Institute of Systems Science
National University of Singapore

MASTER OF TECHNOLOGY IN ENTERPRISE BUSINESS ANALYTICS

Graduate Certificate Examination Semester I 2020/21

Subject: Big Data Engineering and Web Analytics

APPENDIX A

'GET Platform' Case Study

Appendix A

GET Platform – Case Study

A Food Ordering, Delivery Platform

(A Hypothetical Case Study)

Introduction and Background

GET is a local company incorporated in 2014. The company has a scalable data processing platform to support its core business towards food ordering and delivery services. The platform connects the customers, Food and Beverages (F&B) outlets and the delivery service providers. The customers can be individuals or corporate clients, F&B outlets include hawker stalls, fast food chains, restaurants and food caterers. Delivery service providers are freelance individuals or delivery companies having their own fleet of vehicles. The platform is available to all its stakeholders via the GET app, supporting multiple devices such as phones and tablets or via the browser of the GET company website.

A typical food ordering process starts with the customer placing order to the platform. The customer can choose either to dine-in or delivery. If the customers choose to dine-in, the F&B outlet will retrieve the order and prepare the food for the customers. If the customers opt for delivery, then both the F&B outlet and a selected delivery driver nearby will be notified of the order. Once the F&B outlet finishes preparing food, they will notify the platform, that will further direct the driver. The driver will then pick-up the food from the F&B outlet and deliver the food to the customer.

For the use of the platform, GET will charge the following:

- Both customers and delivery drivers will be charged based on the individual transactions created from orders created and orders delivered respectively.
- However, for F&B outlets, the company charges are monthly. It is calculated based on total storage, hosting options, and transaction volume incurred.

Current System

The current GET platform support its three key stakeholders i.e.: *Customers, F&B outlets and Delivery Drivers* as below:

1. The platform enables customer more viable food options from multiple F&B outlets, located anywhere in the island - provided the F&B is agreeable. But all content is as of now text based.
2. The platform enables the F&B to cater food services to a larger audience of customer there by improving overall sales.
3. The platform performs route and zone delivery optimisation, thereby consolidating delivery orders when and wherever possible. Drivers will benefit from effective planning in terms of more order delivered in similar route.

The current system provides the below core services:

1. Customers are able to:

- Search for different F&B outlets by location and cuisines.
- Place order for selected dishes and beverages from multiple F&B outlets.
- Make payment for the order. Watch the order status progress.

2. F&B outlets are able to:
   - Provide text-based menu, platters, combo meals and promotion details (if any).
   - Notify order status to both customers and delivery drivers.
3. Delivery providers are able to:
   - Receive notifications about the available delivery orders and their current status.
   - Be alerted on key activities such as pickup, route alterations and delivery special instructions (if any).
   - Communicate with the customers and the F&B outlets in case an issue is encountered during the order delivery process.

Current GET App

The current app is divided into THREE components: (1) Web application and Mobile Application, (2) Different services, such as customer service, order service, F&B service, and payment service & (3) Notification system. The following diagram (Figure 1 GET App Architecture) displays the status:

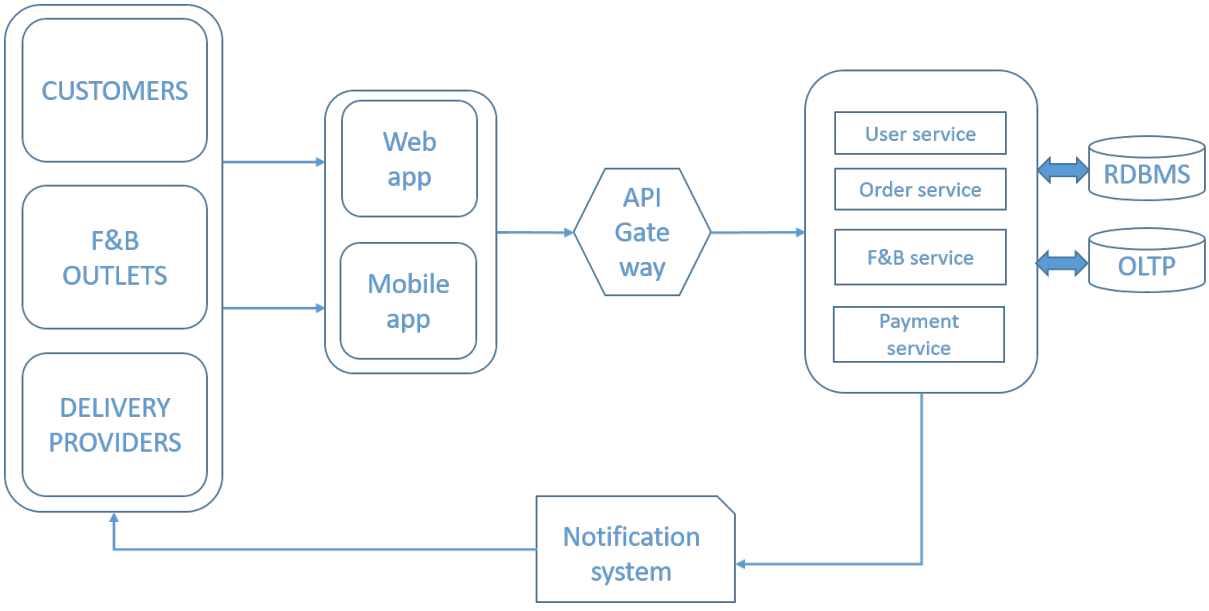

Figure 1 GET App Architecture

In the current GET App:

- Mobile and web applications only focuses towards fulfilling key business functionalities such as user management, F&B services, order management, payment system and delivery services.
- Different partners (customers, F&B outlets, delivery drivers) will access the web app or mobile app and make different requests. All the requests will go to different services via the API gateway.

- Different services including user service, order service, F&B service and payment service will use OLTP (Online Transaction Processing) database. Information about different F&B outlets, the menu, prices will be text-based and stored in RDBMS (Relational Database Management System).
- Warehousing capabilities are limited to stores' single day-to-day transactions.
- Once the order is placed, all the information is sent to the notification publish subscribe messaging server. It notifies the selected F&B outlet and the selected delivery driver about the order. Once order is ready, delivery drivers will be notified about the location details of the F&B outlet.

Current and Envisioned Data Architecture

The current data architecture of GET deals with structured and repetitive data. These are handled via OLTP systems, Data Mining (DM) and Data Warehousing(DW) systems. The order is handled via a regular RDBMS and the company is exploring NoSQL document options moving forward. OLTP, DW and DM generate a lot of log files and these are not processed at the moment. They are dumped into the Data Lake's file store. The main layers involved in the current architecture are ingestion, data preparation, processing pipelines, data work flows, query interaction and visualization layers. Most actionable insights, reports and business decisions currently derived do not have any analytics involved. The figure below explains the current data architecture layering.

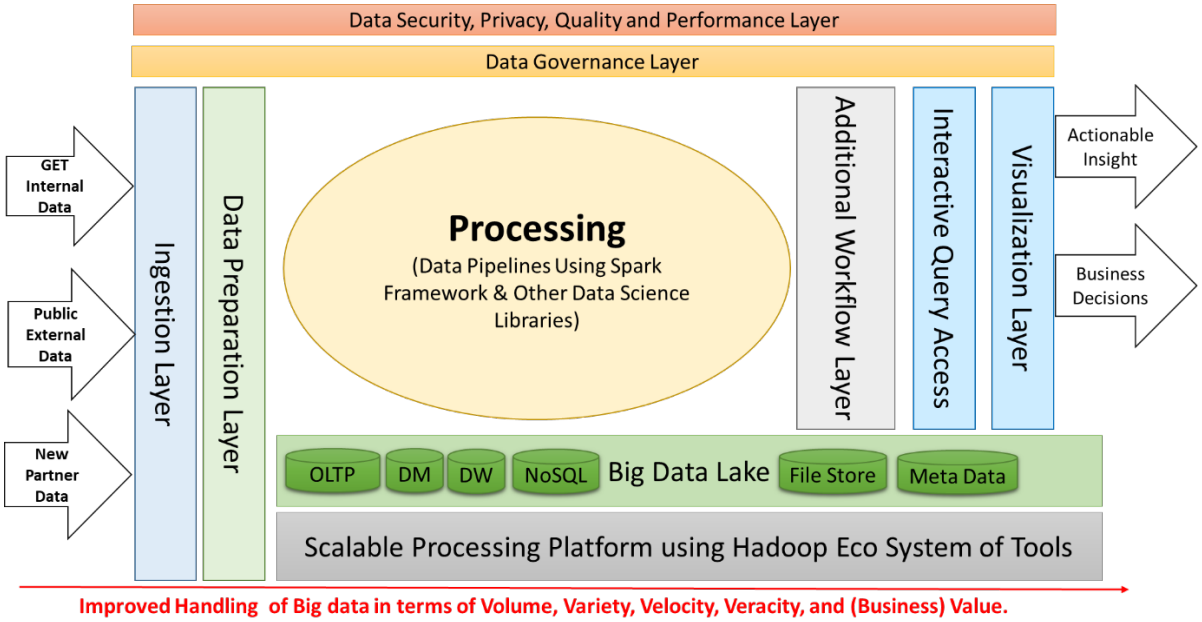

Figure 2 Current Data Architecture

Operational Challenges: Tremendous Surge in Traffic, and New F&B Outlets; Occasional Platform Crashes.

During the COVID-19 Circuit Breaker (CB) period, F&B outlets were disallowed to have dine-in customers. Many F&B outlets then started allowing take-away and delivery. Individuals not in the essential services sector had to work from home. This created a huge increase in the demand for food delivery services and there was an increase in the number of customers that downloaded the GET app too.

This caused tremendous stress and load on the platform. The new peak loads and new F&B partner onboarding process is creating new challenges in the master data management and governance layer in terms of data formats, mapping, transformation and encoding. Also the increase in platform adoption is pushing the real time loads and scalable resilient app provisioning expected out of the data platform. There were periods, especially during the peak e.g. dinner time, where it could not handle such large demand and load and it caused the app and website to hang. There were also incidents where the customers passed through the ordering stage and paid for the order but then the platform was not in proper receipt of the same as the customer experienced app crash and restart. There were also incidents where the F&B outlets were not notified of active orders.

Thus, there were many unhappy customers who had posted negative feedbacks and reviews on the internet forums. Many customers also dialed the Company hotline and due to the surge in call numbers, many were unable to get through.

Directive by the Management to Enhance Capabilities

There are several new capabilities that the GET management wants to introduce to the platform to improve the situation. GET wants to improve the Enterprise-level data architecture to ensure that the disintegration of integrated data stores is minimized. This will enable GET platform to produce more meaningful insights and decisions that are scientifically enable by effective use of analytics, statics and machine learning automation in their data architecture.

- For ***customers***, the new platform should provide an image/video enriched interactive catalogue of the cuisines. The management wants to employ analytics capabilities in understanding and enhancing the customers' experience. Based on the data collected corresponding to an individual customer, statistical and machine learning techniques are to be used to find out the customer's preferences. Prediction and recommendation engines were envisioned. For example, in the food ordering function, based on the individual's past food preferences similar food items can be recommended. Customers can also track their orders real-time. The customers should be able to view the stages of the order, e.g. F&B preparing the food, a delivery driver has accepted the job and the estimated time of delivery etc.
- For ***F&B outlets***, the new enhanced capabilities would be, the ability of the customer to provide review and feedback to the F&B outlets in terms of, e.g., the quality of the items sold by the F&B outlet, via the app and website. The platform should be able to process this non-repetitive, semi-structured/ unstructured content for feedback analysis and provide insights on food items such as top rated items, best-seller items etc. using analytics. The F&B outlets should be able upload different formats of menu such as image, video and picture to enhance the customers' experience.
- For ***delivery providers***, to improve operational efficiency it should suggest the optimal route to the driver while delivering the food to the customer by leveraging graph and web analytics. The new platform should be able to integrate with Google maps or other similar map software and update the dynamic traffic conditions, so that the drivers can reach the destination in the shortest time.

Data Enhancement on the Platform

The GET platform currently has the following data sets stored in their Database:

- Consumers' profile such as name, address, date of birth, phone numbers, etc.
- F&B outlets' information, such as restaurant name, address, menu items listed, price, etc.
- Order Delivery Location data for Customers.
- Payment and account related transaction information against the various orders from customers.
- Charges and Invoice payment redirection towards F&B on an aggregated manner.

Potential New Data Sources:

- Image of the dishes
- Review from customers
- App logs
- Clickstreams collected from customers browsing the new interactive food menu catalogues for various F&B outlets
- Sensors' information
- Map information
- Location information
- Built-in GPS data of the delivery provider

Sample F&B vs Customer Interaction Logs

	cust_id	Food_id	SpendingSoFar
1	B570	C7894	1345.60
2	E2867	D5447	967.45
	. . .	. . .	. . .

Sample Application Log

```
2020-02-03 18:35:34 UseCase6 [INFO] everything normal for id 577725851
2020-02-03 18:35:34 UseCase4 [FATAL] system problem at id 1991281254
2020-02-03 18:35:34 UseCase3 [DEBUG] detail for id 1304807656
2020-02-03 18:35:34 UseCase3 [WARN] missing id 423340895
2020-02-03 18:35:34 UseCase5 [TRACE] verbose detail for id 2082654978
2020-02-03 18:35:34 UseCase10 [ERROR] incorrect id 1886438513
2020-02-03 18:35:34 UseCase9 [TRACE] verbose detail for id 438634209
2020-02-03 18:35:34 UseCase8 [DEBUG] detail for id 2074121310
2020-02-03 18:35:34 UseCase0 [TRACE] verbose detail for id 1505582508
2020-02-03 18:35:34 UseCase10 [TRACE] verbose detail for id 1903854437
2020-02-03 18:35:34 UseCase7 [DEBUG] detail for id 915853141
```

Sample Click Stream

	server_time	device_type	session_id	cust_id	Food_id
1	02/03/2020 18:35:34	android	B65430	B570	C7894
2	02/03/2020 18:35:34	android	B4305	E2867	D5447
3	02/03/2020 18:35:34	android	H9862	H1850	F2937
4	02/03/2020 18:35:34	android	E38850	H9140	C342
5	02/03/2020 18:35:34	android	G19497	D5051	H2284
6	02/03/2020 18:35:34	android	D25514	D3612	C5346
7	02/03/2020 18:35:34	android	B12443	C6117	B5757
8	02/03/2020 18:35:34	android	B089565	I9587	I8013
9	02/03/2020 18:35:34	android	E97567	F8149	B18262
10	02/03/2020 18:35:34	android	I31739	D3557	B13644
11	02/03/2020 18:35:34	android	B00737	G8784	J1397
12	02/03/2020 18:35:34	android	D25383	D461	H8243
13	02/03/2020 18:35:34	android	D22314	J1340	D8737
14	02/03/2020 18:35:34	android	C93018	B6365	I541
15	02/03/2020 18:35:34	android	B43838	I890	B449
16	02/03/2020 18:35:34	android	I72653	D0758	F7819
17	02/03/2020 18:35:34	android	C76009	G207	B12632
18	02/03/2020 18:35:34	android	D43675	H131	H6109
19	02/03/2020 18:35:34	android	B12443	C6117	C8034

Business Outcomes Expected from Data Enhancements:

The GET platform aims to obtain insights into its operational performance, customer experience and business value with a view to optimizing its overall business strategy. A few noteworthy expectations are listed here:

1. GET wants to improve sales and profit.
2. GET wants to increase active customer base.
3. GET wants to monitor application performance, system behaviour, and any kind of unusual activity across the entire application stack.
4. GET wants to maintain Service Level Agreements (SLAs) with F&B Stalls and its customers. By taking a proactive stance on problem detection (such as missed delivery or wrong order), GET wants to avoid service disruptions and customer displeasure, potentially leading to lost revenue. GET wants the platform to tag such situations proactively and flag possible counter offers.
5. GET wants to demonstrate compliance. GET has internal policies to ensure consistent service, many are also legally required to adhere to regulations and security standards like HIPAA, PCI DSS, or GDPR.
6. GET wants to measure the effectiveness of its targeted marketing and sales campaign.

Data Lake

For the new GET platform, the IT team aims to build a more inclusive data lake with the following key characteristics:

- Data can be of different types, i.e., it can be structured, semi-structured and unstructured. Data can be repetitive and non-repetitive (RDBMS, NoSQL In-Memory and File Stores)
- The data lake should be able to handle the increase order volumes moving forward. It should provide scalable and fault resistant framework.
- It should provide the following types of analytics processing on the collected data lake:
    - Real-time processing. Customers' orders and payments should be performed in seconds. It should also provide real-time tracking for customers.
    - Transactional analytics: once data has been processed by batch or streaming processing, it needs to be stored in such a way that it can be quickly accessed and queried.

Future Strategic Expansion Plans

The management believes that the people are now more comfortable with online food delivery services and moving forward there will be even more demand. The number of Customers in 2014 was 50,000 and currently it has grown to 1,800,000 customers. In addition, moving forward, the company has plans to expand to the Southeast Asia region, where it estimates that the number of customers would increase by more than five folds to 10 million in the new market. Though GET may go regional, the companies headquarter will continue to remain in Singapore.

Service Enhancement by Usage of IoT Data

After upgrading the current systems, GET realized that it was still facing three key challenges:

1. The consumers' reduced tolerance of the degradation of perishable foods.
2. The lack of supervision that may cause the degraded food reach the customers, threatening consumers' health.
3. The urgent need to reduce the high supply chain management cost and improve operational efficiency.

The senior management team of GET realizes that, introducing IoT devices in the existing infrastructure will make kitchens smarter and delivery mechanism more efficient. For example:

1. Smart, connected kitchen: Smart kitchens are efficient, and they can ensure food quality with a speedy delivery as per customer expectation, out of the delivery apps.
2. Fresh food dispatched; fresh food received: IoT solution architecture can pass tracking information, data from various sensors and other devices to the kitchen platform. The AI engine build into the platform will empower it to take simple decisions without the need of human intervention. The IoT-powered Food Delivery app Solution can be structured in the form of delivery boxes which are equipped with temperature sensors that warns the delivery person and the restaurant management through the system placed inside the restaurant, whether the temperature inside the box has dropped below the optimum level.

3. Hyperlocal delivery services: An ordered item may not be available in a store and the delivery person might have to shop at various stores which may delay the delivery. By bringing the partner merchants on the same platform and enabling their establishments with IoT devices, the delivery person doesn't have to visit one store after another. The delivery person can check the status of nearby stores with a mobile app connected to the platform to the list of the items to be delivered to the end customer.

GET realizes that the "faster efficient delivery" is the key to enhance service quality. GET wants the delivery person to arrive just in time when the order is ready. If it is too early then the delivery person will wait unnecessarily, losing money from possible other orders. But if the driver arrives too late, the food may be delivered late or cold to the hungry customers.

For each order, the system must make three predictions upfront:

1. Driving time to reach the F&B outlet
2. Driving time to deliver the food and
3. Preparation time for the restaurant to prepare the order.

Without processing IoT signals, predictions can be difficult, given that GET does not have any insight into meal preparation time.

The execution process of the whole supply chain needs to be dynamically monitored. The sensor networks are to be used to measure the dynamic parameters such as environment (e.g. temperature, pressure, humidity, etc.), movement (e.g. velocity, vibration, etc.), and the real-time status of preparation of foods. GET plans to procure Sensor technology that can be used to monitor intelligently, temperature and humidity during the transportation of the freshly cooked food as a primary technique.

The real-time operations of the supply chain can be captured and monitored through the cloud platform. IoT and cloud service platform can be implemented for monitoring and diagnosing issues of supply chain operations.

Closing Remarks

In addition to the current capabilities of the existing platform, the proposed new platform will enable and integrate more enhanced capabilities. It will have the ability to process and handle increased amount of structured and unstructured data from a larger variety of sources (apps on phones, devices and sensors) that are aggregated by the data lake. The platform will clean and transform the data and use the data to make predictions and analysis on specific outcomes. The enhanced platform will incorporate predictive and reasoning ability as it stores and makes use of data modelling via statistical and machine learning algorithms based on individual behaviors, preferences, and habits.