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INFORMATION SYSTEMS EDUCATION JOURNAL

Editors

Teaching Case

100 Million Doses in 100 Days: Analyzing the COVID-19 Vaccination Supply Chain

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Abstract

With the impactful nature of the COVID-19 pandemic, this manuscript describes a teaching case for COVID-19 vaccinations to develop students' knowledge of analytics and supply chain management. The experiential learning activity is developed in the context of an undergraduate upper-level course on descriptive analytics and data visualization. The contributions of this teaching case are an experiential learning activity applied to a real-world current event and an experiential learning activity that allows students to apply and develop their course knowledge. The overall case objectives are to assess the 100 million doses in 100 days US vaccination goal capability and offer additional vaccination supply chain insights and recommendations to policymakers based on the analysis. The COVID-19 pandemic can be utilized as a real-world case study for teaching the next generation of analytics leaders and supply chain managers through an applied vaccine distribution and data analysis scenario.

Keywords: COVID-19, Data Analytics, Visual Analytics, Supply Chain Management, Experiential Learning, Teaching Case

1. INTRODUCTION AND OBJECTIVES

In the weeks before entering office in January 2021, US President Biden announced a goal of 100-150 million coronavirus (COVID-19) vaccinations, before finalizing the goal of 100 million vaccinations in the first 100 days in office (Murphy, 2021). During his first press conference on March 25, President Biden announced a new goal of 200 million vaccinations within the first 100 days or by April 29, 2021. As a note, the goal included the total number of vaccinations, both first and second shots, separate from full vaccinations. Each shot contains one dose of the vaccine, and a vial contains several doses of the vaccine varying by the manufacturer (Murphy, 2021). In addition, the comprehensive strategy outlined plans to expand the number of vaccine locations, increase resources, and make all adults in the US eligible for vaccination by May 1st (The White House, 2021).

The availability of the COVID-19 vaccine was a significant milestone, however global healthcare systems were faced with the complex task of securing, distributing, and administering the vaccines. This included ordering a sufficient number of vaccines and supplies, safely transporting to potentially thousands of locations, storing at the necessary temperatures, and end-to-end tracking to ensure integrity and quality. While other vaccines have been successfully distributed in the past, the COVID-19 vaccine was different in terms of the magnitude of scale to immediately provide the number of vaccines to all people that wished to be vaccinated, and had impacts on global health and economic wellness, requiring a fast and efficient supply chain at each stage (Foster & Liddell, 2020; CDC, 2021).

In early 2021 the US lagged other countries in vaccinations, and the increasing number of COVID-19 cases put additional pressure on policymakers to ensure vaccinations could be

distributed and administered as soon as possible (Barnhill, 2021). Potential supply chain issues included national security issues, shortages of personnel and supplies, limited coordination and capacity, vaccine damage and cold storage requirements, rural administration gaps, and misinformation. Security issues involved transfer points at each stage of the supply chain, with possible risks of theft, sabotage, and counterfeiting (Barnhill, 2021). The overall objectives for this case are to determine whether the 100 million goal will be met by May 1st and to offer insights and recommendations to improve the vaccine supply chain.

2. BACKGROUND

COVID-19 Global Supply Chain Management
COVID-19 vaccines have been developed at a significant pace, however, limitations in the global supply chain could halt this momentum and further contribute to economic losses and loss of life. At the end of 2020, the primary issue was how to deliver the vaccine efficiently and equitably to over 300 million Americans. Various supply chain management challenges included procuring raw materials, manufacturing capacity, cold storage requirements, patient preferences, social distancing requirements, 360-degree supply chain view capabilities, and advanced analytics for predicting demand (Young, Chane & Isgur, 2020; Yadav & Weintraub, 2021). The COVID-19 pandemic caused a major market shock across all industries with significant impacts and disruptions to the global supply chain, both to upstream suppliers and downstream customers with supply shortages and overages (Sherman, 2020; Woodside, 2020). The World Health Organization (WHO) declared COVID-19 a global pandemic, which spread with high velocity reaching 199 countries and territories around the world. At various points, 40% of the world population was under lockdown to reduce virus transmission, and these mass disruptions resulted in the closure of businesses and related impacts to supply chain activities (Gupta, 2020; Woodside, 2020).

As a comparison, during the 2009-2010 H1N1 pandemic, the initial consumer demand for the H1N1 vaccine exceeded supply due to an inefficient supply chain, and later many doses were returned as demand waned. To achieve COVID-19 herd immunity in the US an estimated 230 million people or 460 million doses would be required, if a two-shot dose were administered. Under ideal conditions from prior H1N1 modeling, herd immunity could have been reached in 237 days, however, due to supply chain inefficiencies and failures, herd immunity was delayed by approximately 100 days. With the COVID-19 pandemic, a similar delay may result in tens of thousands of lives lost (Young, Chane & Isgur, 2020).

Outside of the US, global vaccinations experienced several challenges, with the European Union (EU) and other countries having missed early vaccination goals by the European Commission. These goals included vaccinating 80 percent of people over the age of 80 and vaccinating 70 percent of the adult population by summer 2021. Identified causes for the delay included the delivery of millions of doses less than projected, countries pausing doses amid potential safety concerns, and countries holding onto additional doses (Deutsch and Hirsch, 2021). For example, the US had purchased more doses of vaccination than needed, and additional pressure was being applied to distribute excess vaccines globally where there was the greatest demand. Otherwise, according to US Treasury Secretary Janet Yellen, global cases could lead to increased inequality and be damaging to the US (Liptak, Atwood, & Alvarez, 2021).

Vaccine Manufacturers and Supply Chains
A successful supply chain is dependent on the relationships between suppliers and customers. Supply Chain Management (SCM) involves the planning and management of all items related to sourcing, procurement, production, logistics, and combining people, processes, and information (Sacristan-Diaz, Garrido-Vega, and Moyano-Fuentes, 2018). Supply chains flow from the upstream supplier of materials to the downstream customer distribution and are often complex and span multiple countries (Choudary, 2020). The supply chains developed by the leading vaccine manufacturers Pfizer, AstraZeneca, Moderna, Johnson & Johnson, and Novavax are described further by type, partners, manufacturing locations, price, dosing, and efficacy (Kansteiner & Sagonowsky, 2021; Terry, 2021).

Pfizer
Pfizer was the first manufacturer to receive US Food and Drug Administration (FDA) emergency use authorization (EUA) at the end of 2020. Pfizer partnered with BioNTech, Novartis, and Sanofi to increase manufacturing to produce 2 billion doses in 2021. Pfizer's US supply chain begins in St. Louis where the raw materials are made and plasmid DNA is produced. From there a site in Andover, MA produces and purifies the messenger RNA (mRNA) drug substance. After shipping the substance to Kalamazoo, MI, mRNA drug substances and materials are used to create

and transfer the vaccine into vials. Before distribution, the vials are inspected, labeled, and packaged. Similarly, Pfizer's additional sites in Belgium, Germany, and Austria, create the vaccine, fill, and packages vials. Vials must be stored in freezers and dry ice, and Global Positioning System (GPS) temperature monitors are added to the crates during shipping. The production plant in Germany is projected to produce 750 million doses annually. In addition, Sanofi who is also working on a vaccine candidate, partnered with Pfizer to produce 100 million doses for Europe in 2021 from their Frankfurt, Germany site with the first doses beginning in August 2021. Novartis is also partnering with Pfizer from their site in Stein, Switzerland to fill vials and assist with shipments of bulk mRNA at their site in Stein, Switzerland, for global distribution beginning in the 3rd quarter of 2021 (Kansteiner & Sagonowsky, 2021).

AstraZeneca

AstraZeneca set a goal of 3 billion doses delivered by the end of 2021. To achieve this goal, AstraZeneca planned production within 15 countries and 25 manufacturing locations. Within the US, AstraZeneca's vaccines are produced in Maryland by Emergent BioSolutions and filled and packaged in Ohio. In Europe, partners Halix in the Netherlands, Novasep in Belgium, and CDMO IDT Biologika in Germany are producing the vaccine, filling, and finishing. However, AstraZeneca's complex supply chain in Europe has caused a production shortfall during its initial rollout. AstraZeneca also partnered with Serum Institute of India to supply 1 billion doses internationally, and R-Pharm in Russia to supply the Commonwealth of Independent States which includes Russia, the Middle East, and the Balkans. Additional licensing has been completed with Fiocruz in Brazil and BioKangtai in China, with 150-250 million doses to be made in Mexico and Argentina in 2021 (Kansteiner & Sagonowsky, 2021).

Moderna

Moderna was the second mRNA vaccine to receive FDA emergency use authorization in December 2020. Moderna has set up 5 partners for global manufacturing and plans to deliver over 2 billion doses in the next two years, with 700 million doses in 2021 and 1.4 billion doses in 2022. Moderna collaborated with Lonza in Switzerland to scale the program and partnered with Catalent in Indiana for fill-finish to deliver 100 million doses in the US which was later expanded to 300 million doses. Moderna will produce the majority of vaccines in Massachusetts, with additional Lonza locations in New Hampshire and Switzerland. For international delivery, Moderna is working with Kuehne+Nagel a global logistics company (Kansteiner & Sagonowsky, 2021).

Johnson & Johnson

Johnson & Johnson (J&J) received FDA emergency use authorization in 2021 for their one-dose shot. J&J planned to produce 1 billion doses in 2021 with several partners including global companies Merck and Sanofi to improve supply. Partners include Leiden in the Netherlands, Emergent Biosolutions, Catalant, Aspen Pharmacare in Africa, Reig Jofre in Spain, Biological E in India, and Grand River Aseptic Manufacturing in the US and Europe. J&J develops the vaccine in several stages, through raw materials, converting these substances into batches of vaccines, and sending them to fill-finish sites for packaging and distribution (Kansteiner & Sagonowsky, 2021).

Novavax

Novavax secured a $1.6 billion Operation Warp speed deal and planned an FDA emergency use authorization in May. Novavax set a goal to generate 2 billion doses in 2021 through facilities in Maryland, Sweden, and the Czech Republic. The company has also partnered with AGC Biologies and Takeda in Japan, Biofabri in Spain, SK Bioscience in Korea, Serum Institute in India, and Polypeptide Group in Sweden. The partnerships were established to improve scale and vaccine component production at facilities in the US, Denmark, and Sweden (Kansteiner & Sagonowsky, 2021).

Supply Chain Challenges and Scenarios

There have been many challenges to successfully manufacturing and distributing the COVID-19 vaccines including last-mile delivery, temperature-controlled storage, manufacturing, organizational and regulatory coordination (Alam, Ahmed, Ali, Sarker, Kabier, & ul-Islam, 2021; Runde, Savoy, & Staguh, 2021). Actual supply chain scenarios and issues have been included below to consider for reflection, discussion, and recommendations. One of the most critical issues identified during COVID-19 manufacturing was the availability of raw materials including sodium chloride, tubing, and vials, with estimated deliveries for some materials forecasted up to 15 months (Dakin, 2021). In 2020, Pfizer announced that it was only able to ship half of the vaccines originally planned, with a decrease from 100 million to 50 million, due to supply chain constraints with raw materials (Paris, 2021). Another potential issue was the availability of personnel, requiring additional remote workers and training to support new manufacturing

processes (Dakin, 2021). Global coordination also proved problematic. In June 2021, responding to the second wave of COVID-19 and difficulty obtaining raw materials, India banned COVID-19 exports to focus on domestic vaccinations. At the time of the ban, India was the largest global manufacturer of COVID-19 vaccines, supplying both AstraZeneca and J&J. Similarly, other countries including the US imposed export bans on raw materials relating to COVID-19 production (GlobalData Healthcare, 2021). Even once manufactured, quality issues affected vaccine distribution. At the end of March 2021 J&J released information that a batch of the COVID-19 vaccine, upwards of 15 million doses produced by Emergent Biosolutions did not proceed to the fill and package vials stage as a result of a quality review (Nadeem, Anilkumar, & Adler, 2021).

3. SUPPLY CHAIN DISTRIBUTION DATASET

Your first objective is to compile a dataset with COVID-19 Vaccine Distribution Allocations by Jurisdiction. The dataset manufacturers include Moderna, Pfizer, and Janssen (J&J). The data is available in the public US Domain through the Centers for Disease Control (CDC) website data.cdc.gov. The columns in the dataset are shown in Table 1 (HHS ASPA, 2021a; HHS ASPA, 2021b; HHS ASPA, 2021c). Data should be collected through the first quarter of 2021 or the Week of Allocations on March 29, 2021. Alternatively, your instructor may provide you with an available data file. The COVID-19 vaccinations began on December 14, 2020. Shipments of the FDA-authorized COVID-19 vaccine arrive at various locations across the US. Jurisdictions receive first and second doses at the same time to optimize transportation logistics. Weekly vaccination dose allocations are posted each week on Tuesdays, and on Thursdays, states can order doses from that week's allocation of first doses. Based on the manufacturer, two weeks for Pfizer or three weeks for Moderna from the following Sunday, states can order doses from that week's allocation of second doses. Following vaccination doses ordering, shipment begins on Monday, and orders may arrive throughout the week vs. a single shipment (CDC, 2021).

Table 1: COVID-19 Vaccine Supply Chain Distribution Dataset

Column Name	Column Description	Data Type
Jurisdiction	City, State, or Territory	Text
Week of Allocations	The week that vaccines are allocated to a jurisdiction	Date & Time
1st Dose Allocations	Number of 1st dose allocations that a jurisdiction can order from	Number
2nd Dose Allocations	Number of 2nd dose allocations that a jurisdiction can order from	Number

4. SUPPLY CHAIN AND ANALYTICS EXPERIENTIAL LEARNING ACTIVITY

The experiential learning activity (ELA) can be completed through the visual analytics platform Tableau or any equivalent visual analytics platform may be utilized (Tableau, 2021). Visual supply chain analytics through graphs, charts, dashboards, and other methods can augment and enhance the decision-making processes of supply chain managers uncovering patterns and generating insights (Park, Bellamy, and Basole, 2016; IBM, 2021). The discussion questions and initial tasks are formatted similarly to prior student competition datasets (Willden, 2021). An ELA template has been provided in the Appendix following a repeatable analytics process (Woodside, 2016). The steps and objectives are listed within the template including developing a dataset, developing a set of data visualizations following best design practices, providing a summary of findings insights, and recommendations following the analysis.

Discussion Questions

Your initial task is to reflect on and answer the following discussion questions. In your discussion response, consider potential supply chain scenarios and issues, and offer additional vaccination supply chain insights and recommendations to policymakers.

1. How many total first dose and second dose vaccinations have been allocated to all states?
2. Which 3 states have the most first dose vaccinations allocated? What would you recommend for future allocations?
3. What is the total number of vaccinations distributed for the week of 2/1/21 by vaccine manufacturer?
4. Create an animation by week for the allocations by vaccine manufacturer. Are there any significant changes by week? (Tableau hint: click Format-> Animations to enable, drag Week dimension to Pages card)
5. Predict the total # First Dose Vaccinations by May 1st. Will the goals of 100 million and 200

million vaccinations be possible based on the supply chain distributions by May 1st?
6. To further connect your knowledge, what lessons were learned and how can you apply this knowledge to current or future events?

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Appendix

Appendix A: COVID-19 Vaccine Manufacturers

Manufacturer	Pfizer	AstraZeneca	Moderna	Johnson & Johnson (Janssen)	Novavax
Type	mRNA	Adenovirus-based	mRNA	Adenovirus-based	Protein-based
FDA EUA	12/11/2020	Est. Spring 2021	12/18/2020	2/27/2021	Est. Spring 2021
Key Partners	BioNTech, Novartis, Sanofi	Oxford University, Halix, Novasep, Biologika, Serum Institute, R-Pharm, Fiocruz, BioKangtai	Lonza, Catalent, Keuhne+Nagel	Leiden, Emergent Biosolutions, Catalant, Aspen Pharmacare, Reig Jofre, Biological E, Grand River Aseptic Manufacturing	AGC Biologies, Takeda, Biofabri, SK Bioscience, Serum Institute, Polypeptide Group
2021 Production Estimate	2 billion doses	3 billion doses	700 million doses	1 billion doses	2 billion doses
Manufacturing and Supply Chain Locations	US, Belgium, Germany, Austria, Switzerland	US, Netherlands, Belgium, Germany, India, Russia, Mexico, Argentina	US, Switzerland	US, Netherlands, Africa, Spain, India, Europe	US, Sweden, Czech Republic, Denmark
Dosing	2 doses, 21 days apart	2 doses, 28 days apart	2 doses, 28 days apart	1 dose	2 doses, 21 days apart
Price Charged (may vary by location/volume)	$19.50 per dose	$2.15-$5.25 per dose	$25-$37 per dose	$10 per dose	$16 per dose
Efficacy	95%	70%	95%	66%-72%	89%

Appendix B: Experiential Learning Activity Template

Experiential Learning Activity

Name

- ELA Aligned Learning Outcomes:

Learning Outcomes	
1. Written Communication	✓
2. Information Fluency	✓
3. Tools and Techniques	✓
4. Critical and Analytical Thinking	✓
5. Global Decision Making	✓
6. Ethical Reasoning	✓
7. Personal and Social Responsibility	✓
8. Integration of Learning	✓

- Employer-Valued Knowledge, Skills, and Abilities (KSAs) Gained:
    - Knowledge of Data Visualization

- Knowledge of Business Reports
- Skilled in Developing Dashboard Visualizations
- Skilled in Knowledge Delivery
- Skilled in Tableau
- Ability to analyze supply chain data to generate insights and recommendations
- Ability to select appropriate data and information visualizations

Title: CDC COVID-19 Vaccine Distributions
Description:

- Review and develop a CDC dataset
- Develop a set of data visualizations in Tableau Desktop following best design practices
- Utilize the Data Viz Story template to complete each section
- Provide an overall summary of findings, insights, and recommendations following the analysis
- Upload responses to the Learning Management System (LMS)

Data Viz Story	
Title:	
Business Opportunity	*Key story message /objectives / goal* *Outline business opportunity / problem*
Data Exploration	*Exploratory data analytics* *Data source(s)* *Data taxonomy: data types, preparation, data dictionary* *Data descriptive statistics*
Model Building and Analytics	*Explanatory data analytics* *Visual analytics* *Data mining taxonomy* *Dashboard design and visuals to support discussion questions:* *1. How many total first dose and second dose vaccinations have been allocated to all states?* *2. Which 3 states have the most first dose vaccinations allocated? What would you recommend for future allocations?* *3. What is the total number of vaccinations distributed for the week of 2/1/21 by vaccine manufacturer?* *4. Create an animation by week for the allocations by vaccine manufacturer, are there any significant changes by week? (Tableau hint: click Format-> Animations to enable, drag Week dimension to Pages card)* *5. Predict the total # First Dose Vaccinations by May 1st. Will the goals of 100 million and 200 million vaccinations be possible based on the supply chain distributions by May 1st?* *6. To further connect your knowledge, what lessons were learned and how can you apply this knowledge to current or future events?*
Operationalization and Deployment	*Potential supply chain scenarios and issues* *Proposed solution, timeline, resources, project plan* *Overall findings, supply chain insights, and recommendations to policymakers*

Teaching Case

Here We Grow Again! An Expansion for Mark's Doggy Day Care: A Database Design and Development Case

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Abstract

The pet care service industry is booming. The U.S. Census Bureau (2019) recorded pet service industry payroll numbers at almost $11.2 billion (excluding veterinarian services). In this teaching case, Mark, the owner of a successful dog boarding business, is looking to capitalize on that growth as he expands his customer demographic to welcome cats and rabbits, provide rehabilitative pet care, and better address the increasing needs of his longtime customers. This is a follow-up case to the *System Development and Data Modeling for Mark's Doggy Daycare and Boutique* case that focused upon developing a database for Mark's new entrepreneurial venture. The database created in the first case was not constructed for keeping track of repeated health care services administered to his clients throughout their stay nor to allow for other types of pets. In this case, Mark meets with the systems analyst consultant to discuss the requirements for upgrading his database. He describes in detail the organization's business processes, thus allowing the case to standalone without the need to reference the original case. Processes described in the case include customer management, reservations, invoicing, inventory management, and accounts receivables.

Keywords: Teaching Case, Process Modeling, Systems Analysis, Database Design

1. INTRODUCTION

Mark, the owner of Mark's Doggy Daycare, busied himself catching up on paperwork while he waited for his old college roommate to arrive. The doggy daycare's business was booming. Mark was preparing to expand his operations to board and care for even more pets. The database he was currently using was great, but since he was offering rehabilitative care for injured pets, companion care for aging pets, and expanding into caring for rabbits and cats, the current database needed some modifications. In addition, there were some features he had forgotten to request in the first database, like the ability to track medication administration and wound care, that he would like to have included.

2. HELP FROM AN OLD FRIEND

"Scott!" Mark exclaimed as he crossed the daycare lobby towards the door. "It's good to see you, buddy! Thanks for coming over and especially for being willing to modify the database for me!"

"I hope there is nothing wrong with it?" Scott asked as he sat down on a lobby couch.

"Absolutely not!" Mark reassured. "We're getting ready to expand our client base to include cats and rabbits. We have also started doing some rehabilitative care and are now finding that some of our older clients are needing to have medications administered and tracked multiple times throughout the day. I hadn't thought of

those things when I initially asked you to create the database. Now that we are offering more services to our customers, we need to be able to track that data. Thus, our current database needs some modifications."

"That's good to hear! I thought that there might be something wrong with it." Scott breathed as he pulled out his notebook. "Well, you know how I like to start. I want to know everything about your business operations. Remind me again about how your business processes work here… from the moment that you get a client to the time that they leave."

3. EXPECTED DAILY OPERATIONS

"Since we have been using the system you created for us," Mark began, "we no longer rely upon paper records. Let me tell you how we currently operate here. I'll adjust for the changes to our operations as I go. We provide basically the same services as we had in the past. Not only do we provide hourly care and extended overnight boarding, but we also provide grooming, behavioral training, surgery rehabilitation therapy, and health services through a partnership with a local small animal veterinarian. Dr. Williams visits on a regular basis to give wellness check-ups, shots, and in-house visits. Those are the main medical services that she offers on-site. If the client requires an in-office visit, we have one of our staff transport the client to Dr. Williams' office, stay with the client to take notes, ask questions, update the client's parents, and then transport the client back to our center or to their home. We just handle reservations and logistics and the costs associated with them. The medical service billing is handled through Dr. Williams' office.

"We have an in-house grooming service in which we provide services such as baths, haircuts, ear cleaning, teeth cleaning, nail trimming, and flea treatments for dogs and cats. These can be purchased as needed or set up as standing appointments. If a regular client comes in for daycare, he is checked in at the front desk by Becky and assigned to his standard kennel containing his preferred inventory. This normally includes his freshly laundered blanket and favorite sanitized toys. The kennels, blankets, and toys are cleaned every night before we leave. During the day, we take dogs on walks and admit cats and rabbits to the corresponding exercise areas. Cats and rabbits require a little less maintenance. Dogs will have supervised play time with the other dogs, take potty breaks, be given one meal and one snack, and be provided with a KONG puzzle containing his favorite treat. Although we usually know what the regulars like, we post a *Favorites* list for each client near his kennel along with a *Conditions* list as a reminder of medical issues that need to be addressed. Because the database was not initially developed to track health conditions and multiple medical administrations, we are currently recording the conditions in the *Favorites* area of the database. This has worked for us so far. However, as more of our clients start developing health issues that require tracking throughout the day, I want to address this issue before it causes a problem.

"Andy is our Activities Director and oversees daily operations associated with the immediate care of the pets. Andy has two full time assistants, Kathy and Tom, who are dedicated to taking care of our clients' daily needs. During the day, they record notes in the database on each client's activities to provide an end-of-the-day report to each client's parents. We also use this information to update our file on each client, such as unusual behavioral issues, which pets get along together and which do not, favorite foods, and odd behaviors. Our overnight and extended boarding is very similar to our daycare except we have one additional meal, snack, another exercise time, and then bedtime. However, some of our clients have normal evening routines. If those are provided, they are included on the *Favorites* list posted by the kennel.

"We have been hosting special events for our clients such as birthday parties, holiday bashes, and sleepovers. Special events usually have event-themed activities and food such as birthday cake, Christmas cookies, or holiday ice cream. The attendees will also receive snacks, a special party favor (e.g., toy, bandana, treat bag, etc.), and one of our activity coordinators will take pictures during the party to post on social media. The parties usually last for about two to four hours depending upon the package that the clients' parents purchased and can be packaged with daycare or boarding.

"We also offer dog walking and behavioral training services for both daycare and stay-at-home clients. Andy manages these services and has four part-time college students who assist him in providing the personalized services. The focus of behavioral training is determined by an initial consultation with the client and his parents. Training usually addresses problems with interactions with adults, children, or other animals.

"Our boutique stocks pet food and treats, vitamins, and healthcare products, pet toys, leashes, shampoos, and fashion accessories such as bandanas, collars, and bows. We try to mostly stock pet food and treats based upon the individual preferences of our clients. Rather than having to go to the store to restock, our clients' parents are able to purchase it from us and we have it ready to load into their vehicles when they come to pick up their pet at the end of the day."

4. BUSINESS PROCESSES

"In regard to processes," Mark continued, "when a clients' parent wants to reserve a slot for daycare or boarding, they just call our front desk and Becky, our office manager, will enter the pet's name, pet type, parent, approximate arrival time, services requested, and contact phone number in the system. When that day or event arrives, Becky pulls the event up on her tablet and records attendees as they arrive. Each pet is initially given a tag that can be placed on their pet collar and connected to the database so that we can easily associate data entered throughout the day with the pet. When the pet arrives, we just scan the tag to check the pet in and to immediately know the client's and parent's preferences. During check in, we record the actual time that they arrive, the time that they leave, who brought them, and who is supposed to pick them up. Just as a backup, we can also print an attendee report to record this information on as well.

"When a client's parent purchases one of our services, such as a teeth cleaning, nail trimming, haircut, or bath, Becky indicates what the service is, when it is to occur, any special requests, how it is to be billed, who is supposed to perform the service, the price of the service, and if it is a standing request. All our staff are trained to provide those services.

"For boutique purchases, the parents can pay Becky immediately for items at our cash register or have the items added to the customer's account. When an item is added to the customer's account, we record the customer's name, the date purchased, the item purchased, the price of the item, the quantity purchased, and the total cost of the purchase. For standing requests such as pet food, treats, or vitamins, costs are usually added to the parents' account and paid at the end of the month. We take checks, cash, and debit/credit card payments using Square. Parents receive a bill at the end of each month for services rendered and items on account.

"When a client terminates a relationship with us due to death or just moving on, we will include a short note in the client's record indicating the date and reason for departure.

"Becky usually handles all of these functions including the phone at the front desk as well as checking clients in and out, taking reservations, selling items in the boutique, and taking cash or adjusting customer accounts as products and services are purchased."

5. REPORTS

"That's great! You gave me a lot of nice detail. Tell me about the reports you would like to run," Scott requested.

"We run daily reports, weekly invoices, and regular status reports regarding accounts receivable and inventory levels," Mark started. "Our daily reports include a daily income report with a breakdown of the clients we served that day, the services we provided, the employee who provided that service, and the price of the service. We also run a favorites report for each pet client that is posted on their kennel. At the end of the day, we provide each pet's parent with a daily activity report letting them know about their pet's day. We send this as an email to the parents. We also need to have reports to know how our different products, services, and promotions are doing so that we can recognize trends and be sure to offer the most popular products and services to our clients." (Examples of some of the proposed reports are found in the Appendices.)

6. THE NEXT STEP

"Let me put together a few diagrams with narratives to make sure we are both on the same page as to what your processes look like and the flow of data through your system," Scott said as he stood to leave. "I will also create some diagrams of what I think your database should look like so that we can make sure we are collecting all of the data elements you will need. I'll try to get back to you in a couple of days."

"You did a great job of developing our current system. I look forward to your implementing the upgrades," Mark smiled as he walked Scott to the door. "Thanks so much for helping us out again."

7. ASSIGNMENTS

Students should assume the role of Scott or a systems analyst consultant. The systems

analysts' roles and responsibilities will vary depending upon the course and assignment. Examples of possible assignments are provided.

Process Modeling
Courses: Systems Analysis and Design, Process Modeling, Database Development, general graduate level MIS course

Scott would like to draw out the business processes to verify that he understands them correctly.

1. Create process models to diagram one of the business processes such as the reservation process, the sales recording and accounts receivable process, or the boutique sales process.
2. Write short narratives to accompany your diagrams to verify and support your interpretation of the process.
3. As the diagrams are developed, record any assumptions you make, regarding the processes, in a separate document.

Systems Analysis Design and Database Development
Courses: Systems Analysis and Design, Database Development, graduate level MIS course

Assume that Scott would like to develop a prototype of the system to be developed. He would want to:

1. Accumulate the functional and technical requirements for the system.
2. Prioritize the requirements.
3. Create system development diagrams.
4. Create a data dictionary.
5. Create data entry forms.
6. Create queries to generate inventory reports customer invoices, reservation sheets, client favorites reports, client conditions reports, client daily activity reports, monthly customer statements, account receivable reports, and profitability reports.
7. Create reports including inventory reports, customer invoices, reservation sheets, client favorites reports, client condition reports, client daily activity reports, monthly customer statements, account receivable reports, and profitability reports.
8. As the database is developed, record any assumptions that you make in a short report.

Skillset Discussion
Courses: General graduate level MIS course

Ask the students to reflect upon the project, the skills that they used, and the systems development process.

1. Review and discuss the skillsets used to complete the project
2. Discuss the transferability of those skillsets to other industries such as their area of interest.
3. Discuss the business and technical opportunities that developing a system like this provides for an organization.
4. Discuss the business and technical challenges that could arise during the development process.

8. REFERENCES

Schwieger, D. & Humphrey, R. (2018). System Development and Data Modeling for Mark's Doggy Daycare and Boutique. *2018 Proceedings of the EDSIG Conference*, 4(4764), 1-9. https://proc.iscap.info/2018/cases/4764.pdf.

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APPENDICES

Mark's Pet Boarding Center & Boutique Reservation Example Document

Mark's Pet Boarding Center & Boutique for discriminating pets

Reservation

06/03/2021
at 10am

Canine Client Name	Account Number
Trixie	234567

Owner's Name	Phone Numbers
Tyler Wildman	314-555-3333/314-555-2222

Requested Services

Item	Description	Provider
S2000	Dog Obedience Class – 1 hour	Betsy
S1050	Hair cut	Frank
S1030	Grooming	
S1100	Clip nails	Pam

Notes:
Keep Trixie away from Atlas. Atlas makes Trixie anxious.

Mark's Pet Boarding Center & Boutique Invoice Example Document

for discriminating pets

Invoice 5768
06/03/2021

Sold to:
Jason Busman
1234 Apple Street
St. Louis, MO, 63101
(314)555-4444

Canine Client Name	Account Number
Scooter	123456

Item	Description	Quantity	Service Provider	Unit Price	Line Total
S1000	Individual Run	1	Mark	20.00	20.00
S0020	Bath	1	Jane	25.00	25.00
S3010	Shots	3	Vet	10.00	30.00
I2500	Green Buffalo Special Food – 25 pound bag	2		30.00	60.00
			Subtotal		135.00
			Sales Taxes		5.10
			Total		140.10

Thank you for your business!

Mark's Doggy Daycare & Boutique
45 Abbey Lane, St. Louis, MO, 63101
Phone: (314) 555-5555 Email: mark@bestdogcare.com

Mark's Pet Boarding Center & Boutique Client Daily Report Example Document

Mark's Pet Boarding Center & Boutique for discriminating pets

Daily Report

06/03/2021

Client Name	Account Number
Trixie	345671

Dear Mr. Busman,

Trixie had a wonderful day at Mark's Pet Boarding Center & Boutique. In the morning, she played ball with Mark and two other dogs, Max and Spot, in the outside yard. The afternoon was hot so she stayed inside, played hide-and-seek with Mark, ate, and took a nap. Trixie ate one meal, one snack and had a bath during her day with us.

Thank you,
Mark

Requested Services

Item	Description	Provider
S2000	Dog Obedience Class – 1 hour	Betsy
S1050	Hair cut	Frank
S1030	Grooming	
S1100	Clip nails	Pam

Notes:
Keep Atlas away from Trixie. Atlas makes Trixie anxious.

Teaching Case:

An IT Start-Up meets a Conglomerate – the Integration Challenge

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Abstract

This case is a narrative of the acquisition of HIRA, a healthcare IT startup, by Conversant, a large global consulting powerhouse from a few years back. The clash of two different company cultures, their conflicting business strategies, different IT infrastructures, and very different customer sets created significant challenges in their integration after the acquisition. The case requires the reader to analyze the initial backlash from multiple stakeholders and then to formulate an integration project and systems architecture to successfully support the aligned business goals. The strategic vision of the merger provides an articulation of the ideal state of resource usage (human and technology) and a context for decision-making to select joint strategic initiatives to implement in order to achieve the desired integration successfully. When HIRA was acquired by Conversant, a global conglomerate with significant offshore personnel, a service area of HIRA needed to be automated to improve their business profitability. This was more easily conceptualized and realized when HIRA leaders applied metrics to their information technology service management processes. This complex integration project could only succeed through the active participation and leadership of both companies and by carefully addressing their conflicting strategies, policies, cultures, technology and human resources.

Keywords: IT Strategy, IT Management, Merger and Acquisition, Software as a Service, Integration, Change Management.

1. INTRODUCTION

Conversant Technologies, a global and diversified consulting giant, with over 270,000 employees, just announced their acquisition of a small start-up, HIRA, for $5 billion US dollars. HIRA is a healthcare information technology SaaS (software as a service) company with only 60 employees that was founded during the 1990s in Boulder, Colorado. While the market capitalization of Conversant is upwards of $40 billion, HIRA was valued at $700 million before the acquisition. The market analysts were abuzz with a lot of speculation as to how these two companies with different cultures, IT systems and clientele will integrate with each other. On this cool Spring evening in 2017 in northern California, Dave Gerber, the Chief Executive Officer (CEO) of Conversant was enjoying his drive home after a busy day at work. Although his eyes were on the road, his mind was still pondering the changes that were going to take place in the company in the next 12 months. "*How will the merger work and how will our two cultures mesh? What does Conversant as a company need to do in order to take advantage of the new emerging opportunities in eHealth? Who do we need to retain from HIRA to ensure that a successful merger happens? What changes will this trigger in Conversant?"*

The merger between Conversant and HIRA was going to cost a lot of money, time, and reorganization – for people, process, IT systems, and structural change, and would involve adopting new philosophies. There were also

significant barriers to retaining the existing HIRA customers, who were highly averse to any changes. Also, if those barriers could not be overcome, the competitive landscape in which Conversant operated might shift in unfavorable ways. As an IT professional and the CEO of Conversant, Gerber viewed the merger as one with a lot of potential and opportunity. However, his years of management consulting experience had shown Gerber that integration of different cultures, IT systems, and inherent business processes could be challenging (Weber, Tarba and Bachar, 2011).

On the other side, HIRA employees were quite surprised when the founder of the company announced in the fourth quarter of 2016, that HIRA had been purchased by Conversant Technology Solutions! Conversant was a global conglomerate in the information technology space that was primarily known for systems integration. When Conversant merged companies into their conglomerate, those companies became a billable project to Conversant resources. Projects typically have a start and end date, unlike a long-term application hosting relationship. Initially many HIRA employees felt worried by the news of the acquisition, but operations continued as they always had, except for all the Conversant personnel available to work on HIRA hosting processes.

2. HIRA BACKGROUND

HIRA has a service catalogue filled with proprietary software products that decrease the administrative overhead costs of healthcare organizations by expediting the revenue management cycle (Figure 1). These applications can be licensed to the customer; however, the bulk of HIRA's business was from their hosted clients. HIRA generates revenue through three channels: consulting services, application management services, and business process outsourcing. HIRA's Consulting services is very traditional. Teams in this service area fulfill the implementation services for the software, provide training on the software and administer certifications based on the proficiency of users. HIRA's Health IT application management (hosting) and Healthcare business process outsourcing offers are what allowed its valuation to grow exponentially over the past two decades.

HIRA had become an industry leader in delivering innovative services that drive improved efficiency, connectivity, and industry collaboration to help their clients across all areas of healthcare billing and payment collections. Their systems touch over one-hundred eighty million consumers every single day. On an annual basis HIRA processes approximately two billion transactions on the Healthcare payer and provider sides. On the payer side, HIRA has more than 360 organizations as clients. At the close of the third quarter (2016) prior to the acquisition, during an all-hands meeting, HIRA founder and CEO, Mike Margolis had stated with a lot of enthusiasm: "*HIRA is uniquely positioned to solve the cost and quality of care dilemma in the healthcare industry with its complete range of software and services offered in the catalogue. I'm so passionate about working at HIRA because we can make a difference. And we are making a difference.*"

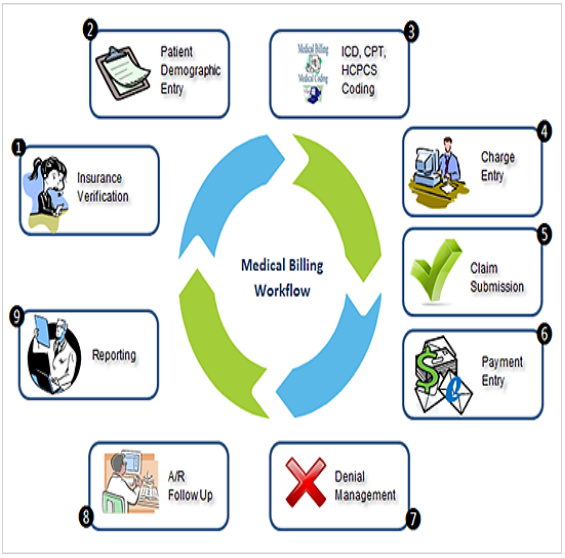

Figure 1 – HIRA's Healthcare billing hosted application workflow (FGT, 2015)

Different Business Models

Conversant was a traditional IT consulting services company, that served clients through general technical consulting, and not just around "*hosting their own applications products*". Conversant also offered business process outsourcing (BPO) services that assisted clients with the people-aspect of sociotechnical information system projects along with technical solution design and implementation. However, HIRA was highly specialized in supporting only technology involved for enablement of their healthcare billing application product. HIRA's Application Management Services (AMS), also known as hosting, had broad and dynamic capabilities for their hosted clients. Hosting was the foundation of HIRA's SaaS model. Hosting resources had the deep technical skillsets to support the client environment portfolios, which

include databases, network infrastructure, operating systems, monitoring, storage, security, middleware, systems administration, and the applications. HIRA's BPO services focused on providing front end services, claims processing and adjudication, and customer service on a seasonal or ongoing contract during annual enrollment periods or throughout the entire year for a payer organization (Figure 1).

3. INTEGRATION CHALLENGES

Consulting services and business process outsourcing were a core competency of Conversant. Conversant teams had no challenges assimilating these service areas from HIRA; but hosting was more of a challenge. Conversant management noticed that while hosting was satisfying the service level agreements to their customers, the HIRA teams with the deepest technical knowledge were the least mature of all the service areas in their incident management practices. Hansen, Nohria and Tierney (1999) identify two enabling strategies for organizational knowledge sharing - a personalization strategy for sharing tacit knowledge with emphasis on building relationships verses a codification strategy for sharing explicit knowledge with emphasis on IT systems and infrastructure. HIRA's practice relied on weighty customer interactions and collaborative relationship building among their staff to mask their ineffective incident management IT infrastructure (Feeney, 1998).

In a meeting in January 2017 with the senior management of hosting at HIRA, Conversant leadership expressed its concern about hosting's lack of systems maturity. John Richardson, Vice President of HIRA Technical Support, explained that "*The processes of hosting are done using tacit knowledge gained through experience. This culture was developed by our founder, Mike Margolis, who believed the quality of talent in our people is a greater asset than documentation*." The lack of a methodological approach to managing HIRA's SaaS hosting processes became evident to Conversant leadership.

Orders of Change Management

The successful integration of HIRA and Conversant demanded significant change-new systems and work processes to support the codification of HIRA's SaaS application hosting knowledge and the relationship knowledge of their consulting clients and new processes for HIRA hosting staff (Comuzzi and Parhizkar 2017). Don Turtle, a Vice President at Conversant who was assigned to the HIRA project after its acquisition, clearly stated the vision of "*Hosting processes must be automated as thoroughly as feasible. The technical support teams in application management services need to document their procedures for new resources to reference*. *There are too many HIRA employees billing (hours) to the service area and this is hurting the profitability of hosting. At the initiation of the fourth quarter of 2017, we will commence staff reductions on the HIRA project until we reach an 80:20 ratio between Conversant and HIRA resources on Hosting. This is a second order change that I expect to be fully implemented by the end of the year*".

Turtle was referring to the orders of change framework (O'Hara, Watson and Kavan, 1999). A first order change does not inherently require users to change the way they do their work, but does require them to change how they interface with their work. However, a second order change incorporates a more disruptive effect, where additional tasks and skills are demanded of the staff. This sort of change requires users to not only change the "how" of their work behavior but also the more immediate "why" (O'Hara, Watson and Kavan, 1999).

Stakeholder Conflicts

The disparities in each other's business models resulted in early mistrust during the integration. Each party in the merger decided to engage separate consulting teams to assist with the evaluation of the changes that they foresaw will impact data and systems, business strategy, tactical processes, and people and customers in the merged universe.

One of the biggest challenges for the integration teams was to manage the competing priorities for the business teams on the Conversant side. These teams' leads had their regular day-to-day job that had its own demands. The integration project was an added responsibility for them that they had to fulfill in the margins. There were weeks when the teams were not available because they had to support other customer-facing projects and travel to other locations. As a result, the integration team was behind in key activities and constantly had to work overtime/weekends to make ends meet. To counter this lack of participation, some Conversant business teams brought in additional contractors/consultants to work on just integration activities on behalf of their business teams. Working in such a multi-vendor project became a tremendous challenge for the integration teams as there were delays due to onboarding, hierarchy, complex reporting structures in the multi-vendor model. Each

consulting group wanted to get extended in their "*own*" client setting and not deal with competition from other consultants. There were times when consultants from two or three companies were sitting in the same conference room working on project timelines, and often had access to budgets and worked on future resource needs, creating conflicts of interests.

Geography and time zone difference posed additional challenges and there was only one 3-hour period (5am-8am) during the day that worked for integration staff in Europe to work with teams in Colorado and California. There was a lack of accountability with Conversant functional leads. They were still being evaluated based on how they performed in their regular day-to-day roles, and now had to work on the assigned integration tasks in the margins. Overall, integration work was low on their priority and far more complicated with all the different groups, consultants, and integration teams from the Program Management Office (PMO), change management, etc. There was a low level of interest by the Conversant business leads to get involved more actively as their focus was more on completing their regular jobs.

4. IT STRATEGY CHALLENGES

When the dust settled and the multiple consultants, HIRA, and Conversant teams were able to focus on the integration project, they realized that they would have to address the following areas: overall strategy, people integration, data, technology, and process integration, while meeting their financial and external customer timelines. The strategy team was charged to build plans and share not only upwards but also to the impacted teams and people at the same time: (a) Identify what business functions were impacted, and (b) Identify personnel impact as not all people from HIRA would be retained post-merger.

HIRA's clients (Healthcare companies) were Late Majority/Laggards in IT adoption and so HIRA followed a "penetration" strategy (Ansoff, 1957). Late Majority/Laggard healthcare organizations deferred technology adoptions until they absolutely "*had to*" and "*were pushed to do so*" to stay competitive. This sharply contrasted with a "Early Majority" adoption strategy and a diversified focus used by Conversant with its clients (Utterback, 1996). Conversant's typical clients were "technology visionaries" and implemented emerging technology to differentiate themselves in their marketplace. Healthcare organizations needed HIRA's payment management solution, but change management was difficult and required a lot of hand-holding by HIRA 's personnel, which was unfamiliar to Conversant's business case driven consulting staff.

The HIRA and Conversant teams also needed to understand how their own internal IT systems would integrate. There were architectural inconsistencies in terms of how business processes and users in the two companies were utilizing existing systems. One example was how their client/case data was used and stored in the two companies. HIRA's customers demanded strict data validation that came under high scrutiny and went through rigorous processes; more so than Conversant's other clients. HIRA's key information systems such as Incident Management, Contract Management and Software Release Management were all built with an interactive strategy supporting frequent interactions among their 60 person staff with the real-time sharing of tacit knowledge (Zack, 1999). On the other hand, integrative information systems played a larger role in supporting Conversant's diverse consulting businesses. These integrative information systems supported the seamless workflow of explicit knowledge without the express need for real-time interactions among their globally dispersed personnel (Zack, 1999). Such contrasting strategies now demanded a unified architectural definition to provide guidance to plan, design, configure, and construct merged organizational systems (Sowa and Zachman, 1992). Don Turtle realized that architectural elements would be the primary means to help align information systems with strategy, and support business activities/processes amid the execution constraints of the merged companies (Sowa and Zachman, 1992). Turtle, remarked, "*standardized approaches and proven architectural models, could also help us overcome resistance to change among the stakeholders of each of the two companies*".

The Integration project formed a strategy team, which was responsible for evaluating the following items. They leveraged the Open Group Architectural Framework or TOGAF (Open Group, 2018), which defines the architectural process in four dimensions – business, data, applications, and technology.

1. An overall change management and program office that would focus on
    a. Budget
    b. Timelines
    c. Resourcing

2. Scope of Data Integration/Management
    a. Identifying data with high impact and integration
    b. Data validation
    c. Data security management
3. Scope of Systems Integration
    a. Policy and procedure for application retention
    b. Decide what applications should be retired and when to retire
4. Scope of Information Technology
    a. Create a shared infrastructure to support identified business use cases, operational processes, and data models
    b. Create a governance structure to communicate the big picture, and strategy.

5. HIRA APP HOSTING MANAGEMENT CHALLENGES

There was also an urgent need to identify key processes that were impacted in either company. The intent was to figure out between the two companies how similar and/or different their business processes were and what service benefits, external customers of HIRA, needed. Conversant leadership was pushing HIRA to automate their application hosting processes (AMS). John Richardson understood that he must assess the most critical functions in HIRA using concrete metrics and a measurement framework before he met with Conversant leadership at the end of the second quarter (Kefi, 2007; Vitharana and Mone, 2008; Pitt, Watson and Kavan, 1995; Parasuraman, Zeithaml and Berry, 1985). Many questions surrounding policy and procedure for application retention and retirements, and data archival guidelines also needed to be addressed. What systems would be used for internal integration and joint execution? The planned impact on HIRA staff was critical because not all people from the HIRA team would be retained post-merger.

Richardson was aware that the managers had been collecting operational metrics for their respective functions in isolated instances using a ticketing system (Vitharana and Mone, 2008). He planned to use these metrics to develop key performance indicators (KPI) that would illustrate the level of HIRA's AMS operational excellence to Conversant leadership (Quinn and Barly, 1994). A collection of metrics can also provide a better validated measurement of the business operational area. However, metrics can be problematic if they induce operational staff/managers to behave in ways that only lead to "better" metrics (Witman, 2018). It is therefore necessary to collect metrics closely aligned with the business objectives of the integration. The key was to extract knowledge from people before they were asked to leave the company in a few months and the challenge was to keep employees motivated and help them deal with change in their day-to-day job situation.

Incident Management
Erick Zucker is the manager of the incident response team at HIRA. Incident management is the process responsible for managing the lifecycle of all incidents. Incident management in the ITL 4 framework ensures that normal service operation is restored as quickly as possible and the business impact is minimized (Axelos, 2011; Potgieter, Botha, and Lew, 2007). Due to the strong "*talented people owning their work*" corporate culture at HIRA, the incident management function involved placing a conference call contacting the HIRA subject matter expert and remediating the interruption by any means necessary each time an interruption to service was reported. There were no "service process workflows" in this adhoc approach and the small company culture prevailed, albeit without any formal analysis or broader quality management framework.

Problem Management
Rob Flight oversaw the problem management function, which is the process responsible for managing the lifecycle of all problems. Problem management proactively prevents incidents from happening and minimizes the impact of incidents that cannot be prevented. (Axelos, 2011; Potgieter, Botha, and Lew, 2007). The problem management function is typically engaged immediately following restoration if the incident cannot be prevented, so that the staff responsible for service restoration can be leveraged for a permanent resolution.

Change Management
The change management process is directed by Tamar Robinson. This process was responsible for controlling the lifecycle of all changes, enabling beneficial changes to be made with minimum disruption to IT services. (Axelos, 2011; Potgieter, Botha, and Lew, 2007).

Release Management
Release management is the process responsible for planning, scheduling, and controlling the build, test and deployment of application releases, and for delivering new functionality required by the business while protecting the integrity of existing services (Axelos, 2011;

Potgieter, Botha, and Lew, 2007). Of all the teams in Hosting, Release Management experienced the least amount of difficulty capturing operating metrics as Ricardo Dominguez modeled his measurements after Tamar because releases had to be approved by Change Management (Kife, 2007; Vitharana and Mone, 2008).

Configuration Management
The configuration management process was responsible for ensuring that the assets required to deliver services are properly controlled, and that accurate and reliable information about those assets is available when and where it is needed. This information includes details of how the assets have been configured and the relationships between assets. (Axelos, 2011; Potgieter, Botha, and Lew, 2007).

6. IT PROJECT ORGANIZATION

The integration team spent time to build an overall "people strategy" and identify the key personnel for each functional area from both sides of the merger. Once the strategy team was able to spend time with key stakeholders from both companies, they drafted a game plan and an execution team with three sub-teams. Execution team 1 was the central team that acted as the PMO, Change Management, and provided overall funding, project timeline governance. They also worked with Conversant IT governance to define data validation, archival retention and decommission policies and procedures. Execution team 2 focused on data integration and technology from defined business functions and associated IT systems. This team took all the systems and identified if any data needs to be migrated, where and how. Finally, execution team 3 was created to manage people.

The first task for execution team 1 was to create an organization structure and a reporting governance structure. This allowed them to figure out how the integration program office would need to be organized, how the reporting/dashboard and timelines management would take place. In addition, they wanted to manage the budget centrally.

Execution team 2 created the application inventory and a people inventory. They identified all the IT systems, files that were used by HIRA and mapped them to corresponding Conversant systems. They distributed these documents to other execution teams so they could start to manage data integration for their areas, respectively. They later distributed the inventory documents to business leads on the Conversant side and asked them to identify which people they wanted to work with for data integration.

Execution team 3 worked with individual teams and HIRA business functions to identify which people will come over to the Conversant side. They also asked for the list of people that Conversant wanted to retain from HIRA to further assist with day-to-day functions and which people Conversant wanted to let go.

7. PROJECT CHALLENGES

The integration project experienced new complications when they learned about the Conversant hardware retention policy. As per the IT quality organization, the project teams were asked to hold onto all hardware for 6 months after all data was archived. This was significant because it meant that the individual business/work streams and projects couldn't be closed and the personnel had to be extended, which in turn meant extending budget approvals. These project delays and budgets were unexpected and had to be communicated to the CIO level, who wanted to complete the integration in 12 months. In addition, there was also a risk of losing deeply engaged integration consulting teams and other contractors prior to hardware decommissioning.

The program suffered a major setback when the IT technology lead, Ed Wesse from HIRA, who had a thorough knowledge of all IT applications, unexpectedly left the company. Ed was involved in installing and configuring all HIRA applications and was one of the staff members, who was not asked to be retained. He was not happy and started looking for other positions while supporting integration efforts. While the execution teams identified this risk early and did their best to gather all systems knowledge, Ed was hard to replace as he was someone who knew a good deal about how all systems worked as well as the data organization and management.

Management Support
Given the delays and complications, the project sponsors and the management did all they could to create transparency and keep the team morale high. They scheduled regular town hall meetings, monthly celebrations to give credit for small wins/completions. They held ice cream socials, breakfast check-ins and gave out program merchandise to celebrate people and project wins. They were flexible with timelines and budgets when complications arose. Despite the constant motivation and support, there were a lot

of unanswered questions about people and systems integrations that posed barriers to integration efforts completing in a timely manner. Dave Gerber was worried: *"How could the integration teams continue to work without much support from Conversant business teams and without technical knowledge from the HIRA IT team, which had lost its technical leader"*?

8. CONCLUSIONS

After four months of collecting operating metrics in the first quarter of 2017 from his functional teams, John Richardson spent the next month analyzing the data for trends and business opportunities for improvement (Vitharana and Mone, 2008). Throughout his analysis John found that some valuable data that could be collected was not recorded by the functional managers. Had this data been collected, it may support an interdependence between the hosting functions; presenting an opportunity for an automated system to optimize staff resources as opposed to exclusively reducing them. With this data, John believed he could present Conversant leadership a justification to maintain more of the original HIRA hosting personnel. John shared the other metrics he identified for each of his managers to capture going forward. Excited about his discovery he also requested his meeting with Conversant be postponed. His request was approved contingent upon him developing critical success factors to complement and validate the key metrics that he had collected directly from frontline HIRA staff (Witman, 2018).

9. QUESTIONS

1. Create a SWOT to analyze the Conversant and HIRA merger from each company's perspective. Evaluate this merger decision by considering both the external risks and opportunities and the internal conflicts in strategy, systems, and business processes.

2. List the objectives of the integration project and critique the project's organizational structure. How did the integration project address the internal conflicts between HIRA and Conversant?

3. Describe possible metrics and KPI's that John Richardson could use to improve the efficiency of HIRA's Application hosting processes listed in Section 5.0. How could the reliability of the metrics data be improved?

4. Discuss the strategic and operational elements of the merged company's information systems architecture. What are key business and technical components?

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Editor's Note:

This paper was selected for inclusion in the journal as an EDSIGCON 2021 Distinguished Paper. The acceptance rate is typically 7% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2021.

Teaching Case

Interacting with Bloomberg Terminal from an Information Technology Perspective (Student Assignment)

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Abstract

Bloomberg Terminal is one of the most prominent and valuable tools for business and technology professionals. Having familiarity with Bloomberg is a desirable qualification for business students upon graduation. This classroom activity introduces Bloomberg Terminal in an introductory information technology (IT) digital literacy course at a business university. This activity guides students to find and analyze data related to capital markets that they will need to understand regardless of their chosen major. Students learn to apply IT concepts and develop their technology skills to complete the activity.

Keywords: Bloomberg Terminal, Digital Literacy, Career Skills, Business Education

1. INTRODUCTION

Bloomberg is a financial data, news, and media company. Their Bloomberg Terminal application provides information on financial markets, industries, and companies around the world. You can access the Bloomberg Terminal application in person in the University's Trading Room or using your own computer remotely. The Bloomberg Terminal application uses a proprietary database which resides on Bloomberg's servers. Having familiarity with Bloomberg Terminal is a desirable qualification for business students upon graduation. Introducing you to Bloomberg Terminal in your introductory information technology course will allow you to apply your technology skills to use the application and give you the opportunity to develop useful skills in the business world.

This activity will also introduce you to the University's Center for Financial Services (aka "the Trading Room") a comprehensive, online service for global financial information including stock performance, financial statements, emerging and global markets, as well as corporate information. You can access Bloomberg Terminal from the Trading Room or remotely, and make use of its tools for searching, visualizing, graphing, analyzing, exploring, and interpreting financial data. The Trading Room is a state-of-the-art facility where students can have first-hand exposure to financial concepts such as

trading, portfolio construction, corporate finance, and risk management.

You may complete the assignment in the University's Trading Room, or online depending on your situation.

Information Technology Skills
While business students usually get their first exposure to Bloomberg Terminal in a business or finance course, developing these skills now will give you additional skills that may lead to summer employment and internships at local firms by the end of your first year of college. Some students, after completing the training, may choose to pursue Bloomberg Market Concept (BMC) Certification.

By completing this Bloomberg Terminal activity as part of your information systems / technology literacy course, you will identify how the Bloomberg Terminal application implements several important information technology concepts and develop your own technology skills. In addition to learning basic features of Bloomberg Terminal, you also will:

- Interact with financial software and online databases,
- Describe the role of the client and server when connecting to Bloomberg Terminal as you use an application with a client-server architecture,
- Use a web or client application to access software over a network,
- Define Application Programming Interface (API) and describe how an API allows third-party applications such as Microsoft Excel to access Bloomberg data
- Use an application other than a search engine to do basic research on a company,
- Move files and data from multiple sources across multiple devices and platforms,
- import, analyze, and chart data using Excel,
- Use application software with a text-based command line interface,
- Distinguish between open-source and proprietary software.

Section 2 describes the Bloomberg Terminal activity. Section 3 summarizes this lesson's learning goals.

Appendix 1 contains suggested readings to help you become familiar with Bloomberg Terminal and lists some of its basic functions; Appendix 2 shows the tasks you will accomplish using Bloomberg Terminal and provides a slide deck you can use to submit screenshots showing your work.

2. THE BLOOMBERG TERMINAL ACTIVITY

You will use Bloomberg Terminal to research a company of interest, by completing these tasks:

- Find ticker symbol for your company.
- Use Bloomberg Terminal to find information about your company.
- Download the balance sheet and income statement for your company for the most recent 3 years.
- Use the Bloomberg function GP to plot stock price using 3 years of daily data.
- Use the Bloomberg function CN to find recent news about the Company.
- Using the Excel add-in, download daily stock prices for 3 years for Apple and your assigned company
- Download 3 years of currency values for the Euro, Yen, and Canadian dollar

Learn about Bloomberg Terminal
To prepare for the Bloomberg Terminal activity, read several articles about Bloomberg Terminal. Do independent research or look at those provided in Appendix 1 Table 1.

Write responses to the discussion questions on the online discussion board, or in another format as specified by your instructor:

- How might companies make use of Bloomberg Terminal services?
- What factors contributed to Bloomberg's success?
- Which features of Bloomberg Terminal that you read about most interest you, and why?
- Consider the technology required to provide the Bloomberg Terminal application to users around the world. Describe the role of the client and server, the flow of information that takes place, and the different devices / platforms on which the application is available.

Accessing Bloomberg Terminal
To use Bloomberg Terminal, you will need to create an account for Bloomberg for Education at https://portal.bloombergforeducation.com/sign_up. Your school administrator will need to approve your account.

Bloomberg Anywhere is a web app that lets you access the Bloomberg Terminal application in a browser on any device. If accessing Bloomberg Terminal remotely, you need to set up the Citrix Workspace App client. Follow the instructions at https://bba.bloomberg.net/Install/Client to install the Citrix Receiver, client software to connect to the Bloomberg server. Start Bloomberg Anywhere by opening a browser and visiting https://bba.bloomberg.net.

If working in the Trading Room in person, you can use the computers there, which are already equipped to run Bloomberg Terminal.

Overview

You will work in teams of two/ to complete the activity. Working in person, two students sit at the same workstation to complete the activity in person. Working online, the student who signs in to Bloomberg Terminal shares their screen with their partner.

The student viewing the Bloomberg Terminal screen reads the task aloud to their partner; discuss your solution, and your partner enters the commands in Bloomberg Terminal to carry them out. Then trade roles after a few steps, so each of you can be both a reader and a follower of instructions.

You will download a shared Google presentation containing each step of the tutorial and outlining the questions to answer.

Take screenshots of your solutions to each step, and add callouts or descriptions pointing out meaningful information that you are able to discern from each screen.

Appendix 2 contains a Google Slides deck which your team can copy to present your results. Add screenshots to each slide, and include callouts to show how you interpret the Bloomberg Terminal screens. You can download this presentation from https://bit.ly/EDSIGCon2021-Bloomberg.

You can work together on the project, but each student should reflect their own learning and then answer the open-ended questions on the last slide individually. Also consider the technology skills you used when completing is activity.

Interacting with Bloomberg Terminal

After launching Bloomberg Terminal either in-person or remotely, you can type phrases such as "US 100 Year Yield" or type the names of pre-defined functions (given by three or four-letter abbreviations) as commands to accomplish specific tasks. Appendix I Table 2 lists several commonly used functions.

You will use these functions in the sample activity: CN (company news), DES (company description), FA (company fundamentals), CF (company filings, and GP (general plot). In addition to these functions, please feel free to explore other commands on your own to see what they do. To complete the activity, issue the appropriate commands to solve each task.

Computers equipped to run Bloomberg Terminal have keyboards whose function keys have been pre-programmed to type many of these common abbreviations. Becoming familiar with the function keys allows advanced users to improve their efficiency when using Bloomberg Terminal.

In this activity, you will use Bloomberg Terminal to accomplish these tasks:

- Find the ticker symbol for your team's company (Figure 1).
- Investigate the different types of data available for that company (Figure 2).
- Download the balance sheet and income statement for that company for the most recent 3 years (Figure 3).
- Use the general plot function GP to plot stock price using 3 years of daily data (Figure 4).
- Use the company news function CN to find recent news about the company. (Figure 5).

The figures below show screens from Bloomberg Terminal as you complete each task. Search for videos online for additional information or guidance.

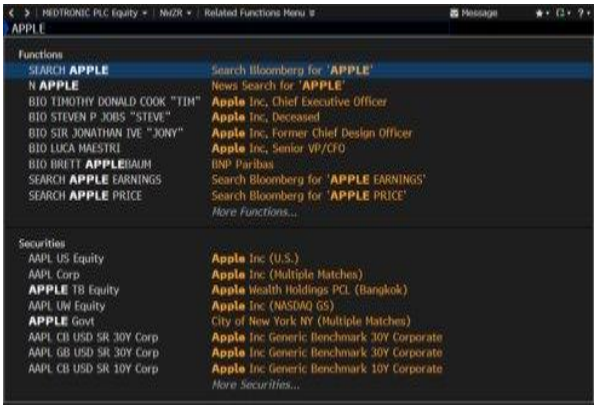

Figure 1. Find the ticker symbol for your team's company.

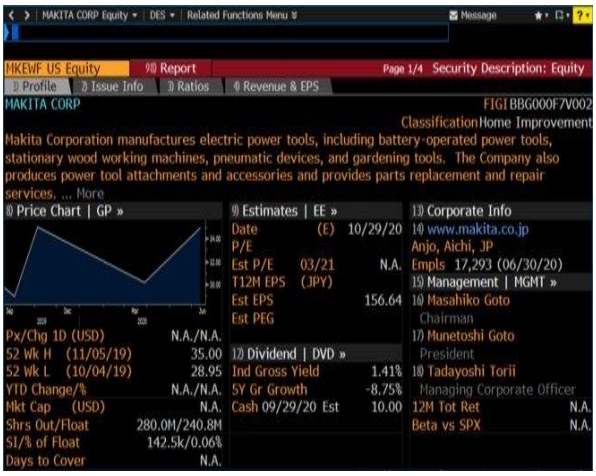

Figure 2. Investigate the different types of data that Bloomberg has on that company.

Figure 3. Download the balance sheet and income statement for that company for the most recent 3 years.

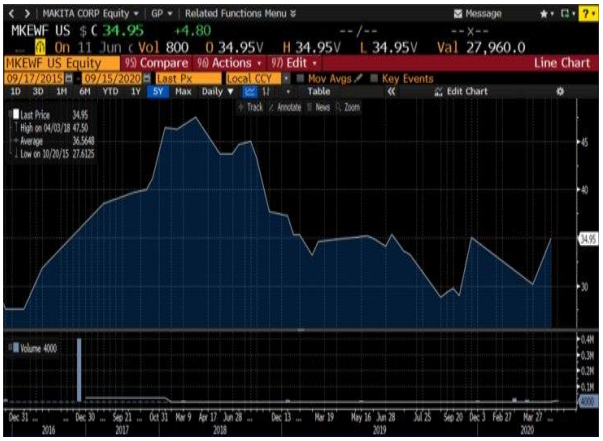

Figure 4. Use the general plot function GP to plot stock price using 3 years of daily data.

Figure 5. Use the company news function CN to find recent news about the company.

Using the Bloomberg Office Tools Add-in for Excel

In the next part of the activity, you will install the Bloomberg Spreadsheet Builder and Function Builder add-ins for Microsoft Excel. These tools extract information from Bloomberg Terminal and create search queries for Bloomberg Terminal to import data into Excel.

To download the add-in installer, navigate to https://tinyurl.com/Download-Excel-Add-in and locate the download link for Bloomberg Office Tools in the Office Tools section, as shown in Figure 6. Click the Download arrow link to download the file.

Figure 6. Locating the Bloomberg Office Tools Add-in for Excel.

It will be named something like bxla31_11_56.exe (depending on the version available when downloaded) and appear with a Bloomberg icon in your Downloads folder. Double-click the icon to install the add-in, then start excel to see it. When installed in Excel, these appear as three buttons in the Create group of the Bloomberg tab in Microsoft Excel. See Figure 7.

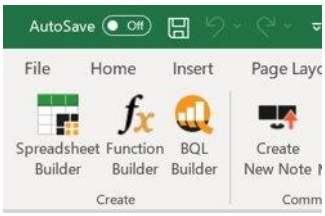

Figure 7. Bloomberg add-ins for Excel.

The Spreadsheet Builder is a spreadsheet wizard that allows you to extract information from the terminal and display it in Excel. The Function Builder allows you to create a search query for the terminal and display the data on Excel.

Using this Excel add-in, you can download daily or historical stock or currency prices for a given date interval into Excel. Excel will request the data from a Bloomberg server and import it automatically into Excel. By clicking the Spreadsheet Builder button in Excel, you can specify the data to import. The Spreadsheet Builder will ask you to specify a task (such as Analyze Historical Data), then enter the ticker symbol or currency of interest. Choose the fields of interest (such as Last Price) and specify a date range. The Spreadsheet Builder will show the row and column headings for your worksheet (see Figure 8). This example shows what the spreadsheet will look like after selecting the last price one stock and two international currencies.

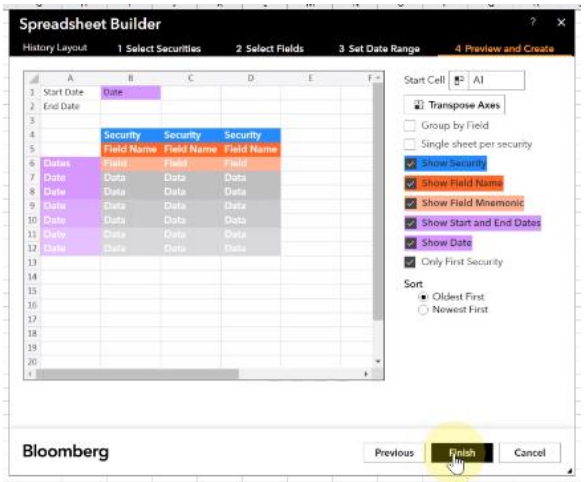

Figure 8. Importing Bloomberg stock data into Microsoft Excel using the Bloomberg Spreadsheet Builder.

After clicking the Finish button, Figure 9 shows the data been imported into Excel.

1	Start Date	9/22/2015		
2	End Date			
3				
4		AAPL US Equity	JPY Currncy	QQQ US Equity
5		Last Price	Last Price	Last Price
6	Dates	PX_LAST	PX_LAST	PX_LAST
7	9/22/2015	28.35	120.15	104.1
8	9/23/2015	28.58	120.28	104.18
9	9/24/2015	28.75	120.07	103.8
10	9/25/2015	28.678	120.59	102.92
11	9/28/2015	28.11	119.92	99.99
12	9/29/2015	27.265	119.74	99.47
13	9/30/2015	27.575	119.88	101.76
14	10/1/2015	27.395	119.93	102.22
15	10/2/2015	27.595	119.91	104.01
16	10/5/2015	27.695	120.46	105.5
17	10/6/2015	27.828	120.23	105
18	10/7/2015	27.695	120.01	105.63
19	10/8/2015	27.375	119.93	106.05
20	10/9/2015	28.03	120.27	106.53
21	10/12/2015	27.9	120.04	106.79
22	10/13/2015	27.948	119.75	106.1
23	10/14/2015	27.553	118.83	105.93

Figure 9. Financial data from Bloomberg imported into Excel after using the Bloomberg Terminal.

Using these add-ins, you can download stock data and currency data into Microsoft Excel and then apply your knowledge of Excel to create line charts plotting this data.

3. SUMMARY

Bloomberg Terminal offers tools to explore the technology companies and their developments in business through wide-ranging technology research and news coverage as well as data analysis tools. To understand the basic architecture and make use of this tool, you need to understand several basic technology concepts. Completing this project allows you to experience them in a hands-on setting. Your study of the Bloomberg Company also taught you about the technology that makes the Bloomberg Terminal application possible, enabling businesses to use information technology to provide consistent information to all of their employees.

Appendix 1.

Table 1. Readings

About Tech at Bloomberg. (2021). Tech at Bloomberg. https://www.techatbloomberg.com/about/

Bloomberg for Education, Getting Started Guide for Students. (2014). https://guides.library.uwa.edu.au/ld.php?content_id=14674823

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McCracken, H. (2015, October 6). How the Bloomberg Terminal Made History–And Stays Ever Relevant. https://www.fastcompany.com/3051883/the-bloomberg-terminal

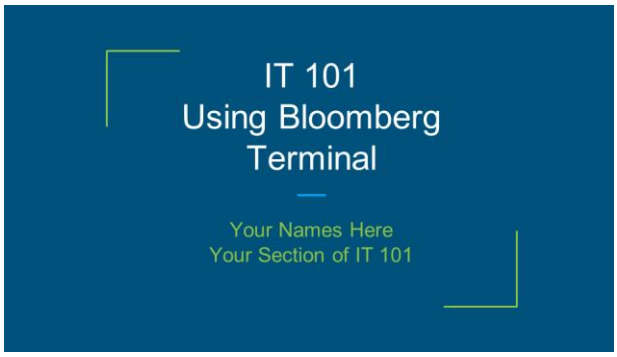
Woodie, A. (2017, September 18). The Data Science Inside the Bloomberg Terminal. Datanami. https://www.datanami.com/2017/09/18/data-science-inside-bloomberg-terminal/

Table 2. Common Bloomberg Terminal Commands
(Italicized commands are used in this lab activity.)

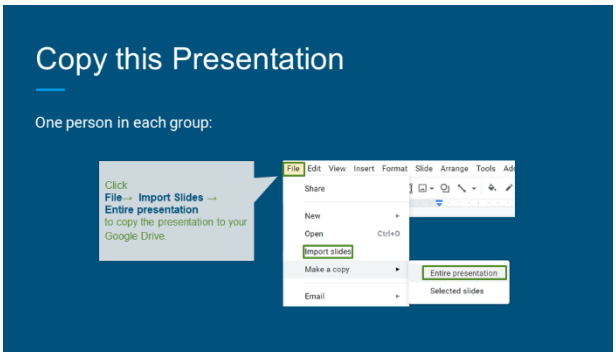
News *CN – Company News* *BI – Bloomberg Intelligence* IPO – Equity Offerings **FX – Foreign Exchange** FXFC – FX Forecasts **Economics** ECFC – Economic Forecasts FOMC – FOMC Activities WECO – Economic Calendars **Screens** WEI – World Equity Index WB – World Bond Markets EMEQ – Emerging Market Equity Indices EQS – Equity Screening WM – World Equity Markets MEMB – Member Weightings **People** PEOP – People Search Rich – Bloomberg Billionaires	**Equity Analysis** *DES – Company Description* *FA – Company Fundamentals* EE – Earnings Estimates ANR – Analyst Recommendations CRPR – Credit Ratings DRSK – Default Risk CF – Company Filings CACS – Corporate Action Calendar *GP – Historical Graphs/Table* CAST – Capital Structure EV – Enterprise Value TECH – Technical Study Browser WACC – Weighted Average Cost of Capital SPLC - Supply Chain Analysis **Comparative & Historical Analysis** RV – Competitor Relative Value BETA – Historical Beta **Excel** XLTP – Excel Template Library

Appendix 2.

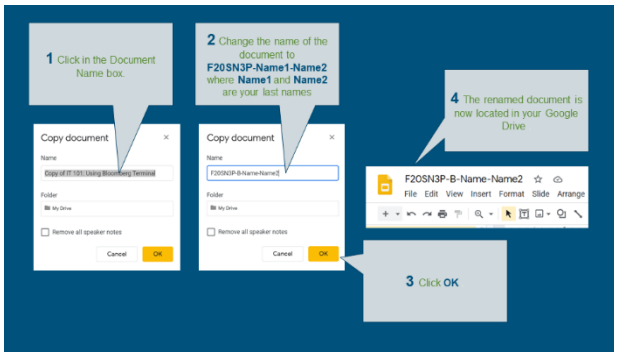
Copy this template from Google Slides and share it with your group members. (Slides 2-6 describe how to copy and share a Google Slides presentation.) Discuss each step with your partner. Take screenshots as you complete each step, and add call-outs to describe what you interpreted from the Bloomberg screens. You can access this sample template from https://bit.ly/EDSIGCon2021-Bloomberg . Provide the link to your group's Google Slides presentation to submit it.



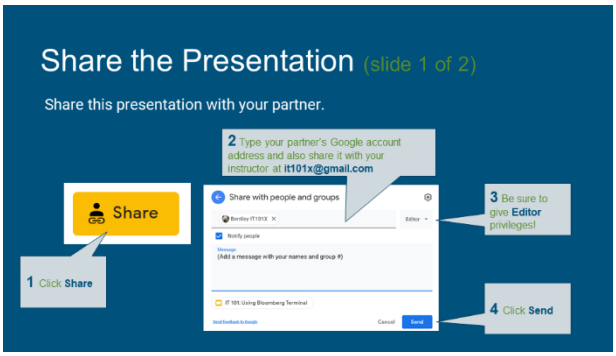
Slide 1.



Slide 2.



Slide 3.



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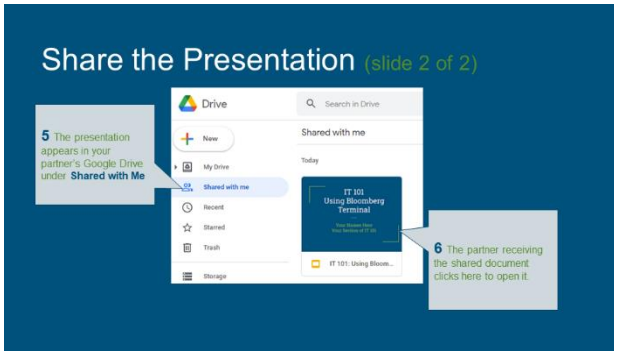
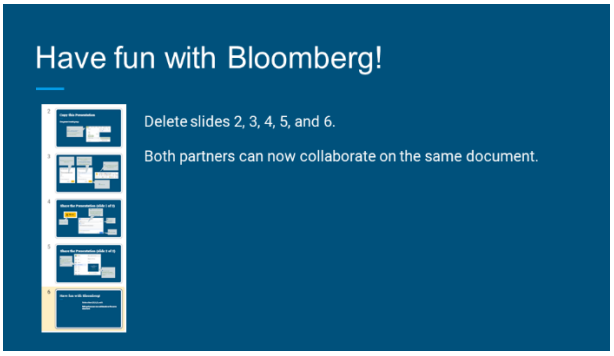
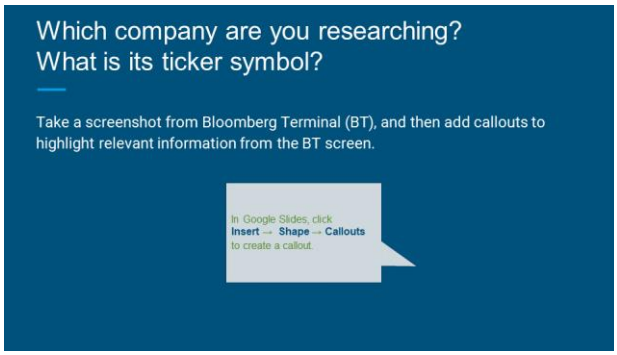


Slide 5.



Slide 6.



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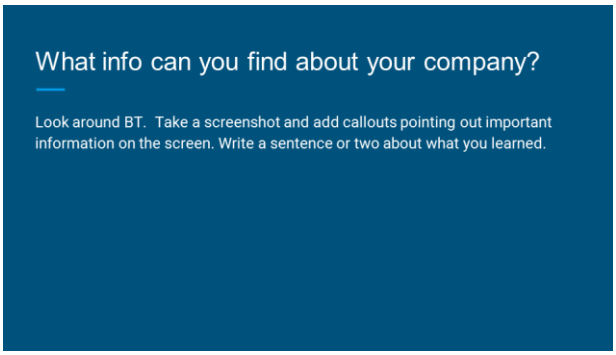

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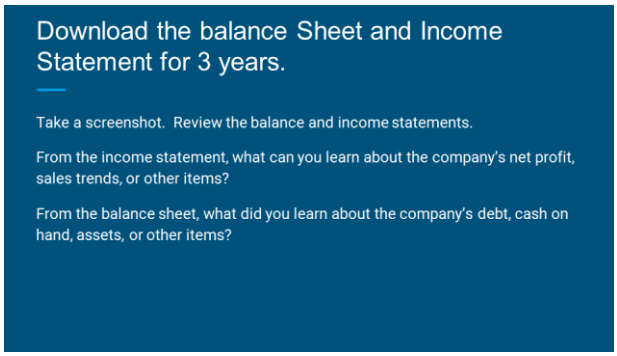
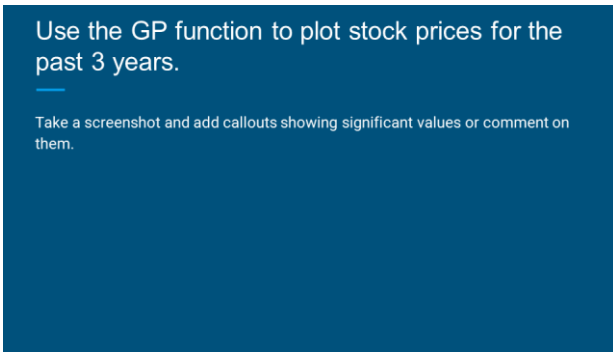
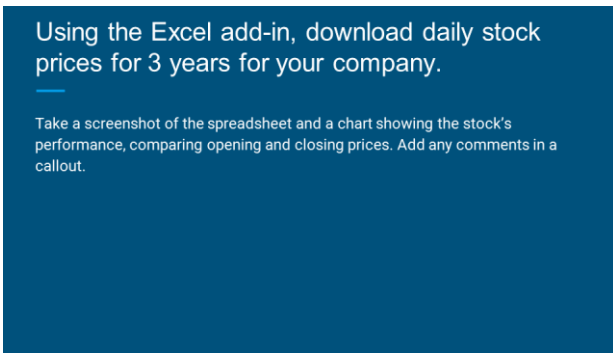


Slide 9.

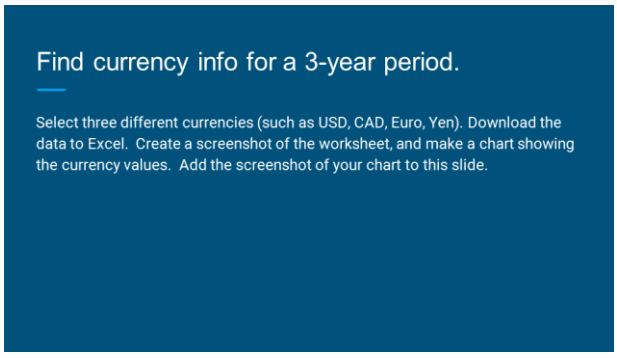


Slide 10.

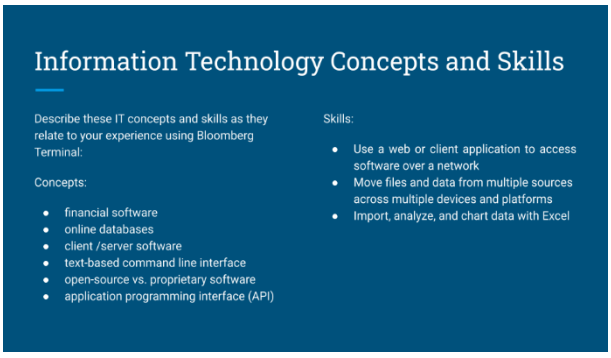
Slide 11.



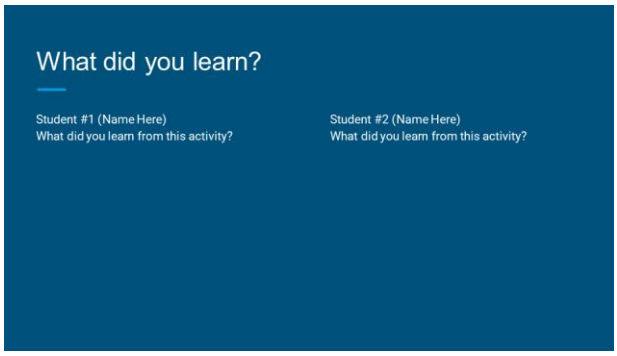
Slide 12.



Slide 13.



Slide 14.


What did you learn?
Student #1 (Name Here)
What did you learn from this activity?
Student #2 (Name Here)
What did you learn from this activity?

Slide 15.

Teaching Case (Instructor Notes)

An Experiential Learning Project using Sentiment Analysis of Twitter Posts

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Hook

What's the word on the tweet? This project enables students to collect tweets about topics of their choice and use sentiment analysis to measure the current perspectives from the Twittersphere about those topics.

Abstract

In this teaching case, we describe an experiential learning project that allows students to perform sentiment analysis on a set of tweets (posts made on the social media platform, Twitter) by collecting and analyzing posts that include key words selected by the students. Sentiment analysis refers to the process of identifying and categorizing opinions expressed in a piece of text. The project requires students to make edits to an R script, execute the script to save a collection of tweets that contain specific keywords, then open the file and paste the results into a macro-enabled Excel file that is provided. Students then edit the dataset to cleanse the data and write a report to interpret the findings. The assignment requires only a cursory knowledge of programming and Excel. We assign the project to students taking an introductory information systems course but the project could be suitable for courses in business analytics, marketing, social media, computer science, and other subjects.

Keywords: experiential learning, analytics, sentiment analysis, twitter

1. INTRODUCTION

Students enjoy coursework that is experiential, engaging, and relevant to their interests. Kolb and Kolb (2005) are known for their theory of experiential learning which includes learning as a whole process. In this study, we describe a project that allows students to perform sentiment analysis on a set of tweets (posts made on the social media platform, Twitter) by collecting and analyzing posts that include key words selected by the students. The project enables students to perform real-time analytics while providing exposure to a programming language without having to learn in-depth coding skills. This project allows students to grasp new concepts, to be

creative and reflective resulting in a much deeper level of learning due to the experiential format of the assignment.

2. OVERVIEW OF SENTIMENT ANALYSIS

Sentiment analysis refers to the use of natural language processing, text analysis, computational linguistics, and biometrics to systematically identify, extract, quantify, and study affective states and subjective information (Medium.com, 2021). Sentiment analysis models have been developed and tested to estimate the extent to which a string of text is positive or negative and to quantify the emotions that are expressed. Sentiment analyses have been applied to customer reviews, survey responses, social media, and other data sources across various fields of study. For example, one study demonstrated how the analysis of Twitter sentiment was closely correlated to a Gallup poll of public opinion (O'Connor, Balasubramanyan, and Routledge, 2010). Another study showed how the moods depicted in tweets can predict stock market trends (Bollen, Mao, and Zeng, 2011).

In this project, three different methods of analyzing sentiment are provided to students. The AFinn model uses a list of English words rated on a scale between -5 (negative) and +5 (positive). The model was developed by Finn Årup Nielsen between 2009 and 2011 (Nielsen, 2011). The Bing index (Liu & Hu, 2004) model assigns selected words as either negative (-1) or positive (+1). Applied to Twitter entries, each word in a tweet string is tabulated to determine the net positive or negative score. The NRC model (Mohammad & Turney, 2014) was coordinated by the National Research Council of Canada. Its model categorizes English words in alignment with eight emotions: anger, anticipation, disgust, fear, joy, sadness, surprise, and trust. When applied to Twitter entries, each tweet's word count for each emotion is tabulated. The emotions are then compared to a total to determine the relative percentage of each emotion that is found in the set of extracted tweets.

3. PROJECT DESCRIPTION

Pre-Project Requirements

To search and extract the tweets that contain the selected keywords into a dataset, students need to register for a (or use a provided) development account on Twitter that allows access to an open API. Students must also either register for a cloud based R-studio account or students can download R and R Studio to their computer or use applications installed on lab or classroom computers. We give students a short introduction to R, including an example that edits the script used in the assignment. Similar open-source scripts are available for use in Python if instructors prefer using Python instead of R. Our students have prior instruction using Excel prior to starting the assignment. The assignment timeline can be expected to last approximately one week, given the possible delay in approval for the Twitter development account and the time to give students a brief introduction to programming in R.

Editing the R Script

One student accounts are approved, students then open and edit an R script that installs the rtweet open source package and library. The required edits include editing search terms, maximum number of records requested, variable names, and file names. Note that the script in Figure 1 represents a simple usage of the r-tweet application. Many additional arguments and options can be use with additional code to filter or refine the extracted set of tweets. (Kearney, 2019)

In our assignment, students select keywords that represent a particular brand, product, person, or topic then select two additional related keywords to make comparisons. For example, students could compare a specific style of Nike shoe with competing brands offered by Adidas or Under Armour. Students could also select keywords to compare sentiment towards politicians, celebrities, sports teams, or other topics.

Using Excel for Sentiment Analyses

After successful execution of the code, files will be generated that store the collection of tweets in csv (comma separate values) formatted files that could then be opened in Excel or read by a programming language to score the tweets in accordance with the sentiment models. The resulting csv file contains the text of each tweet in separate rows, along with the ninety other columns of data, including the screen name, date and time, location, number of retweets, and various other attributes. For this assignment, students can filter the csv file manually or by creating a table. Figure 2 shows a partial screen shot showing extracted tweets in the csv file with a table inserted to allow filtering of records.

```
# To collect tweets, pass a search criteria to the
# search_tweets() function and assign the output
# as a new R object.

# Define a new data object based on a Twitter
# search. The "n=200" augment is used to
# specify the number of tweets requested.
rtweet_xavier<-search_tweets("xavier
University", n = 200)

# Many other arguments exist, including
restricting language to only English...
rtweet_xavier_en <- search_tweets("Xavier
University", n = 200, lang = 'en')

# ...or you can opt to not include retweets:
rtweet_xavier_en_nort <- search_tweets("Xavier
University", n=200,include_rts = FALSE)

# You can learn about the many other possible
arguments by viewing the help:
help("search_tweets")
```

Figure 1: Sample R-Tweet Script

screen_name	text
mha_online	Online MSN in Nursing Administration Programs Ranked b
ShayTAllenESQ	Support a fantastic event on July 24th! Proceeds go towar
xuecosoc	With this, we welcome you to Xavier University Economics
gageywagey15	@DTV89 I once went to a party at Xavier. Can confirm, that
WyattEarp1969	@daraghson_ Welcome to the Xavier family, young man.
WindsorMBB	Xavier is a transfer from Dalhousie University. There he w
XULAalumni	The Alumni would like to formally introduce Mr. Phillip Ac
juellieana	xavier university see u next year
unitassateneo	The Xavier University United Arts and Sciences and Studer
MindanaoGSD	THAT question continues to loiter in the minds of Xavier U
XU_JMAofficial	The Junior Marketing Association of Xavier University is op
PaigeThomas_30	SO excited to announce my verbal commitment to St.Xavi
ericcrawford	CONGRATS to St. Xavier product Trey Sweeney, of Eastern
andypic17	The Cleveland Indians are selecting Naji Marshall, LF, Xavi
IAMKPSmith	Xavier University is coming up on #CollegeBowl.

Figure 2: Excel CSV File with Table

In our project, once students finish filtering, they copy and paste the data from the "text" column into a separate macro-enabled Excel file with embedded Visual Basic code that performs the sentiment analyses and summarizes the results. Figure 3 shows a partial screen shot of the sentiment analysis Excel file. The image shows the summary Afinn and Bing scores for the tweets and the first four (of eight) of the emotion scores from the NRC model. In order to compare the sentiment analysis results of multiple search terms, the processes shown above would need to be repeated or code from the R-script could be added to produce multiple csv files along with the need to copy and paste the text results into additional worksheets.

Average Tweet Score	1.15	0.96				
Total Subject Score	26.34	22.00	5%	26%	0%	5%
Text	Afinn	Bing	Anger	Anticipation	Disgust	Fear
Happy 4th of July, Musketeers! Wishing you a fun and safe holiday weekend.	2.67	3	0	3	0	0
Let's all give a big Xavier welcome to @PrezHanycz as she celebrates three big milestones today! Canada Day	1.75	1	0	0	0	0
Xavier is strongly encouraging our community to receive a #COVID19 vaccine this summer.<U+2063> Students who update their records this summer will be entered into a special	2.5	2	0	2	0	0

Figure 3: Excel File with Sentiment Analysis Results

Although we do not teach students the Visual Basic code that computes the sentiment scores for each model, students are shown how to enable the Developer menu in Excel and shown how to open and view the code. Note that the macro-enabled Excel file was developed in-house by one of this study's authors for teaching purposes. Sentiment analysis code can also be deployed in other programming languages but may be more complex for students and instructors to implement. Figure 4 shows a small portion of the code used to compute the scores summarized in the worksheet.

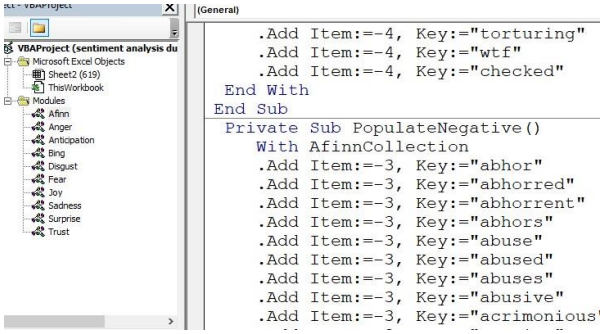

Figure 4: Excel Visual Basic Code to Compute Sentiment Analysis Scores

Limitations of Twitter for Sentiment Analysis

Students should be informed that sentiment analyses simply examine the words contained in posts and compares them against a set of words and their respective scores in accordance with each model. The process can be imperfect and can inaccurately score individual posts depending on the context of the use of the words contained in the post. Students should try to be specific in their search terms and be aware that some terms may be used in differing contexts. For example, if students chose "Google" as a brand to evaluate, tweets using google as a verb would also be captured. Since the assignment uses tweets, students should be aware that re-tweets and tweets generated by bots can cause records of the same tweet to be represented multiple times in the dataset which may impact the accuracy of

the overall sentiment scores. Twitter is also used as a marketing platform and not all posts represent opinions on a topic. For example, there may be a series of posts referencing the Nike shoe brand that are simply links to eBay product offerings. The extracted tweets might also include posts that are not in English or that contain images or other media that cannot be interpreted by the sentiment analysis code. Depending on the purpose of the sentiment analyses (a real-life consulting project, graduate thesis, etc.), time-consuming filtering may be needed to cleanse the data. As an alternative to this assignment, students could collect data from other sources (such as Yelp, TripAdvisor, Amazon, etc.) that contain text that can be scraped using programming language scripts or manually copied and pasted into the Excel file.

Final Report and Project Deliverables

We feel it is important for students to write a short report that summarizes their findings. While students may not fully comprehend the R code that extracts the data nor the VBA code that scores each record using the three sentiment analysis models, students should convey a big-picture understanding of the process and be able to interpret their findings along with any limitations or problematic records in their datasets. We require students to limit their report to a one-page document that summarizes and compares the average sentiment scores for each search term, compares significant emotion percentage differences between the terms, and reflects on the tweets collected and the reasons for the resulting scores. In terms of deliverables, students are required to turn in their R code, their excel workbook with separate worksheets for each search term, and the written report. We typically allow students to work in groups of three on the assignment, offer peer evaluation and provide students with a grading rubric that accompanies the project instructions.

4. CONCLUSIONS

This experiential sentiment exercise was assigned to undergraduate business students taking their first information systems course. Upon conclusion of the assignment, it is clear to us that a hands-on learning exercise such as this can provide a superior learning experience for students that transcends the typical activities found in a beginning IS or Computer Science course. As Kolb and Kolb (2005: 43-44) repeatedly discuss in their research, "Learning is a holistic process of adaptation. It is not just the result of cognition but involves the integrated functioning of the total person – thinking, feeling, perceiving and behaving." This activity successfully meets each of these experiential requirements.

On a separate Word document, summarize your findings on the three search terms in one page or less. Be sure to comment on:

- Average tweet score for Afinn and Bing sentiments. Is it positive or negative? Judging by some of the tweets and what you know of the terms, why do you think this might be the case?
- How do the emotions compare between search terms? Are they consistent or do they have different profiles?

Submit the following under the "R Twitter Project" assignment link:

- Your R code for extracting the data from Twitter using the rtweet package
- A sentiment analysis workbook with three sheets calculating sentiment (one for each search term)
- The final Word document summarizing your findings

Figure 5: Final Report and Project Deliverables

By the end of the exercise, we observed the following of our introductory students:

- Students initially perceived the assignment to be very intimidating. Most likely, this was due to their inexperience with programming and basic data analysis. Post-assignment, in almost all cases students indicated it was much easier than they imagined. • Students were surprised to find that results from analyses were easily swayed by when the data was collected and/or by the keywords used.
- Students found that sometimes the results didn't make sense because sentiment analysis is not perfect.
- At first, many students struggled to come up with things to compare because they were not familiar with how sentiment analysis tools work. After performing the tasks, they were able to perceive the value in the tools and could imagine easily applying to a variety of situations.
- The majority of students indicated that this was a fun and practical activity. They

were impressed with the simplicity and yet the power of this analytical method.

Experiential learning is a significant trend in higher education. It boosts students' involvement with the learning process. We believe employing this novel sentiment analysis exercise as a participatory experience enhanced both the students' ability to absorb the concepts as well as their retention of the knowledge to a significant degree.

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APPENDICIES

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WindsorMBB	Xavier is a transfer from Dalhousie University. There he w
XULAalumni	The Alumni would like to formally introduce Mr. Phillip Ac
juellieana	xavier university see u next year
unitassateneo	The Xavier University United Arts and Sciences and Studer
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Figure 2: Excel CSV File with Table

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Xavier is strongly encouraging our community to receive a #COVID19 vaccine this summer.<U+2063> Students who update their records this summer will be entered into a special	2.5	2	0	2	0	0

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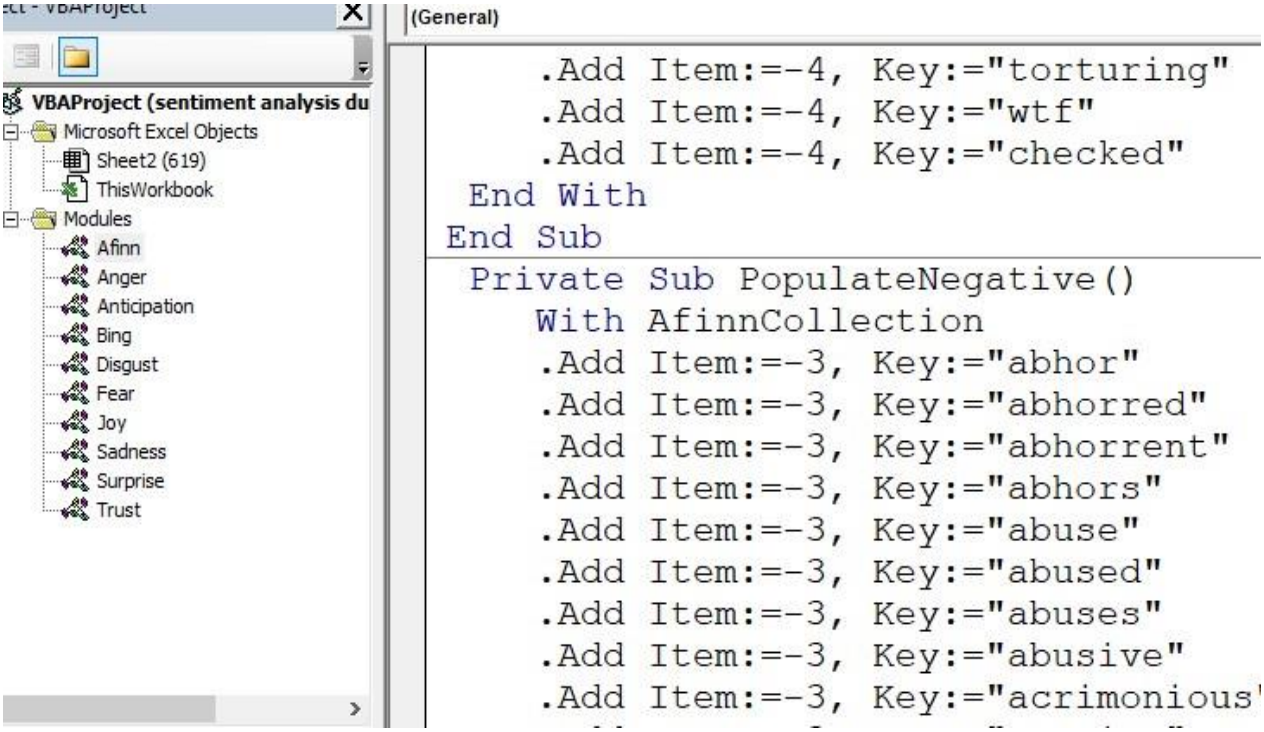

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Figure 5: Final Report and Project Deliverables

Teaching Case

Bracketology: Predicting Winners from Music March Madness

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Abstract

Organizations are keenly interested in data gathering from websites where discussions of products and brands occur. This increasingly means that programmers need an understanding of how to work with website application programming interfaces (APIs) for data acquisition. In this hands-on lab activity, students will learn how to gather data from several prominent websites using APIs and then build predictive models using that data. Unlike popular challenges on competition sites such as Kaggle where challenges often supply the data, this project emphasizes the data acquisition step of the analytics lifecycle. Working with data from Spotify, YouTube, and Twitter, students will fill out a music based March Madness bracket to predict the winner of the annual Locura De Marzo, a popular middle and high school Spanish competition. By becoming familiar with the data available from each site, through the analysis of the JSON formatted data returned by the APIs, students will be able to explore which features of a song might lend themselves to higher voting by high school students in order to build better prediction models.

Keywords: Bracketology, March Madness, Python, Data Science, Data Analytics, APIs, Hit Song Science

1. INTRODUCTION

The most well-known March Madness event is the annual NCAA basketball tournament that occurs each spring when 68 college teams compete for the national championship. The competition is commonly displayed as a bracket showing each division with the head-to-head matchups comprising the tournament. The winner of each head-to-head matchup moves on to the next round while the loser goes home. The study of predicting winners in this format is called

Bracketology. However, March Madness isn't just for basketball: similar tournaments, usually based on public voting, have occurred for science fiction TV shows (*Io9's March TV Madness*, n.d.), the Cooking Channel's Best College Eats (*Bracket Battle Best College Eats*, n.d.), and the Consumerist's Worst Companies in America (*Here Are Your Contestants For The 2013 Worst Company In America Tournament!*, 2013) where Electronic Arts trounced Bank of America in the final round earning them the title of Worst Company in America in 2013. In each of these tournaments the general public was asked to vote for the best (or worst) in each head-to-head matchup.

Consider the following challenge: if you were given 16 songs and asked to predict which song middle and high school students would select as their favorite, do you think you could do it?

This project will look at another, non-sports related, bracket style tournament run by middle school Spanish teacher Señor Ashby titled Locura De Marzo (*Locura De Marzo 2021*, n.d.). In this event, 16 songs go head-to-head in a bracket style competition for best song.

Using data that you will gather from Spotify, YouTube, and Twitter, you will develop models to fill out the Locura De Marzo bracket and to see how well you can predict the winner. The model will be trained using data from prior years' competitions.

2. LEARNING OUTCOMES

Before starting this project you should be familiar with the following

- A basic level of Python as you would obtain in an Introduction to Python class.
- Familiarity with installing libraries in your Python environment.
- Familiarity with Python Pandas (refer to this site for a good overview of Pandas: https://www.learndatasci.com/tutorials/python-pandas-tutorial-complete-introduction-for-beginners/).
- General familiarity with Spotify, YouTube, and Twitter, from a user's perspective.
- A general understanding of predictive modeling techniques such as linear regression and decision trees.

After completing this project, you will be able to:

- Automate data gathering from websites using several different APIs
- Import Python libraries and call methods in those libraries
- Generate a correlation matrix to explore your data for feature identification
- Build basic predictive models including a linear regression and random forest model
- Interpret results from the regression and random forest models
- Create a bracket-style elimination model

3. PROJECT DESCRIPTION

In this project, you will build a Python application that carries out the process of acquiring data, building a model, obtaining characteristics, and performing linear regression and machine learning analysis to predict the winner of a music tournament. Your instructor may provide a starter code file to help you develop or run this solution.

Discussion Questions

Each step of the project ends with questions for your consideration as you complete this project. Discuss the questions with your group, prepare responses for class discussion, or share your responses in a format as specified by your instructor.

Figure 1 provides an overview of the work flow and data flow for this project.

Your solution will follow these steps:

Setup Step (Step 0). If you do not already have free accounts on Spotify, YouTube, and Twitter, then you need to create those accounts. Next you will create Developer Accounts for these social media sites. You will need these to gather data about the songs and artists.

Step 1. Collect data on the past results of the Locura de Marzo tournaments. Manually enter it into a Pandas DataFrame. Features include the song title, artist, and performance of that particular song in the tournament.

Step 2. Call Application Programming Interfaces (APIs), passing collected song titles, and artist information to gather additional information. The Spotify API provides more advanced features on the song such as liveliness and tempo. The YouTube and Twitter APIs collect additional data about the song and artist's exposure on social media. The program uses this complete dataset to train the model.

Step 3. Create a correlation matrix to identify key features related to the target variables.

Step 4. Use the data and previous findings to train a Linear Regression model. Explore how machine learning can enhance this solution.

Step 5. Build a bracketed model solution to predict which songs will win in the tournament.

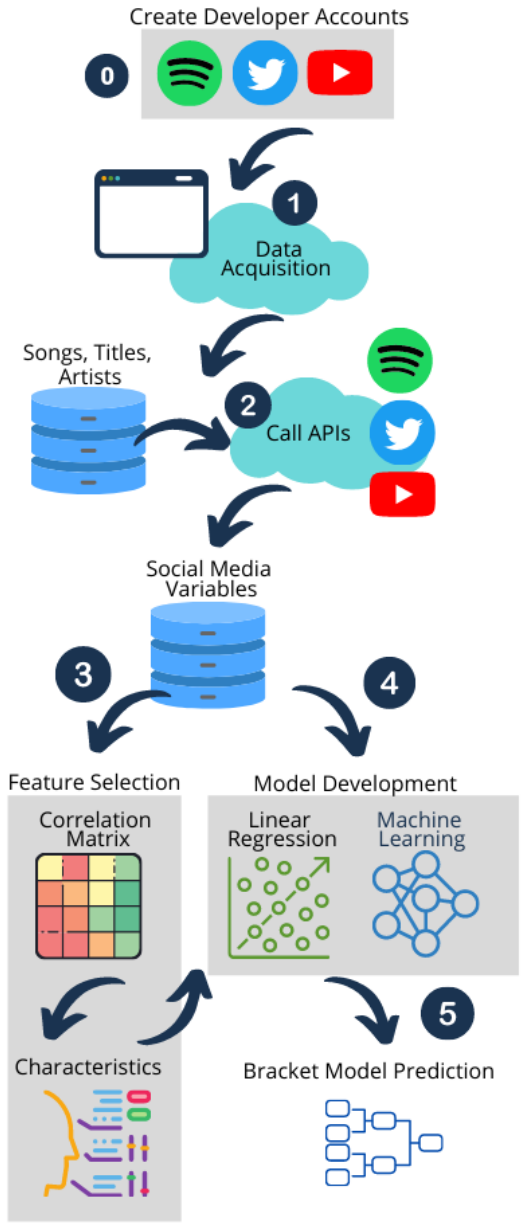

Figure 1. Workflow and Data Flow for Bracketology Project

Setup Step (Step 0 on Figure 1). Create Developer Accounts

Application Programming Interfaces (APIs) are callable functions that allow developers to access data from a website for use in other applications. Not all websites have APIs, and sometimes developers resort to screen scraping, or gathering information from a webpage based on its position on the page when an API is not available. Calling an information provider's API is always the preferred method when gathering large amounts of data. While most large social media sites offer APIs to developers, they frequently restrict the amount of type of data that can be gathered from the website.

To work with APIs, you usually have to create a developer account and get a license key, a unique identifier that allows the API provider to track the amount of information you request. These keys are unique for each user and the different websites have their own processes to obtain these keys.

In this project you will obtain data from Spotify, YouTube, and Twitter by calling their APIs. Follow the instructions in the paragraphs below to create developer accounts so you can access each service's API.

Follow the steps on these sites to create your developer accounts for the three social media sites:

- https://developer.twitter.com/en
- https://developer.spotify.com/
- https://developers.google.com/youtube/

Things to watch out for

When filling out the questions to submit to the various social media platforms, make sure you explain that you are requesting access as a student in order to do a social media project for your class. You may want to include your class name and your professor's name. It is preferred that you use an email address with a .edu extension in order to support your documentation.

Discussion Questions

1. *Looking at the Spotify API documentation, discuss which pieces of data could help with building a predictive model for song success.*
2. *Looking at the YouTube documentation, which fields could be used to predict popularity of a song?*

Step 1. Data Acquisition

Gather information about songs, titles, artists, and song performance in prior Locura de Marzo

tournaments from the SenorAshby.com website. Manually enter it into a Pandas DataFrame.

Things to watch out for

Some years the songs may have total number of votes while other years may include percent of votes received or even simply whether the song won or not. Consider how you will compare various years and make sure you use the same measure across years. This may require you to convert total vote count to a percentage or some other transformation.

Discussion Questions

1. *Looking at the data you were able to gather from the competition website, what fields provide the most insight and which fields do you think you could ignore?*
2. *Considering the data you examined in the API documentation along with the competition website, how would you ensure that the song on the competition website is the official song on the other sites (Spotify and YouTube)?*

Step 2. Call APIs

Call APIs from Spotify, Twitter, and YouTube to obtain additional information about these songs.

Your application will also need code to access and interact with the data that the APIs provide. Open-source libraries written in Python exist that provide this capability. The next sections describe those libraries and the data they make available.

To include a library in your Python application, you need to install it in your environment and then specify an *import* statement to include it in your project.

Spotipy. To interface with Spotify we will use the Spotipy library. Review the documentation for the Spotipy project here: https://spotipy.readthedocs.io/en/2.18.0/. Scroll down to the API Reference section of the documentation and you can see that there are methods for getting data related to Artists, Albums, Playlists, and Tracks, just to highlight a few.

Appendix 1, Figure 1 shows a code sample for accessing the Spotipy API along with the expected results. You can use this code to validate that your developer keys are working properly. The output from each of these calls is returned in a JSON format. This is a common format used with APIs, so if you are unfamiliar with the format then we suggest you read more about it at https://www.json.org/.

Since we are concerned with predicting which song will win in a head-to-head matchup with another song, we will focus on song level data (called a Track in the music industry). Looking at the documentation for the Track method we see the following:

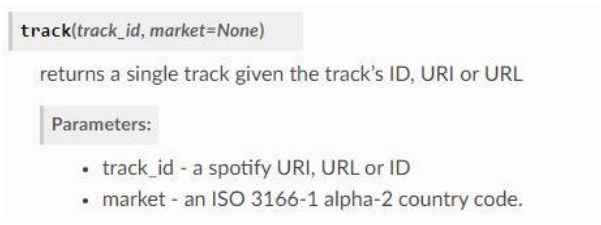

Figure 2. Spotipy Track Method

In order to make the call to the track method, we need to supply the track_id and an optional market. The track_id is Spotify's unique id for a specific song in their database.

The Locura de Marzo website makes track retrieval easier by supplying a playlist of each song in the competition. This allows us to call the API that retrieves the song details using that playlist which eliminates the need to loop through each song individually. This also reduces the calls to Spotify to 1 call per year of the competition. It is best practice to minimize the number of calls to the APIs in order to reduce your chances of hitting rate limits.

Spotify Features	Description
Release Date	Date song was released
Length	Length of the song in milliseconds
Popularity	Scale of how popular the song is (0-80)
Acousticness	Confidence measure if the song is acoustic
Danceability	Suitability for dancing
Energy	Measure of intensity and activity
Instrumentalness	Predicts whether a track contains no vocals
Liveness	The presence of an audience in the recording
Loudness	Loudness in decibels
Speechiness	Presence of spoken words
Tempo	Tempo in beats per minute
Key	Main group of pitches of a track
Mode	Modality of a track (1= Major, 0 = Minor)

Table 1. Spotify Features

The code in Appendix 1, Figure 2 validates that the list of songs can be retrieved using the playlist as supplied by the competition website.

Appendix 1, Figure 3 shows a code sample for retrieving track details for each of the songs in the playlist. The getTrackInformation() function is called once for each song in each playlist. The result of this call gives us the features found in Table 1.

Tweepy. In order to access Twitter information for each artist we need to find the handle for each. This is a manual lookup process. An artist's Twitter handle can be found in their Twitter profile, as shown in Figure 3.

Figure 3. Finding a Twitter Handle

We can see that the artist's handle is @CamiloMusica. We'll use this handle below to interface with the Twitter APIs. We use the Tweepy library to interface with the Twitter APIs. Review the documentation for the Tweepy project here: https://docs.tweepy.org/en/latest/.

See Appendix 1, Figure 4 for a code snippet to collect Camilo's number of followers, a value which we will use in our model. The result of this call gives us the following features from Twitter:

Twitter Feature	Description
Number Followers	Number of followers for an account

Table 2. Twitter Features

YouTube. Your solution/notebook will obtain information about music videos for each song from YouTube. Google provides an official Python library for YouTube found here: https://developers.google.com/youtube/v3

The code in Appendix 1, Figure 5 validates that your YouTube credentials are correct and you are able to retrieve the total number of views for the music video for *Vida De Rico* by Camilo. Table 3 shows some of the features available for each music video.

At this point you should have been able to validate that your developer accounts for the three websites are working properly. The next step is to collect the data for each song for both the training date (i.e. prior year competitions) and the testing data (current year challenge).

YouTube Features	Description
View Count	Number of views for the video
Like Count	Number of likes for the video
Dislike Count	Number of dislikes for the video
Comment Count	Number of comments for the video
Tags	Tags associated with the video

Table 3. YouTube Features

Discussion Questions

1. *If you could only pick a single piece of data to predict popularity, which would it be and why?*
2. *Based on your personal knowledge of the songs, what values surprise you most? Why?*

Step 3. Feature Selection

After gathering data about each song from the three different sources (Spotify, YouTube, Twitter), the next step is to decide which fields to use in our models.

One way to approach this step is to consider which variables are highly correlated with our target variable. In this case our target is the percentage of votes. By examining the correlation matrix (see Appendix 2, Figure 1) we look for fields that score high (using the absolute value, so high positive or high negative) in relation to the total number of votes. We see that the feature that has the highest positive correlation with our target variable is YouTube View Count, and Like Count. Seed number appears to be our strongest negatively correlated variable followed by mode and acousticness.

Discussion Questions

1. *Research and discuss the limitations related to correlation matrices.*
2. *Discuss what other features you think should be included in the analysis and why they should be included.*

3. *Are there features that were selected that you think shouldn't be used in the analysis and why?*

Step 4. Model Development

One way to select a modeling technique would be to examine how others have solved similar challenges in a related area. In this case we can consider how others have approached trying to predict the winner of the NCAA March Madness Tournament.

Prior literature has shown that a team's Seed number is one of the best predictors of success. Our correlation matrix suggests that Seed number is important in this tournament as well. Boulier and Stekler (1999) found that by using seed alone one is able to predict winners with a 73.5% accuracy. Stekler and Klein (2012), however, stress that this approach appears to work well only for the early rounds of the tournament. One reason this is the case is that an incorrect prediction in the first round will feed into subsequent rounds, which is known as a forward propagation error.

Using a similar approach, we can look at the 2020 results (see Appendix 2, Figure 2) to see how well Seed number predicted the win. There are 11 head-to-head matchups in the 2020 competition and the higher Seed won in 11 of those 17 matchups for an accuracy of 64.71%. This can be considered an improvement over a 50% probability were we to simply use a random guess. However, using Seed number alone in predicting each head-to-head matchup assumes that we know each head-to-head matchup while this is only known (prior to the competition) for the first round.

Let us see if we can improve upon this model using the features we identified earlier as highly correlated with percent of vote. We can use a multivariate linear regression to predict percentage of vote. The equation for the multivariate linear regression is shown in Equation 1.

$$Y_i = \alpha + \beta_1 x_i^{(1)} + \beta_2 x_i^{(2)} + \ldots + \beta_n x_i^{(n)}$$

Equation 1. Multivariate Linear Regression

Multivariate Linear Regression is a supervised machine learning technique since the target variable is known and we build the model using that target (in this case, the target is percent of vote). Code to set up the linear regression is shown in Appendix 1, Figure 6. We use the results of the regression to predict the winners of the 2021 challenge discussed next.

Discussion Questions

1. *Using Seed number alone, how accurate would the model be in predicting the 2019 competition?*
2. *Find another example of how others have tried to predict the winner of the NCAA March Madness tournament and discuss the model(s) used and whether they were effective or not?*
3. *How might machine learning algorithms enhance your solution?*

Step 5. Bracket Model Prediction

Looking at the regression coefficients for each (see Appendix 1, Figure 7) of the independent variables we can state the following:

- As the Locura de Marzo Seed number increases, the win percentage decreases
- As the number of YouTube views increase, the win percentage also increases
- As the number of Twitter Followers increase, the win percentage also increases
- As the Spotify tempo increase, the win percentage decreases.

The first three appear to make sense. Keep in mind that the number 1 seed is a lower number that than the number 16 seed even though it would be considered the higher ranked song, so an increase in Seed number means a lower rank song. Therefore, as the Seed number increases (song has a poorer Seed number), the predicted percentage decreases.

Finally we can consider the tempo. A song's tempo is the beats per minute. Our model suggests slower paced songs are more likely to win.

Next we are able to use our model to predict the winners of each matchup in the 2021 challenge. You can see our round one predictions in Appendix 2, Figure 3.

Completing the rest of the rounds allows us to create the complete predicted bracket as shown in Appendix 2, Figure 4. Comparing our results (Figure 4a) to the 2021 actual results (Figure 4b) we can see that we correctly predicted 5 of the 8 matchups in round 1 yet only 1 of the final 4 and neither of the final matchup. Clearly there is room for improvement.

Discussion Questions

1. *Would you consider the regression model an improvement over random guessing? An*

improvement over using just the Seed number? Explain your reasoning.

2. *What would be a logical next step in trying to improve the model?*

4. CONCLUSIONS AND NEXT STEPS

There are many ways to improve upon this model.

First, you can expand on the data being used to build the model. There are many other variables being retrieved from the websites that weren't used in the development of the initial model. Alternatively, you could consider data that we haven't yet retrieved such as a sentiment analysis of Tweets that mention each song or artist.

Second, our model was based on the results from the first round of data and the strongest showing in the first round was predicted to win the entire tournament. This model doesn't take into account that some songs had weak or strong competitors in the first round which influenced our results. Building a model that takes into account the strength of each competitor would be a logical future step.

Third, we have built and trained a multivariate linear regression model. Based on some of your own research in answering the discussion questions, you have probably already found alternative techniques (i.e. Decision Trees, Random Forest, Neural Networks, etc.) that may be a better fit for a challenge such as this one.

We caution you from being over exuberant, or disappointed, if your model performs extremely well, or poorly, for any given year. With such a limited amount of data to train the models, we are unable to split our data into an appropriate training and testing dataset. As such, any model is most certainly going to be overfitted based on the prior year's results.

Finally, we request that you do not reach out to Señor Ashby or anyone else responsible for the Locura de Marzo challenge. The website is to support Spanish language learning and not machine learning.

5. REFERENCES

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Appendix 1. Code Samples

Calling the Spotify API (spotipy)

The Spotify API will gather data on the songs included in the Locura de Marzo tournament. The API allows for the collection of advanced measures for each song, including the loudness and danceability. To run this code, you will need your own client_id and client_secret values from your Spotify developer account.

```
# The highest ranked song for 2021 is Vida De Rico by Camilo.
# Use this song ID to see what data is available to us in regards to each song and
validate developer credentials.
# Import the necessary libraries
import spotipy
from spotipy.oauth2 import SpotifyOAuth
from spotipy.oauth2 import SpotifyClientCredentials

# MAKE SURE YOU INSERT THE CLIENT ID AND CLIENT SECRET BELOW
# Set up a connection using the Spotify API credentials
auth_manager = spotipy.oauth2.SpotifyClientCredentials(client_id='INSERT CLIENT
ID', client_secret='INSERT SECRET')
sp = spotipy.Spotify(auth_manager=auth_manager)

# Songs have metadata associated with them along with audio features. We make a call
 for each.
meta = sp.track('73nAK3HgQK8dak83Y2WQ8F')
features = sp.audio_features('73nAK3HgQK8dak83Y2WQ8F')

print(meta)
print(features)
```

Output:

```
{'album':{'album_type': 'single', 'artists': [{'external_urls': {'spotify':
'https://open.spotify.com/artist/28gNT5KBp7IjEOQoevXf9N'} ,
'href':
'https://api.spotify.com/v1/artists/28gNT5KBp7IjEOQoevXf9N',
'id': '28gNT5KBp7IjEOQoevXf9N', …

[{'danceability': 0.824, 'energy': 0.457, 'key': 6, 'loudness': -5.428, 'mode': 1,
'speechiness': 0.0543, 'acousticness': 0.167, 'instrumentalness': 0, 'liveness':
0.041, 'valence': 0.95, 'tempo': 87.977, 'type': 'audio_features', 'id':
'73nAK3HgQK8dak83Y2WQ8F', 'uri': 'spotify:track:73nAK3HgQK8dak83Y2WQ8F',
'track_href':
'https://api.spotify.com/v1/tracks/73nAK3HgQK8dak83Y2WQ8F',
'analysis_url': 'https://api.spotify.com/v1/audio-
analysis/73nAK3HgQK8dak83Y2WQ8F', 'duration_ms': 187427, 'time_signature':
4}]
```

Figure 1. Calling the Spotify API Code and partial results

Obtaining Track List using Playlist Information

The following code sets up a function to retrieve a list of tracks using the playlist as supplied by the Locura de Marzo website.

```
#creating a function to get the trackID
def getTrackIDs(playlist_id):
    ids = []
    playlist = sp.playlist(playlist_id)
    for item in playlist['tracks']['items']:
        track = item['track']
        ids.append(track['id'])
    return ids

# Senor Ashby supplied playlist for 2021 - you can find this list ID in the URL
when you click on the playlist link.
playlist = getTrackIDs('5uR6hSLXusr18AERyVmnbE')

print(playlist)
```

```
Output:
['73nAK3HgQK8dak83Y2WQ8F', '0GARcbxLIOmzrs0lHpuvmi', '4N7yGB3c8GXPMEeoc15Ekr',
'02dsc9B5N8BFatjGcGhk1u', '1pqnQ41XbfKjaFu6M0eGJp', …
```

Figure 2. Obtaining Track IDs for songs in a playlist.

Obtaining Track Details using Playlist

The following code shows how to get tracks from a playlist and add them to a list. The getTrackFeatures function obtains the features for each track.

```
def getTrackFeatures(id):
    meta = sp.track(id)
    features = sp.audio_features(id)

    # meta
    name = meta['name']
    album = meta['album']['name']
    artist = meta['album']['artists'][0]['name']
    release_date = meta['album']['release_date']
    length = meta['duration_ms']
    popularity = meta['popularity']

    # features
    acousticness = features[0]['acousticness']
    danceability = features[0]['danceability']
    energy = features[0]['energy']
    instrumentalness = features[0]['instrumentalness']
    liveness = features[0]['liveness']
    loudness = features[0]['loudness']
    speechiness = features[0]['speechiness']
    tempo = features[0]['tempo']
    key = features[0]['key']
    mode = features[0]['mode']
    time_signature = features[0]['time_signature']

    track = [name, album, artist, release_date, length, popularity, danceability, ac
ousticness, energy, instrumentalness, liveness, loudness, speechiness, tempo, key, m
ode, time_signature]
    return track

track_labels = ['name', 'album', 'artist', 'release_date', 'length', 'popularity',
'danceability', 'acousticness', 'energy', 'instrumentalness', 'liveness',
'loudness', 'speechiness', 'tempo', 'key', 'mode', 'time_signature']

playlist_features = []
for i in range(len(playlist)):
    track = getTrackFeatures(playlist[i])
    playlist_features.append(track)

df_playlist = pd.DataFrame(playlist_features, columns = track_labels)
```

Figure 3. Obtaining Track information for songs in a playlist.

Calling the Twitter API

The Twitter API provides much more data than just the number of followers but that is the only feature we will collect for each artist.

```
import tweepy
# assign the values accordingly
consumer_key = "INSERT CONSUMER KEY"
consumer_secret = "INSERT CONSUMER SECRET"
access_token = "INSERT ACCESS TOKEN"
access_token_secret = "INSERT ACCESS TOKEN SECRET"
# authorization of consumer key and consumer secret
auth = tweepy.OAuthHandler(consumer_key, consumer_secret)
# set access to user's access key and access secret
auth.set_access_token(access_token, access_token_secret)
# calling the api
api = tweepy.API(auth)

print(f'Number of followers: {api.get_user("@CamiloMusica").followers_count}')
```

Output:
```
Number of followers: 1483544
```

Figure 4. Calling the Twitter API

Calling the YouTube API

This code block shows how to obtain information about videos in a Play List.

```
# importing necessary packages
from apiclient.discovery import build
from apiclient.errors import HttpError
from oauth2client.tools import argparser

# setting up the YouTube api with the appropriate credentials
DEVELOPER_KEY = 'INSERT DEVELOPER KEY'
YOUTUBE_API_SERVICE_NAME = "youtube"
YOUTUBE_API_VERSION = "v3"
youtube = build(YOUTUBE_API_SERVICE_NAME, YOUTUBE_API_VERSION,developerKey=DEVELOPE
R_KEY)

# setting up the video request and then executing
vid_request = youtube.videos().list(
        part="statistics, snippet",
        id='qKp1f7Vn9dM')

vid_response = vid_request.execute()

print(f'Total Number of Views: {vid_response["items"][0]["statistics"]["viewCount"]
}')
```

Output:
```
Total Number of Views: 606345247
```

Figure 5. Obtaining Video Information from a Play List.

Linear Regression

This code sample shows how to set up a linear regression model. This code assumes that you have a dataframe called train_df with all of the data from prior years and a test_df with data about the current year's competition.

```
from sklearn.linear_model import LinearRegression

linear_model_data = train_df[['seed','viewCount', 'followers', 'tempo', 'vote_perce
ntage']]
inputs = linear_model_data.drop(columns  = ['vote_percentage'])
target = linear_model_data.vote_percentage

# training the model on the previous results
regression = LinearRegression().fit(inputs, target)

# getting the predictions for the 2021 tournament
tournament_2021_data = test_df [['seed','viewCount', 'followers', 'tempo']]
predictions_2021 = regression.predict(tournament_2021_data).tolist()

# adding those predictions to the 2021 DataFrmae
test_df ['predicted_win_percentage'] = predictions_2021
```

Figure 6. Setting up a linear regression.

Regression Coefficients

This sample code shows how to display the regression coefficients.

```
# Show Regression Coefficients for Locura de Marzo Seed #, YouTube View Count (per
# Million views), Number of Twitter Followers (per Million
# followers), and Spotify Tempo
print(regression.coef_)

Output:
array([-2.41596475e-02,  3.01212645e-05,  2.48028881e-03, -9.50443717e-
04])
```

Figure 7. Showing Regression Coefficients.

Appendix 2. Additional Figures

Correlation Matrix

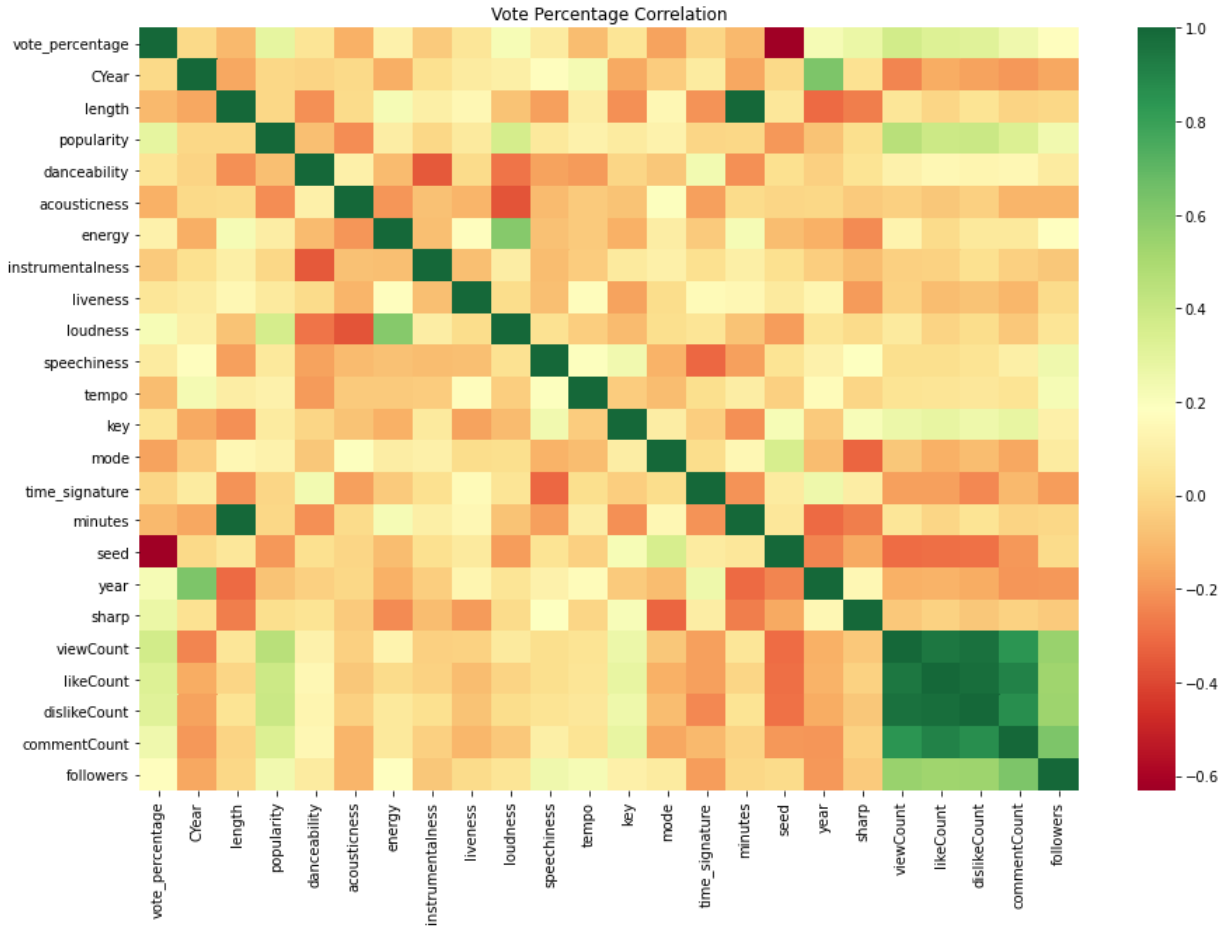


Figure 1. Correlation Matrix

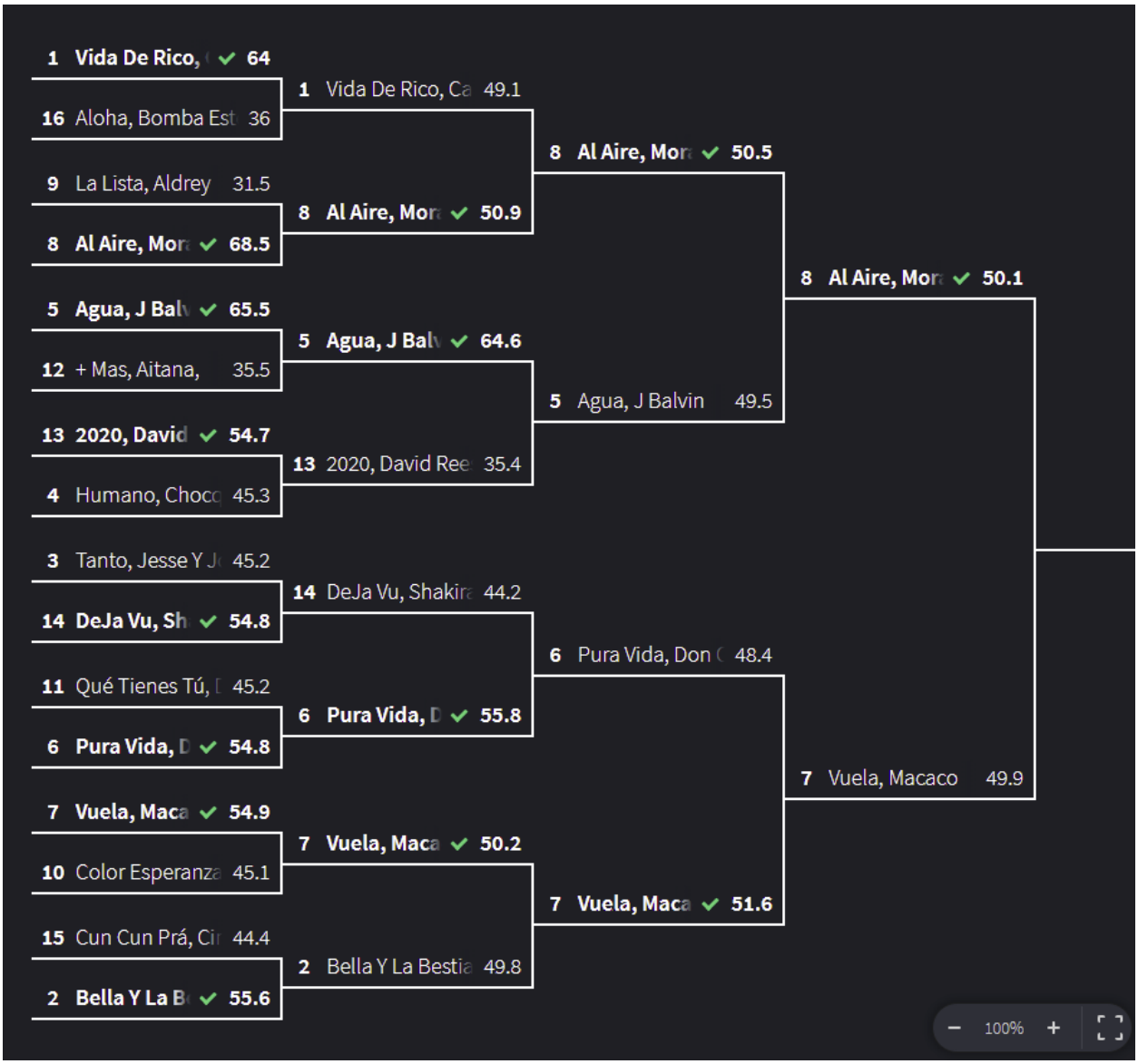
Figure 2. 2020 Results Compared with Seed Number Prediction

Round 1 Results

	Winning Song	Winning Seed	Losing Song	Losing Seed
0	Vida de Rico	1	Aloha	16
1	La Bella y la Bestia	2	Cun Cun Prá	15
2	Deja vu	14	Tanto	3
3	Humano	4	dos mil veinte	13
4	Agua (with J Balvin) - Music From "Sponge On T...	5	+ (MÁS)	12
5	Pura Vida	6	Qué Tienes Tú (feat. Jesús de Reik & Mau y Ricky)	11
6	Color Esperanza 2020	10	Vuela	7
7	La Lista	9	Al Aire	8

Figure 3. Linear Regression Round 1 Predictions

(a) Predicted Bracket



(b) Actual results

Figure 4. (a) Predicted Bracket and (b) Actual Results.