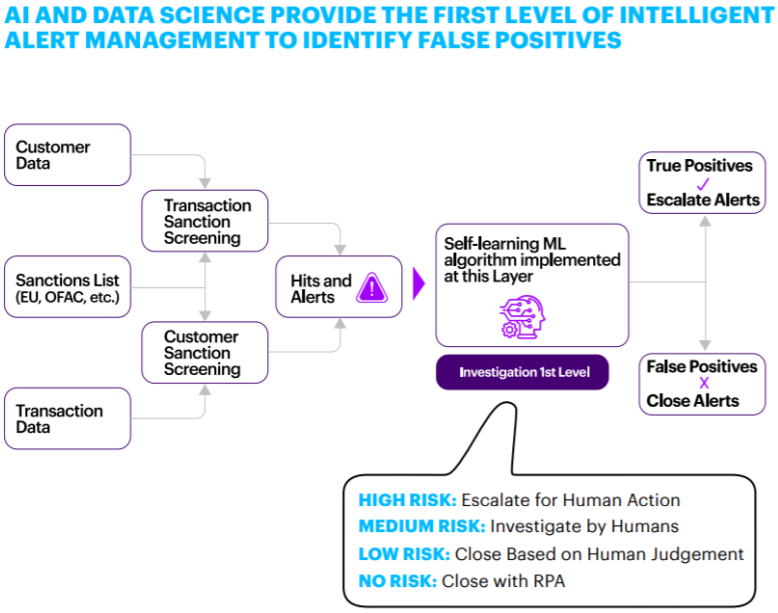
Machine learning techniques can be coupled with predictive calculations based on historical investigator decisions to substantially lower the number of alerts to be safely dispositioned, so investigators can focus on those with the greatest likelihood of being true positives.

6869

[67] (Financial crime data science to the rescue|Accenture, 2017)
[68] (How data analytics is leading the fight against financial crime| EY, 2019)
[69] (Emerj, n.d)

How are false positives reduced?

AI analyses alerts by name and location matching strength, rarity of the name in customer population, historical match rate, and true match and false positive rate analysis. RPA sources additional data for analysis, working together with the AI engine. Clear false positives are closed using rules-based classification. AI categorizes alerts and RPA routes cases to human operators.



Key considerations when selecting AML software include:

1. Can the system monitoring incorporate the customer's risk assessment and customer profile (e.g. Customer identification information and KYC, etc.)?
2. Can the system monitoring take account of the customer's historic transactions?
3. Can the system link related accounts?
4. Are the criteria for generating flags flexible enough to enable customization to the institution and its customer base?
5. Is the software compatible with the institution's existing hardware or will additional hardware need to be purchased?
6. Is the software user-friendly (e.g., does it have a graphic user interface or GUI, etc.)?
7. Does the system include a case management feature for tracking and documenting investigations?
8. Does the system include a reporting/trending capability of suspicious activity based on investigations?
9. Does the software have the ability to assist the financial institution with identifying when a currency transaction report (CTR) filing may be necessary?
10. Does the system include a reporting/trending capability of historical CTR filings on a customer level?

Recognizing Money Laundering Activities[70] [71]

NLP software converts data into text and can replace most of the work that investigators are traditionally putting into writing the reports that support their decisions on a case when it's filed. Integrated with the case-management workflows, it can generate the SARs as soon as the investigator pushes the "generate report" button

An **RPA** process is used to collect and populate cases in the ECMS with KYC , Transaction, Account, Look back and historical data.

Natural language generation (NLG) engine populates narrative for suspicious activity report

Robotics is used to score alerts on a risk-based basis. Rule acquittal logic parks low scoring alerts.

[70] Consulted practice leaders of consulting organizations (reference may be provided on request)
[71] (Financial crime data science to the rescue| Accenture, 2017)

Data Footprint [72] [73]

Volume	Variety	Velocity	Veracity
- The exact amount of data needed is not known. - Effective behavior detection requires analysis of large amounts of internal transaction and customer data, including recent as well as historical data. - Risk assessment of individuals and entities increasingly depends on access to and analysis of external data sources, such as adverse media, increasing the data volume requirements.	- Modern AML processes increasingly rely on unstructured data. Unstructured data analysis and NLG enable the automated compiling of entity profiles based on these data, replacing arduous manual processes. - Range of sources including adverse media, public databases, corporate directories, and commercially available datasets such as PEP profiles. - Data available in the bank, such as unstructured customer data in the form of mails and chats, or transaction data - Third party data including social media and web-based information	- Rapid detection of suspicious behavior not only increases the overall efficiency of AML processes, it can also help stop money laundering schemes such as fraudulent "mule" transfers in their tracks. - Seamless KYC processes result in less friction in onboarding and an improved customer experience.	Data should be in line with the Data Quality Metrics as described in the 'Technology' Section, for example completeness, richness, consistency, etc. For details, refer Appendix 4

[72] (CloudTweaks, 2015)
[73] (aba, n.d.)

Feasibility and Challenges of AI Implementation[74] [75]

1. Data Quality Management and Profile Refresh: Both static files, for example KYC files, and dynamic data held by FIs on their customers' transactions have seen low completeness ratios in areas such as missing payment information and high error rates in recent years. Additionally, there is also a general lack of data traceability and data lineage.
2. The nature of the data gathering and analysis as well as the level of oversight required make automation difficult.
3. Machine Learning can seem like a "black box," with its inner workings unclear to regulators and compliance officers.
4. Lack of 360-degree view of Customer: Financial services firms do not have the global freedom to share information about their customers to build a comprehensive network. a 360-degree view would require collaboration across FIs and information agencies that does not exist today. However, Regulators are increasingly leaning toward data sharing between banks.
5. Limited Regulatory Appetite: The consequences of AML / KYC violations are increasingly severe regulatory fines and reputational damage is a real threat, therefore trust in any system is a big factor. Also, In the regulators' view, the models should be designed in a way that allows for results to be reproduced given the same input data. This is not always possible with ML algorithms.
6. Lack of Straightforward processes: Without knowing what to look for, teaching systems to detect certain types of financial crime can be tricky.

To ensure accountability, it is advisable to implement a set of metrics and practices to measure effectiveness of the KYC/AML processes and assess impact from operational and system improvements. Potential metrics could include the following:[76]

a. Establish the expected volume and quantity of alerts. For example, set targets in 90-day intervals to reduce false alerts as new controls are launched.

b. Set rate of conversion of alerts to cases: for example, aim to reduce the SAR conversion rate by 1 or 2 percent every 90 days.

c. Reduce time per case: for example, set a target to reduce the investigation time by case type.

d. Set targets to reduce false positives and negatives, rather than focusing on the number of SARs filed or overall transaction volumes.

[74] (Accenture,2020)
[75] (Risk Vs Reward - Automation with KYC and AML | Linedata, 2020)
[76] (McKinsey, 2020)

Impact

From an operational perspective, combining functions such as fraud and AML into a single tool creates substantial efficiencies by reducing request-based overhead and greatly expediting processes Functionality within the technology directs the alerts to the right investigator based on the type of risk. Such a platform can also create efficiencies beyond transaction monitoring alerts and SAR filings.

The single customer view that often accompanies the implementation of centralized case management can greatly reduce the time investigators spend in manually accessing disparate systems or in requesting data from other divisions. That reduction not only results in operational efficiencies but also increases investigational effectiveness.

In aggregate, proper implementation of enterprise risk case management technology provides substantial tangible business benefit in four key categories as follows.

IMPACT	INDICATIVE BENEFITS
Operational Efficiency	• Consistent, streamlined processes and automation reduce time spent on manual processes, reduce the number of false positive alerts, and increase teams' productivity. • Consolidation of financial crime investigation reduces overhead costs. • Integration of resources into less expensive labor markets reduces labor costs.
Information Technology Efficiency	• Consolidation of multiple hardware platforms reduces ongoing expenses of technology procurement and maintenance. • A single centralized tool reduces the cost and speeds the process of adapting systems in response to regulatory changes, internal process changes, and emerging threats.
Investigative effectiveness	• Increased effectiveness in identification and investigation of suspicious activity results in lower costs associated with financial crime loss (lack of deterrence, unidentified fraud, inefficient fraud-event response).
Regulatory risk reduction	• Effectively enabling groups responsible for organizational compliance and risk case management reduces the risk of fines, consent orders, and reputational damage

Using NICE Actimize, Capital One spearheaded an effort to adopt a more intelligent concept, one that would allow it to integrate fraud and AML investigation activity into a single platform. As a result, Capital One was able to:

- Cut its AML and fraud staff by 20 percent;
- Develop a system that allows all SARs to be filed through a single source;
- Maintain an infrastructure that allows Capital One's various fraud departments to retain certain levels of autonomy.

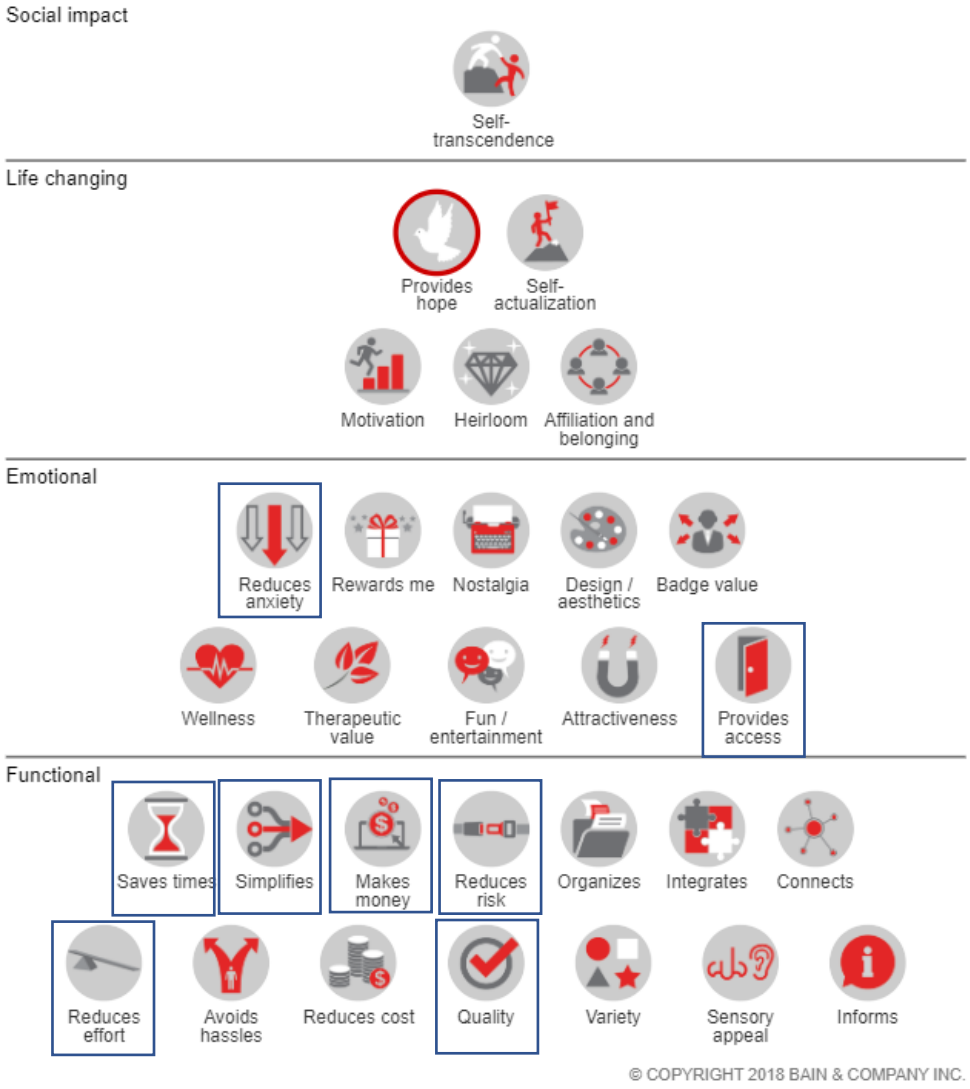
If Revolut were to develop their own AML solution based on Actimize platform , they would need a team of 9 people team comprising a project manager, a compliance business analyst, a technical lead, 4 system integrators and software developers and 2 testing resources

The implementation takes typically 4 to 6 months and costs around 150K GBP and an additional of ~300K GBP for a SaaS based Actimize instance and professional services

Impact

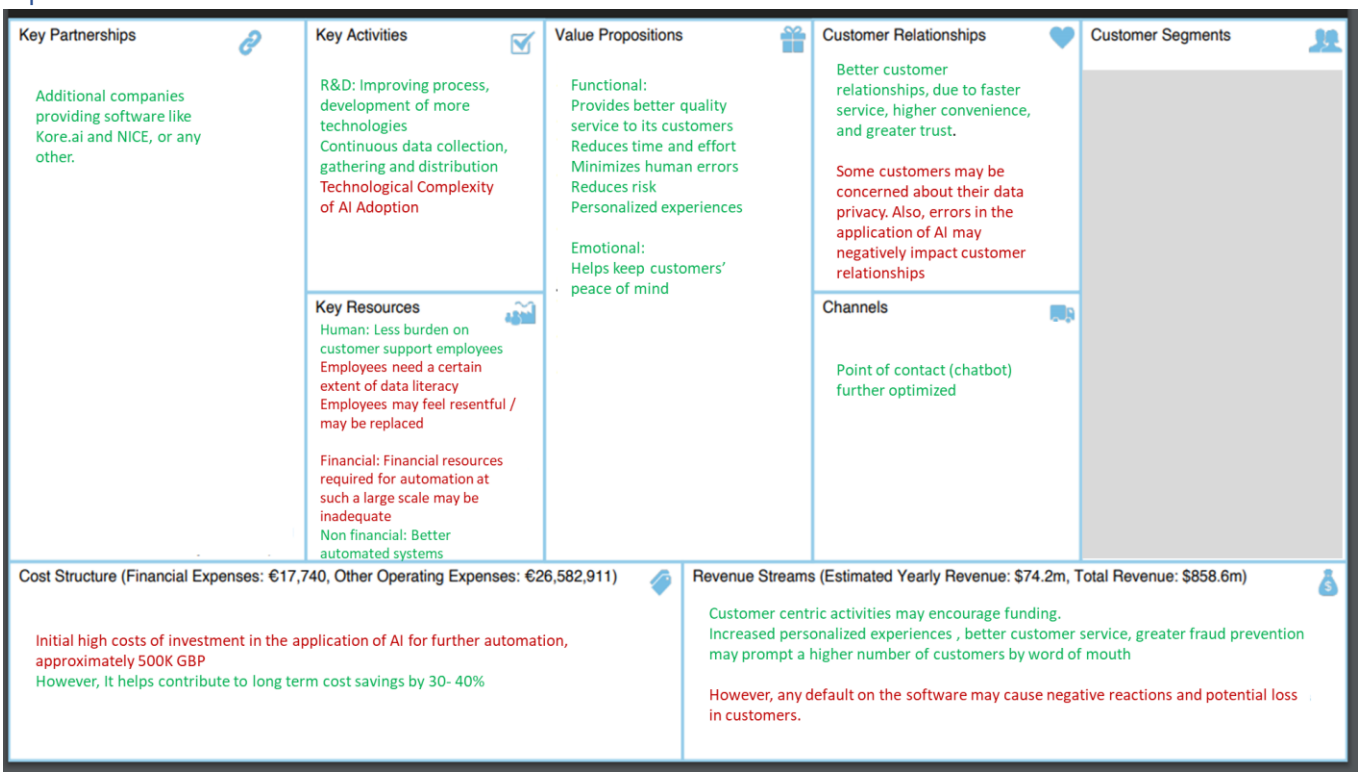
Elements of Value

The proposed solution offers the following value to customers and helps us analyze the impact of the proposed solutions on Revolut. [77]



[77] https://media.bain.com/elements-of-value/#

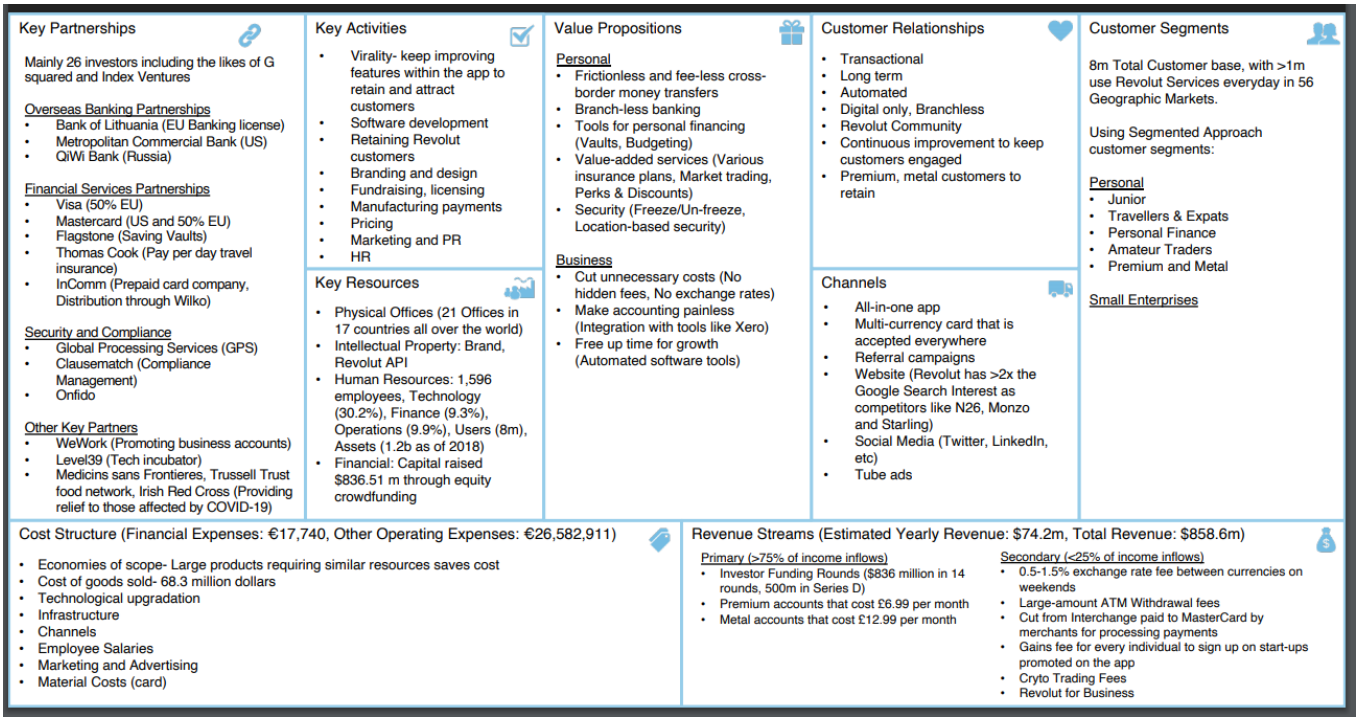
Updated Business Model Canvas



Appendix

Appendix 1- Understanding the Organization

Business Model Canvas



Customer Segments

This section refers to the people the company is creating value for. Revolut has a total of 10 million customers in a total of 56 markets globally, and more than 1 million customers use its services every day. The customers of its Personal Account include Travelers & Expats, personal finance enthusiasts, amateur traders, and now, under 18-year old's. In the US, Revolut is targeting migrants who struggle to access credit and US Overseas students. Revolut also attracts SMEs and businesses with its business account offerings.

Value Propositions

Revolut's value propositions are diverse. Functionally, these include Frictionless and fee-less cross-border money transfers, Branch-less banking, Tools for personal financing like vaults and budgeting, Value-added services , for example, Various insurance plans, Market trading, Perks & Discounts, Security features like freezing and unfreezing of cards, Location-based security, and Physical and Virtual cards, including disposable virtual cards – all through an easy to use app. In addition, for businesses, Revolut allows you to cut unnecessary costs through no hidden fees or exchange rates, make accounting painless with the help of integration with tools like Xero and free up time for growth by providing automated software tools.

Emotionally, it offers consumers convenience, builds trust, and allows them to feel secure with features like one- time virtual cards. It also helps appeal to customers by being digital, and thus, highly sustainable and environment friendly.

Distribution Channels

The touch points between the firm and its customers through which it delivers its offerings comprise an all-in-one app, multi-currency card that is accepted everywhere, referral campaigns, website (Revolut has >2x the web searches compared to competitors like Monzo, Starling and N26), Social Media (Twitter, LinkedIn, etic) and Tube ads.

Customer Relationships

This section outlines the type of relationships that are established with the customers. Revolut maintains a long term, Transactional, and automated (Digital only, no branches) relationship with its customers. It also keeps them engaged and invites discussions and suggestions through the Revolut Community and Blog. The firm constantly strives for improvement to keep its customers engaged and retain them.

Revenue streams

How and through which pricing models is the company capturing value? Revolut has an Estimated Yearly Revenue of 74.2M (USD) and is valued at USD 5.5B (Source: Quid) Its primary sources of revenue are Premium accounts that cost £6.99 per month and Metal accounts that cost £12.99 per month. Other sources of income include 0.5-1.5% exchange rate fee between currencies on weekends, Large-amount ATM Withdrawal fees, Cut from Interchange paid to MasterCard by merchants for processing payments, fee for every individual to sign up on startups promoted on the app, Crypto trading fees and Revolut for business.

Key Resources

The resources which are essential to the business model and help in creating, delivering and capturing value include its 1600 employees, the most populous sectors being Technology (30.2%), Finance (9.3%) and Operations (9.9%) and its users (10m). Another vital resource is its Intellectual Property, comprising the brand, API, etc. Revolut holds 1.2 billion dollars' worth of assets (as of 2018) and has 21 Offices in 17 countries all over the world. Financial resources include capital raised $836.51 m through equity crowdfunding. Software and technology make up a huge part of its resources as well.

Key Activities

Generating Virality- improving features within the app to retain and attract customers, Software development, Branding and design, Fundraising, licensing, Manufacturing payments, Pricing, Marketing and PR and HR (recruitment) are some of the key activities carried out.

Key Partnerships

To leverage this business model, Revolut has joined hands with several partner companies. The names of these providers, business functions and services provided are detailed in the canvas.

Cost Structure

Revolut's model benefits from economies of scope as large products requiring similar resources saves cost. Total expenses for the year 2018 were 32m EUR. [78]Expenses may include technological upgradation, infrastructure, channels, employee salaries, marketing and advertising, and material costs (for example physical card).

PESTLE Analysis

Political	Economic	Sociological
Brexit- Political instability can cause problems such as investors not wanting to commit to companies, negative impact on credit constraints and capital accumulation (Herrela and Ariss, 2013). However, Revolut seems to have accounted for this fact and is prepared to face this situation. Challengers have also been hit by "**ringfencing"**, [79]another set of rules introduced in response to the last financial crisis to insulate retail banks from the risks of investment banking. At the time of elections, if a different party wins, this could mean **new regulations** or legislation could be implemented.	**Fraud** can be a major issue for Revolut, with studies suggesting that fraud contributes to economic losses, with the global cost of economic fraud, when taken as a proportion of global GDP for 2017, being equal to £3.24 trillion (Crowe, 2019). Thus, Revolut should prioritize this issue. While Revolut seems to have prepared itself for the consequences of **Brexit,** research suggests: - The impact of a no-deal Brexit on the UK economy would be less severe than first thought and estimating that GDP would drop by 5.5%. (Governor of the bank of England) - UK Economy may be plunged into	**Negative Publicity**– Revolut is under a lot of pressure from media due to accusations regarding its anti- money laundering algorithms that additionally trigger the automated suspension of accounts, high turnover, and workplace culture. **Changing customer preferences**: Changing consumer expectations are fueling the increase of digital banks in the UK, which could be a great opportunity for Monzo and Revolut . According to EY's "Global FinTech Adoption Index 2019," financial technology services adoption among internet users has nearly doubled during the past two years, and the adoption rate is growing. Its March 2019 data shows that 64% of digitally active consumers

[78] Amadeus

Accusations of ties to the Kremlin- political ties Lithuania vs Russia. However, these have been contradicted by CEO political pressure in a second European country, after a member of Luxembourg's parliament raised concerns about its bid for a bank license.	recession (Tolhurst,2019) - Increased unemployment rate, at about 7% - Inflation could also double to more than 5.5% (Partington and Weardon, 2019). How does this affect Revolut? How income flows, whether the economy is prospering or barely surviving during times of recession, affects how much capital banks can access. [80]Challenger banks are more exposed to risks and will be more vulnerable in any potential Brexit-caused economic downturn than others, a credit rating agency has warned. This is further worsened by the ongoing COVID-19 **pandemic**.	across 27 markets used fintech. A study commissioned by Mastercard found that : Convenience seems to be the biggest advantage of digital banking solutions Europeans demand security more than ever as their most important criteria for using digital banking solutions. Thus, Revolut should place emphasis on reassuring consumers about the **convenience and security** strategies they have in place, to further inform and persuade consumers about the benefits of digital alternatives.
<u>Technological</u> A study found that consumers are still somewhat nervous about adopting new technologies, with two in three never using voice recognition or fingerprint access to log into their banking app (Greaves, 2019). This suggests that Revolut should wait until consumers are fully confident with the digital-only approach, before pushing other new	<u>Legal</u> Regulations differ from Country to country. in the United States, Fintech companies must comply with both federal laws and a patchwork of state laws. Although certain federal agencies and state regulators have voiced support for promoting Fintech innovation by simplifying the applicable regulatory regime, in the near term, Fintech	<u>Environmental</u> **Sustainability** has become a matter of great significance The purpose is to clean the environment, and more efficient use of energy. Fintechs like Revolut have the digital- only advantage, and lead to more sustainable practices, and are hence more attractive to customers. The Global **Pandemic** may pose hindrances.

technologies in their marketing, such as voice recognition and build trust through other means as well.

With the advent of new technology every day, Revolut is already making use of this very well. However, it is important to keep up with the times and leverage new solutions for further improvement, for example, optimizing chatbots. It can partner with some technology companies which specialize in certain specific areas for this purpose.

companies should expect to engage specialized legal counsel experienced in navigating the morass of laws, regulations, and court decisions that could apply. Many countries (such as Singapore, Australia, and the UK) have "Regulatory Sandboxes" that can assist and guide Fintech companies.

Licensing: Revolut needs a license from established banks in the countries where it operates.

Consumer privacy, data security, and financial services-related laws or regulatory schemes relevant to Revolut include Federal Trade Commission, Consumer Financial Protection Bureau, European Union GDPR rules, Anti-Money Laundering laws, International Laws among other others. Details of these laws and some other regulations which may apply can be found at https://www.forbes.com/-sites/allbusiness/2019/10/12/fintech-startup-companies-key-challenges/#4c50aeb83e45

SWOT And Competitor Analysis

INTERNAL FACTORS				
STRENGTHS (+)	**OUR COMPANY - REVOLUT**	**COMPETITOR -A- MONZO**	**COMPETITOR -B- N26**	**COMPETITOR -C- STARLING BANK**
SUPERIOR QUALITIES	**Extra benefits** : overseas medical, baggage and delayed flight insurance, LoungeKey Pass, which offers access to airport lounges. **High Return On Investment (ROI**), with investors seeing a 1900% return on the original stake in just two years.	F**airly unique energy switching system** (able to save consumers money by switching to cheapest deal available for them if they use the account to pay for their gas and electric bill) Monzo was ranked as one of the **best ethical current accounts** (Jones, 2018) Monzo is a digital bank, particularly strong in its unique **customer support service** which is available twenty-four hours a day, seven days a week. . it was crowned during the 2019 British Bank Awards as the bank with the "Best Banking App".	N26 claims it is not competing with other challenger banks and and the traditional bank has a glaring weak spot. By doing so, it has detached itself as a threat to its more abundant competitors in the United Kingdom.N26 has positioned itself in such a way that it accorded itself breathing room to grow. This reflects effective analytical and marketing skills.	A large number of accolades to its name for example Best British Bank
BEST REVENUE SOURCES	**Premium and Metal** Accounts with attractive perks	Overdrafts and current accounts	The N26 bank's standout strength is its enormous backing as a startup where Its funding value stands at around $2.7 billion. World-renowned names behind that backing include Allianz X and Tencent Holdings	Support for Flux means businesses can start to collect some receipts and get cashback, too. That's via the Marketplace, which lets third-party providers integrate with Starling, meaning businesses can take advantage of the latest fintech ideas.
CORE COMPETENCIES	Best choice for frequent **travellers:** best ability to transfer, Sending money and exchange foreign currencies, cryptocurrencies Revolut's monthly subscription plans have relatively higher **threshol**ds for no fees	**Ease of use of app** and options such as instant spending notifications and a clear and intelligent budgeting system for consumers to use (Fotis, 2019) Security options to help reassure consumers, such as freezing of card option (Janes, 2019). **FSCS deposit** protection for further protection	No surcharge to use their card when overseas, and has no cap on the amount of cash that can be withdrawn from an ATM Has integrated **Transferwise** into the app, so you can send money overseas using that more straightforward fintech, which also boasts low fees. Purchase protection insurance	Starling is the bank to turn to for small businesses or sole traders, with accounting software integration for Starling and Free Agent, no fees for transfers or withdrawals (though there's a daily limit of £300 from ATMs), and a fee-free overdraft, though there are interest charges.
OVERALL ADVANTAGES	Larger **global market** of users, compared to key competitor Monzo (Whitwell, 2018). Larger potential target market and operate in more countries than Monzo does, too. Guaranteed financial protection for Brexit	Monzo's app is **compatible** with a variety of different products, including iPads, smartphones and Apple watches	MasterCard 3D Secure, In app customer service, instand spending notification, easy block/unblock card	Multi currency account, free account opening
WEAKNESSES (-)	**OUR COMPANY**	**COMPETITOR -A-**	**COMPETITOR -B-**	**COMPETITOR -C-**
INCOMPETENCIES	Revolut consumers are **not protected by the FSC**S, but competitors Monzo and Starling consumers are (Whitwell, 2018). Reduces trust of customers in terms of security.	**Security breac**h which led to customer PINS being copied onto files which could then be accessed by engineers, despite being encrypted through Typeform – a third-party survey firm, which indicates gaps in security system and reduces faith	1.7% charge for withdrawing cash abroad for basic account No telephone and reduced hour chat support No guaranteed financial protection with Brexit	Has a limit on foreign and national transactions (£300 per day). Also, local ATM charges may apply. You cannot set monthly budgets. 3D Secure online payments have been rolled out as a standard feature.

SOURCES OF REVENUE LOSS	**Negative Publicity** regarding toxic work culture, regulatory scrutiny over an alleged compliance lapse from 2018 (Revolut disabled a system designed to automatically halt transactions to individuals who matched against sanction lists, a move that potentially allowed illegal transactions to pass across the banking platform.)may result in revenue losses as they might lose potential customers.	**No multi currency account** Monzo is an international digital bank, however, it is currently available to **UK residents** only. This puts it at a disadvantage compared to its competitors such as Monese, Starling and N26 who are operational in over 20 countries each. Its account holders **cannot receive international payments**. This is due to the fact that the bank does not have an International Bank Account Number (IBAN).	No overdraft facility, standing orders, or loans No business accounts Recently in the news for poor security, N26 even offers a reward on its official website for any flaws found on its platform	No premium accounts available
RESOURCE DEFICITS	**Downgrade fees for consumers who want to swap to a cheaper accoun**t option or for those with a premium account who just to close their account altogether (Whitwell, 2018), which can lead to frustrations and bad word of mouth.	After declaring a loss of £7.9 million (before tax) in 2017, Monzo reported an additional loss of £33.1 million (before tax) in its 2018 annual report. In order to convert into a fully operational bank, there was an increase in the company's overall operating costs by £26.9 million in 2017.	In Germany and other places around Europe, the worst they had to deal with was experienced established banks. However in the UK, it had a greater competition. This weakness highlighted the fact that it had not yet developed a corporate culture that was experienced in approaching other markets.	The bank advocates profligacy.
AREAS OF IMPROVEMENT	Can only be contacted by online chat, there is no telephone number (Whitwell, 2018) , with a chatbot that is not very optimized, leading to impersonalized and **inefficient customer service.**	Provision of competitive features	provision of Business Accounts	Currently open to UK residents only Only two currencies, GBP and EUR
EXTERNAL FACTORS				
OPPORTUNITIES (+)	**OUR COMPANY**	**COMPETITOR -A-**	**COMPETITOR -B-**	**COMPETITOR -C-**
TECHNOLOGICAL ADVANCEMENTS	**Further automation** in areas like Chatbots, and processes like source of funds	Use of **AI for fraud protection**, following in the footsteps of fellow UK fintech Mimiro (Fawthrop, 2019c). Mimiro managed to raise 22.9 million in financing for its anti-money laundering fraud prevention (Fawthrop, 2019c). Implementing AI correctly could reap big rewards for the company, including increased security, lower costs and higher customer satisfaction (Fawthrop, 2019c).	Greater services facilitated by the use of technology to match with its competitors	Greater services facilitated by the use of technology to match with its competitors
EVOLVING CUSTOMER NEEDS	Better customer service, and security mechanisms	Useful to inform consumers that Monzo could be the more **environmentally friendly brand**, with the lack of need to go to a branch and less need to waste paper	Provision of **Business Accounts**	The bank has an opportunity to generate more revenue by offering **Banking-as-a-Service** solutions.
MARKET VOIDS	Continous global expansion and higher funding. Potential partnerships with companies like freetrade, which offers lucrative trading facilities persuade consumers to use their digital-only service as their **primary bank.**	Expand **further internationally,** into Asian markets, where there is a growing number of digital banks appearing (Cheh, 2019). This is thought to be due to the regions growing number of young, affluent and smartphone-first population (Cheh, 2019).	The general manager of the N26 bank in the United Kingdom stated, its design will help the bank stand out with its **focus** on customers who are slightly more first-class, a little older and more mature than its competitors' clients. This would help the growth of the bank in its new market.	The bank also has an opportunity to grow its **SME business** accounts and individual current accounts customer base.
FAVORABLE TRENDS	A **shift in the employee culture** of the company to be more accommodating of work-life balance and have clear, defined, and realistic goals for the staff could help with employee retention and improve Revolut's employer-of-choice image.	40% of people in the 18-27 age bracket were choosing to use a banking app as their primary bank, instead of a more well-known name (Fawthrop, 2019a). This suggests that Monzo should primarily **aim the app at people in this age rang**e, as it seems that they are already potentially interested in this type of product, and are, therefore, a key market.	With the banks massive backing, its ability to market itself extensively in the United Kingdom is huge. This can only bode well in a competitive market.	There is a big opportunity in the **mobile banking sphere** where the bank can concentrate and expand its services.
THREATS (-)	**OUR COMPANY**	**COMPETITOR -A-**	**COMPETITOR -B-**	**COMPETITOR -C-**

OBSTACLES	**Traditional banks** are trying to keep up with digital only by investing in newer technology, e.g Lloyds have revamped their banking app, including introduction of a savings pot, and instant payment notifications (Nixon, 2019)	**Traditional banks** are responding to challenger banks by investing in and partnering with new technology providers to better compete, which could negatively impact digital only banks (Taddia, 2016). Monzo will need to comprehensively look at what messages they can push with their marketing to show consumers how they don't need any of the bonuses of traditional banks, such as in-store customer service.	**Fintech competitors** in the United Kingdom who are more established in the marketplace. For instance, Monzo not only is at the top of the account satisfaction survey it is moreover one of Britain's best banks.	Increasing **competition** from big banks which are starting to offer similar services.
ECONOMIC CLIMATE	**Brexit** could cause chaos in terms of the economy and could mean changing regulations and legislation in the banking industry	**Brexit** could cause chaos in terms of the economy and could mean changing regulations and legislation in the banking industry, which could negatively impact Monzo. Monzo currently faces criticism regarding its **crowdfunding model.** The bank is being criticized for allowing its customers to borrow money, through overdrafts, in order to buy shares. This criticism is a major economic threat and might potentially affect its ability to raise funds.	**Brexit** could cause chaos in terms of the economy and could mean changing regulations and legislation in the banking industry	
MARKET SHIFTS	Convincing people to make the switch before high-street banks close the gap.	Convincing people to make the switch before high-street banks close the gap.	Convincing people to make the switch before high-street banks close the gap.	Convincing people to make the switch before high-street banks close the gap.
AREAS OF VULNERABILITY	Competitors Monzo and Starling offer some interest with certain account criteria and partners e.g Monzo has partnered with Osk North and now offers 1% with an instant access account, with a minimum initial deposit of £500, whereas Revolut offer no interest at all (Richardson, 2019). Competitors Monzo and Starling offer higher ATM withdrawals, whereas Revolut only allow up to £200 free (Revolut, 2019).	Another threat to Monzo is how consumers are using the banking service. Few people are currently using digital banks as their main banks, and are therefore keeping lower amounts of money in them (Fotis, 2019). This is shown through a study which found 47% of consumers using digital banks kept less than £1000 in the account (Greaves, 2019). Monzo, therefore, needs to focus on how to persuade consumers to use their **digital-only service as their primary bank.**	**Security issue** is more likely to have a higher adverse impact on the reputation of N26 than it would on other general internet services because of the financial nature of the business and the maximum potential loss.	Customers continually use the bank's services and products without having any real l**oyalty** to the brand.

Appendix 2- Understanding Technology

Explanation of key Technical Terms[81] [82]

1. **Data:** Simply put, data refers to information, generally facts or numbers, which have been collected over a period of time.
    a. **Big data:** Big data is a term applied to data sets whose size or type is beyond the ability of traditional relational databases to capture, manage and process the data with low latency. Big data has one or more of the following characteristics: high volume, high velocity or high variety (additionally, veracity)[83]
    b. **Structured Data:** Structured data is data that adheres to a pre-defined data model and is therefore straightforward to analyse. Structured data conforms to a tabular format with relationship between the different rows and columns. Common examples of structured data are Excel files or SQL databases.
    c. **Unstructured Data:** Unstructured data is information that either does not have a predefined data model or is not organised in a pre-defined manner. Unstructured information is typically text-heavy, but may contain data such as dates, numbers, and facts as well. This results in irregularities and ambiguities that make it difficult to understand using traditional programs as compared to data stored in structured databases. Common examples of unstructured data include audio, video files or No-SQL databases.
    d. **Semi Structured Data:** Semi-structured data is a form of structured data that does not conform with the formal structure of data models associated with relational databases or other forms of data tables, but nonetheless contain tags or other markers to separate semantic elements and enforce hierarchies of records and fields within the data. Therefore, it is also known as self-describing structure. Examples of semi-structured data include JSON and XML are forms of semi-structured data.[84]
    e. **Internal Data:** Internal sources of data reflect those data that are under the control of the business. These data are housed in financial reporting system, operational systems, HR systems and CRM systems, among others.
    f. **External Data:** External sources of data, on the other hand, are any data generated outside the walls of the business. These data sources include social media, online communities, open data sources and more. Due to the nature of source of data, external sources of data are under less control by the business than are internal sources of data. These data are collected by other companies, each using their unique systems and processes.[85]
2. **Data Analytics:** Data analytics is the process of transforming a raw dataset into useful knowledge.

[81](An Executives guide to AI|McKinsey)
[82] (NVIDIA Blog: Supervised Vs. Unsupervised Learning, 2020)
[83] (Big Data Analytics, 2020)
[84] (Framework, 2020)
[85] (Hayes,2018)

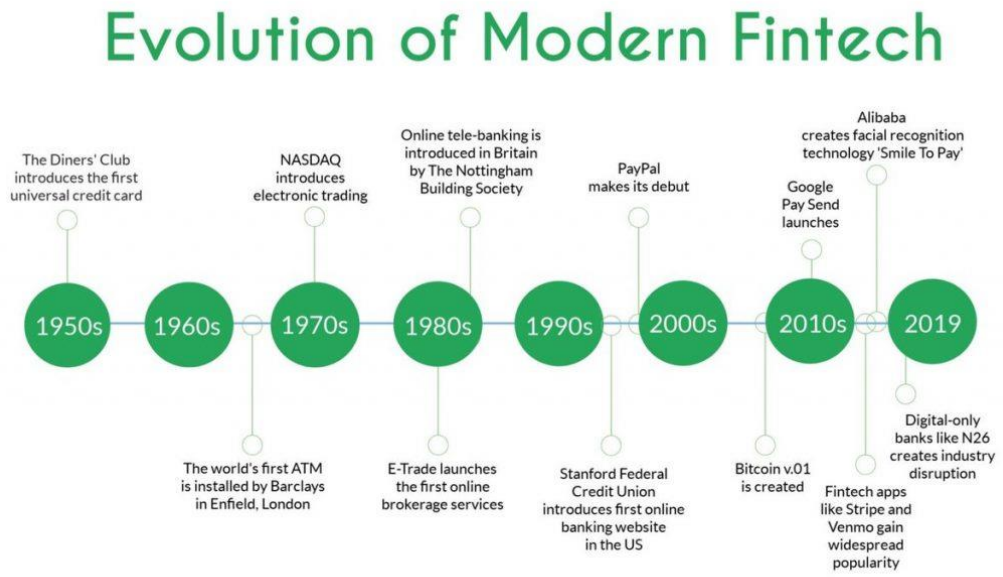
3. **Artificial Intelligence:** AI is typically defined as the ability of a machine to perform cognitive functions we associate with human minds, such as perceiving, reasoning, learning, and problem solving[86]
    a. **Prescriptive Analytics:** Gives us recommendations for future actions.
    b. **Predictive Analytics:** Uses machine learning model to interpret past data into trends and patterns; helps business predict what could happen next
    c. **Descriptive Analytics:** Tells us what happened in the past; helps business understand its performance [87]
    d. **Diagnostic Analytics:** Tells us why something happened in the past; helps business with root cause analysis
    e. **Machine Learning: Machine learning** is a form of artificial intelligence that uses algorithms to enable a system to learn from data rather than through explicit programming.[88]
    f. **Supervised Learning:** In a supervised learning model, the algorithm learns on a labeled dataset, providing an answer key that the algorithm can use to evaluate its accuracy on training data. Fully labeled means that each example in the training dataset is tagged with the answer the algorithm should come up with on its own.
    g. **Unsupervised Learning:** provides unlabeled data that the algorithm tries to make sense of by extracting features and patterns on its own. A deep learning model is handed a dataset without explicit instructions on what to do with it. The neural network then attempts to automatically find structure in the data by extracting useful features and analyzing its structure.
    h. **Semi Supervised Learning:** training dataset with both labeled and unlabeled data. This method is particularly useful when extracting relevant features from the data is difficult, and labeling examples is a time-intensive task for experts.
    i. **Natural Language Processing (NLP):** branch of artificial intelligence that helps computers understand, interpret and manipulate human language.[89]
    j. **Deep Learning:** Deep learning is a type of machine learning that can process a wider range of data resources, requires less data preprocessing by humans, and can often produce more accurate results than traditional machine-learning approaches.
        i. **Convolutional neural networks:** A multilayered neural network with a special architecture designed to extract increasingly complex features of the data at each layer to determine the output
        ii. **Recurrent neural networks:** A multilayered neural network that can store information in context nodes, allowing it to learn data sequences and output a number or another sequence

[87] (Morgan,2019)
[88] (What is machine learning?, 2020)
[89] (SAS,2020)

k. **Reinforcement Learning:** Trains an algorithm with a reward system, providing feedback when an artificial intelligence agent performs the best action in a particular situation.
l. **Computer Vision:** Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs – and take actions or make recommendations based on that information. If AI enables computers to think, computer vision enables them to see, observe and understand.[90]

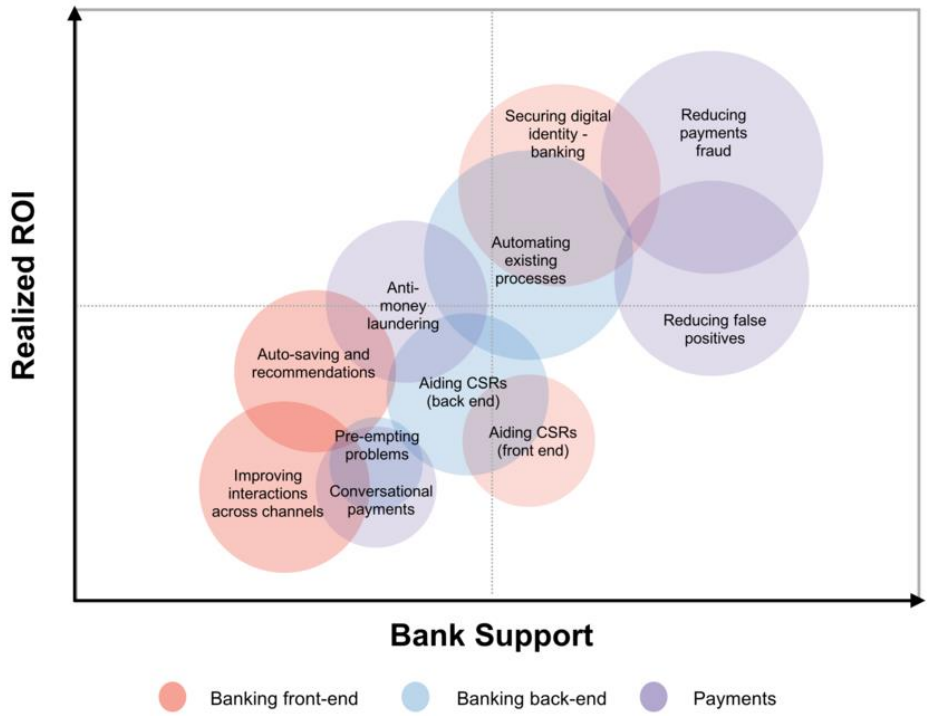
Evolving Fintech Landscape

The following timeline shows the evolution of Data, Analytics and Artificial Intelligence in the Finance industry:



[90] (What is computer vision?, 2020)

Maturity Of Uses Of Artificial Intelligence In Banking And Payments

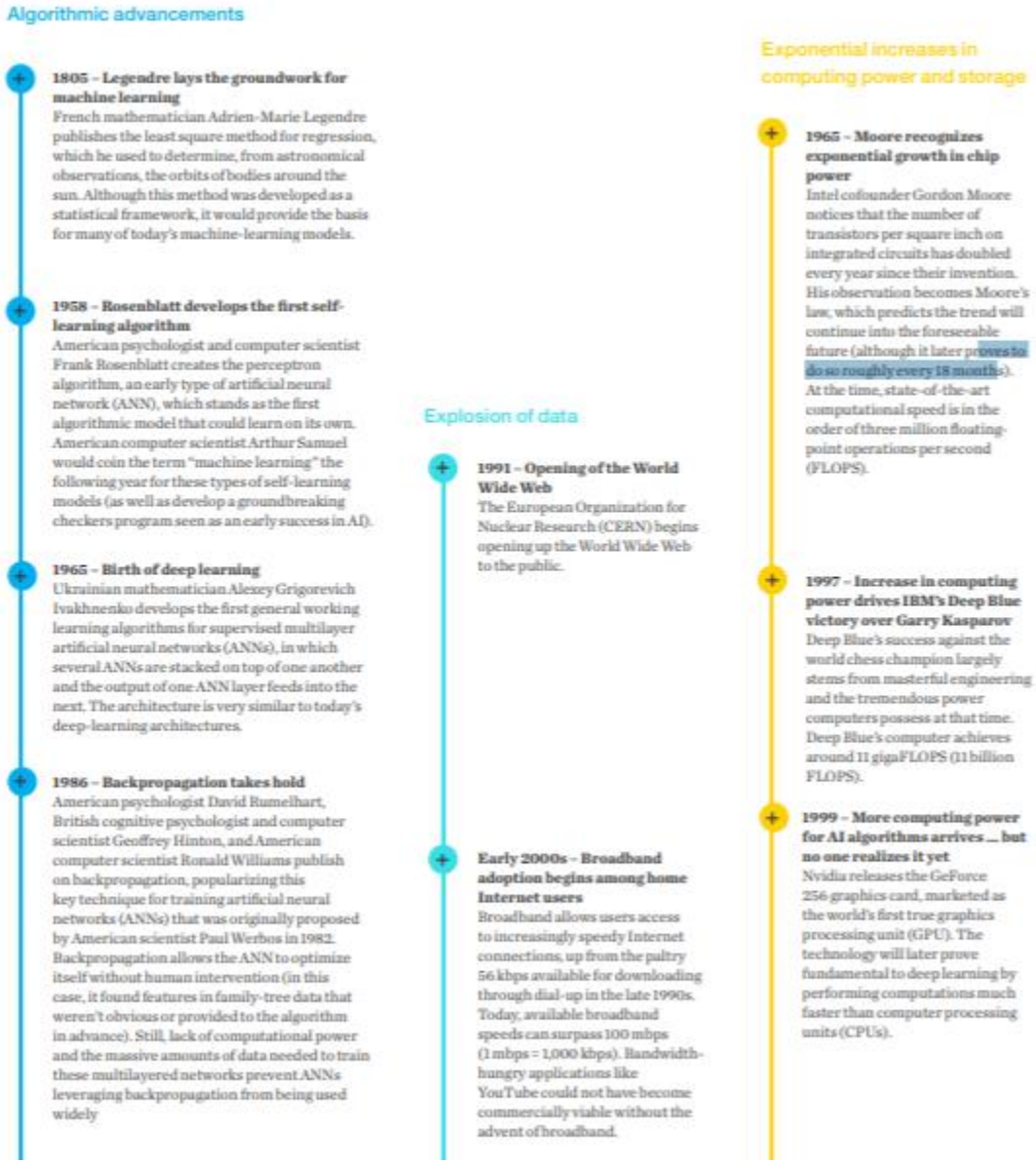


Size of bubble = Five-year potential ROI
Source: Estimated qualitatively by BI Intelligence analysts

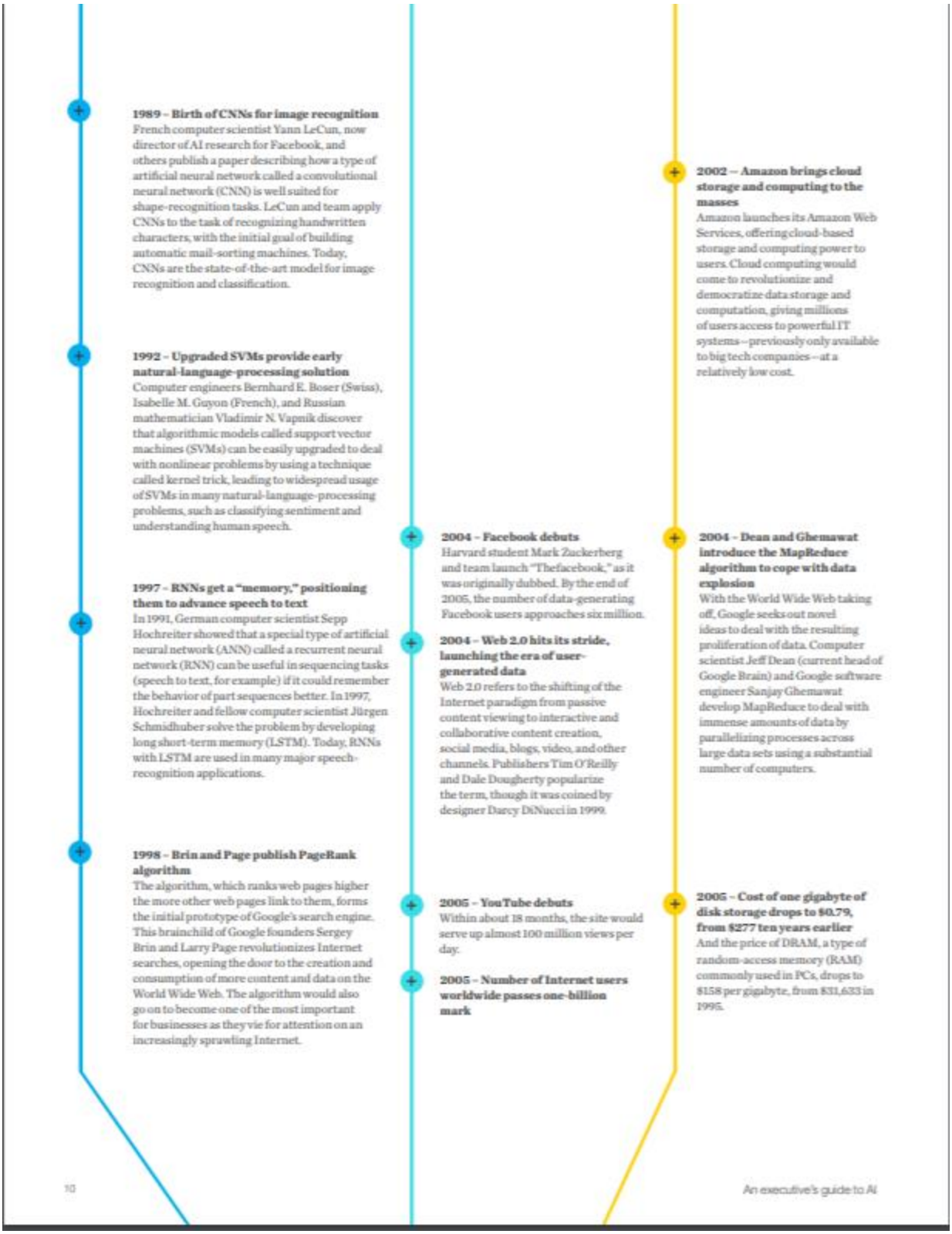
BI INTELLIGENCE [91]

[91] (Insider, 2020)

Evolution/ Timeline of AI and Data and Key Performance Characteristics[92]



[92] (mcKinsey and Company, An Executive's guide to AI)



1989 – Birth of CNNs for image recognition
French computer scientist Yann LeCun, now director of AI research for Facebook, and others publish a paper describing how a type of artificial neural network called a convolutional neural network (CNN) is well suited for shape-recognition tasks. LeCun and team apply CNNs to the task of recognizing handwritten characters, with the initial goal of building automatic mail-sorting machines. Today, CNNs are the state-of-the-art model for image recognition and classification.

1992 – Upgraded SVMs provide early natural-language-processing solution
Computer engineers Bernhard E. Boser (Swiss), Isabelle M. Guyon (French), and Russian mathematician Vladimir N. Vapnik discover that algorithmic models called support vector machines (SVMs) can be easily upgraded to deal with nonlinear problems by using a technique called kernel trick, leading to widespread usage of SVMs in many natural-language-processing problems, such as classifying sentiment and understanding human speech.

1997 – RNNs get a "memory," positioning them to advance speech to text
In 1991, German computer scientist Sepp Hochreiter showed that a special type of artificial neural network (ANN) called a recurrent neural network (RNN) can be useful in sequencing tasks (speech to text, for example) if it could remember the behavior of part sequences better. In 1997, Hochreiter and fellow computer scientist Jürgen Schmidhuber solve the problem by developing long short-term memory (LSTM). Today, RNNs with LSTM are used in many major speech-recognition applications.

1998 – Brin and Page publish PageRank algorithm
The algorithm, which ranks web pages higher the more other web pages link to them, forms the initial prototype of Google's search engine. This brainchild of Google founders Sergey Brin and Larry Page revolutionizes Internet searches, opening the door to the creation and consumption of more content and data on the World Wide Web. The algorithm would also go on to become one of the most important for businesses as they vie for attention on an increasingly sprawling Internet.

2004 – Facebook debuts
Harvard student Mark Zuckerberg and team launch "Thefacebook," as it was originally dubbed. By the end of 2005, the number of data-generating Facebook users approaches six million.

2004 – Web 2.0 hits its stride, launching the era of user-generated data
Web 2.0 refers to the shifting of the Internet paradigm from passive content viewing to interactive and collaborative content creation, social media, blogs, video, and other channels. Publishers Tim O'Reilly and Dale Dougherty popularize the term, though it was coined by designer Darcy DiNucci in 1999.

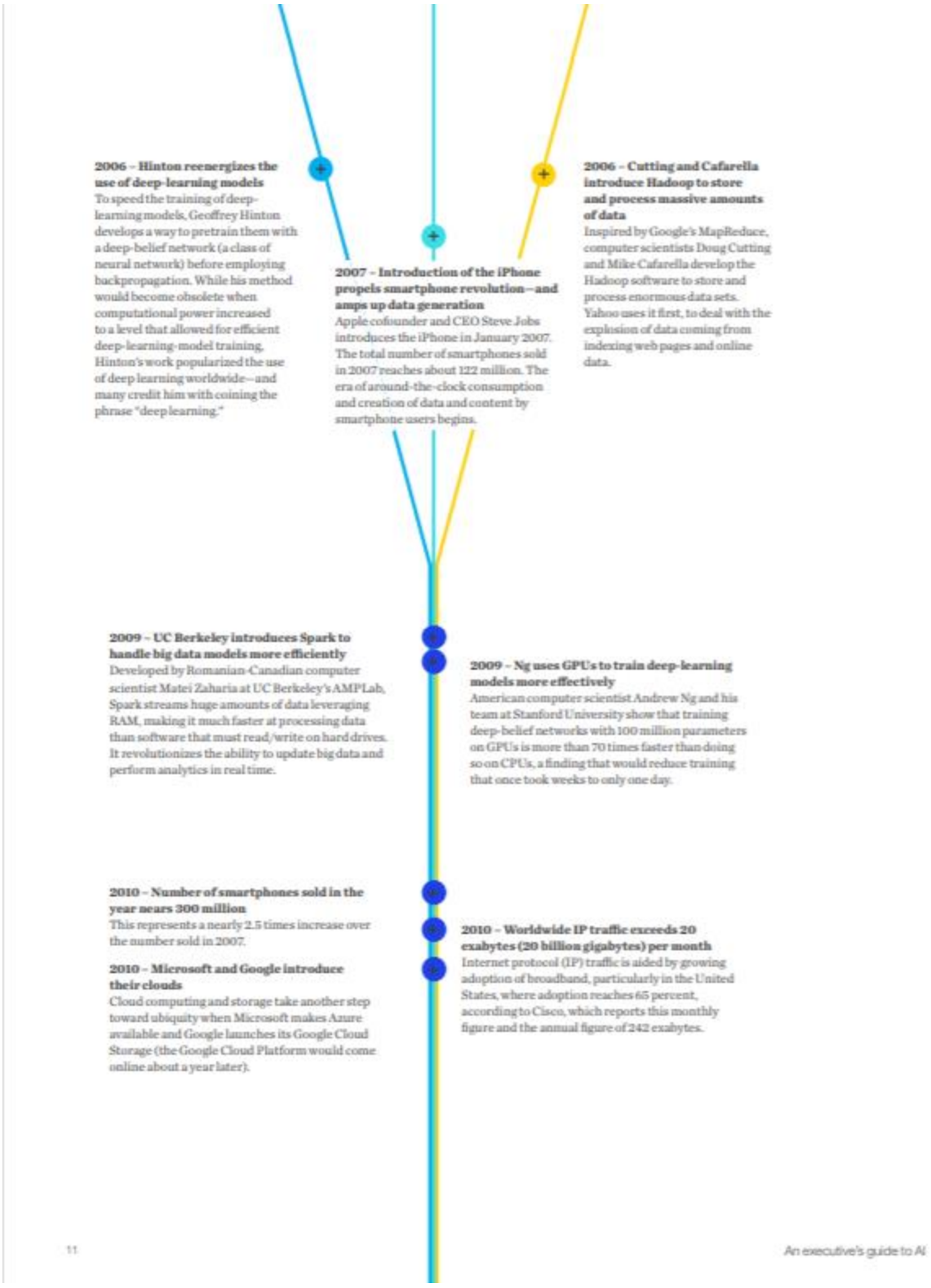
2005 – YouTube debuts
Within about 18 months, the site would serve up almost 100 million views per day.

2005 – Number of Internet users worldwide passes one-billion mark

2002 – Amazon brings cloud storage and computing to the masses
Amazon launches its Amazon Web Services, offering cloud-based storage and computing power to users. Cloud computing would come to revolutionize and democratize data storage and computation, giving millions of users access to powerful IT systems—previously only available to big tech companies—at a relatively low cost.

2004 – Dean and Ghemawat introduce the MapReduce algorithm to cope with data explosion
With the World Wide Web taking off, Google seeks out novel ideas to deal with the resulting proliferation of data. Computer scientist Jeff Dean (current head of Google Brain) and Google software engineer Sanjay Ghemawat develop MapReduce to deal with immense amounts of data by parallelizing processes across large data sets using a substantial number of computers.

2005 – Cost of one gigabyte of disk storage drops to $0.79, from $277 ten years earlier
And the price of DRAM, a type of random-access memory (RAM) commonly used in PCs, drops to $158 per gigabyte, from $31,633 in 1995.



2006 – Hinton reenergizes the use of deep-learning models
To speed the training of deep-learning models, Geoffrey Hinton develops a way to pretrain them with a deep-belief network (a class of neural network) before employing backpropagation. While his method would become obsolete when computational power increased to a level that allowed for efficient deep-learning-model training, Hinton's work popularized the use of deep learning worldwide—and many credit him with coining the phrase "deep learning."

2007 – Introduction of the iPhone propels smartphone revolution—and amps up data generation
Apple cofounder and CEO Steve Jobs introduces the iPhone in January 2007. The total number of smartphones sold in 2007 reaches about 122 million. The era of around-the-clock consumption and creation of data and content by smartphone users begins.

2006 – Cutting and Cafarella introduce Hadoop to store and process massive amounts of data
Inspired by Google's MapReduce, computer scientists Doug Cutting and Mike Cafarella develop the Hadoop software to store and process enormous data sets. Yahoo uses it first, to deal with the explosion of data coming from indexing web pages and online data.

2009 – UC Berkeley introduces Spark to handle big data models more efficiently
Developed by Romanian-Canadian computer scientist Matei Zaharia at UC Berkeley's AMPLab, Spark streams huge amounts of data leveraging RAM, making it much faster at processing data than software that must read/write on hard drives. It revolutionizes the ability to update big data and perform analytics in real time.

2009 – Ng uses GPUs to train deep-learning models more effectively
American computer scientist Andrew Ng and his team at Stanford University show that training deep-belief networks with 100 million parameters on GPUs is more than 70 times faster than doing so on CPUs, a finding that would reduce training that once took weeks to only one day.

2010 – Number of smartphones sold in the year nears 300 million
This represents a nearly 2.5 times increase over the number sold in 2007.

2010 – Microsoft and Google introduce their clouds
Cloud computing and storage take another step toward ubiquity when Microsoft makes Azure available and Google launches its Google Cloud Storage (the Google Cloud Platform would come online about a year later).

2010 – Worldwide IP traffic exceeds 20 exabytes (20 billion gigabytes) per month
Internet protocol (IP) traffic is aided by growing adoption of broadband, particularly in the United States, where adoption reaches 65 percent, according to Cisco, which reports this monthly figure and the annual figure of 242 exabytes.

2011 – IBM Watson beats *Jeopardy!*
IBM's question answering system, Watson, defeats the two greatest *Jeopardy!* champions, Brad Rutter and Ken Jennings, by a significant margin. IBM Watson uses ten racks of IBM Power 750 servers capable of 80 teraFLOPS (that's 80 trillion FLOPS – the state of the art in the mid-1960s was around three million FLOPS).

2012 – Number of Facebook users hits one billion
The amount of data processed by the company's systems soars past 500 terabytes.

2012 – Google demonstrates the effectiveness of deep learning for image recognition
Google uses 16,000 processors to train a deep artificial neural network with one billion connections on ten million randomly selected YouTube video thumbnails over the course of three days. Without receiving any information about the images, the network starts recognizing pictures of cats, marking the beginning of significant advances in image recognition.

2012 – Deep-learning system wins renowned image-classification contest for the first time
Geoffrey Hinton's team wins ImageNet's image-classification competition by a large margin, with an error rate of 15.3 percent versus the second-best error rate of 26.2 percent, using a convolutional neural network (CNN). Hinton's team trained its CNN on 1.2 million images using

2013 – DeepMind teaches an algorithm to play Atari using reinforcement learning and deep learning
While reinforcement learning dates to the late 1950s, it gains in popularity this year when Canadian research scientist Vlad Mnih from DeepMind (not yet a Google company) applies it in conjunction with a convolutional neural network to play Atari video games at superhuman levels.

2014 – Number of mobile devices exceeds number of humans
As of October 2014, GSMA reports the number of mobile devices at around 7.22 billion, while the US Census Bureau reports the number of people globally at around 7.20 billion.

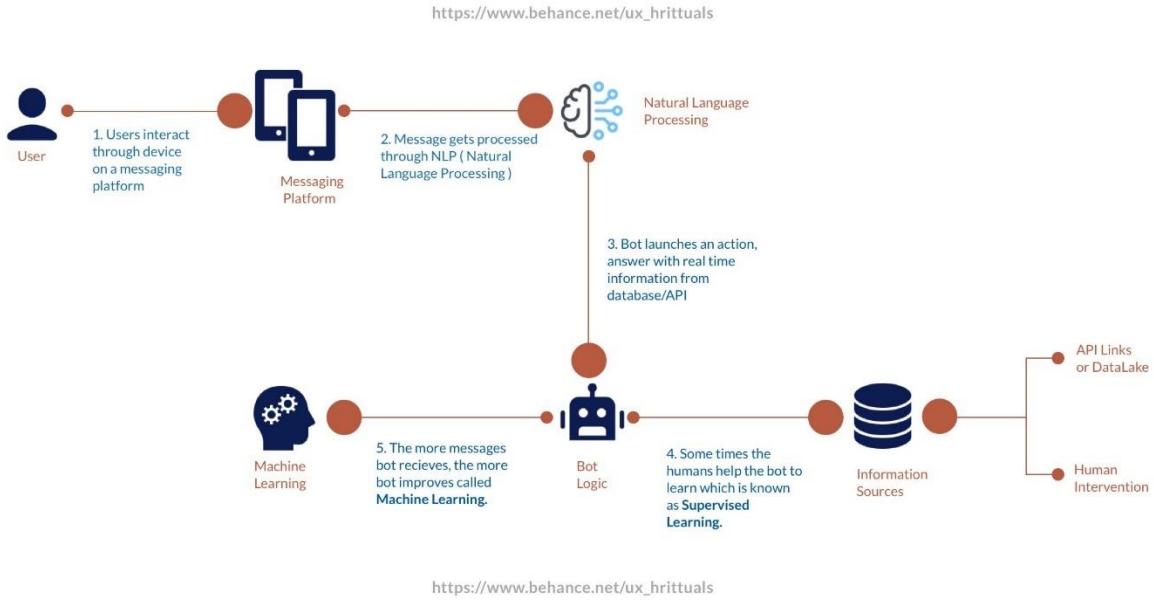
2017 – Electronic-device users generate 2.5 quintillion bytes of data per day
According to this estimate, about 90 percent of the world's data were produced in the past two years. And, every minute, YouTube users watch more than four million videos and mobile users send more than 15 million texts.

2017 – Google introduces upgraded TPU that speeds machine-learning processes
Google first introduced its tensor processing unit (TPU) in 2016, which it used to run its own machine-learning models at a reported 15 to 30 times faster than GPUs and CPUs. In 2017, Google announced an upgraded version of the TPU that was faster (180 million teraFLOPS – more when multiple TPUs are combined), could be used to train models in addition to running them, and would be offered to the paying public via the cloud. TPU availability could spawn even more (and more powerful and efficient) machine-learning-based business applications.

2017 – AlphaZero beats AlphaGo Zero after learning to play three different games in less than 24 hours
While creating AI software with full general intelligence remains decades off (if possible at all), Google's DeepMind takes another step closer to it with AlphaZero, which learns three computer games: Go, chess, and shogi. Unlike AlphaGo Zero, which received some instruction from human experts, AlphaZero learns strictly by playing itself, and then goes on to defeat its predecessor AlphaGo Zero at Go (after eight hours of self-play) as well as some of the world's best chess- and shogi-playing computer programs (after four and two hours of self-play, respectively).

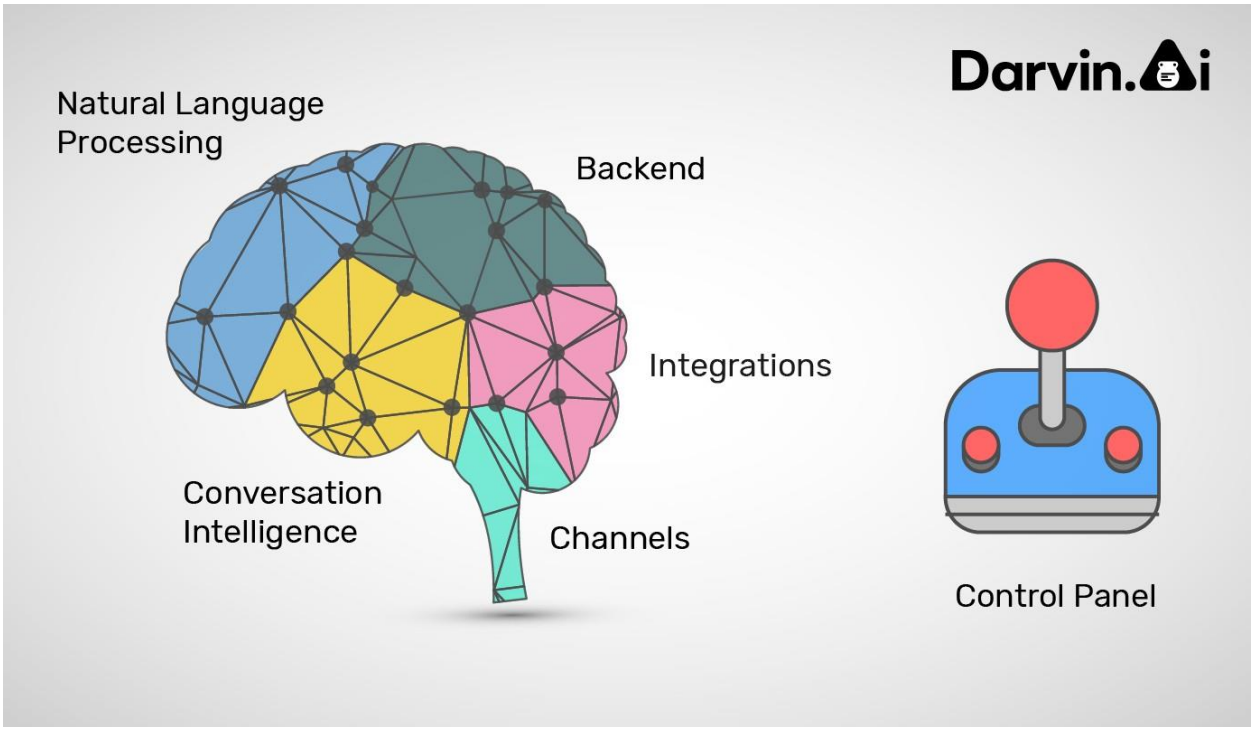
Appendix 3: Application- Chatbot Optimization

How does a Chatbot Work?



[93]

Components of a Chatbot:

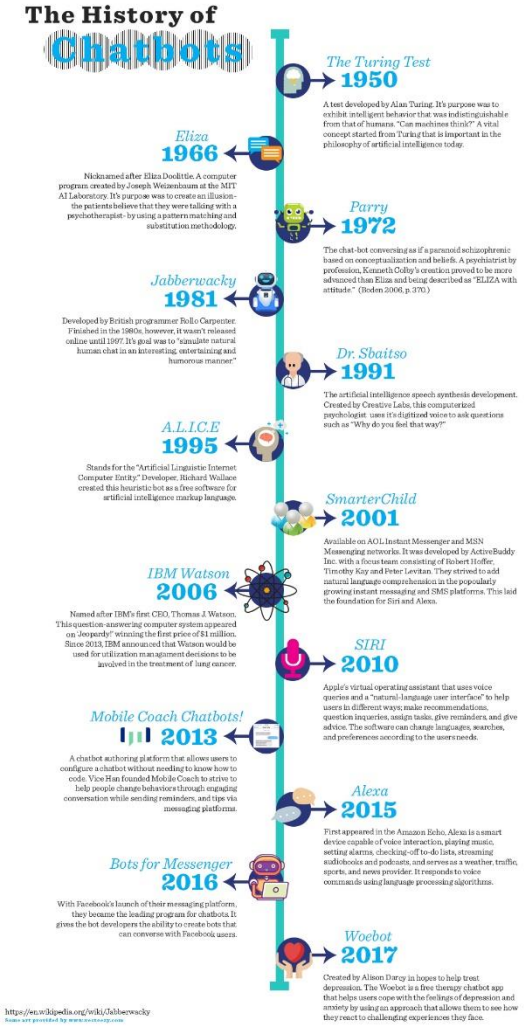


[93] (Your chatbot is cool—but how does it work?, 2020)

The chatbot consists of these key components:

- A front-end interface, which connects to a variety of channels, such as websites, email, SMS, or messaging applications such as Facebook Messenger or Slack, through which users interact with the chatbot.
- Understanding intent is responsible for recognizing the user's intent. This element uses natural language processing and machine learning to parse user messages, collect relevant parameters from words and sentences, and map those to actions to take.
- Another component manages the dialogue by maintaining a representation of the conversational logic and keeping track of context.

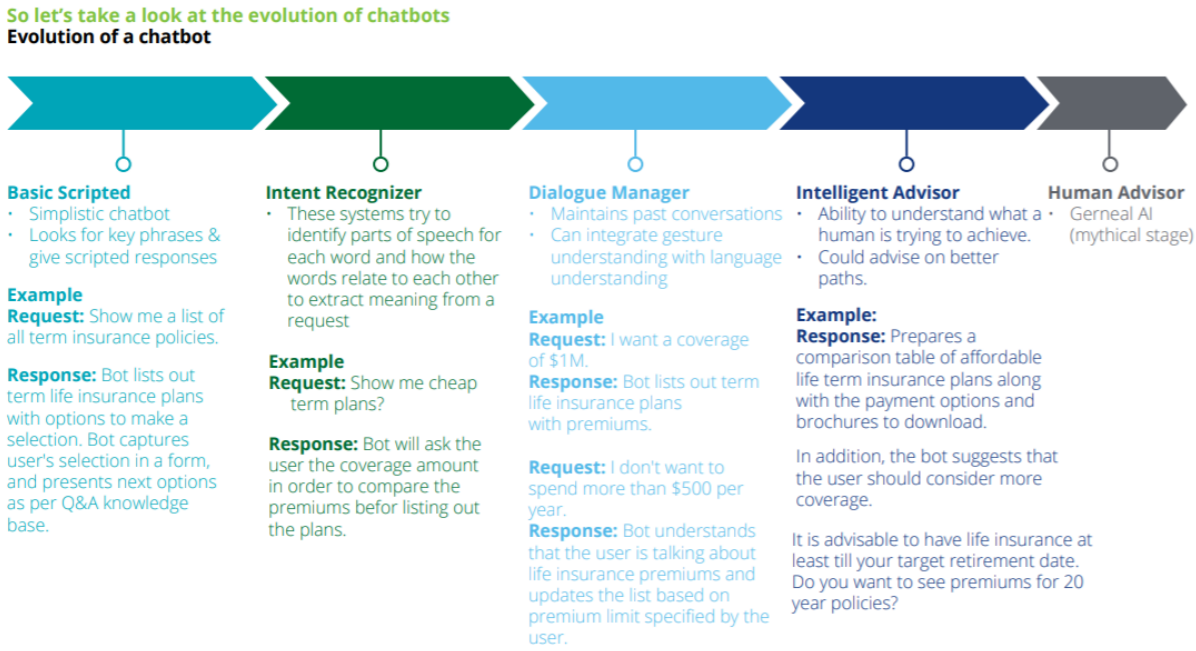
How have chatbots evolved? / Rise of Chatbots



Factors that have contributed to the rise of chatbots:

- The upswing in the use of messaging applications by every generation:
- The augmenting prominence of conversational interfaces:
- Propelling growth of Artificial Intelligence:
- Customer oriented progression:
- Automation on the spree:
- Highly- remunerative and cost-effective:

Evolution of chatbots (Future)



94

Technology Providers

Technology System	Technology Provider	Regions Covered/ Languages	Popular Clients	Efficiency	Cost
Chatbot Development	Kore.ai[95] https://kore.ai/	20+, including English, German, Spanish, French, Chinese Italian, Japanese, Korean, Finnish, Polish	Accenture, Capgemini, Cisco	Not specified	$2000 for premium account, special prices for enterprises(no access available)
	Kai https://kasisto.com/kai-consumer-banking/	Countries: Canada, China, Indonesia, India, Singapore, South Africa, UAE, USA Languages: English, Cantonese, Bahasa, French, and many more on the way	Mastercard, DBS, Standard Chartered	80%[96]	Not specified
	Plum		Monzo, Starling Bank	Monzo reduced the number of customers that needed to get in touch with its contact centre by 33 per cent	Fees to company not mentioned

[94] (Deloitte,2020)
[95] https://kore.ai/conversational-ai/conversational-ai-journey/
[96] (How DBS Bank's KAI banking chatbot is setting a new benchmark in customer service, 2020)

				in three months.	
	Rasa		N26, Lemonade	30%	Not Specified for enterprises
	Dialogflow https://dialogflow.com/	20+ languages	Dominos, Mercedes, WSJ, Singapore Airlines, Ticketmaster		Pricing subject to queries, details at https://cloud.google.com/dialogflow/pricing
	Conversable http://conversable.com/use-cases/		Pizza Hut, Facebook, P&G, Qantas		
	Chatfuel https://chatfuel.com/		Netflix, NatGeo, Visa		Premium price not mentioned
	Pypsetream		BerkleyNet, Shell, American Claims Management		

Metrics to assess the Quality of the Chatbot

The performance of chatbot can be determined using a dashboard based on the following parameters

- 1. Number of users
- 2. Number of new users
- 3. Number of messages
- 4. Number of messages per user
- 5. Popular topics
- 6. Confidence score
- 7. Bot Vs Human ratio
- 8. Message rate per day

EFFICIENCY		
Category	**Quality Attribute**	**Reference**
Performance	• Graceful degradation • Robustness to manipulation • Robustness to unexpected input • Avoid inappropriate utterances and be able to perform damage control • Effective function allocation, provides appropriate escalation channels to humans	• Cohen & Lane (2016) • Thieltges (2016) • Kluwer (2011) • Morrissey and Kirakowski (2013) • Staven (2017)
EFFECTIVENESS		
Category	**Quality Attribute**	**Reference**
Functionality	• Accurate speech synthesis • Interprets commands accurately • Use appropriate degrees of formality, linguistic register • Linguistic accuracy of outputs • Execute requested tasks • Facilitate transactions and follows up with status reports • General ease of use • Engage in on-the-fly problem solving • Contains breadth of knowledge, is flexible in interpreting it	• Kuligowska (2015) • Eeuwen (2017) • Morrissey & Kirakowski (2013) • Wallace (2003) • Ramos (2017) • Eeuwen (2017) • Solomon (2017) • Cohen & Lane (2016)
Humanity	• Passes the Turing test	• Weizenbaum (1966); Wallace (2003)

	• Does not have to pass the Turing Test • Transparent to inspection, discloses its chatbot identity • Include errors to increase realism • Convincing, satisfying, & natural interaction • Able to respond to specific questions • Able to maintain themed discussion	• Ramos (2017) • Bostrom & Yudkowski (2014) • Coniam (2014) • Morrissey & Kirakowski (2013)
SATISFACTION		
Category	**Quality Attribute**	**Reference**
Affect	• Provide greetings, convey personality • Give conversational cues • Provide emotional information through tone, inflection, and expressivity • Exude warmth and authenticity • Make tasks more fun and interesting • Entertain and/or enable participant to enjoy the interaction • Read and respond to moods of human participant	• Morrissey & Kirakowski (2013) • Pauletto et al. (2013) • Solomon (2017) • Eeuwen (2017) • Ramos (2017) • Meira & Canuto (2015)
Ethics & Behavior	• Respect, inclusion, and preservation of dignity (linked to choice of training set) • Ethics and cultural knowledge of users • Protect and respect privacy • Nondeception • Sensitivity to safety and social concerns • Trustworthiness (linked to perceived quality) • Awareness of trends and social context	• Neff & Nagy (2016) • Applin & Fischer (2015) • Eeuwen (2017) • Isaac & Bridewell (2014) • Miner et al. (2016) • Herzum et al. (2002) • Vetter (2002)
Accessibility	• Responds to social cues or lack thereof • Can detect meaning or intent • Meets neurodiverse needs such as extra response time and text interface	• Morrissey and Kirakowski (2013) • Wilson et al. (2017) • Radziwill & Benton (2017)

97 98

[97] (Arxiv, 2020)
[98] (20 Key Metrics for Chatbot Conversational Analytics in 2020, 2020)

Impact – Key Statistics and Premises

Globally, banks want to reduce costs.

Customers these days expect help on real time basis, on demand. They want to access banking services in multiple ways. Banks are onboarding conversational chatbots to manage high volumes of customer interactions and to free up agents for more complex issues, with the promise of having a greater impact on the customer experience, handling queries that are too complex or personal for bots to handle, even as they become smarter through AI, natural language processing and training experience. Currently, most bots handle balance checks, paying bills, transfers to linked accounts, making appointments and querying transactions.

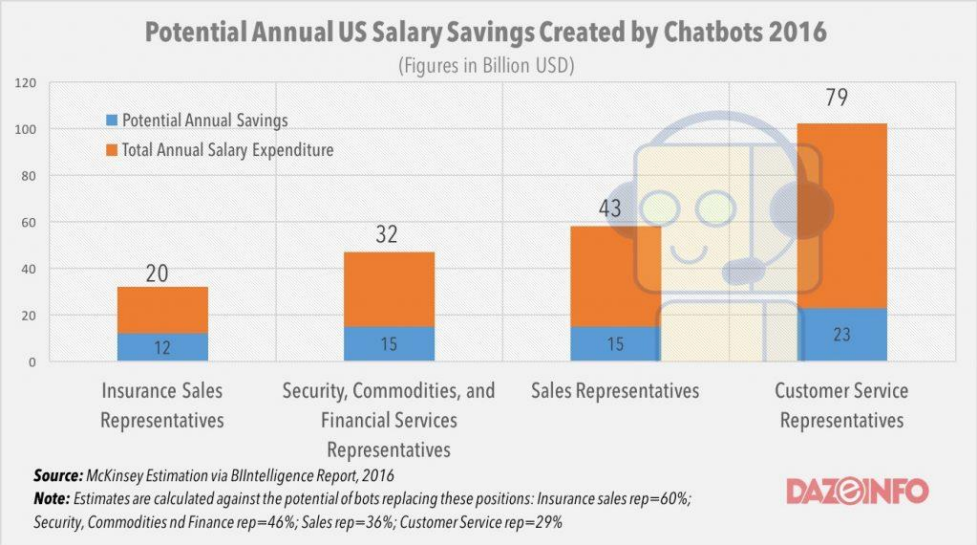
As with most industries, AI automation enables 24/7 always-on support, efficiency savings for customer service automation. Chatbots can take their part in the process to explain the processes and help move their money to better products or money-saving and other initiatives.

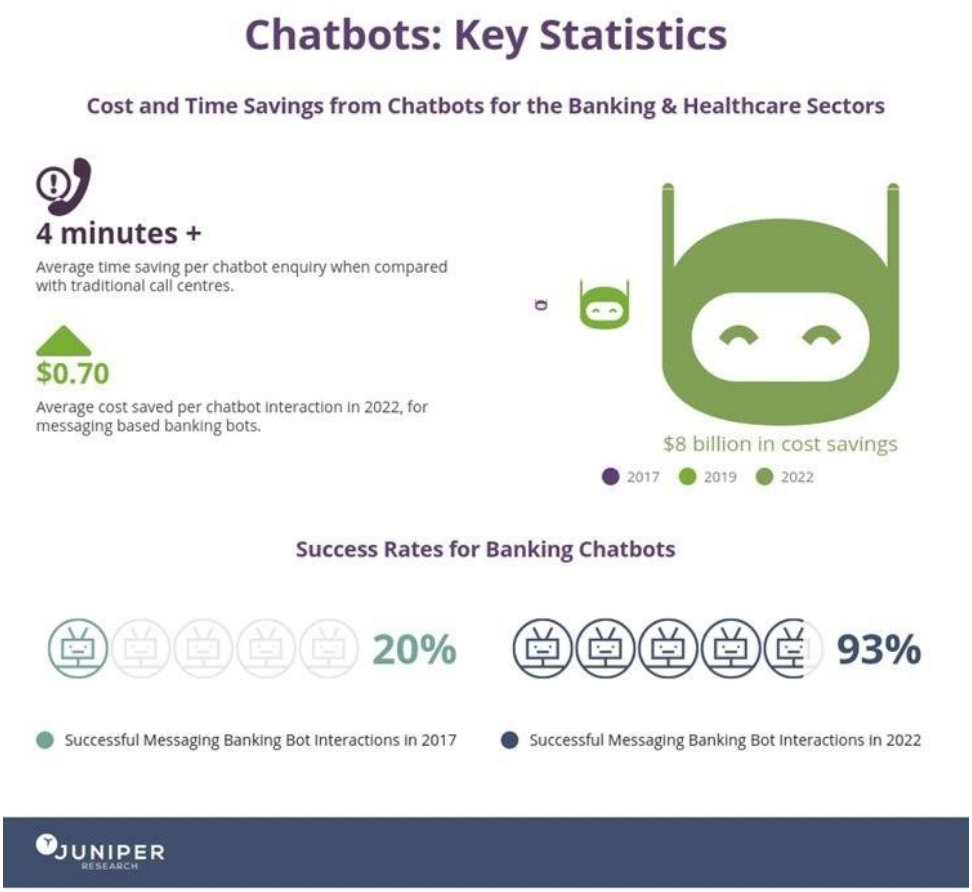
According to an interview of Monzo CEO, Tom Blomfield mentioned that traditional banks spend on an average GBP 150 per customer per year to maintain each customer account. A challenger Bank like Monzo does this in a tenth of that cost. Using a range of customer interaction channels has been key to this cost reduction, frontline leader being Chatbot Technology to help customers to find answers in the most customer-friendly and cost-efficient way.

Writing in Monzo's annual report, Blomfield wrote, "We've also been able to make savings by helping our customer support team become more efficient. Together, this has helped us lower the cost per account to around £15. With banks under increasing pressure from new and agile competitors and a more demanding and tech-savvy generation of banking customers, creating superior experiences is a must. Chat, combined with the power of AI, is the key.

To meet the needs of millennial customers, Revolut needs to up the ante on convenience, trust, and personalization, applying the latest technology to attract and retain this growing customer segment. Potentially Revolut can save between 25 to 40% cost on customer support services and free up the bandwidth of human support to render further value add services to its customers.

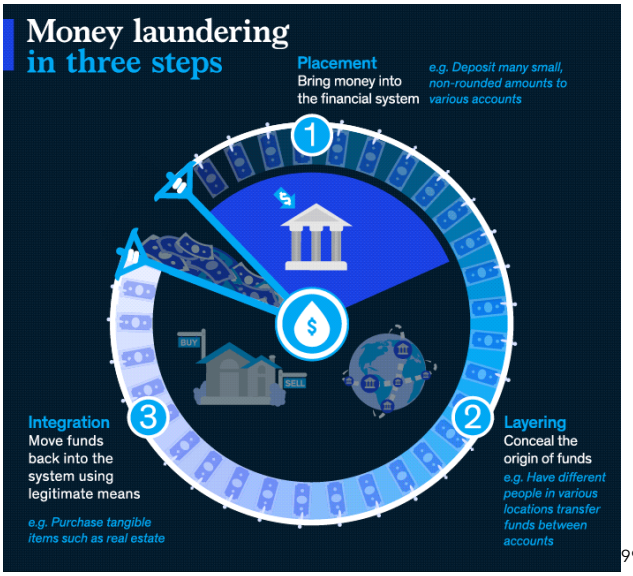
Wells Fargo uses a chatbot to allow customers to check their latest transactions over Facebook Messenger. Using technology to pre-empt questions, Monzo reduced the number of customers that needed to get in touch with its contact centre by 33 per cent in three months.


Potential Annual US Salary Savings Created by Chatbots 2016
(Figures in Billion USD)
120
100
80
60
40
20
0
Potential Annual Savings
Total Annual Salary Expenditure
20
12
32
15
43
15
79
23
Insurance Sales Representatives
Security, Commodities, and Financial Services Representatives
Sales Representatives
Customer Service Representatives
Source: McKinsey Estimation via BIIntelligence Report, 2016
Note: Estimates are calculated against the potential of bots replacing these positions: Insurance sales rep=60%; Security, Commodities nd Finance rep=46%; Sales rep=36%; Customer Service rep=29%
DAZEINFO


Chatbots: Key Statistics
Cost and Time Savings from Chatbots for the Banking & Healthcare Sectors
4 minutes +
Average time saving per chatbot enquiry when compared with traditional call centres.
$0.70
Average cost saved per chatbot interaction in 2022, for messaging based banking bots.
$8 billion in cost savings
2017
2019
2022
Success Rates for Banking Chatbots
20%
93%
Successful Messaging Banking Bot Interactions in 2017
Successful Messaging Banking Bot Interactions in 2022
JUNIPER RESEARCH

Appendix 4: Application- Anti Money Laundering

Steps involved in ML



[99]

Placement

Large volumes of small denominations.

At this stage, the launderer inserts the dirty money into a legitimate financial institution, often in the form of cash bank deposits or through "Smurfing".

This is the riskiest stage of the laundering process because large amounts of cash are pretty conspicuous, and banks are required to report high-value transactions.

This is the stage where OFAC and USA PATRIOT Act comes into picture (regulations)

Layering

Moving funds to obscure paper trail.

Layering involves sending the money through various financial transactions to change its form and make it difficult to follow. It may consist of several bank-to-bank transfers, wire transfers between different accounts in different names in different countries.

Making deposits and withdrawals to continually vary the amount of money in the accounts, changing the money's currency, and purchasing high-value items (boats, houses, cars, diamonds) to change the form of the money. This is the most complex step in any laundering scheme, and it's all about making the original dirty money as hard to trace as possible

This is the stage where Bank Secrecy Act comes into picture.

Integration

Reinvestment in legitimate business

At the integration stage, the money re-enters the mainstream economy in legitimate-looking form -- it appears to come from an legal transaction.

This may involve a final bank transfer into the account of a local business in which the launderer is "investing" in exchange for a cut of the profits, the sale of a yacht bought during the layering stage or the purchase of a $10 million screwdriver from a company owned by the launderer.

At this point, the launderer can use the money without getting caught. It's very difficult to catch a launderer during the integration stage if there is no documentation during the previous stages.

(Network Analytics and the fight against money laundering, McKinsey and Company, 2020)

Key Terms

Know Your Customer (KYC)	KYC refers to provisions in current AML regulations as well as published guidance that stipulate specific practices that should be undertaken by financial institutions in connection with establishing the identity of a prospective or existing customer.
Enhanced Due Diligence (EDD)	EDD refers to customer due diligence procedures that are required to be taken in connection with private banking and correspondent banking accounts maintained for Non-U.S. persons.
Customer Information Program (CIP)	CIP is part of the USA Patriot Act; this act stipulates that financial institutions have to have a reasonable belief that they know the true identity of their customers. CIP is done through a combination of documentary and non-documentary verification.

Technology Providers

After careful consideration, the list for relevant technology providers for Revolut was narrowed down to the following providers:

Provider	**Cost**
Datameer https://www.datameer.com/wp-content/uploads/pdf/solution_brief/Anti-Money-Laundering.pdf	Contact vendor for enterprise prices.
Accenture https://www.accenture.com/_acnmedia/pdf-61/accenture-leveraging-machine-learning-anti-money-laundering-transaction-monitoring.pdf	
Oracle https://www.oracle.com/industries/financial-services/aml-and-financial-crime-compliance/	
SAS https://www.sas.com/content/dam/SAS/en_us/doc/partners/intel-cloudera-sas-reduce-money-laundering-risks.pdf	

Assessing data Quality[100]

Timeliness

Unscrupulous Data vendors will often exaggerate their value proposition, selling the size of their dataset, without telling enterprise buyers how often they purge expired records or how accurate the information is.

- ✓ Are they just "pinging" servers to se if email domains and other digital identifiers exist? This is no longer valid, as many Internet service providers will silently drop these requests[7]
- ✓ Do they have policies in place to delete inaccurate records?
- ✓ Do they have any statistically reliab systems to verify timeliness?

Structure

Enterprise data buyers need to ask prospective vendors how they organize their data and what type of information they include in their data sets.

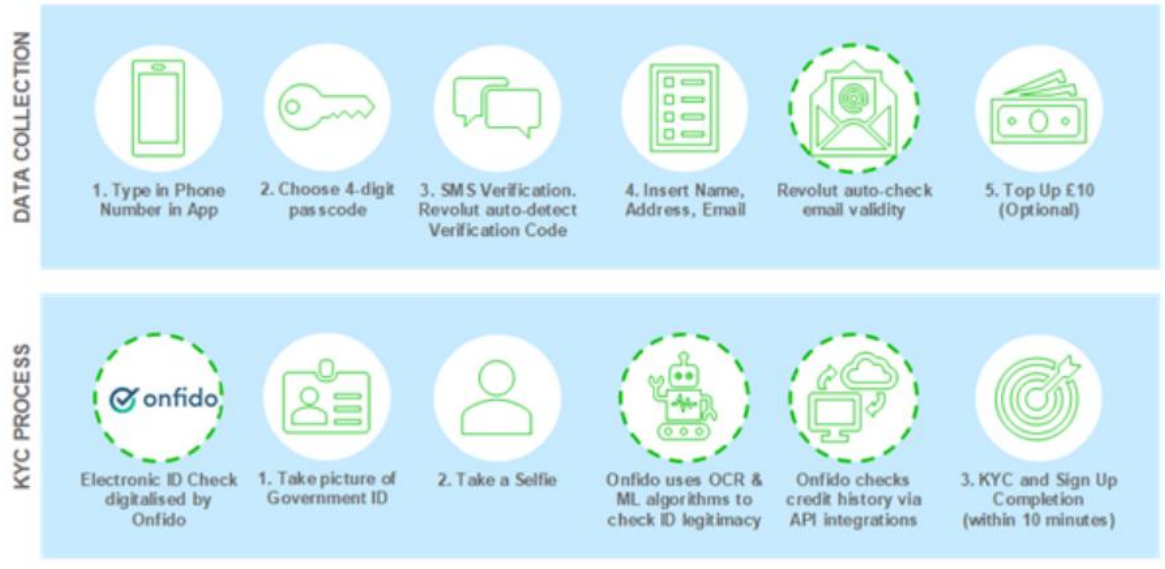
- ✓ What type of data do they offer?
- ✓ What are the column headers of the data set?
- ✓ What are the table-driven values of fields, or analytics derived from the data?

The best AML data providers will have the ability to modify output documents in a way that aligns with the business needs

Completion Ratio for Each Field

Unfortunately, a thorough and thoughtful database structure offers no guarantees that those records will be complete, recent or accurate. Therefore, FIs need to ask their AML analytics vendors what their fill rates are for fields that are most pertinent to their compliance risks.

Revolut's Current Onboarding Process[101]



Source: Personal research

[100] (Banking Journal, 2018)

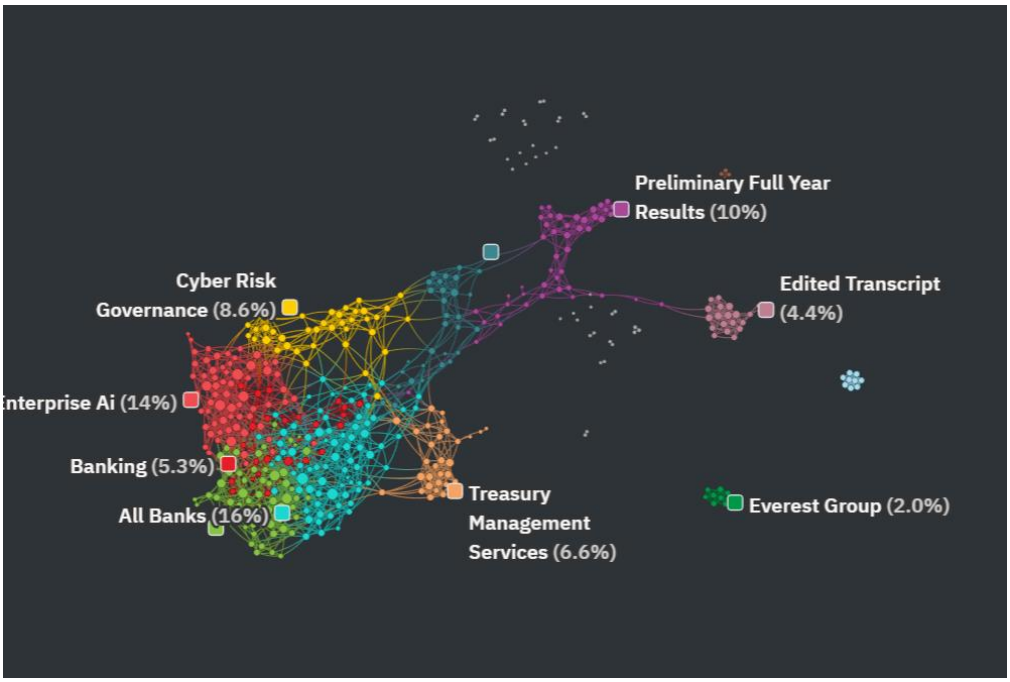
[101] (Nguyen, 2019)

For Further details on How different technology helps with AML

1. Network analysis: https://www.mckinsey.com/industries/financial-services/our-insights/banking-matters/network-analytics-and-the-fight-against-money-laundering
2. RPA: https://www.accenture.com/_acnmedia/PDF-61/Accenture-Operational-Transformation-Anti-Money-Laundering-Robotic-Process-Automation.pdf#zoom=50
3. AI, ML: https://www.accenture.com/_acnmedia/PDF-61/Accenture-Leveraging-Machine-Learning-Anti-Money-Laundering-Transaction-Monitoring.pdf#zoom=50 https://www.accenture.com/_acnmedia/PDF-61/Accenture-BalancingInternal-External-Virtual-Work.pdf#zoom=50
4. Cloud: https://www.aba.com/-/media/documents/industry-insights/guardian-analytics-path-to-modern-aml-compliance.pdf?rev=fe32dbf3148d47e289271425d7e2e0d1
5. More tools: https://www.corporatecomplianceinsights.com/advanced-analytics-for-anti-fraud-and-aml-systems/
6. Blockchain: https://www.dentons.com/en/insights/articles/2019/may/28/using-blockchain-for-kyc-aml-compliance

Appendix 5: Quid

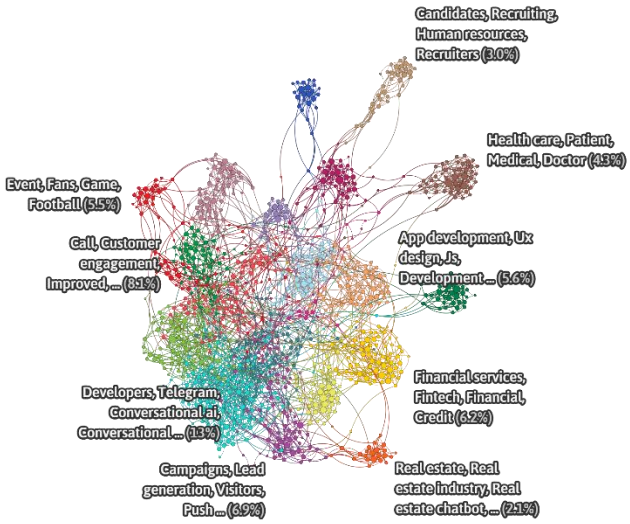
1. Purpose/ Question: in order to begin our research on Revolut's applications we should read about data analytics in the whole banking industry as a whole, giving us a great overview of trends and challenges these companies face.
   Search: ("Data Analytics" OR "artificial intelligence" OR "machine learning" OR "big data") AND "banking"
   Modifications: Deleted "lifestyle", "sports", and industries except for banking.
   Visualization:



   Interpretation: Results were not clear at all, however it did yield "cyber risk governance" and "treasury management services" as two potential application categories.

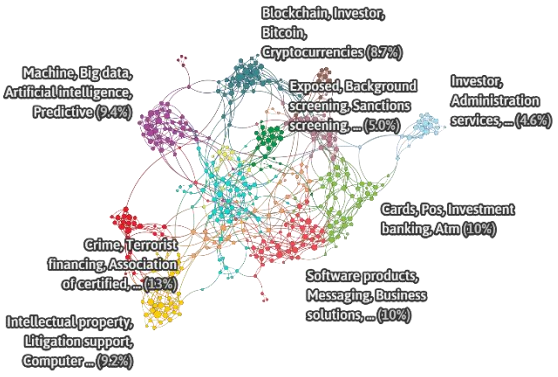
2. Purpose/ Question: What does the overall chatbot landscape look like?
   Search: "chatbots" in the COMPANIES dataset.
   Modifications: None

Visualization:



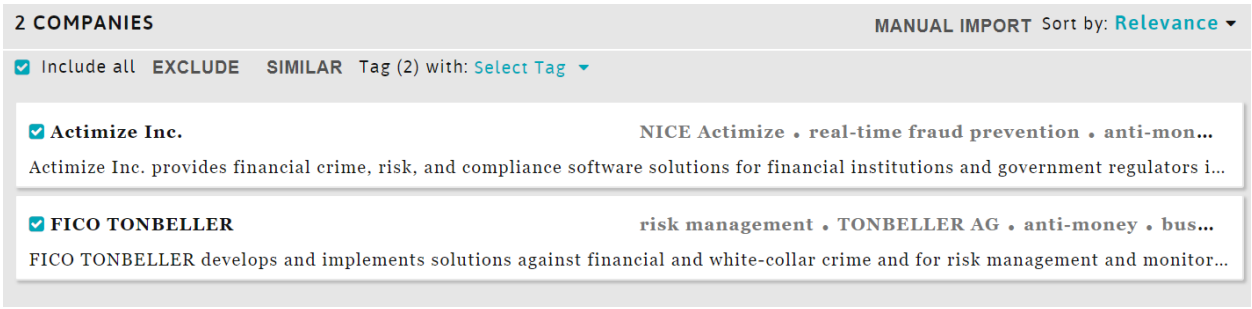
Result: This visualization helped understand the various applications of chatbots, and allowed me to determine whether overlaps were possible between the type of technology required in other industries and specifically, banking. It also helped me identify the top players in the finance industry.

3. Purpose/ Question: which technology providers are suitable for aml?
   Search: "Anti money laundering" OR "financial crime" in COMPANIES dataset
   Modifications: None
   Visualization:



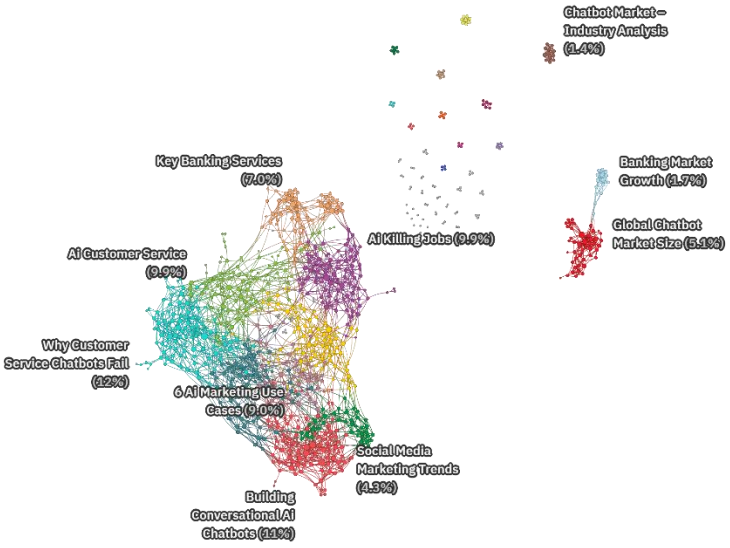
Result: This visualization gave me an overview as to what sub categories under AML are prominent among software providers. It also helped me filter the irrelevant ones like cards in my next search.

4. Purpose/ Question: Among these, which solution best suits our needs?
   Search: Anti- money laundering AND compliance AND fraud prevention AND trading AND due diligence AND sanctions
   Modifications: None
   Visualization:



   Result: I was able to narrow my search down to two technology providers.

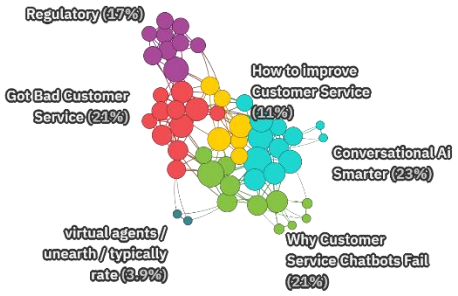
5. Purpose/ Question:. How is AI changing chatbot landscape and how successful is it?
   Search: (data OR "artificial intelligence" OR "AI" OR "deep learning" OR "machine learning" OR "nlp") AND "chatbot" AND ("customer service" OR "conversational UI") AND ("queries" OR "request" OR "complaint") In the NEWS/ BLOGS database
   Modifications: Tagging by keywords and labeling.
   Visualization:

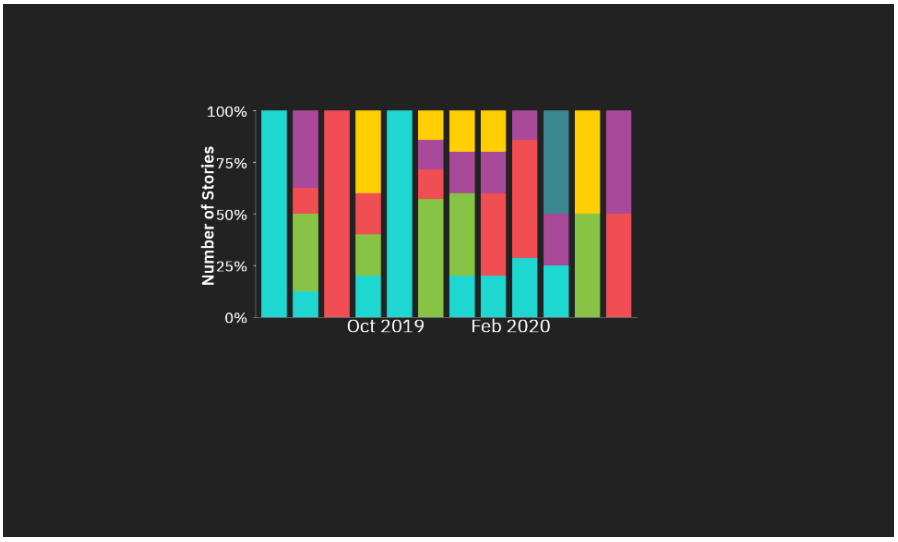


   Result: While this visualization did not provide very clear results, the "Chatbot Market – Industry Analysis" cluster was very informative. The cluster "why customer service chatbots fail" was also very useful as it was a key question I was looking to answer.

6. Purpose/ Question: What is the customers' perception of chatbots?

Search: (data OR "artificial intelligence" OR "AI" OR "deep learning" OR "machine learning" OR "nlp") AND "chatbot" AND ("customer service" OR "conversational UI") AND ("queries" OR "request" OR "complaint") AND "fail"
Modifications: Renaming clusters for better understanding
Visualization:

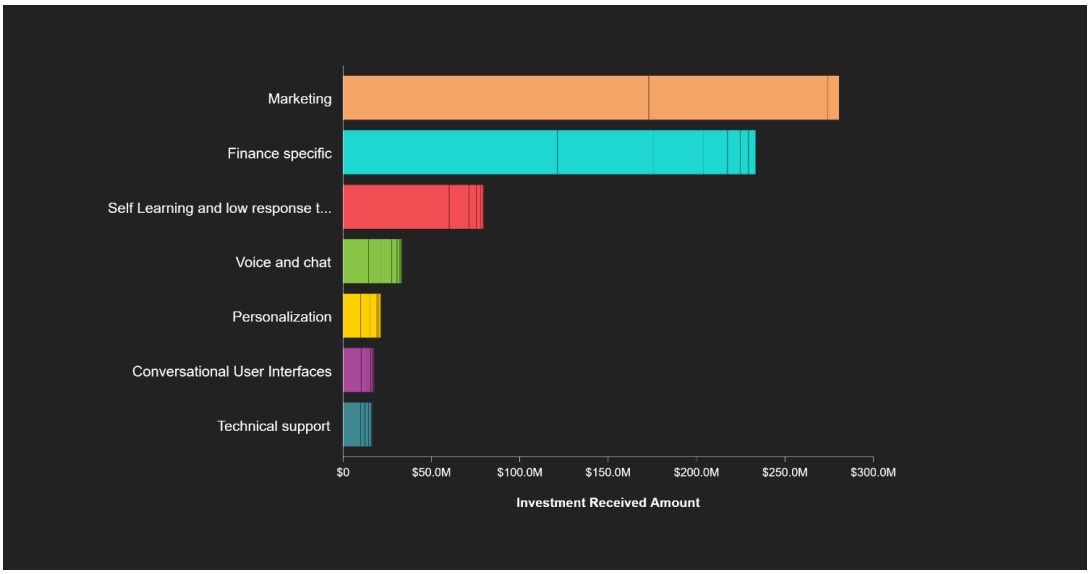


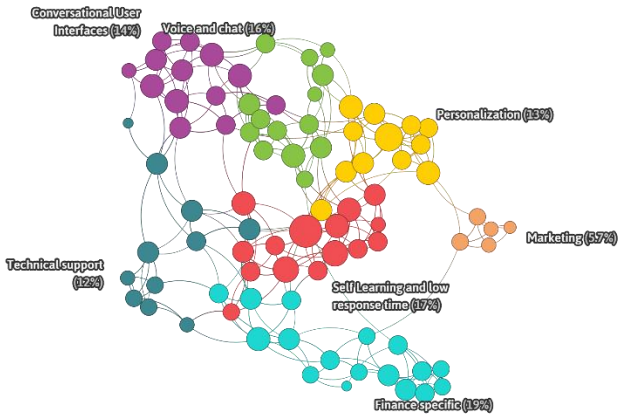


Result: The Network map provided some good articles to understand what problems customers are facing in terms of customer service, as well as automation in the field, and how the system can be improved. Furthermore, I explored the timeline analysis to discover trends regarding customer satisfaction over the last few months.

7. Purpose/ Question: What are the specific segmentations of chatbot companies?
   Search: ("personalization" OR "speed" OR "customer service" OR "conversational UI") AND ("AI" OR "artificial intelligence" OR "machine learning" OR "deep learning" OR "nlp" OR "analytics tools" OR "bi tools") AND ("chatbots")
   Modifications: Renaming clusters for better understanding.

Visualization:

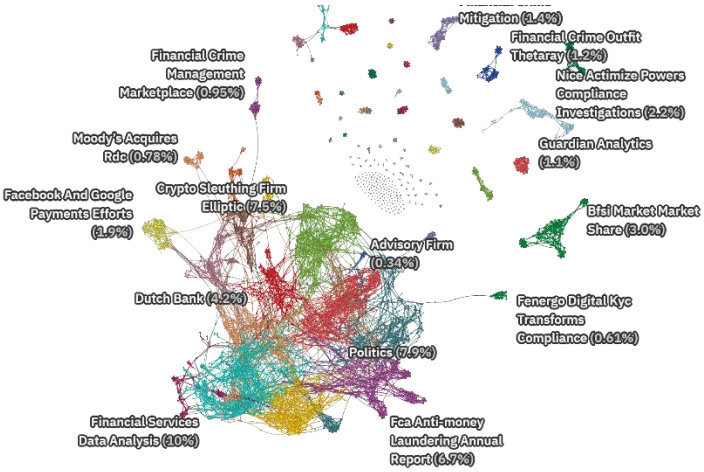




Result: This helped me understand the chatbot landscape, what sub- categories are present, and more importantly, which of them call for the highest investment.

8. Purpose/ Question: How are companies using automation to fight money laundering and financial crime?
   Search: ("artificial intelligence" OR "AI" OR "big data" OR "big data analytics" OR "neural networks" OR "natural language processing" OR "machine learning" OR "deep learning" OR "deep learning algorithms" OR "automation") AND ("financial crime" OR "money laundering") AND NOT ("social media" OR "social networks" OR "ads" OR "advertisement" OR "advertising" OR "games" OR "gaming" OR "esports" OR "healthcare" OR "religion" OR "army" OR "military" OR "finance" OR "stocks" OR "stock market")
   Modifications: Deleted “Sports” and “lifestyle” and all “industry” segments except Banking

Visualization:



Result: Was not that effective, but did highlight NICE Actimize, which indicates greater popularity and presence on the web. It also helped highlight a prime area in fraud prevention, which is “identity verification fraud prevention” (not displayed above as a label due to magnitude of labels)

The PATENTS dataset was looked into, however, Revolut does not have any patents.

Appendix 6: Critical Analytical Thinking

Critical Analytical Thinking is defined as the skill of using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.[102]

- The report aims to address several key questions and acknowledges the importance of asking questions before researching or investigating.
- The report considers important factors while coming up with solutions, such as the existing process of the specific application, what exactly is missing and can be done to solve the problem, how to measure the efficiency of the solution
- High level analysis was performed to identify and collate the list of relevant and top technology providers for each application, and alternatives have also been mentioned.
- It takes into account the level of feasibility of the proposed solution, and the challenges which may hinder the progress of AI implementation. Revolut already uses data, analytics and AI to a large extent, and thus further automation is highly feasible.

Why Revolut? The topic of the project itself was chosen keeping in mind that Revolut already uses data and analytics, so it would be a relatively more achievable goal. Moreover, from my observations and experiences with the company and visiting its office, I realized my developing interest in this field.

Sources: Throughout the report, **multiple** sources have been investigated into, and information has been cross validated across a series of **reliable** sources.

Cognitive Flexibility: Several different principles/ rules were used to group the application categories and technology components together.

Assumptions: Some assumptions have been made, based on historical data and future predictions. These may not be completely accurate but have been formed after careful consideration of evidence.

Lack of complete information: A considerable amount of information needed (for example the cost of technology providers or the exact quantitative impact of the solution) was not available on the public domain, so assumptions had to be made based on other case studies and their results, which might not reflect the results on Revolut, because of various factors like difference in customer base, services provided, and hidden factors which may have contributed to those results.

Audience: The report has been carefully designed keeping in mind the audience, i.e. senior management of Revolut. Thus, some details like the evolution of each of Revolut's products and services which would be relevant for another audience, for example, customers, have been omitted from this report.

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Systems thinking: Systems thinking has been vital to this report – AI can be considered a system which is then broken down into its components, which can further be broken down into subcomponents. Similarly, a conversational user interface or an end- to- end AML software may also be considered a system. Both convergent and divergent thinking have been crucial to understand the big picture as well as the details and generate themes across different ideas.

Process of gradual elimination: Instead of directly coming to a specific technology provider, I narrowed down my options continuously, from about 50 potential software providers to 25, further to 10, 5, and finally, one. The one mentioned might not be the best solution after all, it is just a recommendation based on my analysis. Some of the alternatives have the potential to be good solutions.

At every stage of the project, I asked myself some key questions which help understand the minute details of any idea- What, Who, When, Where, Why, How. Asking myself this reminded me to look at every aspect of the problem or the solution and truly getting a good grasp over the material.

Evidence: Forms of evidence used to construct this report include observations, experiences, investigation, reflection, research, and reasoning, premises and conclusions.

Communication: Focus was placed on the presentation of the report, so it looks appealing and information is provided as digestible bites, instead of overloading.

Challenges I faced: Analysis Paralysis! I found myself becoming overwhelmed with the amount of information I was exposed to at certain times. This leads to “thinking more and acting less”.

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