Headquarter: Switzerland	Company: Elite Bank	Date: 18th July 2017
Banking / Finance: Banks	Departmental Function(s): Technology and Operations	Nature: Solution Proposal

REVEALING THE PROMISED LAND: Synergy for Achieving Financial Excellence

A Glimpse of Price Discrepancy in Derivative Trading

Price discrepancy has two layers of meaning. Firstly, it is the difference of price quotes amidst different external data source. For instance, the stock price of HSBC shown at one particular time on Bloomberg Terminal is $58 whereas from Thomson Reuters is $58.2. Secondly, it is the discrepancy between the real spot price and the wrongly captured spot price. In addition, the daily generated P/L is based on the difference between the spot price and the strike price.
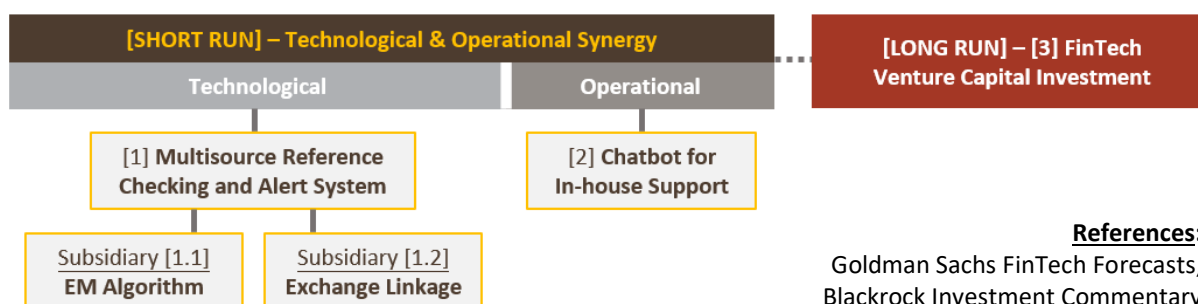
(a) – Unreliable External Data Sources

MarketBox is a warehouse which stores market movement data, and oftentimes such data is captured by external data sources. For instance, Thomson Reuters is the subscribed database for Elite Bank. There is a possibility for reporting errors to occur in Reuters, and relying on only one source is therefore unwise. Thus, multisource reference checking is recommended [1]. Prior to the recording of spot price, a cross-check is conducted to detect any price discrepancy (e.g. between Bloomberg Terminal and Thomson Reuters) [2].

(b) – Wrong Capturing of Spot Price

MoneyClip is where price discrepancy can occur due to the inconsistent treatment of how spot price should be taken, together with inappropriate instructions for departmental surveillance. Corrective actions can be taken by first understanding thoroughly the guidelines of determining spot price [3]. Consequently, regular instruction checks of MoneyClip should be adopted. For instance, currency is traded in a decentralized market, and it is essential to determine how the unrealized profit is calculated. This implies it is necessary to consider which exchange is referred to when unrealized profit is detected [4].

ELITE BANK FOR THE WINNING EDGE: Smarter Solution Made Simple

[SHORT RUN] – Technological & Operational Synergy

Technological

Operational

[LONG RUN] – [3] FinTech Venture Capital Investment

[1] Multisource Reference Checking and Alert System

[2] Chatbot for In-house Support

Subsidiary [1.1] EM Algorithm

Subsidiary [1.2] Exchange Linkage

References:
Goldman Sachs FinTech Forecasts, Blackrock Investment Commentary

[01]. Goldman Sachs. (2017). Securities Division: Electronic Trading SIGMA X MTF™ Participant Manual.
[02]. Accenture. (2016). Bridging the technology gap in financial services boardrooms.
[03]. Ernst and Young. (2016). Capital Markets: Building the Investment Bank of the Future.
[04]. Boston Consulting Group. (2017). Global Capital Markets 2017: Mastering the Value Migration.

INTRINSICALLY MOTIVATED, TECHNICALLY DRIVEN: Problems Identification

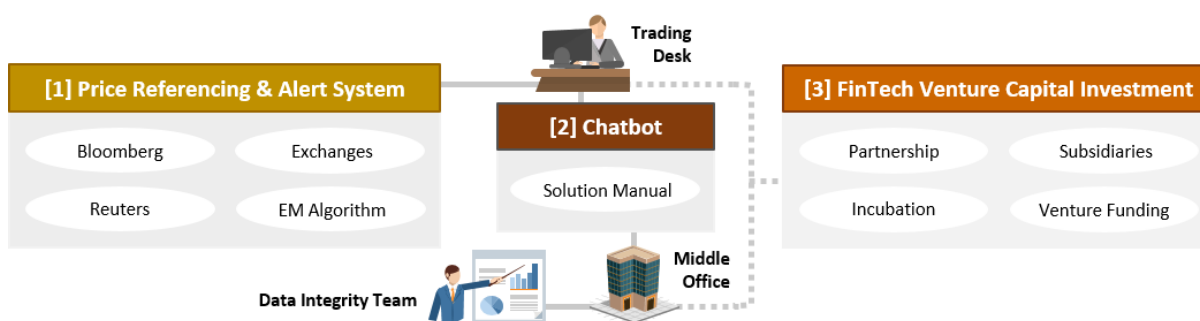|		Problem(s)	Suggested Perspective(s)	Solution(s)	Mitigation Ability
Technological	1	Unreliable External Data Sources	Front-to-Back Trading Cycle Improvement	Multisource Referencing & Alert System	87%
Technological	2	Wrong Capturing of Spot Price	Improvement of Timeliness & Efficiency	EM Algorithm & Exchange Linkage	91%
Operational	3	High Maintenance Manpower Cost	Operational Risk Controls	Chatbot for Inhouse Support	80%
Operational	4	In-house System Incompetence	Cost Reduction via Offshoring & Outsourcing	FinTech Venture Capital Investment	83%

[Problem 1: Unreliable External Data Sources]: The authenticity of data available on external data sources (e.g. Thomson Reuters) and the reliability of using only one data source [5].

[Problem 2: Wrong Capturing of Spot Price]: Functional components in the trade system (e.g. MoneyClip) fails to capture the closing price as spot price due to unanticipated errors [6].

[Problem 3: High Maintenance Manpower Cost]: Inconvenience caused when system supporters are off-duty and the low operational efficiency in addressing general inquiries [7].

[Problem 4: In-house System Incompetence]: Obsolescence of existing system infrastructure in pursuit of operational efficiency enhancement and accuracy in reporting [8].

SYNERGIZING TALENTS FOR A GREATER VISION: User Case Analysis Overview

Technically speaking, price discrepancy is highly correlated to errors of external data sources (MarketBox) and the wrong capturing of spot price (MoneyClip). Therefore, a desirable solution proposal should jostle to negotiate a course of action that best serves the interests of different stakeholders. Furthermore, the trading desk demands the accurate price quotes, while the data integrity team is expected to provide timely support when emergencies happen.

[05]. Morgan Stanley. (2016). Blockchain in Banking: Disruptive Threat or Tool?.
[06]. Hong Kong Monetary Authority. (2016). Whitepaper on Distributed Ledger Technology.
[07]. Ernst and Young. (2016). Global Banking Outlook: Transforming Talent - The Banker of the Future.
[08]. World Economic Forum. (2015). The Future of Financial Services Yearly Report.

TRADE SYSTEM SOLUTIONS ON DEMAND: Technology & Operations Area

[1] Multisource Reference Checking and Alert System

Price discrepancy risk is not mitigated if Elite Bank continues to lean on single data source for compiling daily profit and loss. To capture a more accurate market price, it is advisable to have at least one more market data source for comparison purpose. For instance, Bloomberg is a renowned financial data vendor with the provision of data terminal services. Cross-checking between the market data from Reuters and Bloomberg is necessary to confirm the data accuracy, especially during the market-close period. Whenever there is a price discrepancy, the alert system will be triggered and corrective actions must be taken. Below are the two layers of the defense mechanism.

[1.1] EM Algorithm for Stock Price Forecasting

Expectation-Maximization (EM) algorithm is an iterative algorithm for parameter estimation by maximum likelihood when random variables involved in a time series are not served (i.e. missing stock prices in certain time stamps). Missing data points can be estimated through multiple layers of simulations, the trendline of a certain stock can therefore be generalized [9].
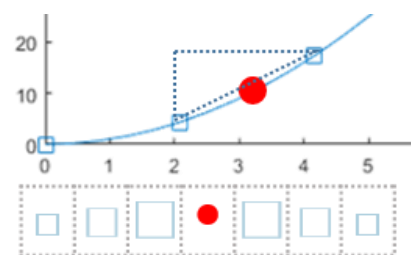
Simplified Data Log-Likelihood (Rubin 1976):

$$F(\theta | Y_{observation}) = f_1(\theta | Y) - \log[\, f_2(Y_{missing} | Y_{observation}\, ; \theta)\,]$$

Elite bank recognizes the quotes provided by exchanges should be the most reliable data. However, the deployment of EM algorithmic machine learning system can be utilized as preliminary parameters for alert trigger, in accordance with the mean squared errors of deviant data points [10]. Despite accessible information can be provided by exchanges directly, it is still essential to rely on Blomberg and Reuters for real-time market data feeding, especially for financial instruments traded outside the exchange.

EM Algorithmic Simulation

Suppose the red dot indicates a missing data point, whereas the blue squares are subsets of the time series plot. The value of red dot is computed by simulating the expected value through observing the whole dataset [11]. A prototype has been created to simulate the estimation of missing stock quotes by using SAS and Excel, entitled **"EM-Algorithm (0005HK_Missing Value Estimation).xlsx"**.

[09]. G. Andrew Karolyi. (2015). Cracking the Emerging Markets Enigma.
[10]. J.P. Morgan. (2016). Local Markets Guide: Emerging Market Research.
[11]. Doz, C., Giannone, D., & Reichlin, L. (2012). A quasi–maximum likelihood approach for large, approximate dynamic factor models.

[1.2] System Linkage with Exchange

In case the emergency alert is triggered due to the inconsistency of market data from Bloomberg and Reuters, the data from the exchange determines the closing price of the securities. For securities traded on the exchange, data from the exchange must be reliable. For example, the closing price of HSBC (HKG:0005) can be found on HKEx whereas the closing price of The Coca-Cola Co (NYSE: KO) can be identified on New York Stock Exchange.

With a sharp focus on the equity desk, Elite Bank can purchase stock price data from HKEx and other exchanges directly. All essential stock information, such as high, low, closing price and turnover can be obtained in CSV format. Since a broad range of products such as options and futures are being traded by the equity desk on a daily basis, the costs of price data subscription (e.g. from HKEx) are therefore reasonable expenses.
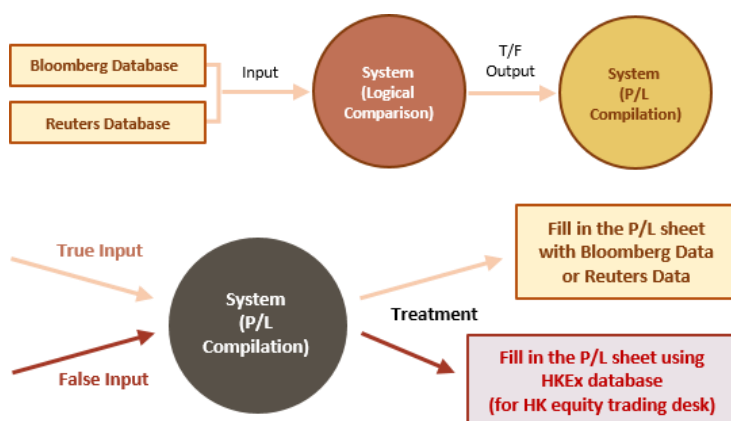
HKEx Subscription	
	($ in HKD)
Entry Level Package (Morning & market close)	500
One Cross Connect	1500
Daily Market Reports – Futures & Options	600
Monthly Recurrent Fee ($)	**2600**

Scenario Analysis: Real Time Data Feeding

Step 1 – Input Bloomberg data and Reuters data into the internal warehouse, let the automated system conduct the logical comparison.
("Elite Bank Multisource Reference Checking.xlsx")

Step 2 – If the data matches, it passes "true" to EM system such that Bloomberg market data is adopted to compute the real-time P/L.

Step 3 – If the data doesn't match, it passes "false" to EM system, triggering the EM algorithmic function to approximate the "should-be" value. The figures generated by EM algorithm is then used to compute the real-time P/L for error estimation.

References:
J.P. Morgan Investor Services – eXecute & KPMG Global Analysis

Industrial News

Monday's Plunge in the Yuan Freaked Out China Watchers

In December 2016, professional traders using Bloomberg terminals observed the yuan spot prices from a dozen banks all hovering around the actual price of 6.86/$1. Then there was ICAP's ask price at 7.48 to $1. Reasons for capturing erroneous yuan exchange rate were still unclear.

[12]. Thomson Reuters. (2016). Accessing Rates via Bloomberg - Thomson Reuters.
[13]. HKEx. (2017). HKEx Market Data Services: Real-time Securities Market Data.
[14]. Bank of *America Merrill Lynch* (2016). Impact Investing: The Performance Realities.
[15]. U.S. Securities and Exchange Commission. (2014). Deutsche Bank Securities Complaints.
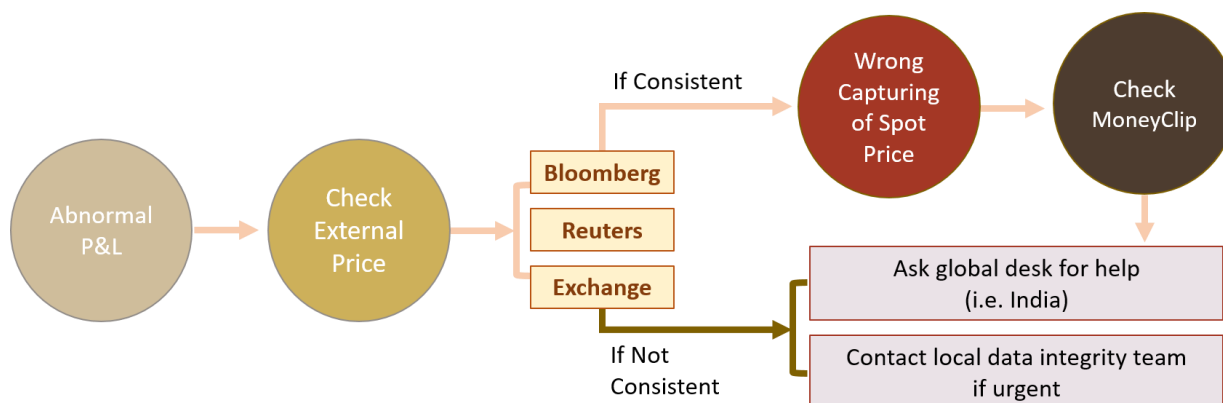
[2] Chatbot for In-house Support

P&L corrections were unable to be completed after office hours due to the lack of workforce in the Data Integrity Team. With the help of Chatbots or conventional robotic advisors, instant feedback can be generated with preset computerized program designated to simulate an intelligent conversation with one or multiple human users, in natural language via auditory or textual methods. Preinstalled solution manual can be immediately delivered with 90% of relevance and is available 24/7 **[16]**. The application of Chatbots is a time-saving and cost-efficient process, which eases the burden of system supporters. Below are two scenarios of how Elite Bank can utilize Chatbot to enhance its operational efficiency.

Scenario Analysis 1: Learning to Become Familiarized with the Trading System

New employees in Elite Bank may not be familiar with the current system architecture for Equity Trading Desk. Hence, approaching Chatbot for instant assistance provides information on the trade system description (e.g. functions of MoneyClip) and the linkages between various systems (e.g. MarketBox and StatBox) **[17]**.

Scenario Analysis 2: Solving Price Discrepancy Problem

In this scenario, there are two different layers of suggestions. Firstly, when a trader finds out there exists abnormal P&L after working hours which Data Integrity team is off duty, he/she can ask Chatbot on the potential error leading to this problem **[18]**. After identifying the root causes, Chatbot will then advise trader with different approaches to mitigate price discrepancy. If it is due to inaccurate external data sources, contacting global desk for correcting the internal price quotes is highly recommended. For instance, India office (GMT+5.5) is still in normal working hours to provide technical support for core business locations, like Hong Kong, Singapore, Japan and Australia. Calling local Data Integrity Team for help is also understandable for emergencies. If it is due to wrong capturing of spot price, Chatbot will propose the user to conduct instruction checks of MoneyClip in the first place **[19]**, and the remaining procedures are similar to the above instructions. (" http://56e5a1c8.ngrok.io/ ")

[16]. Boston Consulting Group. (2017). Global Risk 2017: Staying the Course in Banking.
[17]. Deloitte. (2016). How chatbots can answer questions for both customers and employees.
[18]. Accenture. (2017). Embracing the Disruptive Power of Chatbots.
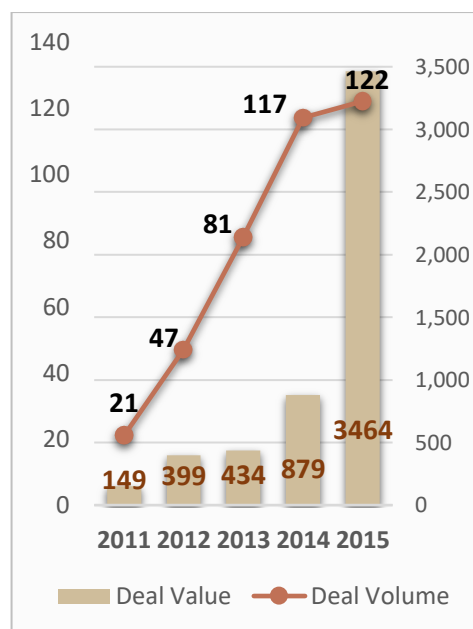**[19].** Forbes. (2016). UBS And Amazon Team Up For 'Ask UBS' Chatbot.

[3] FinTech Venture Capital Investment

System upgrades, starting from detecting price discrepancy to automatedly generating daily P&L, are essential to keep pace with the continuous growth and expansion of financial markets. Investing in firms which promote the use of automation and even artificial intelligence can be a potential alternative **[20]**.

Outsourcing system maintenance duties to the India Office (GMT+5.5) might be one of the many options available in the long run. However, time differences between India and Hong Kong might result in a less fully-covered support for the provision of system maintenance services. To abide by the regulatory requirements and internal requirements of accurate P/L generation, fully-covered support is in no doubt the foundation. Granting the aforementioned reasons, it is important to start considering investments in technology firms, which supports the automation of the whole P/L reporting service in the technical support centre (e.g. India).

APAC FinTech Investment Volume and Value 2011-2015 (USD Millions) [21]

Global financial institutions	FinTech Venture Capital funds	Fund Size (USD mm)	Country of Fund	Year of Origin
Goldman Sachs	Goldman Sachs Strategic Investments	Undisclosed	U.S.	Since 2009
Citigroup	Citi Ventures	Undisclosed	U.S.	Jan 2010
HSBC	HSBC Fund	100	U.K.	May 2014
AXA	AXA Strategic Ventures	220	U.S.	Feb 2015
NAB	NAB Ventures	50	Australia	July 2015

The new investment initiatives share the following benefits. First, the technology firm invested can generate long-term income source. The firm is not only providing integrated service to Elite Bank, but it can also provide one-stop service to other financial institutions. Thus, a wider revenue source is given. Second, the commitment to technological investment is considered as a stepping stone to the advancement of technology, maintaining the competitive edges of Elite Bank in the long run **[22]**. The first step taken by Elite Bank to automate the whole P/L reporting service can promote future use of technology, such as applying artificial intelligence in generating trading algorithms and execution of trades **[23]**.

[20]. Barclays. (2016). *Venture Capital in the UK: Its Vital Role in Driving Growth.*
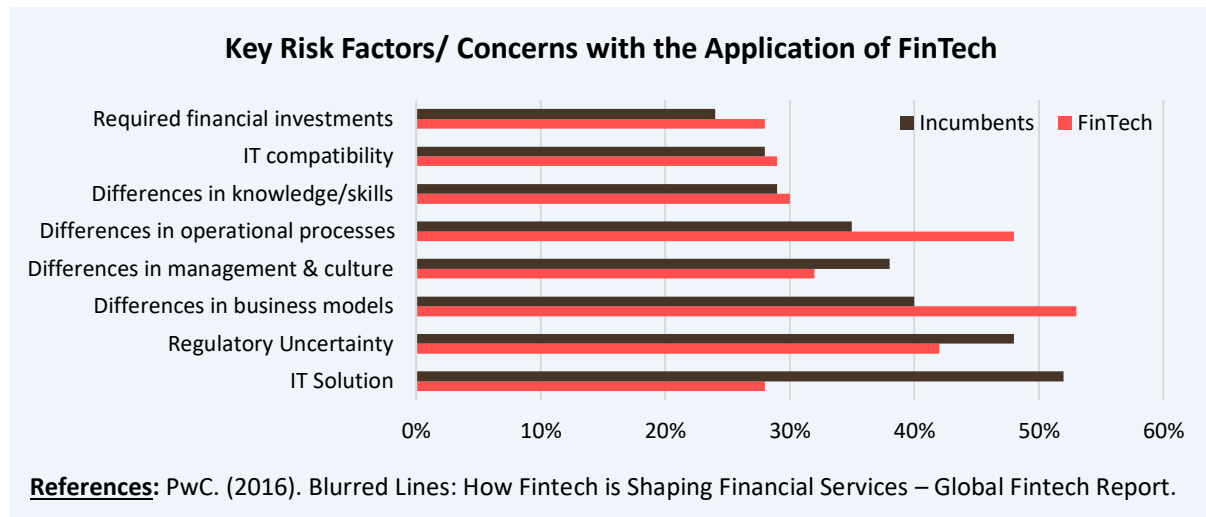**[21].** Deloitte. (2016). *Development, Prospect and Regulatory Environment of Fintech.*
[22]. Deutsche Bank. (2017). *FinTech 2.0: Creating New Opportunities Through Strategic Alliance.*
[23]. KPMG. (2017). *The Pulse of Fintech Q1 2017: Global Analysis of Investment in Fintech.*

BEYOND THE BORDERS: Risk Oversight and Mitigation

Key Risk Factors/ Concerns with the Application of FinTech

References: PwC. (2016). Blurred Lines: How Fintech is Shaping Financial Services – Global Fintech Report.
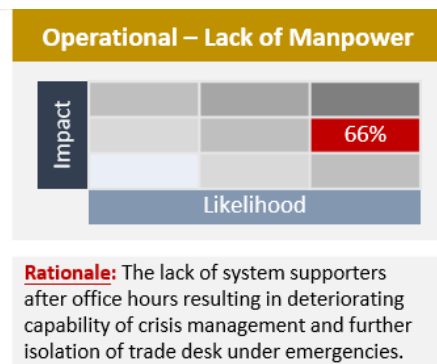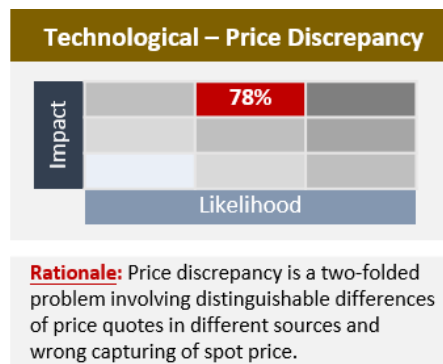
There are several areas where risk factors are obstructing the application of FinTech in the banking industry. These areas include financial investments, differences in operational processes and the collision of business models.

(1) Long Term Financial Burden: Outsourcing and offshoring are continuous cost items for Elite Bank as the reliance on supportive infrastructure will grow when the scalability of technology deployment is accelerating in the future **[24]**.

(2) Differences in Operational Processes: Given that different financial institutions hold their respective operational processes **[25]**, which implies that establishing joint ventures is indeed a tougher road for FinTech innovation.

(3) Collision of Business Models: As investment banking department heavily relies on financial modeling and marketing materials whereas smooth transaction and P/L generation are the key elements for sales and trading department, the perquisite of bringing quality technological solutions is to thoroughly understand the needs of Elite Bank promptly **[26]**.

Technological – Price Discrepancy — Impact / Likelihood — 78%

Rationale: Price discrepancy is a two-folded problem involving distinguishable differences of price quotes in different sources and wrong capturing of spot price.

Operational – Lack of Manpower — Impact / Likelihood — 66%

Rationale: The lack of system supporters after office hours resulting in deteriorating capability of crisis management and further isolation of trade desk under emergencies.

[Remark]: As Elite Bank projects that investing in technological firms can provide tailored solutions to our financial institution, venture capital investment **[27]** thus contributes to a sustainable and profitable business model in the long-run.

[24]. Oracle. (2015). The Benefits of Risk Assessment for Projects, Portfolios, and Businesses.
[25]. Citibank. (2017). Digital Disruption: How FinTech is Forcing Banking to a Tipping Point.
[26]. Nomura. (2016). Why FinTech is hot and how it will change financial services.
[27]. The Institute of Risk Management. (2014). Risk Culture in the Microscope Guidance for Boards

PRIMING ELITE BANK FOR SUCCESS: Three-Year Implementation Timeline [28]

Intrinsically Motivated. Technically Driven.		2017		2018				2019				2020	
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Short Term	**[1.1] EM Algorithm for Stock Price Forecasting**												
	Assumptions & Algorithmic Setup	■											
	Implementation Action planning	■	■										
	System Architecture Development	■	■										
	Ongoing System Maintenance			■	■	■	■	■	■	■	■	■	■
	[1.2] Multi-Source Reference Checking & System Linkage with Exchange												
	Subscription of Bloomberg Terminal & Stock Exchange Data Feed	■											
	Development of Cross-Checking Alert	■	■										
	Ongoing System Maintenance		■	■	■	■	■	■	■	■	■	■	■
	[2] Chatbot for In-house Support												
	Data Analytics and Robotics Setup [29]	■	■										
	Continuous Feedback Receival & UI Modification		■	■	■	■	■	■	■	■	■	■	■
Long Term	**[3] FinTech Venture Capital Investment**												
	Business Negotiation and Due Diligence	■	■										
	Strategic Partnership Confirmation		■	■	■	■	■	■	■	■	■	■	■

Nowadays, FinTech offerings come on stream and new opportunities exist from front office to back office throughout the whole investment bank. As for examples of innovation in post-trade operations, Robotic Process Automation (RPA) can be used to reduce costs associated with repetitive manual process, meanwhile, increasing speed and improving quality and consistency. Therefore, part of this solution proposal advocates the significance of robotics chatbot for system support and emergency alert. Currently, RPA are being adopted across a wide range of operational functions, including remediation activities. The cost savings from automating suboptimal process can be reinvested in longer-term strategic initiatives, such as the application of Blockchain and Smart Contracts to clearing, settlement and reporting [30].

The investment bank of the future is taking shape today. For capital market firms, now is the time to evolve, or risk facing a struggle to catch up in the years to come [31]. Therefore, a clear message on FinTech development is stated at the start of this page:

"Game-changing innovation in investment banking is no longer optional, but imperative."

[28]. McKinsey & Company. (2015). Cutting Through the FinTech Noise: Markers of Success, Imperatives for Banks.
[29]. CFA Institute. (2017). FinTech disruption in the financial Industry and its impact on banks
[30]. Accenture. (2016). Strategic workforce planning finally gets strategic.
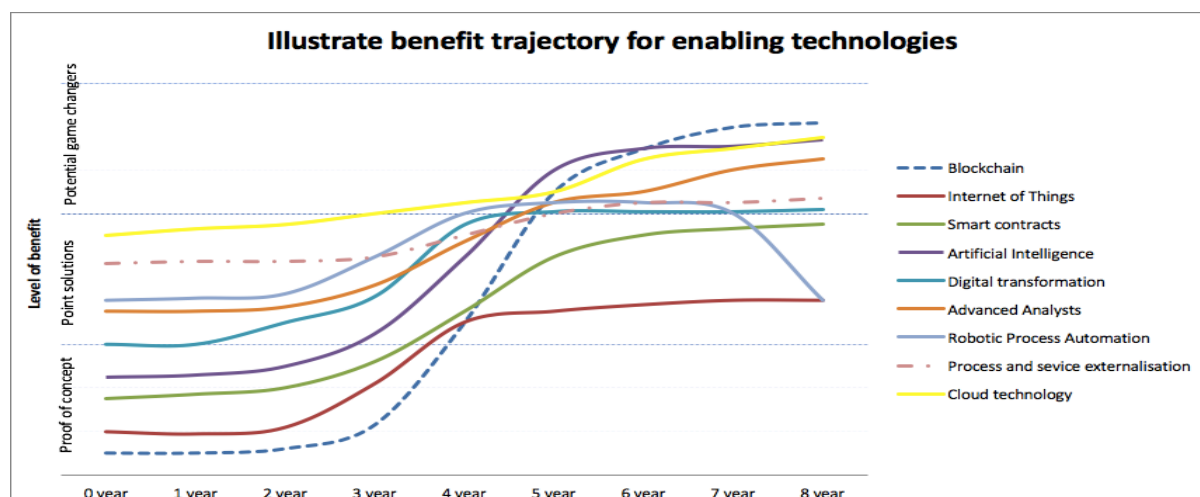[31]. Deloitte. (2016). Investment Banking current and future challenges and changes.

LOOKING AHEAD: Financial Budgeting and Forecasting

Developmental Cost Break-Down	Year 1	Year 2	Year 3
[1.1] EM Algorithm for Stock Price Forecasting			
Development	<Inhouse design>	/	/
Maintenance & Modification	<Inhouse design>	<Inhouse design>	<Inhouse design>
[1.2] Multi-Source Reference Checking & System Linkage with Exchange			
Subscription Fee (HKEx) [17]	$1500 per month	$1500 per month	$1500 per month
Subscription Fee (Bloomberg) [32]	$20,000 per year	$20,000 per year	$20,000 per year
Development	<Inhouse design>	/	/
Maintenance & Modification	<Inhouse design>	<Inhouse design>	<Inhouse design>
[2] Chatbot for In-house Support			
Development [33]	<Inhouse design>	/	/
Maintenance & Modification	<Inhouse design>	<Inhouse design>	<Inhouse design>

FinTech Venture Capital Investment by Financial Institutions ($USD Millions) [34]

Fund	Invested FinTech Company	Amount
AXA Strategic Ventures	One, Inc.	$20M / Series B (Lead)
AXA Strategic Ventures	Particeep	$0.92M / Venture
Citi Ventures	Kinetica	$50M / Series A
Citi Ventures	Trading Ticket	$2.5M / Seed
Goldman Sachs Principal Strategic Investments	DiffBlue	$19.63M / Series A (Lead)
Goldman Sachs Principal Strategic Investments	Dyadic Security	$12M / Series B (Lead)
NAB Ventures	Veem	$24M / Series B (Lead)
NAB Ventures	Data Republic	$10.5M / Series A (Lead)

Illustrate benefit trajectory for enabling technologies

[32]. Bloomberg. (2017). Bloomberg Professional Services | Bloomberg Finance LP.
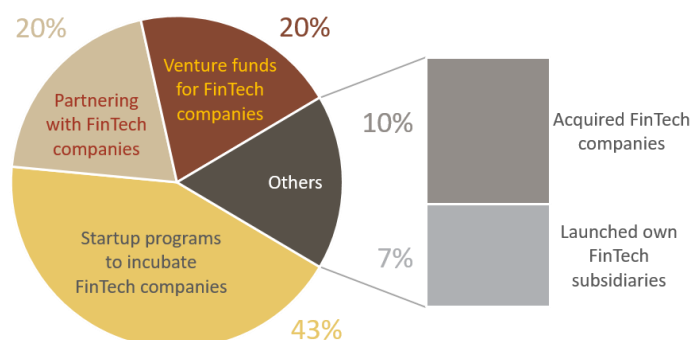[33]. The Economist. (2017). Artificial intelligence in the Real World.
[34]. CB Insights. (2017). The Boom in Global Fintech Investment.

AMBITION AND IDENTITY OF THE ELITE: To Inspire, Be Inspired

Comparative Analysis of FinTech Investments in Banking Industry

The changes and evolution of the financial services landscape that the banking industry has witnessed nowadays are just the beginning of an ever-developing banking eco-system [35]. Technology forces changes in the new financial industry, and it is crucial to deploy innovative and more efficient strategies when combating new disruptions [36].

43%	Rabobank, BBVA, ABN·AMRO, CRÉDIT AGRICOLE, LLOYDS BANK, BARCLAYS, Bank of Ireland, UniCredit, COMMERZBANK, STATE STREET
20%	HSBC, citibank, SBERBANK DIRECT, Santander
20%	HSBC, TD Bank, METROBANK, Santander
10%	BARCLAYS, citibank, BBVA
7%	ABN·AMRO, AEGON

References:
CurrencyCloud. (2016).
Banks and the FinTech Challenge

In order to keep pace with other competitors, Elite Bank should be open to digital and FinTech solutions to mitigate enterprise-wide risks and lower operational expenses [37]. This Bank holds the firm belief that smarter solution could be made simple, and the intrinsic motivation to alleviate the bank's operation should be complemented with technological tools. Understanding, regulating and maximizing the benefit of FinTech is set to be a critical means of not only success, but also the survival in the future investment banking landscape [38].

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Ken CHEUNG
Senior Manager
IT Infrastructure

[35]. BBVA. (2017). Ebook CIBBVA Fintech Revolution - Centro de Innovación BBVA.
[36]. Ernst and Young. (2017). Banking in emerging markets - GCC FinTech play 2017.
[37]. Goldman Sachs. (2017). Fintech Developer as Robo-Advisers in The Works.
[38]. Fidelity. (2016). Fintech: The next disruptive frontier.

[APPENDIX 1]: EM Algorithm for Stock Price Forecasting

Please refer to **"EM-Algorithm (0005HK_Missing Value Estimation).xlsx"**

Estimating Missing Values Using Likelihood Approach

The expectation–maximization (EM) algorithm is a very general iterative algorithm for parameter estimation by maximum likelihood when some of the random variables involved are not observed, (i.e., considered missing or incomplete.) It formalizes an intuitive idea for obtaining parameter estimates when some of the data are missing **[39]**:

(1). Replace missing values by estimated values

(2). Estimate parameters

(3). Repeat Step 1 using estimated parameter values as true values, and

Step 2 using estimated values as "observed" values, iterating until convergence.

SAS Programming Code (PROC MI statement in SAS Software System)

```
EliteBank EM Algorithm (0005HK).sas *

proc mi data = "EM-Algorithm (0005HK_Missing Value Estimation)";
        em itprint outem=outem;
    run;
```

	A	B	C	D	E
1	0005.HK - HSBC Holdings PLC				
2	**Date**	**Last Price**	Real Value of the Missing Quotes	Piecewise 5-Stamp Moving Average	Percentage Error
3	07/14/2017 16:09	75.15		75.06	N/A
4	07/14/2017 15:59	75.1		75.05	N/A
5	07/14/2017 15:58	75.05		75.0375	N/A
6	07/14/2017 15:57	75.05		75.0375	N/A
7	07/14/2017 15:56	75.05		75.0375	N/A
8	07/14/2017 15:55	75.05		75.025	N/A
9	07/14/2017 15:54		75	75.17316842	0.002308912

=Missing Value	= Estimated Value Using Maximum Likelihood Simulation	= Real Minute Quote from Bloomberg

Remark: The Maximum Likelihood Simulation was satisfactory in simulating 0005.HK missing quote at 15:54 on 14th July 2017. The estimated value is approximated to 75.173 while the percentage error is less than 0.0025, indicating that the data set fits well in the user-defined partition **[40]**.

[39]. Hu, W. (2005). Calibration of multivariate generalized hyperbolic distributions using the EM algorithm, with applications in risk management, portfolio optimization and portfolio credit risk.
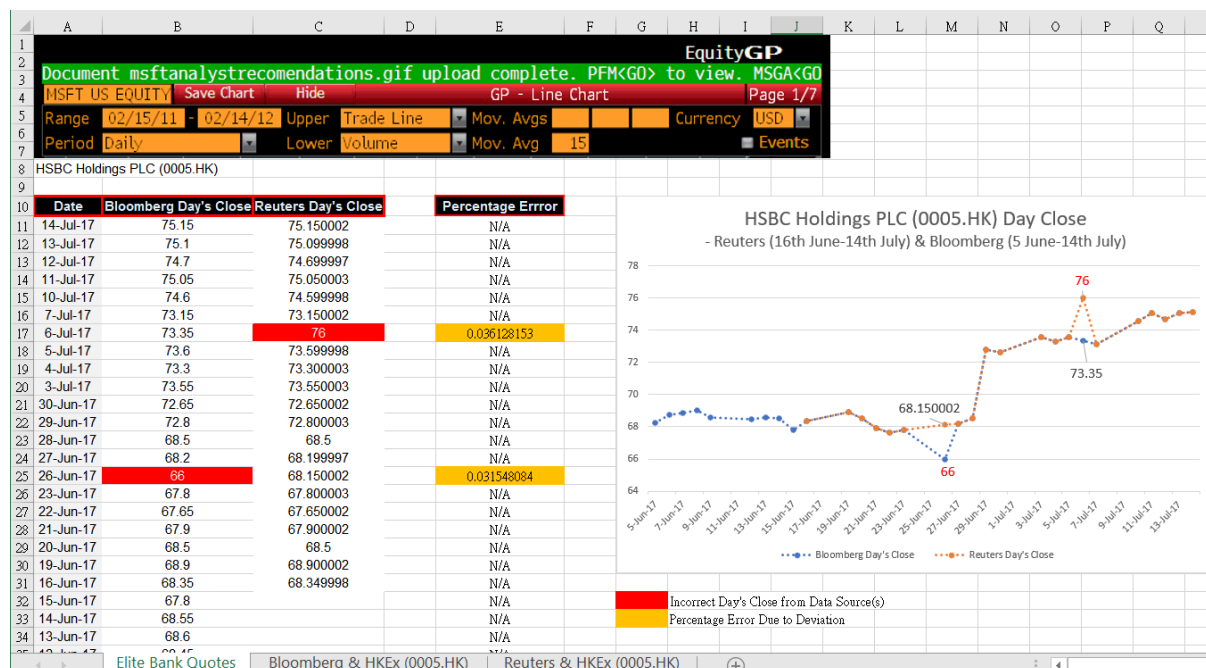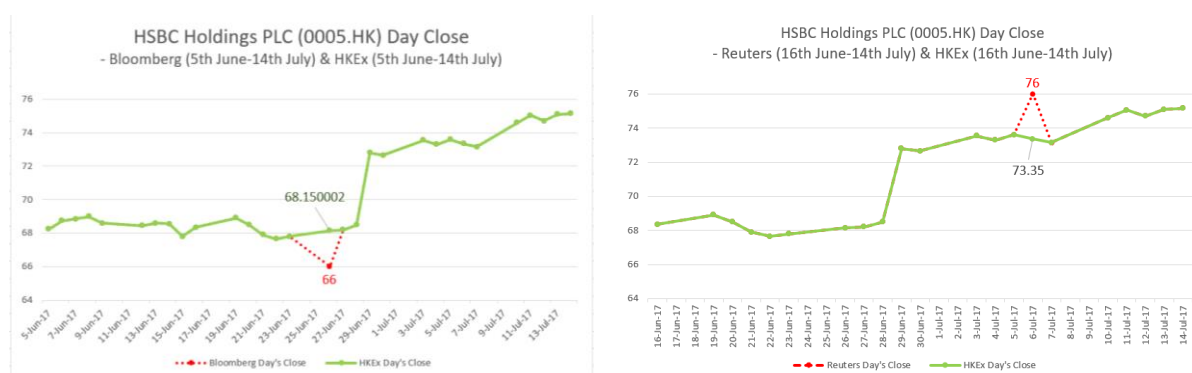**[40].** Xu, L., & Jordan, M. I. (1996). On convergence properties of the EM algorithm for Gaussian mixtures.

[APPENDIX 2]: System Linkage with Exchange

Please refer to **"Elite Bank Multisource Reference Checking and Alert System (0005HK).xlsx"**

Under the multisource reference checking and alert system, the occurrence of price discrepancy indicates that quote prices of Bloomberg and Reuters do not converge. Suppose there were two errors occurred on 06/07/2017 and 26/06/2017) and the alert was triggered.

Utilizing Exchange Data as the Second Line of Defense

After matching the separated data sources with HKEx Day's Close (0005.HK), it was detected that error on 6/7/2017 belongs to Reuters' incompetency, whereas error on 26/06/2017 belongs to Bloomberg's incompetency.

[41]. Mazzucato, M., & Penna, C. C. (2016). Beyond market failures: The market creating and shaping roles of state investment banks.

[42]. Berger, A. N., Imbierowicz, B., & Rauch, C. (2016). The roles of corporate governance in bank failures during the recent financial crisis.

[APPENDIX 3]: ChatBot for In-House Support

Guideline of Using the ChatBot:

Step 1: Please access the following link: "http://56e5a1c8.ngrok.io/"

Step 2: You can then start your conversation with ChatBot. However, if you cannot access the above link, please contact us by michelle03211997@gmail.com. The problem might occur as the server of the link is held by us. In case our server is not connected to the Internet, the link cannot be accessed. However, we endeavor to ensure that the server is connected to the Internet at all times, in order to provide a smooth ChatBot experience.

Step 3: You might want to read the following scenarios to understand how ChatBot can support the operations team.
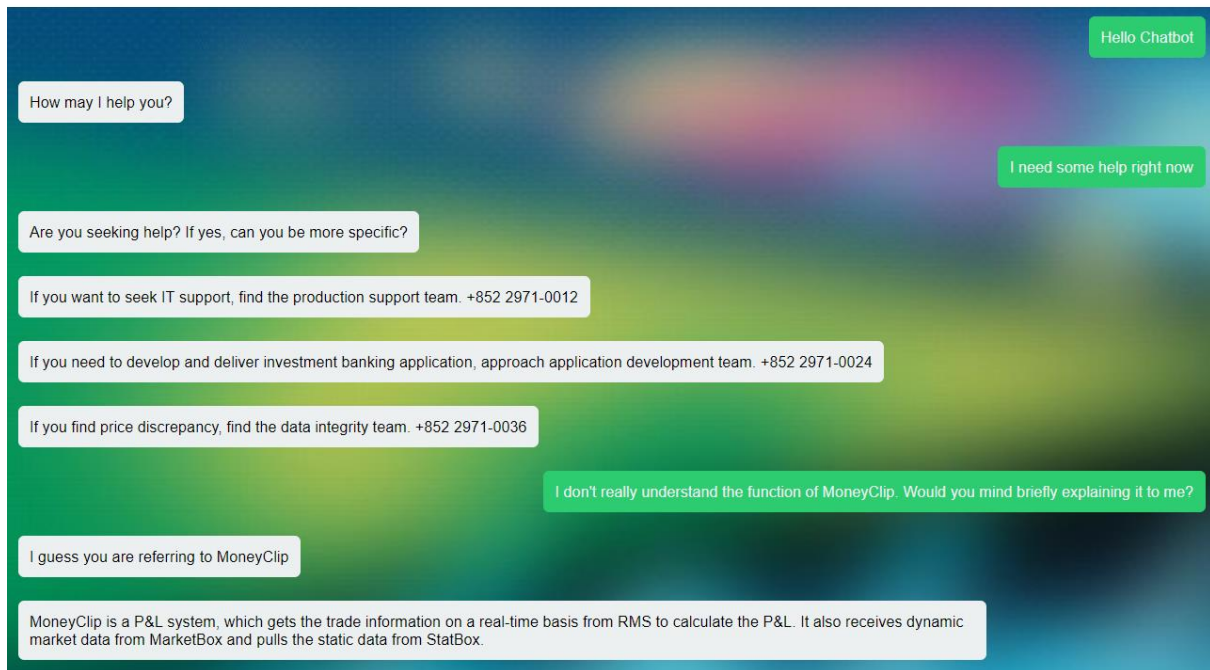
Scenario 1

(a) Greet ChatBot by typing "Hello, I need support", then a message of "How may I help you?" pops out. ChatBot then provides you the phone number of the production team, application development team, and Data Integrity team, respectively.

(b) If you are not familiar with the functions of segments within the trade systems (e.g. TradeCather, TradeLife etc), ChatBot can provide you these descriptions. Suppose you do not understand the function of "TradeCatcher", you might ask "Can you tell me the function of TradeCatcher?". Then, a detailed explanation is given. Occasionally, you might forget the exact name of the parts of the trading system, you can simply type the keywords listed below.

Trading System Components	Key Words
TradeCatcher	Tradecatcher/execute/book
TradeLife	operations/Tradelife/products
RMS	Risk/ RMS/ Risk Management/database
MoneyClip	MoneyClip/profit/loss
StatBox	Data storage/ StatBox/ independent/ instruments
WorldDating	date/ WorldDating/calendar
MarketBox	movement/ MarketBox/dynamic/market

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Scenario 2

(a) If you are confused with the seemingly abnormal P&L figures, you can input some keywords that you come up with (i.e. discrepancy, mistake, quote and etc.) to find out the causes. Normally, there are two main situations.

1) **Case One: Unreliable External Data Source**

   It is possible to have reporting errors occurred in Bloomberg or Reuters. Consequently, multisource reference checking is recommended. In addition, when there is price discrepancy between these two sources, double check with the Exchange and take the price quotes from it as the final reference.

2) **Case Two: Wrong Capturing of Spot Price**

   If you find that there is no price discrepancy between the three external data sources (i.e. Reuters, Bloomberg and the Exchange), the occurrence of abnormal P&L generation might be attributed to inappropriate instructions set in MoneyClip.

(b) ChatBot will ask the user to identify the above two scenarios first, and ask him/her to type in "caseone" or "casetwo".

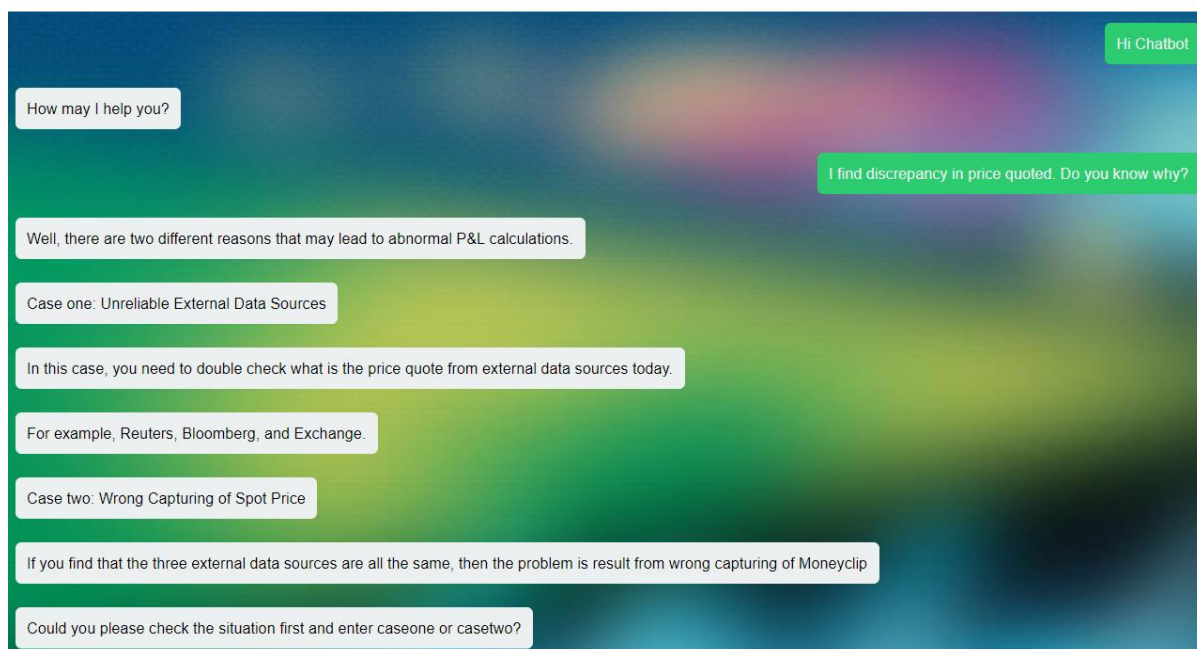**(c)** ChatBot will suggest users two main solutions based on the time of the dialogue.
1) Before 7:30 p.m. HKT (During DI team's normal working hours), contact local DI team to input the accurate market price data into the internal system.

2) After 7:30 p.m. HKT (After DI team's normal working hours), seek help from global support desk. For example, India(GMT+5.5), which is 2-4 hours behind other APAC core financial center, is available to provide real-time assistance for Hong Kong Teams.

(d) If you finish your consultation with ChatBot, say thanks or goodbye to ChatBot. ChatBot is looking forward to serving you again.

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> Hi Chatbot

How may I help you?

> I find discrepancy in price quoted. Do you know why?

Well, there are two different reasons that may lead to abnormal P&L calculations.

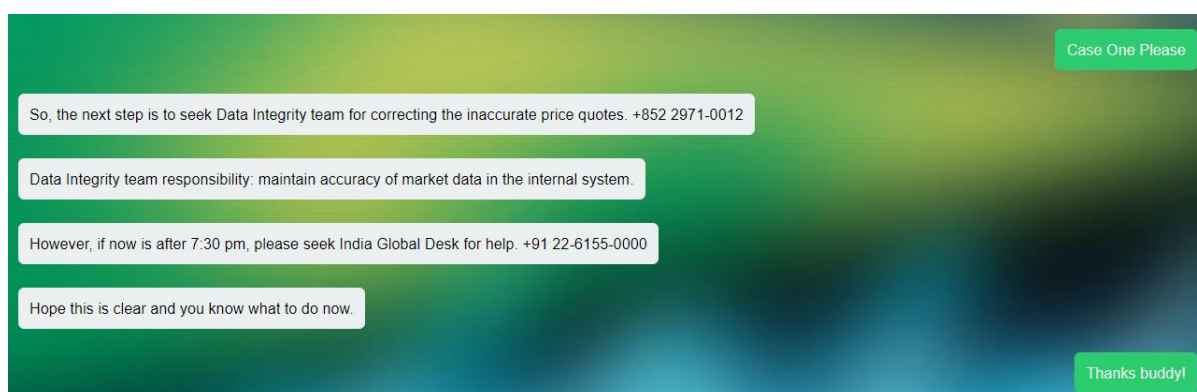Case one: Unreliable External Data Sources

In this case, you need to double check what is the price quote from external data sources today.

For example, Reuters, Bloomberg, and Exchange.

Case two: Wrong Capturing of Spot Price

If you find that the three external data sources are all the same, then the problem is result from wrong capturing of Moneyclip

Could you please check the situation first and enter caseone or casetwo?

> Case One Please

So, the next step is to seek Data Integrity team for correcting the inaccurate price quotes. +852 2971-0012

Data Integrity team responsibility: maintain accuracy of market data in the internal system.

However, if now is after 7:30 pm, please seek India Global Desk for help. +91 22-6155-0000

Hope this is clear and you know what to do now.

> Thanks buddy!

Below are some more keywords that might facilitate your interaction with ChatBot

Support	support/help/people/urgent
P&L	price/discrepancy/ P&L/ report/ abnormal/ mistake / calculation/ quote/ quoting/ external/ capture/ inhouse
Case 1	Caseone/one
Case 2	Casetwo/ two
Closing	thanks/ NO/ thank you/ bye/ goodbye