EMERGING TECHNOLOGY GAME-CHANGERS

NSE 2nd Annual Market Data Workshop

Presented by
Mr. Ade Bajomo
Executive Director,
Market Operations and Technology

October 4, 2017
<table>
<thead>
<tr>
<th><strong>Overview</strong></th>
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<tbody>
<tr>
<td><strong>1. Advanced Analytics &amp; AI</strong></td>
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<tr>
<td>A wide range of historical, current, and forecast data are being used to generate greater actionable insights and build predictive and machine-learning models to identify trends which will inform investment decisions and business strategies.</td>
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<td><strong>2. Blockchain Technology</strong></td>
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<td>Trading and investment management apps have transformed the investment experience of this age. Mobile apps will become a “go to” platform for mass market investing.</td>
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<td><strong>3. Mobile Trading &amp; Smart Apps</strong></td>
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<td>Digital revolution powered by blockchain and other financial technology will deliver “the internet of value”, creating cost savings across the financial services industry.</td>
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<td><strong>4. Algorithmic Trading</strong></td>
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<td>Human intervention in trading and investment will increasingly devolve to algorithms. While HFT is still important, firms are diversifying into longer duration strategies.</td>
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<td><strong>5. Cloud Technologies</strong></td>
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<td>Cloud platforms are no longer the “new normal” for just developers but a standard solution for enterprises. Offering faster deployment; scalability; agility, mobility, and business continuity; and lower total cost of ownership.</td>
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Advanced Analytics & AI
A New World Of Data

Vast amounts of unstructured data are being generated today......

>500 Million tweets per day
1 Billion hours of video watched on YouTube daily
269 Billion emails sent daily
3.2 Trillion searches on Google daily

.. with a significant increase expected over the next 4 years

Global IP traffic (Zettabytes per year)

23% CAGR

2017: 1.39
2021: 3.18

Sources: Radicati Group Email Survey; Omnicore agency twitter statistics; TechCrunch
The Rise of Alternative Data

Alternative data is increasingly being used to inform trading strategies

Any recorded measurement or observation that affects financial markets

- New datasets and applications to the capital market are emerging. E.g.:
  - Twitter sentiment is being used to predict market movement and corporate earnings
  - Weather data now informs commodity trading strategies
  - Advanced analytics (i.e. the structuring and visualization of unstructured data) enables users to extract actionable insights from aggregated data.

Numerical price data from trading activities

Eras in Market Data

- Twitter/ social media sentiment
- Credit card transactions
- News feeds
- Satellite data
- Weather Data

Alternative Data
What does this mean for the Nigerian Capital Market?

- Advanced analytics can support:
  - New trading and investment insights
  - Automated reporting and risk management
  - Market surveillance and compliance

- Harnessing these benefits requires access to a greater volume of varied data, as well as strong analytics capabilities (i.e. tools and personnel).

- Opportunities exist for exchanges, data vendors and software providers, amongst others, to develop new data and analytics products
  - E.g. Nasdaq aggregates its internal feed and third party data (e.g. social media) to develop alpha signals (predictive analytics), to sell to fund managers & traders.

Sources: IBM Analytics: The real-world use of big data in financial services; PwC Global FinTech Survey 2017 Nasdaq Analytics Hub
Creating Value through Data Integration

The **NSE Market Data API and Widget** offer users a simple and inexpensive way to download & integrate market data into their businesses in order to create competitive product and service offerings.

**Broad Coverage**
Get comprehensive NSE market data such as stock quotes, security prices, trade and fundamental data in single package.

**Multiple Formats**
With wide formats supported, market data integration to business solutions cannot be simpler. Options include; widget format, CSV, XML, JSON, Atom & RSS feeds.

**Metered Usage**
Why buy data in bits and pieces when you can access all on your chosen data usage band.

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**What do APIs do?**

API is a technology that allows and manages the interaction between two online/internet connected services.

An example is: The pulling of share price data from the Nigerian Stock Exchange API into a website.

**Why APIs Rock!**

- APIs provide remote processing power for business intelligence.
- APIs facilitate the development of mobile apps with seamless data connectivity, dynamic functionality and power.

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Artificial Intelligence Matters

Growth in Artificial Intelligence (by 2021)

$2.8Bn in investment by financial services firm in AI tech

>$47Bn in revenue from AI business activities

Evolution of AI

- Big Data has supported AI to move from automation to intelligence, and will remain critical to the success of AI as more and new data is used to train AI systems

AI Opportunity Areas in The Capital Markets

<table>
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<tr>
<th>Robotics Process Automation</th>
<th>Machine Learning</th>
<th>Cognitive Analytics</th>
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<tbody>
<tr>
<td>• Client on-boarding</td>
<td>• Client research</td>
<td>• Client insights/ analytics</td>
</tr>
<tr>
<td>• Issuance, M&amp;A</td>
<td>• Client relationship management</td>
<td>• Pre-trade/ post-trade analytics</td>
</tr>
<tr>
<td>• Data Management</td>
<td>• Trade execution</td>
<td>• AML/ surveillance</td>
</tr>
<tr>
<td>• Post-trade Operations</td>
<td>• Reconciliations</td>
<td>• KYC</td>
</tr>
<tr>
<td>• Finance control</td>
<td>• Transaction reporting</td>
<td>• Enterprise risk management</td>
</tr>
<tr>
<td>• KYC</td>
<td>• Cyber security</td>
<td>• Financial/ regulatory reporting</td>
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<tr>
<td>• IT service operations</td>
<td></td>
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<td>• HR</td>
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<tr>
<td>• Legal</td>
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## Getting Ahead With A.I.

### Advantages of Artificial Intelligence

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<tr>
<th>New Businesses</th>
<th>Customer Outcomes</th>
<th>Operational efficiency</th>
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| New and innovative products, services and business models powered by AI | Growth in customer acquisition, retention and overall satisfaction via:  
  • Superior experience to customers and users based on hyper-personalization and curation of real-time information  
  • Ability to attract and engage with customers across various channels e.g. online customer services modules and financial advisors | Intelligent automation enhances profitability through more efficient processes, activities and services  
  • Supports ‘lean’ strategies and headcount reduction |

### Case Use: Robo-Advisors

Robo-advisors provide financial advice and/or online portfolio management with moderate to minimal human intervention, using algorithms. Advantages to businesses/ beneficiaries include:

- Low-cost advisory services
- Greater accessibility (leading to greater customer acquisition)
- Consistent customer support (i.e. investment advice)
The data revolution is upon us, and it is absolutely critical for the Nigerian capital market to get involved, otherwise we will be left behind.
2 Blockchain Technology
### Components of a Distributed Ledger

**Blockchain – The Key Five Parts**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Disruption</th>
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<tbody>
<tr>
<td>Common Database</td>
<td><strong>Tokenisation of assets/contracts</strong></td>
<td>Underlying assets are uniquely identified</td>
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<td></td>
<td></td>
<td>Form a database with ownership rights assigned</td>
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<td></td>
<td></td>
<td>Disruption: Custodians and banking</td>
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<td><strong>Universal ledger</strong></td>
<td>Creates a universal record of ownership and transactions</td>
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<tr>
<td></td>
<td></td>
<td>Updated in realtime with automatic reconciliation</td>
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<tr>
<td></td>
<td></td>
<td>Disruption: Removes reconciliations from finance</td>
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<tr>
<td>Auto-Execution</td>
<td><strong>Self-enforcing smart contracts</strong></td>
<td>Automatic settlement of financial obligations between counterparties</td>
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<tr>
<td></td>
<td></td>
<td>Convert terms of a transaction into “financial code”</td>
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<tr>
<td></td>
<td></td>
<td>Disruption: Removes financial intermediaries in post trade</td>
</tr>
<tr>
<td>Distributed Architecture</td>
<td><strong>Cryptography and update by consensus</strong></td>
<td>Cryptographically enforced database</td>
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<td></td>
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<td>Decentralized nature of the database maintains</td>
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<td></td>
<td></td>
<td>Confidentiality</td>
</tr>
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<td></td>
<td></td>
<td>Disruption: No central point of failure</td>
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<td></td>
<td><strong>Distribution of ledger</strong></td>
<td>Participants mutually agree updates to the database</td>
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<td>All work off a local copy without connectivity to a central source</td>
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<tr>
<td></td>
<td></td>
<td>Disruption: Removes multiple reconciliations and enhances P2P</td>
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Source: Deutsche Borse Group | Celent
Blockchain: Disrupting Data Management

Blockchains are **built on encryption, mutual consensus data and smart contracts.**

They reconcile data between independent parties to create a **single true record, used by all participants**, containing richer datasets than those existing today.

This in turn enables **new industry processes to be developed**, based on the use of transparent real-time data, immediate settlement of transactions and the expansion of auto-executing ‘smart’ contracts.

Sources: Oliver Wyman: Blockchain in the Capital Markets; Mechanism culled from PC Magazine
Blockchain in the Capital Markets

Blockchain is still in its infancy...
..But will be mainstream and integral to the capital markets by 2025.

Potential benefits of Blockchain to the capital markets

<table>
<thead>
<tr>
<th>Pre-trade</th>
<th>Trade</th>
<th>Post-trade</th>
<th>Custody and securities servicing</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Transparency and verification of holdings</td>
<td>• Secure, real-time transaction matching, and immediate irrevocable settlement</td>
<td>• No central clearing for real-time cash transactions</td>
<td>• Primary issuance directly onto a blockchain</td>
</tr>
<tr>
<td>• Reduced credit exposures</td>
<td>• Automatic DVP on a cash ledger</td>
<td>• Reduced margin/collateral requirements</td>
<td>• Automation of servicing processes</td>
</tr>
<tr>
<td>• Mutualisation of static data</td>
<td>• Automatic reporting &amp; more transparent supervision for market authorities</td>
<td>• Faster novation and efficient post-trade processing</td>
<td>• Richer central datasets with flat accounting hierarchies</td>
</tr>
<tr>
<td>• Simpler KYC/KYCC via look through to holdings</td>
<td>• Higher AML standards</td>
<td>• Fungible use of assets on blockchains as collateral</td>
<td>• Common reference data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auto-execution of smart contracts</td>
<td>• Fund subscriptions/redemptions processed automatically on the blockchain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Simplification of fund servicing, accounting, allocations and administration</td>
</tr>
</tbody>
</table>

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3 Mobile Trading & Smart Apps
Mobile Goes Mass Market

Global Mobile Landscape (2017)

- 5.1 billion unique mobile subscribers globally
- 11 exabytes of mobile data traffic generated monthly

50% of global web traffic is from mobile phones
81% of web traffic in Nigeria is from mobile phones

• Mobile technology is critically important to Nigeria
  ✓ High mobile - low broadband penetration
• In January 2017, Nigeria topped the global mobile share ranking, as phones accounted for more than 4 out of 5 web pages served.

Evolution of Mobile Trading Apps

- **Phase 1**: View-Only Buy-Side Mobile Apps
  - Limited ability to only view account/trading dashboards

- **Phase 2**: Action-Oriented Buy-Side Mobile Apps
  - Ability to provide trade alerts, route orders etc.

- **Phase 3**: Dynamic Multifunctional Systems & Buy-side Apps
  - Ability to route orders, monitor bank balance, transfer money etc

Source: Cisco, IBMA

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Algorithmic Trading
The Race to “Zero” and Rise of Algos

Timely access to market intelligence and swift trade execution remain key to wealth creation.

- Today, traders rely not only on high-speed information networks for timely access to news and market data, but also on algorithms to swiftly generate and execute trading decisions in “sub-milliseconds”.

  - Market research company Technavio the predicts the market for global algorithmic trading will grow:

    - 10.3% ↑
    - CAGR between 2016 and 2020

- Meanwhile, the “Quantum Computing Supremacy Race” is expected to result in groundbreaking computing power, enabling disruptive new technologies that will power the future of algo trading.

- The race is projected to propel the Quantum Computing Technologies & Global Market to:

  - $10.7bn ↑
  - By 2024

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Value from Algo Trading

Better investment decisions

- Opportunity to back-test the algorithm, based on available historical and real time data
- Simultaneous automated checks on multiple market conditions
- Reduced possibility of mistakes by human traders based on emotional and psychological factors

Enhanced efficiency

- Instant and accurate trade order placement avoids significant price changes
- Reduced transaction costs
- Reduced risk of manual errors in placing trades
Cloud Technologies
The Rise of Cloud Computing

Cloud computing is increasingly enabling new, complex business models through various platforms...

- **Software as a Service (SaaS)**: Expected to increase 20.1%, reaching $46.3Bn in 2017.
- **Platform as a Service (PaaS)**: Fastest-growing sector of cloud platforms with 32% adoption in 2017.
- **Infrastructure as a Service (IaaS)**: Projected to grow 36.8% to reach $34.6Bn in 2017.

...and is projected to increase from $67B in 2015 to $162Bn in 2020

CAGR: 19%

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# NSE X-Cloud Offering

The NSE X-Cloud is a fully managed, innovative and integrated hosting platform.

<table>
<thead>
<tr>
<th>MOS Compliance</th>
<th>Increase Performance</th>
<th>Cost Effective Solution</th>
<th>Dedicated Support Staff</th>
<th>Flexibility and Service Availability</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Achieve the NSE minimum operating standard requirements by putting in place strong BCP.</td>
<td>• Achieve success in trading strategies with low latency access to the NSE trading servers.</td>
<td>• Avoid fixed infrastructure investment costs and focus on managing your core business.</td>
<td>• Get access to a dedicated support team and a 24/7/365 monitoring system.</td>
<td>• Grow your business at your own pace with guaranteed power and 100% uptime.</td>
<td>• Multiple levels of physical and digital security giving you the highest levels of protection.</td>
</tr>
</tbody>
</table>

Low Cost – High Value Cloud Solution.
**The NSE Provides...**

- **Issuer Info Display**
  Enables listed companies to display their own stock quotes on their corporate website on a near real-time or delayed basis.

- **TV End of Day**
  Enables authorized users to display the end of day all share index and top traded stocks in each sector.

- **X Gen News**
  Receive e-mail alerts on company disclosures as they are disseminated on the trading floor.

- **Ticker Licenses**
  Enables a contracted user to display the NSE scrolling Ticker across TV, website, video walls or other public spaces.

- **Hosting Services**
  Includes co-location, disaster recovery plans and hosting solutions.
“You can’t use up creativity. The more you use, the more you have.”

— Maya Angelou
THANK YOU

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