Section 1: Week 3: Smart Restaurant Proposal

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Smart Restaurant Proposal

The Black Bean started life as a simple ‘mom-and-pop restaurant,’ but has since rapidly grown to over one hundred locations. Now the business faces challenges ensuring the consistently high-quality experience customers know and love. As mitigation, the organization wants to deploy technology that provides business intelligence across the end-to-end lifecycle starting at the supply chain, continuing into each restaurant location, and finally presenting a personalizing mobile and social media presence.

# Current State of the organization

One of the critical challenges for Black Bean comes from its inability to continue scaling existing processes. When the business only needed to manage a handful of sites performing inventory management manually with local spreadsheets was sufficient. As the organization grew, its ability to report on the state became more distorted. The latency between sales information arriving at head-quarters causes incorrectly placed products to spoil in one location and be unavailable in another. Similarly, as a small group of franchises, the marketing team understood the identity of their customers. Now that the business spans numerous locations, they face challenges connecting with the highly diverse communities.

Black Bean’s IT department has addresses aspects of these challenges through point-of-sale solutions. These initial systems have standardized reporting templates that managers can manually populate. The organization also has investments in distribution and supply chain processes that do not yet emit telemetry. They also benefit from a positive work culture where employees are willing to embrace technology, assuming its beneficial and not overly complicated.

# Determine functionality and missing capabilities

There are three distinct pillars that Black Bean wants acumens into, specifically the supply chain, restaurant efficiency, and customer experience. These insights need to answer adaptive questions to leadership in a dynamic market place.

## Supply Chain Monitoring

The company specializes in desserts made from highly perishable ingredients. With the ability to monitor the various distribution centers’ environmental controls, such as humidity and temperature, product life can be extended and reduce waste. Integration of the point-of-sale (PoS) would ensure that products are routing to the ideal regions. As these efficiencies materialize, the forecasting error will reduce inventory in storage without risking shortages.

## Restaurant Efficiency

If the eatery does not have enough wait staff, then the customer might choose a competitor instead. Having enough staff is subjective, given the variability in skill levels between tasks. There are several other key performance indicators (KPI), such as trends in table reservations, that management can monitor to validate efficient order-flow (Liyanage et al., 2018).

## Customer Experience

Customer Relationship Management (CRM) has converged with social media and created a firehose of user-generated content (UGC). Now organizations need new techniques for topic extraction and sentiment analysis across the unstructured text. Traditional loyalty programs are ineffective because they focus on existing customers, despite the majority are new users (Koubai & Bouyakoub, 2018). These issues require pivoting to marketing strategies that align the business personality with the target audience.

# What kinds of tooling would you recommend

The business intelligence solution needs to consume heterogeneous data sources and present role-based perspectives into the operational state. These data sources will originate across the business pillars as IoT sensors, mobile app interactions, point-of-sale data, hierarchical inventory caches, advertising impressions, customer and employee feedback, and internal streams. Different aspects of these feeds will be relevant to customers, material suppliers, the wait staff, leadership, marketing, and sales teams.

The format and mechanism for providing this information to the different audiences require specialization. For instance, identifying too many apples is cached in a regional warehouse should trigger a local advertising campaign to customers for apple pies, and in parallel, notify the local farmers to delay further shipments. The signal to the customer might occur through a mobile push notification, versus the farmer receives an email — meanwhile, the leadership team overseas these communications through a desktop web portal.

Making sense of these micro-optimizations is difficult for humans due to the depth of information to parse (McCrea, 2019). Systems need to detect these ‘too many apples’ scenarios that will happen with sufficient lead-time to make an actionable decision. These situations require machine learning models that can assess big data sets to surface these hidden rewards. Artificial intelligence is becoming democratized through Machine Learning as a Service (MLaaS) technologies, such as Microsoft Cognitive Services and Amazon SageMaker. These tools lower the cost and complexity and allow businesses of any size to reap value.

Other audiences will desire tooling that transforms the data into more personalized views, such as menu recommendations or targeted advertisements. Even something generally appealing, like cake and ice cream, will get a different reaction from vegan customers.

# Research and Evaluate Solutions

## Restaurant as a Service

For businesses that do not want a lot of hassle or need customizations, a SaaS solution might be the best fit. These platforms follow Enterprise Resource Management (ERM) implementation with a few optimizations for vertical restaurant businesses. Two well-known providers are OpenTable (ENP Newswire, 2018) and Rosnet (Marketwired, 2015), both with full business intelligence suites that focus on inventory management, order-flow, employee scheduling, and visitor forecasting. Other providers, such as Foody, concentrate on customer enjoyment through a collection of KPS that measure order delivery times, mobile order-flow, and personalized menus.

## Deploying IoT

The use of Personal Digital Assistants (PDAs), like the Apple iPad, is a well-established trend. These devices reduce order entry errors but lack a broader integration with the rest of the experience (Saeed et al., 2016). Saeed et al. propose a solution that pairs a mobile customer app with an employee web portal. Their solution allows for mobile Near-Field Communication (NFC) to request a table, order items, and pay the check. The employee web portal tracks these lifecycle events and provides real-time updates to the management if wait times exceed a threshold. Koubai and Bouyakoub (2018) designed an IoT solution that augments and facilitates workflows, using dedicated mobile apps for cooks, wait staff, customers, and connected smart devices (e.g., ovens and refrigerators). These apps then provide a continuous feedback loop that delivers transparency to all parties.

## Point of Sale

According to experts, “the larger the forecasting error, the higher the desired customer service level more inventory that must be carried (Viale, 1996).” This inverse relationship means that Black Bean needs to minimize carried inventory to maximize profits. This optimization can be thought-provoking in complex supply chains due to the bullwhip effect (Croson & Donohue, 2003). While local order-flow has a predicable oscillation, upstream producers encounter an amplification effect. These forecasting errors cause inventory shocks and introduce waste. Williams and Waller (2011) pioneered electronic and automated mechanisms that share point-of-sales (PoS) data with both suppliers and internal purchasing teams. Kousiouris et al. (2019) expand on these ideas with a proprietary solution that integrates retail-outlet PoS data (demand) with sensors across the distribution center (supply) to produce a semantic model. A deep neural network (DNN) monitors the semantic model to discover deviations between the supply and demand states.

## Social Business Intelligence

The combination of business intelligence and social media is a relatively young field that attempts to mine user-generated content (UGC) for insights (Gioti, Ponis, & Panayiotou, 2018). Along with personalized marketing and customer relationship management, businesses can use these feeds for corporate reputation monitoring. Hu et al. (2019) describe a cloud-based solution that consumes Twitter tweets and Glassdoor employee reviews to track market sentiments towards brands. Their solution relies on natural language processing (NLP) to normalize text then applies latent Dirichlet allocation (LDA) topic modeling. A supervised learning algorithm uses Elastic-Net regularization and K-Nearest Neighbors (KNN) to track changes over time.

## Ad-hoc AI

Despite a broad agreement that artificial intelligence can fundamentally improve business processes, many businesses are hesitant to adopt it (NEDSI, 2019). NEDSI proposes an adoption strategy that starts simple on a clear business case. For instance, a supervised learning system could use historical table reservations to predict the count of future guests (Ma et al., 2018). Ma et al.’s solution transforms the historical data with multiple regression algorithms and reports the average prediction. This particular solution was bais and effectively returned the mean value from that calendar week. However, MLaaS is reducing the time and complexity to evaluate and potentially abandon hypotheses.

# Choose an Optimal Solution

Black Bean will need to borrow aspects from each of these reference implementations to build a holistic solution across their end-to-end lifecycle. This analytics pipeline would start with instrumenting the distribution centers with IoT sensors. Each distribution center aggregates these ‘high volume/low quality’ data points into ‘low volume/high quality’ real-time service telemetry for the cloud (Harper, 2019). As trucks transport the product, GPS positioning allows centralized supply chain service to update the estimated delivery times continuously. If there are issues during this process (e.g., weather delays), then proactive action can occur.

The transference of products between fulfillment centers and retail-outlets needs to align supply and demand requirements. The bullwhip effect complicates these placements and requires a combination of PoS data sharing and artificial intelligence to discover an optimal arrangement. These challenges become amplified as the depth of the supply chain increases due to regional fulfillment centers populating local distribution hubs.

After the materials arrive at the retail-outlet, customers have specific quality and performance metrics that the franchise needs to meet. These measurements demand that the wait time is acceptable, the price is fair, and the ingredients are fresh. As the wait staff services the order, their workflow should interweave role-specific mobile apps that connect to the cloud. Employees are more productive through automated recommendations, and local supervisors can review the KPIs to identify training and knowledge gaps. Mobile apps also increase customer satisfaction directly by offering shortcuts, such as reorder the last meal.

Customers and employees interact with social media services, such as Twitter and Glassdoor, which becomes the voice of the market. Organizations need a strategy to listen to that voice and ensure it aligns with their cultures and values. Using natural language processing to perform topic extraction can enable aggregate views, and fine tweak the corporate message. Another critical aspect of social media is the ability to connect to the user through targeted personalized ads.

All of these disjoined unstructured data sets need to blend into a more substantial status of the corporation. One strategy is to transform these feeds into a unified logical semantic model. This approach allows the senior leadership to ‘slice and dice’ different sections of the business and confirms the facts that lead to a consistent and coherent story.

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