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Teaching Cases - Special Issue

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INFORMATION SYSTEMS EDUCATION JOURNAL

Teaching Case

Teaching Case
TheatreWorks of Southern Indiana: A Database Design Case

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Abstract

Case studies allow for in-depth exploration of multi-faceted issues found in real world information system development projects. The TheatreWorks of Southern Indiana case examines the requirements of a local community theatre group as it strives to incorporate and leverage database technology in a unique non-profit performing arts setting.

Keywords: teaching case, systems analysis and design, data flow diagram, data dictionary, relational data model.

1. CASE INTRODUCTION

Thespian aficionados in and around New Albany, Indiana are anxiously awaiting the return of live community theatre with the inaugural season of TheatreWorks of Southern Indiana (TOSI) slated for this fall. TOSI is a non-profit theatre company committed to creating a performance space for local artists, providing performance opportunities for actors and technicians, offering quality entertainment to the community, and promoting the education of the cultural arts in the region for both youth and adults. TOSI has procured a multiyear lease for the 7,500 square foot Historic Indiana Bank Building located in New Albany, Indiana. The building was originally constructed in 1837 and has recently been renovated to accommodate the theatre performance requirements of TOSI. The facility now has a thrust stage (also known as a platform stage or open stage) that extends into the audience on three sides and is connected to a backstage area on its upstage end. Instead of fixed seating for the audience, the facility can accommodate up to 400 regular chairs that are typically arranged in 20 rows in front of the stage. This layout provides for an intimate theatre experience and there really is not a bad seat in the house. The acoustics are excellent for a structure not originally designed as a theatre.

2. CASE REQUIREMENTS

Currently, TOSI manages its data using an outdated computerized database system and spreadsheets. TOSI executives and management realized the need to update the system, expanding the basic database operations to

support analytics and facilitate email communication with related parties. TOSI approached Tech Work Solutions (TWS), a local Information Technology (IT) consulting firm that specializes in guidance for non-profit and small business operations. TWS employs many college students through its extensive internship program which has proven to benefit all parties involved including client organizations, student interns, sponsoring universities, and TWS.

After several meetings, TOSI decided to hire TWS to assist with the information system redesign. TWS consultants have begun gathering information about TOSI operations and data requirements. A group of student interns is to serve as system analysts responsible for designing an integrated data structure that meets the operating requirements of TOSI.

3. OPERATIONS AND DATA REQUIREMENTS

Each year, TOSI's Production Planning Committee creates a production agenda, outlining the schedule of performances, workshops, and special events. The operations and data requirements are summarized in this section.

3.1 Productions

Each season, TOSI will present several productions using artistic talent from the local community. A season will run from the fall of one year through the summer the next year. Productions are plays (musicals, comedies, dramas), workshops and special events that are held at the TOSI facility. The anticipated agenda for TOSI's season this year include six plays, four workshops and two fund raising events (a silent auction and a concert). Moving forward, TOSI is also considering the possibility of renting its facility to other organizations for meetings/parties on dates that the building is idle and the new system should be able to incorporate this new source of revenue

The information system needs to retain the name of each production, its seating capacity and its ticket prices. Performing a copyrighted work usually requires the payment of a variable licensing fee to a representation agency. Some productions require the rental of special sets, props and costuming that are too difficult or impossible for local individuals/volunteers to procure or manufacture. Thus, the costs associated with the production vary and are the reason for the variation in ticket prices.

Each production will have a set of announcements associated with it that are posted on the TOSI web page. These announcements include the date and time of casting calls, rehearsals, and other pre- and post-production meetings. A description of the activity is also included in the announcement.

3.2 Performances

Each production will have one or more performances. Plays usually have 15 performances spread over a six-week period, whereas workshops usually have one or two occurrences. Special events are usually one-time affairs, but this can vary. The system will maintain the dates and times of the performances.

There is no assigned seating for the performances so the system needs to keep track of the total tickets sold for each performance to assure that ticket sales do not exceed the seating capacity for each performance.

3.3 Key Stakeholders

Patrons, production staff, and theatre staff are examples of key stakeholders who interact with TOSI and they need to be tracked by the system.

Patrons are the buyers and potential buyers of tickets for performances of productions.

Production staff are those individuals who work directly on a production itself and are responsible for the artistic success of the show. Production staff job titles where most of the work effort is done pre-performance include producer, director, lighting designer, costume designer, sound engineer, music director, and choreographer. Production staff job titles where most of the work is done at the time of the performance include actor, audio technician, dancer, lighting technician, musician, stagehand, stage manager, and wardrobe supervisor.

Theatre staff are individuals not directly associated with the production itself but must be present at each performance for it to be a financial and an operational success. These jobs include ticket agents (also called box office staff), ushers, snack bar workers and janitorial help.

These job classifications are not mutually exclusive. It is likely that a play director (production staff) of one play will also be a season ticket holder (patron) and could be an usher (theatre staff) on occasion. In community theatre, everyone contributes whatever is

necessary to get the job done. The database must contain the name and address of each person with the capability of multiple phone numbers and email addresses.

3.4 Announcements and Notifications
The community members are excited about the opening of TOSI and want to receive news about upcoming productions. Most prefer email notification but there are some individuals (mostly elderly) who request mail notification only.

Upon hearing the announcement of TOSI's season, actors, dancers, musicians, and other artists immediately contacted TOSI requesting that they be notified about any upcoming opportunities to perform and assist. There are usually separate casting calls for actors, dancers, and musicians.

There are also the equivalent of casting calls for other skills such as set designer, lighting technician, etc. The system should be able to capture the interest area of any artist/technician. Individuals can be on as many notification lists as they wish. The database structure must maintain a file of those people who want notifications and their interest areas.

3.5 Ticket Sales
Because there is no assigned seating for the performances, the system needs to keep track of the total tickets sold for each play, workshop, and special event to avoid overbooking.

Tickets have three levels of pricing: adults, seniors (60 + years of age), and students, and the ticket typically cost $20, $17 and $15 respectively.

The first priority for ticket purchases goes to season ticket holders. Season tickets go on sale from March 1 through July 31 annually. Season ticket purchasers receive tickets for all of the plays for that season and the season ticket price is the total of the regular price of the tickets – less a 10% discount. The season ticket holder specifies the number of each category of ticket being purchased (adult, senior, or student) and selects the date and time for each performance for the season at the time of purchase. TOSI then delivers the tickets for all of the performances to the season ticket holder.

Individual performance tickets are available for sale at the regular price starting August 1. Patrons wishing to purchase tickets may do so through the web site or by contacting the box office by phone or in person. Internet or phone sales can be paid by credit card, PayPal, or by direct funds transfer.

The box office opens 2 hours before each performance where cash and check payments are also permitted. All ticket sales are final, no refunds or exchanges are permitted once the tickets are issued to the customer. Tickets for workshops and special events are sold like individual performance tickets for plays. A copy of ticket sales receipts is kept at the Accounting Department for financial reporting purposes.

3.6 Sponsors
TOSI is fortunate that the local community has financially supported it from its conception. Individuals and companies have contributed to TOSI's current sound financial footing. Sponsors are patrons who have made a donation of $1,000 or more to TOSI. At the present time, the sponsorship designations are for only one season. There are three levels of support: Platinum, Gold, and Silver. Currently, donors who make a gift of $5,000 or more are classified as Platinum sponsors and receive 8 season tickets to the current season's productions as well as other perks. Donations of $2,000 - $4,999 classify the patrons as Gold sponsors and includes 4 season tickets. Donors providing $1,000-$1,999 are categorized as Silver sponsors and receive 2 season tickets. If the sponsor wishes, their name could be printed in all the programs that are distributed to the audience at show time. Table 1 summarizes the sponsorship levels and pertinent information.

Sponsorship Levels	Donation Amount	Tickets
Platinum	More than $5,000	8
Gold	$2,000 - $4,999	4
Silver	$1,000 - $1,999	2

Table 1 Sponsorship Levels

Donations to TOSI are tax deductible, excluding the fair market value of items received by patron, e.g., tickets, other perks (Tax Code 501 (c)(3)). The system will provide tax receipt documentation to donors who provide their tax IDs and a copy of the donation receipt is kept at the Accounting Department.

3.7 Production Staffing
Every year, TOSI's Production Planning Committee determines what productions and events will be held in that season and an individual is assigned as the event leader (in the case of plays, it is the director) for each activity. The event leader will then determine which job

positions are required to successfully complete the production. The notification functionality of the system will be utilized to publish these job openings. Hopefully, there is sufficient voluntary response to fill all job positions, but sometime direct recruitment is required. The event leaders hope to utilize the system to review the interest areas and contact individuals to fill these jobs.

Alternately, casting calls can be utilized. The announcement capabilities of the system may be employed to announce casting calls on the TOSI website. Also, all individuals interested in a specific notification interest area can be emailed concerning the dates, times, and specifics of the casting calls. Casting calls with formal auditions are usually used to select the principle actors in a play.

Once the event leader assigns a person a job, this fact is recorded in the database. The data structure needs to provide visibility as to which individuals are working or have worked on which productions and in what job position. The number of production staff working on a production may vary greatly depending on the size and nature of the play.

3.8 Theatre Staffing

The show cannot go on without the assistance of many volunteers. Volunteers make up almost all of the ushers, snack bar workers, and other theatre staff. Play performances are usually held in the evenings with some matinees in the afternoon. Workshops are often in the morning but sometimes go all day. The system needs to maintain a file of all people that are willing to volunteer for theatre staff tasks. Further, the system must record the type of job they are willing to do, as well as the days of the week and time that they are available. For example, a person may state that they can volunteer as an usher on Tuesday, Thursday, and Friday nights from September to October of the current season.

TOSI management is responsible for making sure that there is sufficient theatre staff for a given performance. They also contact the volunteers and schedule them for the required jobs at a specific performance. The system needs to be able to quickly display the theatre staffing for each performance for management review.

3.9 Miscellaneous Requirements

In additional to the basic operations describe in the previous sections, the new information system should be able to produce the following documents:

Funds Receipt Report
This report should include all funds receipts by date and by type of payment, i.e., cash, checks, credit cards and bank transfers.

Production Receipts Report
This report should show all funds receipts by performance for each production.

Email Blasts
This feature will be used to promote TOSI communication with the community as well as targeted individuals. TOSI hopes to be able deliver email based on interest area to the appropriate person, e.g. season ticket holder, platinum sponsor, individuals who have had the job of stagehand, etc.

Mailing Labels
This feature serves similar purpose to the Email blast but will be used for people who have opted for mail notifications.

Donor Acknowledgement Letters
As required by the IRS, TOSI must document donations over $250 in a letter to the donor.

4. DELIVERABLES

System analysts from TWS should develop initial data flow diagram and relational data model. The primary deliverable of this assignment would be an efficient relational data model for a database that may be used to support current and future theatre operations.

TOSI is also interested in using information from the database along with analytics to help with decision making. Although not the highest priority, TOSI would like the new system to be 'analytics ready.' Examples of analytical capabilities include the ticket sales and seats prediction, staffing availability, and donor engagement. When designing the system, TWS consultants should take into account the analytical potential and how the information system should be designed to help TOSI make the most out of its data.

5. CONCLUSION

TOSI's mission is to provide residents in its local area with the ability to experience quality theater at affordable prices. TOSI will create opportunities for individuals to explore their creative side regardless of age, experience, and background. The design of an efficient data

structure to support TOSI operations will be immensely helpful in fulfilling these goals.

6. REFERENCES

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Teaching Case

GlobePort faces a *Knowledge Gap* in its Business Process Outsourcing

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Abstract

GlobePort, a nationwide adult-care business, offers its employees health insurance benefits using a variety of vendors. Each vendor has different medical/dental/life insurance plans with different application formalities. Two years back, GlobePort found it difficult to support all of these variations and decided to pursue business process outsourcing (BPO) of their benefits verification process and information systems updates. Recently there have been multiple complaints about issues faced by employees due to procedural and technological problems as a result of the outsourcing. Analysis of these complaints suggest that a knowledge sharing gap exists between GlobePort, its employees, the BPO provider and the insurance vendors. GlobePort needs to close this gap by adopting suitable knowledge management systems. Additionally, GlobePort is expanding its outsourcing arrangements to include several of their core business processes such as specialized adult-care tasks utilizing multiple vendors. This case asks the reader to select a set of knowledge management practices and collaboration technologies that can help GlobePort address their current employee complaints and support the challenges from the future expansion of outsourcing of their core adult-care processes.

Keywords: Knowledge management, Business Process Outsourcing, Collaboration systems, Business process management.

1. INTRODUCTION

GlobePort is a medium sized nationwide adult-care enterprise that has over 5000 employees. Their business faces a 30% turnover of employees throughout every year. The turnover stems from the grueling work environment that causes excessive attrition and the great demand for experienced workers in the industry. The regulations governing their business require them to provide health benefits to their employees. Health insurance plan choices available to full time employees are based on their individual pay grade level. GlobePort has very limited Human Resources (HR) staff and they were being stretched during their open enrollment period between November and December, when the company allows open benefits enrollment for their employees. With the recent proliferation of insurance vendors and their multitude of plans and a variety of regulations, forms and scrutiny processes, GlobePort's IT department is facing major staffing issues, as they try to support HR (alongside other functional departments) with application systems design, and development to manage the documentation needed for employee benefits enrollment and verification.

David Mayo is the area manager of the IT department supporting HR, and has been involved in supporting these applications for many years. Only two members of his IT team currently work on this enrollment application, that requires custom software design, development, and deployment support for new features every Fall. The two person team is also overloaded with creating difficult integrations with external insurance vendors' information systems. The stakeholders (insurance vendors

and HR managers) keep changing their requirements every year, and even demanded supplemental reports that were not available in the custom in-house information system. All these demands were overwhelming David's limited IT budget/resources with increasingly more and more custom developed application code year after year. Occasionally, the custom developed software failed to meet the requirements of their own legal team. Tim Hardy, HR Director, recently found some discrepancies in how the coverage alternatives were being presented in the insurance verification application to the employees of GlobePort.

2. HEALTH INSURANCE VALIDATION

GlobePort is required to provide health insurance benefits to fulltime employees, who work at least 32 hours per week. However, not all employees need the health insurance plans provided by GlobePort, as some employees are dependents on their parents' or spouses' health insurance. However, those employees having outside health insurance must provide proof to GlobePort of that coverage, so that the regulators do not penalize GlobePort for failing to cover their employees. The employees are informed via their email account to go into the benefits information system and submit an insurance waiver request if they require their insurance premium deduction to be waived from their payroll account due to having other medical coverage. Employees only have a narrow timeline by which they must prove that they have medical insurance. Only after the proof of insurance is ratified, the premiums charged on their payroll is taken off. This validation of medical insurance is a sizable and voluminous process and involves lots of resources and manual effort, such as calling and emailing insurance providers. The employee insurance waiver processing starts a week before the employee starts their job and the employee(s) are apprised via e-mail once every week as long as the insurance premium fees are deducted on their payroll.

The primary goal of the business process outsourcing (BPO) engagement with EIV (Employee Indemnification Validation) was to off-load this exhaustive health insurance verification process to a third-party outsourcing vendor. EIV also does insurance waiver processing for several other organizations in addition to GlobePort and has a team of insurance validators that are very professional and efficient in this task. EIV follows a list of steps in their validation procedure:

1. GlobePort's IT department feeds data daily to EIV's server about any employees that need health insurance verification.
2. EIV's verification database is then loaded daily by their database administrator (DBA) with the above information submitted by employees about their health insurance coverage such as the provider's name, telephone number, insurance number and other contact information.
3. Once the data is loaded into the EIV database, the application then creates a ticket for each new entry. EIV's Insurance Validators then begin contacting the insurance companies to manually verify that the employees do have the valid health Insurance as they claim.
4. The insurance validators make up to three voice calls over the next two days to verify the coverage with the insurance companies and update the ticket each time as part of their employee insurance verification and waiver process.
5. If during the verification process, the validators get information that the health insurance of the employee is invalid then this information is updated by the application in the employee ticket, which can be then be accessed by GlobePort.
6. The EIV application has a design that limits the execution of the ticket to a maximum of three days to keep the ticket open. If within the time frame no information is received the ticket is then updated with a flag indicating 'insurance waiver denied' in their database and transmitted over to GlobePort.
7. Employee health insurance that is validated and approved is given a 'insurance waiver approved' flag which is updated in EIV's database and transmitted over to GlobePort.

The above process was also adopted by GlobePort as an inherent process after their decision to outsource with EIV. However, the failure point in step 5, and the two data upload delays of 24 hours each in steps 4 and 6, have become problematic to GlobePort and is causing unexpected issues with their internal new employee onboarding processes. These issues hint at underlying knowledge sharing disconnects among the four stakeholders

involved in the insurance validation process – GlobePort, their employees, EIV and the insurance vendors (Durst and Edvardsson, 2012). Due to these system failures, David Mayo has had to be in constant contact with the IT person of EIV to collect, interpret and disseminate case status to stakeholders, such as GlobePort's employees and HR managers.

3. KNOWLEDGE MANAGEMENT THEORY

Increasingly, organizations are adopting knowledge management systems (KMS) to support business processes and achieve organizational goals. In the business context, knowledge is defined as any information that is relevant and actionable (Davenport, De Long and Beers, 1998). Knowledge sharing practices have been found to be important in many organizational scenarios, such as learning new skills, solving problems, and responding to new challenges. The KM system must promote the willingness and capacity of individuals to share what they know and how to use what they learn.

Current IS research literature reveals that knowledge sharing is particularly difficult across multiple organizations such as GlobePort and EIV (Burgess, 2005). Many factors can impact knowledge sharing including the characteristics of the organizations, their relationship, the type of knowledge (tacit or explicit) and the knowledge creation, integration and transfer process (Argote, 1999; Ko, Kirsch and King, 2005; Inkpen and Tsang, 2005). There are two types of knowledge processing – interactive and integrative (Zack, 1999). Integrative knowledge processing systems provide better support for creating and using repositories to store and share explicit knowledge among stakeholders. However, interactive KM systems primarily focus on establishing interactions among those stakeholders to allow personalized sharing of tacit knowledge. In contrast to integrative KM systems, the repository is only a by-product of these human interactions, rather than the primary focus of the interactive KM system (Nonaka, 1994).

KMS Strategy Choices

Hansen, Nohria and Tierney (1999) identify two enabling strategies for 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 infrastructure. The codification strategy aligns with the development of intellectual capital, while the personalization strategy aligns with the development of social capital and relationships. Typically, IT solutions (such as FAQ, wiki's and dashboards) can support the codification strategy and facilitate the sharing of explicit knowledge between firms (Hislop, 2002). These tools allow explicit knowledge to be easily captured, codified, stored and shared. Management mechanisms, such as procedure, handbooks, and information technology system promote employees' willingness for sharing their explicit knowledge.

In contrast, human experience forms the foundation of tacit knowledge sharing (Nonaka and Takeuchi, 1995, Polanyi, 1966), because individuals cannot take advantage of "new" tacit knowledge unless they have formed personalized connections with it. Organizational practices that promote socialization, face-to-face interactions and human connections play a major role in tacit knowledge sharing by building social capital, a concept from social capital theory (Nahapiet and Ghoshal, 1998).

KMS Focus Choices

Three focus areas for KM practices have also been identified in the KM research literature (Stewart, 2001) – (1) structural capital, (2) human capital, and (3) customer capital. The KM practices focused on structural capital allow the subunits of an organization to exchange knowledge through established channels that can be easily reconfigured. Examples of structural capital initiatives include setting up dashboards that allow status to be entered, updated and visible in real time. These KM tools allow the exchange of project status among sub teams. KM assets that fall into the human capital focus area have its purpose of "enriching" the vendor's operations personnel. While a web portal to allow customers to submit feedback falls in the domain of harnessing customer capital.

BPO Management Model influences KMS Strategy and Focus

It is clear that the business process outsourcing (BPO) management model and the organizational KM strategy and focus need to be closely aligned. KM practices focused on human and customer capital require a personalization strategy for KMS and are needed for creating and harnessing tacit knowledge. The later are more difficult to implement and only produce benefits when paired with a partnership BPO management model.

Structural capital focused KM practices can succeed in a weakly coupled BPO management model, while human and customer focused KM practices need stronger client vendor partnerships (Zack, 2002). A human capital focused KM initiative will be expensive to implement when a pay-per transaction BPO management model is in place, resulting in lower net business impact. Likewise, a human capital focused KM initiative may not provide enough net benefits to the client firm in a non-core outsourcing strategy resulting in a lower net business impact (Figure 1).

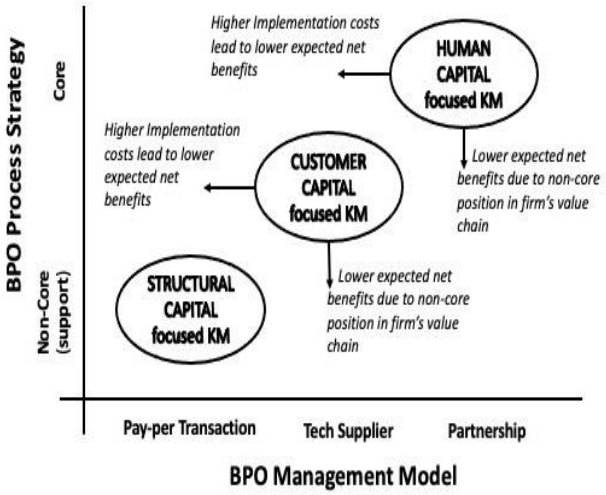

Figure 1: KMS Strategy and Focus selected per BPO Management Model

Dennis Bentley, a new GlobePort employee tried to interpret the ticket that showed his insurance validation was "not approved" and realized that the EIV ticket notes were too complicated to understand. Abbreviations and codified conventions are captured that would need training to fully interpret. Not much help or interpretation was offered by GlobePort's own IT department without the explicit involvement of EIV personnel.

The business goal of the business process outsourcing (BPO) arrangement between GlobePort and EIV was to segregate the two organizations to maximize efficiency using a "pay per transaction" management model. Interactions were limited and there was no synergy among the actors in the client and vendor organizations of the BPO. GlobePort could attempt to develop connections; and process actors on both sides could be encouraged to engage with each other as peers, but it won't be easy to quickly change the BPO work culture, as both organizations are extremely short-staffed.

4. BPO INFRASTRUCTURE ISSUES

The outsourcing vendor, EIV was using a deployed services architecture on the Amazon Cloud to host their insurance validation application. During the first year of the outsourcing, GlobePort received several corrupt files from EIV's application. When EIV was contacted regarding the errors, they took over 24 hours to rebuild a workable file with changes rolled back to a prior validation period. Data was lost and this caused a difficult situation as affected GlobePort employees needed to resubmit their insurance waiver requests. Pam Shaw from the HR staff had to deal with multiple calls and emails asking for updates. The file corruption occurred multiple times (6 times as tracked by David Mayo) and was attributed to a latency problem caused due to concurrency issues in the application.

Additionally, there were also two occasions when the Amazon cloud server was updated with platform patches, which caused the EIV application to fail. The errors were related to user authentication and tickets could not be accessed by GlobePort. A significant outage was experienced in early 2017, when Amazon cloud services was down due to a partial failure of the hosting platform, effecting many AWS customers (including EIV). Again in the month of March 2017, the Amazon cloud was down for a few hours as the Amazon team was troubleshooting a platform problem, that was related to their billing system when one of Amazon's technicians erroneously executed a command that took a large number of AWS servers offline without any prior notification.

While these outages were not the responsibility of EIV, yet the troubles propagated to GlobePort. GlobePort was now stuck with using EIV for thieir validation process as a single outsourcing vendor.

5. GLOBEPORT's BPO EXPANSION PLANS

Even after the occasional troubles and setbacks faced in the BPO, GlobePort's senior leadership and board of directors still viewed outsourcing as a viable strategy. They have asked David to determine the changes necessary to more effectively outsource additional non-core HR processes and core business processes involved in adult-care delivery to external vendors. The goal being to move away from entrenched

internal cost centers towards a "best provider" approach.

Adult care processes are unique in that they rely on professionals to dynamically build flexible care networks of multiple specialized providers and professionals to address an adult's needs (Ghosh and Scott, 2005). The individual is a complex entity that plays multiple roles in the care process as not only the source of knowledge creation and care need identification but also the recipient of the care. This delivery of adult care involves the involvement of multi-disciplinary expertise, which a single person cannot possess. The patient is also a user of the knowledge to better manage his or her own care issues. The effectiveness of the adult-care process is only achieved through facilitating the collective practice of several professionals and the person receiving the care.

As David Mayo reflects on his EIV BPO experience, he realizes that things will get more interesting in the future. Mayo concluded, "*because of the complexities involved with problem identification, interactive knowledge processing and tacit knowledge sharing will play a major role in outsourced adult-care processes*".

6. BUILDING BPO INTEGRATION with EIV

David Mayo had read about using collaboration tools in outsourcing research papers that could allow the IT team on the GlobePort side, to learn in real situations by having one of the vendor staff engaging with them on certain tickets. A key success factor was staff motivation, and budgeting money and staff time for the cross training. David started a pairing process to increase his staff's capabilities and encourage interactions between client and vendor staff on suitable learning tickets. The mentoring resources on either side were limited and needed to be managed effectively. To serve the two-fold goals of providing training to the client personnel as well as supporting the bi-directional knowledge transfer, David decided to institute a program to evaluate and control the mentoring tasks tightly (Ferreira, Mueller and Papa, 2020). He forced his staff to apply for EIV cross training on a per transactional ticket basis. He established a review board to screen each request for knowledge potential and optimal fit for the goals. If a ticket was selected, then staff from the vendor and the client worked collaboratively on the validation over the span of 3 days while the ticket was active.

David found that as staff worked together, they set and met goals, and trust, understanding of cultural diversity and joint ownership of work were all fostered. However, the mentoring program was seen as counter to the objectives of outsourcing and other GlobePort managers viewed it as a drain on their limited client staff, which had been cut in successive company restructuring. With limited staff, who were all very busy even without peering duties, David was pondering whether other means, such as technology and tools might be more effective to build similar capabilities and exchange knowledge.

7. COLLABORATION TOOLS

One of the major factors revolutionizing the nature of electronic knowledge sharing and collaboration was the development of tools for sharing work, commonly referred to as workgroup/collaboration software. Currently Web 2.0 technologies have brought teleconference technologies (e.g. Microsoft's Teams, Zoom and Cisco's WebEx) to the forefront of the Internet. Systems like Wiki's, Weblogs and podcasting have allowed organizations to tap into remote capabilities by leveraging expertise from one part of the world to another. Other complementary technologies include WWW and email and Instant Messaging systems and portals such as SharePoint. They are a loosely organized collection of technologies, such as content management, workflow processing, contact management, scheduling, conferencing, communications, and document sharing; all of which revolved around the theme of supporting collaborative work (Table 1). These systems can only be best utilized with careful organizational strategic planning, training of users, business process analysis, and management tracking.

Collaboration Tool	Objectives and Usage Goals
Listservers, Discussion Boards, Tele-Conferencing	Capturing threads of discussions on topics raised by team members and their subsequent contributions.
Checklists	To guide validation tasks from past experience and ensure that adequate data collection and situational analysis is being done. These checklists support building best practices
Lessons Learnt Lists, FAQ	To ensure that new process expertise is captured and shared for future use

Training Presentations	Training materials are developed by scouring the listservers, discussion boards and FAQ. Presentations include all the listerv threads and their resolutions, the list of lessons learnt and pointers to any checklists or process/product document that is considered a "*must read".*

Table 1: Collaboration Tools for KM

8. CONCLUSIONS

GlobePort had made the hurried decision two years ago to pursue BPO of their health insurance validation process. Even after the occasional troubles and setbacks faced in the BPO, GlobePort's senior leadership and board of directors still view outsourcing as a viable business strategy. They have asked David Mayo to determine a plan to select and outsource additional HR process and expand outsourcing to core business processes, such as adult-care to multiple external vendors. However, integrated adult-care processes (core) will have many stakeholders connected by the input/outputs of the subprocesses and any issues can not only lead to employee dissatisfaction but also process failure.

9. QUESTIONS

After reading the scenario presented in the GlobePort and EIV business process outsourcing case, answer the following questions:

1. Evaluate the decision to outsource the insurance validation process by weighing the benefits and drawbacks?
2. What is the "knowledge sharing gap" in the BPO between GlobePort and EIV?
3. What knowledge management practices and technologies can help address the above "knowledge gap" most effectively?
4. Did David Mayo select the correct KMS strategy and approach to establish knowledge sharing between GlobePort and EIV? Justify your answer.
5. GlobePort wants to expand their use of Business Process Outsourcing to include core processes. What should David Mayo do differently for his KMS in the future to support this new type of outsourcing?
6. Illustrate the differences between KM systems for supporting core adult-care business process that utilize tacit knowledge versus supporting business processes that utilize explicit knowledge.

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Teaching Case

Can you Predict the Money Laundering Cases?

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Abstract

This case is designed to be used in business analytics courses; particularly those that emphasize predictive analytics. Students are given background information on money laundering and data from People's United Bank, a regional bank in the northeast United States. The students must develop their hypothesis, analyze the data, develop and optimize predictive models, and then score the models. Students are challenged to develop a better baseline model than what is currently being used by People's United Bank.

Keywords: Anti-money laundering, business analytics, predictive analytics, SAS Enterprise Miner

1. INTRODUCTION

This case is designed to be used in a business analytics course with a focus on the development and subsequent optimization of predictive models. Six of the nine steps in the Predictive Analytics Process Model (see Figure 1) (McCarthy, McCarthy, Ceccucci, Halawi, 2019) are reinforced through this case. The case begins with the development of a hypothesis that supports the business problem that is described herein. Data is provided with the case. The data must then be analyzed and manipulated for analysis. Predictive models are then developed and subsequently optimized to determine which model provides the best fit.

The case provides an opportunity to build multiple predictive models using a variety of tools (e.g., SAS, R, Python) and to optimize those models. Once a best fit model has been selected, it can then be implemented. One of the requirements for selection of the best fit model is to produce a model that exceeds the benchmark within this case. A scoring data set is provided to analyze how the model supports ongoing production needs and to emphasize that the purpose of predictive models is to apply them to future business activities/decisions.

Students are provided the background of the business problem, a data set for building and testing predictive models and a data set to score the best model. The business problem is to develop an optimized predictive model to determine which cases must be investigated for potential money laundering. Next, the details of the business case are presented; beginning with a definition of money laundering and why it is a critical issue for the banking industry.

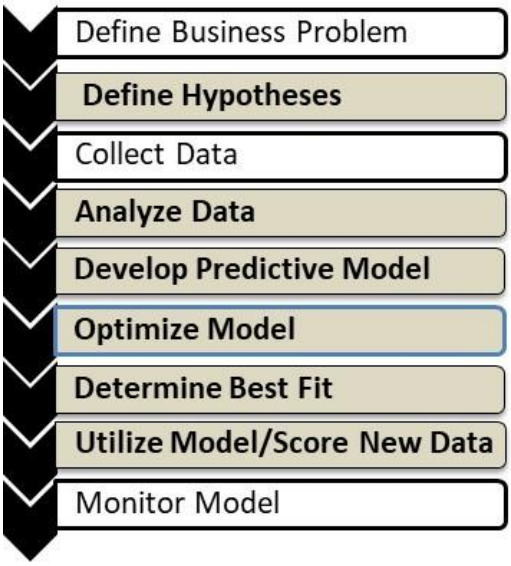

Figure 1 Predictive Analytics Process Model (McCarthy, et. al., 2019)

Money Laundering

Money laundering is the illegal process of concealing the origins of money obtained illegally by passing it through a complex sequence of banking transfers or commercial transactions. An attempt to make large sums of money obtained through illegal activities to look legitimate through banking transactions (Dreyer, 2011). The term money-laundering comes from this process of taking 'dirty' money (i.e., money from illegitimate, criminal activities) and transforming it into 'clean' money (i.e., money that appears legitimate and cannot be traced back to the criminal activity). Money laundering is estimated to be a one to two trillion-dollar problem and may represent two to five percent of the gross domestic product of the entire world (Ruce, 2011).

Dreyer (2011) describes three layers of money laundering:

1. Placement – moving the funds from the criminal activity that generated them.
2. Layering – using complex financial transactions to disguise the funds.
3. Integration – making the money available for subsequent use.

Initially, money laundering was considered to be a tool used by drug dealers and racketeers. More recently, it is also viewed as a tool used by terrorists to finance illicit activities.

Bank Secrecy Act

The Currency and Foreign Transaction Reporting Act (1970) placed a requirement on banks in the United States to work with the U.S. government to investigate money laundering (this act is more commonly known as the Bank Secrecy Act (BSA)). This act placed a requirement on banks to report transaction activity that the government considers useful in monitoring criminal and tax matters (Ruce, 2011). The major tool to perform this monitoring was the creation of the *Suspicious Activity Report* (SAR). A SAR must be filed when a bank has knowledge of, or suspects that, a financial transaction has occurred as a result of funds earned through illegal activities. This report is one of the primary tools used to combat money laundering. There are millions of transactions that occur on a daily basis. The vast majority of these transactions are legitimate. However, while money laundering involves a relatively small number of transactions compared to the total number their consequences can be severe. Under reporting of suspicious activity could therefore lead to an increase in money laundering activity. Conversely, over reporting can result in the investigation of to many legitimate transactions making it more difficult to focus on those that should be scrutinized (Meltzer, 1991). It is important therefore to balance both of these issues and still meet the requirements of the Bank Secrecy Act. A report must be filed when:

1. The transaction is designed to evade the requirements of the BSA or

2. The transaction has no apparent lawful purpose and the bank has no knowledge of a legitimate business reason for why the customer would engage in the activity resulting from the transaction (Ruce, 2011).

The Bank Secrecy Act required the reporting of cash transactions that exceeded $5,000. The threshold was subsequently changed to $10,000 in 1984. This resulted in attempts to circumvent this requirement by structuring multiple transactions that were each below the $10,000 threshold. This caused requirements to be put in place to identify attempts to subvert this threshold. To address this problem, in 1986, the Money Laundering Control Act added to this requirement by criminalizing money laundering. The act defines *specified unlawful activities* (SUA's). These include attempts to conceal the source, control or ownership of funds (Salinger, 2013).

As a result of the September 11, 2001 terrorist attacks on the United States, the *PATRIOT Act of 2001* was passed to strengthen the penalties for terrorist acts that occur either domestically or abroad. This included money laundering and terrorist financing. It enhanced the due diligence requirements and SAR reporting requirements (Sensenbrenner, 2001).

2. BUSINESS PROBLEM

To comply with the requirements of the Banking Secrecy Act and subsequent legislation, banks must have a system in place to identify suspicious activity that has the potential to involve money laundering or terrorist financing. The volume of legitimate banking transactions that they process on a daily basis makes it unrealistic to manually evaluate every transaction. Therefore, they have systems and controls in place to flag suspicious activity for further investigation. It is helpful to have develop a probability for each transaction that indicates the likelihood that a transaction is suspicious for prioritization purposes (Mehmet and Buchholtz, 2014). The system generates alerts using automated rules. The alerts need to be reviewed and investigated by anti-money laundering (AML) analysts. The goal of the alert system (AML System) is to come as close as possible to identifying only those specific transactions that involve these illegal activities. If too many false alerts are generated, it consumes too much time on the part of the analysts to investigate each one. If too few alerts are generated then there is the potential to miss transactions that support illegal activity. The better the model for evaluating alerts, the closer the system gets to its optimal performance.

When an analyst reviews an alert, they either create a case for further investigation because they suspect fraud or they close the alert. Cases requiring further investigation are sent to an operations team for review. Upon completion of the review, cases that still require further investigation require the filing of a Suspicious Activity Report (SAR). Alerts are reviewed based upon priority (i.e., the higher the probability of suspicious activity).

3. ANALYZE DATA

The data for this case was provided by People's United Bank and consists of 38,515 transactions that were a sample of production transactions from October 2014 through September 2015. This data set was used to produce their model. The data set and accompanying documentation serves as the baseline to develop a predictive model that improves upon this baseline.

People's United Bank is a diversified financial services company with more than $60 billion in assets. Founded in 1842, People's United Bank is a community-based, regional Northeast bank with more than 6500 employees, over 400 retail locations in Connecticut, New York, Massachusetts, Vermont, New Hampshire and Maine. There are over 148 branch locations co-located within Stop & Shop grocery stores in Connecticut and New York. They offer full-service, extended hour retail banking and commercial banking and as well as wealth management services.

Two data sets were created from the dataset provided. The first data set is used to develop and train a predictive model to determine if a case requires further investigation for potential money laundering (i.e., the case should result in a SAR). The first data set contains 35,000 observations (records). The data dictionary is presented in Appendix A.

The second dataset used for scoring, contains the remaining 3,515 observations. This dataset is used to test the best fit model and determine differences in cases selected for further review between the best fit model and the baseline model.

The datasets are provided in an Excel, CSV or SAS file format providing flexibility for a variety of analytic tool use.

4. DEVELOPMENT AND OPTIMIZATION OF A BEST FIT MODEL

The baseline model was developed by People's United Bank by analyzing six iterations of predictive models. The best fit model was chosen using the Kolmogorov-Smirnov (KS) and Receiver Operating Characteristic (ROC) statistics. The best fit model was developed using 70% of the data to build the model and 30% to validate the model. The best fit model for this baseline was a backward regression model. The statistics for the model are presented in Table 1.

Statistic	Result
KS	44.13
ROC	0.7923
R-Square	0.1687

Table 1. Baseline Model Statistics.

Regression is one commonly used technique when developing predictive models, however many other techniques are available in the data analyst's toolbox. The goal is to develop a model that provides a better fit. Even a modest improvement can be significant as it will result in better control over the review of cases evaluating potentially illegal activities. Any predictive technique may be utilized, this is not limited to only using regression models.

5. FINAL REPORT

The best fit model enables a bank to identify and detect potentially illegal activity more accurately and quickly. It provides a more precise review of transactions that require investigation and can reduce the investigators workload.

In your final report, you should discuss the following:

1. Determine Hypotheses:
   What were the hypotheses that you tested? If any variables were excluded, discuss why they were removed from the subsequent analysis.

2. Analyze Data:
   Which variable(s) contained missing values and how were they treated? Why was the technique chosen appropriate? Which variable(s) contained outliers? How did you identify and handle them? What variable(s), if any, were skewed? How did you handle them? What partition size(s) were utilized? It is appropriate to replicate the 70/30 split that the baseline utilized; however, if a more optimal partition was utilized that did not result in over-training the model then discuss the results.

3. Predictive Model:
   For each predictive model technique, discuss the technique and the properties that resulted in the best fit model? Compare the results of the selection statistics and discuss which model produced the best fit. Present the results of all of the selection statistics. Compare the misclassification rate of each model type that was evaluated and discuss the difference in the results of both Type I and Type II errors. Recall that a type I error occurs when a true null hypothesis is rejected, and a Type II error occurs when you fail to reject a null hypothesis when it is really false. How do these errors impact investigators?

4. Scored Results:
   Which cases resulted in the five highest probabilities for generating a SAR? Were there any cases that were not previously flagged by the baseline model that were flagged by your best fit model?

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Appendix A – Data Dictionary

Variable ID	Type Unique ID	Note Unique identifier for alerts generated by the anti-money laundering (AML) system
Wires_mult	Derived	The number of wire transfers with more than $10K If an alert has 1 wire transfer more than $10K then wires_mult will be 0, If the same alert has 3 wire transfers with $10K transfer for each wire, then wires_mult will be 2.
Wires_size	Derived	The total wire transfer involved in the AML alert in proportion to the size of the total amount. =Sum (# of wire transfers)/10,000; rounded down to the nearest integer. e.g., if an AML alert has 25,000 wire transfers, wires_size will be 25,000/10,000 =2
Max_crr	Direct	Maximum cash reserve ratio score e.g.: ID 123 has 5 scores available in scoring table – the largest value is used.
Num_tran_alert	Derived	Number of distinct transactions involved in a specific AML alert
Num_acct_alert	Derived	Number of distinct accounts involved in a specific AML alert
Num_related	Derived	Number of related transactions – for that specific AML alert
Num_tran_type	Derived	Number of different transaction types involved in the AML alert
Num_tran_bin	Derived	Number of trigger transactions are grouped in bins by the following order: If num_tran_alert ≤ 5 =’1’ 6 – 15 =’2’ 16 - 25 = ‘3’ 26 – 50 = ‘4’ 51 -100 = ‘5’ ≥101 = ‘6’
Num_acct_bin	Derived	Number of accounts involved in the AML alert are grouped by the following order. If num_acct_alert ≤ 1 =’1’ 2 – 2 =’2’ 3 - 3 = ‘3’ 4 – 4 = ‘4’ ≥5 = ‘5’
Trig_amt_bin	Derived	Trigger amount stratified in ranges – If the amount < 15000 =’1’ 15,000 – 50,000 =’2’ 50,000 – 100,000 = ‘3’ 100,000 – 250,000 = ‘4’ 250,000 - 500,000 = ‘5’ 500,000 – 1,000,000 = ‘6’ 1,000,000 – 2,000,000 = ‘7’ >2,000,000 = ‘8’
Rela_amt_bin	Derived	Related transaction amount stratified in ranges – If the related amount

		< 15000 ='1' 15,000 – 50,000 ='2' 50,000 – 100,000 = '3' 100,000 – 250,000 = '4' 250,000 - 500,000 = '5' 500,000 – 1,000,000 = '6' 1,000,000 – 2,000,000 = '7' >2,000,000 = '8'
Scen_Cat_code	Derived	If an AML alert belongs to a certain scenario then it is set to 1 else it is set to 0. This is computed by analyzing the last 12 months of AML alerts.
Num_rela-bin	Derived	Number of related transactions are grouped in bins by the following order. value numfmt = '1' < 5 ='1' 6 – 15 ='2' 16 - 25 = '3' 26 – 50 = '4' 51 -100 = '5' 101 > = '6'
Num_trigger	Derived	Number of trigger transactions for that specific AML alert
Prod_ind	**Target**	Binary, 1- indicates the alert is a productive alert- Productive is defined as that particular alert for further investigation for AML related activities; 2- 0 – indicates the alert is not a productive alert

Teaching Case

Viral Scalability - Coping with Sudden Demand Swings

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Abstract

The rapid emergence of the novel coronavirus and its impact on human behavior provoked dramatic increases in human usage of a variety of systems. These increases had the potential to stress the scalability of the systems, testing whether the system owners had designed and built those systems to cope with sudden changes in demand. This case invites students to study a variety of different types of systems, and to analyze the means by which they can or did achieve scalability, and efficiently serve their customers.

Keywords: Scalability, coronavirus, cybersecurity, usability

1. OVERVIEW

The emergence of the novel coronavirus sparked a pandemic that rapidly upended many aspects of modern life. Over the course of just a few weeks, offices and schools of all types emptied out, their activities stopped or moved to various online formats. Retail stores and services closed, with many of those activities moved to e-commerce models. The shift was sudden and substantial, and tested the ability of systems and services to rapidly adjust to the increases in demand.

Organizations that were prepared, or made substantive changes quickly, for this sudden demand change will undoubtedly fare better in the weeks and months to come. Organizations that failed to scale quickly suffered reputational and other damage, and may face difficulty in recovering from those failures.

2. SCALABILITY DETAILS

Scalability is a "desirable attribute of a network, system, or process …, to process growing volumes of work gracefully, and/or to be susceptible to enlargement" (Bondi, 2000). Put another way – will the system or process continue to work well as demand for its services rises? Is "work well" a well-defined concept? How is it measured? What aspects of a system need to be scalable? How is scalability achieved?

This case deliberately uses scenarios with a wide variety of underlying industries, technologies, and systems. Information systems professionals, and indeed many non-IT managers, are often called upon to think through the issues of scalability in a systemic fashion. For that reason, we hope you can use the scalability lessons of the COVID-19 pandemic as a tool to help you think about the broader issues of scalability that will arise throughout your career.

We will use the real-world example of a grocery store to consider how these concepts relate, and then apply the concepts to technological systems.

Measuring scalability

Scalability is assessed by measuring various performance metrics for a system – throughput, storage capacity, client satisfaction, etc. As an

example from the grocery store industry, we might choose to gather metrics such as:

- Shopper capacity – how many customers can safely be in the store at once?
- Throughput – how many people can find their needed groceries, check out, and depart in a given period of time?
- Speed of checkout – how long does it take the average customer with a particular collection of items to check out of the store?
- Sales volume – is there sufficient shelf and storeroom capacity to keep the shelves stocked?
- Resupply – is the entire supply chain able to keep the products in stock, in stores, distribution centers, warehouses, etc.?

Types of scalability

Bondi (2000) identifies four basic types of scalability:

- Load scalability – the ability to gracefully service increasing volumes of work without excess delay or resource usage. Example: number of people checking out of the store in a given period of time.
- Space scalability – the ability to service increasing volumes of work without running out of short-term or long-term storage. Example: Volume of product stored on shelves or in warehouse.
- Space-time scalability – the ability to continue to work in a time-efficient way even with a much larger volume of storage. Examples: Moving shelf re-stocking to night-time hours to avoid disrupting shoppers; making the store much larger to allow shoppers to spread out.
- Structural scalability – the ability of the system's design choices to support scalability requirements. Example: Are the shelves big enough to hold a day's demand for certain products before the next re-stocking? Are the aisles wide enough to permit social distancing?

In addition, some additional concepts apply more specifically to technological systems, but also to physical systems.

- Distance scalability – the system works well over short or long distances. Example: How far is the warehouse from the store? How quickly can a truck get to the store with an urgent request?
- Speed/distance scalability – the system works well over short or long distances, and at high or low speeds.

How to achieve scalability

Scalability is accomplished through design and implementation choices, most commonly through two general approaches: horizontal and vertical scalability. Horizontal scalability refers to the ability to have multiple of the same components able to do work in parallel – such as having multiple checkstands at the grocery store. Vertical scalability refers to switching to components that are individually higher in capacity – for example, using self-checkout to allow one staff member to supervise four customer checkouts at the same time.

Scalability also requires architectural and engineering choices to allow the various parts of a system to scale smoothly with one another. There's little value to the customer if we can check them out quickly, but the products they need are not available on the shelves.

Scalability in cloud services

Amazon Web Services (AWS) is a highly visible cloud service provider, and part of their value proposition is the ability to readily scale the capacity for a customer's workload. Morgan (2014) describes the architectural and implementation choices made by AWS to allow for rapid scalability. Those choices include:

- A range of geographic data center locations to address distance scalability.
- Advance planning and capital spending to keep server and network infrastructure ahead of customer requirements. An individual AWS data center is reputed to have 50,000 or more servers, which are partitioned with virtual machine capabilities to allow most efficient use.
- Operational spending to provide sufficient Internet service capacity to each data center.
- Capital and operational spending to provide the power and cooling infrastructure to service all of the equipment in each data center.

One loose analog of the cloud provider to the grocery industry might be the proliferation of delivery services. If the grocery store directly utilized outside delivery services to deliver orders, that would enable them to scale to provide more services without growing their own delivery staff and fleet.

Amazon also makes extensive plans for scalability and reliability, including organizing its many data centers into Availability Zones. This enables customers to spread their workload not

only among enough servers to carry the load, but also among data centers that are close enough to readily keep data synchronized between them.

3. SCALABILITY SCENARIOS

This section documents a range of different scenarios, across a variety of industries, some technology-centric, others less so. Each provides an opportunity to consider the various dimensions of scalability, and to analyze what had to have happened to make that scalability work. Each also provides an opportunity to consider potential problems that still exist, and what problems may still be occurring, but at low frequencies.

Online Conferencing

One very apparent effect of the pandemic was the sudden transition from in-person activities to online video conferencing. One major player in this space, Zoom, reported that their usage grew from 10 million active users to 300 million active users over the months of March and April, 2020 (Grant, 2020). Downdetector.com reports relatively stable numbers of problem reports over those same months, usually fewer than 100 reports per day. One analysis of Zoom's prior history (pre-pandemic) showed that Zoom had not intended to be operated at this massive scale (Bennett and Grant, 2020).

That said, Zoom's growth was not without problems, though perhaps not classically scaling problems (Keck, 2020; Paul, 2020; Zakrzewski and Riley, 2020b). Zoombombing became part of the vocabulary in the US and elsewhere, used to describe rogue users. These (sometimes uninvited) users behaved badly in meetings, sharing unwanted screen views and making noise. In response, Zoom issued updated software that strengthened default security choices.

And of course, this same phenomenon was seen in other countries. For example, after Chinese workers returned to work after an extended Chinese New Year holiday, user counts at conference site DingTalk grew from 26 million to 150 million from January 1 to February 21. WeChat Work's user count more than doubled, from 5.6 million to 13 million, in the same period. DingTalk also reported that there were over 200 million users (some of them the same person in multiple meetings) connecting to meetings on that first day of work, February 3, 2020 (Zhijie and Xin, 2020).

Additional details about online conferencing scalability and its dependencies may be found in the References, such as Baker (2020) and Bennett (2020).

Questions:

- What are the various elements that had to work well for Zoom (or other such services) to scale as readily as it did?
- Why do you think there was a sudden uptick in apparent Zoom security issues, when the software had these issues before the usage spike?
- Scalability can apply to sudden decreases in utilization as well. What can Zoom or other such services do to prepare for sudden decreases such that their cost model scales up and down to maintain profitability?
- Based on this example, what general observations about scalability can you make?

Internet Capacity

The sudden increase in the number of people staying home resulted in increases in, among other things, video conferencing as well as entertainment video streaming. Data consumption in some parts of Europe grew by 30% over a short period of time, with streaming video (pre-COVID) estimated to be 60% of total consumer network traffic. A sudden increase in streaming video, coupled with a huge rise in video conferencing, threatened to cause Internet outages (Baker, 2020).

As a result, Netflix and YouTube, two of the largest streaming video providers, agreed to reduce the quality of their video deliveries in order to reduce data volumes (Gold, 2020). This was expected to reduce total data usage by these two providers by 25%. Other providers, such as Amazon Prime Video and Facebook's video streaming services made similar changes to reduce data usage.

Questions:

- Why does reducing video quality impact data volumes?
- Does reducing the delivered video quality necessarily impact the user's perceived video quality? Why or why not?
- What are some differences between live-streamed video or video conferencing, relative to recorded video? Which one is more likely to be negatively impacted by Internet capacity issues?

- Based on this example, what general observations about scalability can you make?

Online Fitness Services

Fitness services (gyms, spas, exercise studios, and the like) were all quickly impacted by COVID-related shutdowns (Newcomer, 2020). Peloton, an exercise equipment and services company, reported hosting its largest-ever online class, with 23,000 active participants.

The authors spoke with one large service provider (WellnessCo) to that industry, who reported that of the 60,000+ customer locations (usually run by a small business owner) worldwide, about 50,000 of them closed within a several week period. The company was able to see the pattern developing first in Asia and Europe, and then to anticipate the changes coming to the US and Latin American markets.

In a bid to quickly restructure their business for a long period without in-person customers, the company built a series of virtual wellness applications leveraging Amazon cloud services. They include online exercise classes for small groups using Amazon Chime, and large-group game and competition tools based on Amazon Twitch. They built and launched the services over just a few weeks and had 240,000 new classes in operation each day within four weeks of product launch.

Questions:

- What might be the motivation for WellnessCo to use Amazon's cloud offerings to build its new products?
- Certainly, as demand rapidly increased as lockdowns spread, scaling up is important. Do you anticipate a need for the company to be able to scale down? Why?
- How would you anticipate consumer behavior to change over time as the pandemic ends, a vaccine takes hold, etc.? Will all consumers revert to the in-person fitness classes? Why?
- Based on this example, what general observations about scalability can you make?

Mail-in Voting

The contagion risk created by the pandemic has prompted many US states to change their voting procedures. In many cases, states have proposed moving to an all-mail ballot procedure. In this model, voters receive a ballot package in the mail, and are requested to vote their preferences and mail the completed ballot back to election officials. The vote may involve punching out a hole in the ballot, marking a spot on the ballot with a pen, or other means to convey the voter's decision.

Mail-in ballots are already used in many states for voters who for some reason cannot vote in person in their local area, so the basic infrastructure already exists. However, moving all voting to a mail-in model requires a number of things to happen in much higher volumes, from packaging and mailing ballots, to verifying voter identities, to counting the ballots once returned (often using different machines for the in-person ballot counting (Marks and Riley, 2020).

Questions:

- What are the various aspects of the voting system that will need to scale differently to support an entirely or mostly vote-by-mail election? Include systems controlled by elections officials, and those outside of their control. These could be human, mechanical, or electronic systems.
- Where are the potential bottlenecks in the end to end system? What could be done to mitigate the risk of those bottlenecks?
- Based on this example, what general observations about scalability can you make?

Economic Stimulus Checks

In March of 2020, the US government passed legislation that would deliver money to most individual taxpayers, as a support for individuals and the economy. The funds were slated to be delivered electronically to the account used for the individual's tax payment in the most recent tax year. The US government provided some guidance as to the timing, but it was not very specific, leaving users to wonder when their particular payment would arrive.

As the deadline for these deposits approached, large numbers of online banking users logged in, causing unexpected surges of activity for many online banking web sites and apps. This caused slow response times for some, and caused bank web sites and apps to fail entirely for others (Mak, 2020; Rayome, 2020).

Questions:

- Thinking about your own usage of online banking, what types of routine events

would cause a surge in online banking activities?
- Given that banks generally seem to plan and execute well enough to address those routine events, why do you think the stimulus check logins created such problems?
- Research the banking system, and investigate the technological components involved in supporting online banking. Draw a diagram of the components and identify potential bottlenecks.
- Based on this example, what general observations about scalability can you make?

Streaming Church Services

Social media and online services of various forms are often used by non-profit organizations to accomplish their organizational missions (Witman, 2013). In a COVID-19 world, religious organizations were largely forced to move from traditional in-person meetings and worship services to pre-recorded and live-streamed worship delivery.

One church in Southern California chose Facebook Live as its delivery media. Their first week of services went very smoothly, with no significant technological hiccups. See Figure 1, Appendix, for its beginning technology design.

The second week was a bit more challenging. They made seemingly minor technical changes, adding an additional laptop connected to WiFi AP #1, livestreaming content from Facebook, and responding to Chat messages, as well as adding an additional camera for picture in picture. The result was significant pauses – 30-90 seconds – where both video and audio froze for the remote viewers. See Figure 2 for details.

In the third week, they moved the added laptop from the second week to a separate WiFi Access Point to reduce stress on AP#1. Watching a livestream on Facebook reportedly consumes 1-8Mbps; Facebook specifications call for a minimum 5Mbps uplink speed. See Figure 3 for details.

Third week results were more stable, and no new systemic issues have been reported since. It is worth noting, though, that this type of problem can be difficult to diagnose. There might be bottlenecks in the church's own infrastructure (routers, etc.), and in the local internet service provider. From the view of the end user, glitches can be triggered by the video streaming service, the user's viewing device, or any network component in between. Not a simple problem to trace!

Questions:
- Based on the information provided, what seems to be the likely causes for the issues discovered in Week 2?
- What steps, if any, could the church's tech team have done to have caught the Week 2 issues before the event took place publicly?
- How could the church ensure, before the time of a live-stream, that the technology was all working correctly and scalably?
- Based on this example, what general observations about scalability can you make?

Unemployment Insurance Claims

As businesses closed due to the pandemic, many employees were furloughed. Unemployment insurance is a mechanism used in the US to provide some level of income replacement for workers who are temporarily out of work. In many cases, the process of applying for that assistance is intended to be done online, and sometimes only online. The process is administered by the state in which the person lives.

In addition, some states required benefit recipients to log in each week to certify that they remained unemployed and thus eligible for benefits. Many states experienced problems with their online systems, with slow responses, failed application submissions, and other errors preventing access. (Fineout and Caputo, 2020; Zakrzewski and Riley, 2020a).

Questions:
- Given the nature of unemployment insurance as a government-operated social service (rather than a for-profit company), what is the economic or other incentive that would motivate the service to plan appropriately for scalability?
- Some states require all recipients to log in each week. Why does this process affect unemployment website scalability?
- Based on this example, what general observations about scalability can you make?

Family/Friend Connections from Isolation

One unexpected benefit that comes with easy-to-use technology is that people who had not

previously used videoconferencing were able to connect in ways that were previously perceived to be out of reach, either technically or in terms of costs. One student at a southern California university reported that his family was able to connect with an aging grandmother, including many family members from across the US and Latin America. They held daily prayer meeting with the grandmother, live online with many family members, a level of engagement not imagined in a pre-COVID world.

In a more structured fashion, senior centers and arts and other organizations are providing online classes, exercise groups, and social gatherings for older individuals (Finn, 2020).

Questions:

- What happened along with the sudden increase in Zoom and other video conference utilization to enable this sort of additional services to be available to older individuals? Think about things like the broad visibility of conferencing, its ease of use, etc.
- Why do you think online services like Zoom did not get more of this type of usage before the COVID crisis?
- Based on this example, what general observations about scalability can you make?

4. FOLLOW-UP QUESTIONS

These are some follow-up questions to provoke further research and exploration. Your instructor may have other questions, and we encourage you to develop your own questions as well.

- What other examples have you seen where the ability to scale a system has been important? What happened? Why was it important?
- Thinking about the range of different systems and processes noted here, and those that scaled better than others, are there any common aspects that you can identify about successes vs. challenges in systems and organizations?

5. FOLLOW-UP RESEARCH

COVID-19 Vaccine Supply Chain

At the time of this writing, a coronavirus vaccine is yet to be available. Even when the scientific work of designing and testing the vaccine is complete, an enormous logistical challenge lies ahead to get that vaccine (or those vaccines) to as many people and parts of the world as possible, as quickly as possible (NBC News, 2020; Owermohle, 2020).

Even things as mundane as the billions of containers (vials) for vaccine doses must be manufactured of specialized borosilicate glass, and vaccines usually must be shipped under tight constraints of timing and temperature control. Some vaccines must also be administered in two separate doses spaced appropriately apart as well, and of course records of all those vaccinations must be kept.

Questions:

- What are the challenges in delivering and administering a vaccine like this?
- What are the risks if the supply chain is not managed well? How might they be mitigated?
- Are the risks and challenges likely to be the same all around the world? Why might we need to do location-specific planning for vaccine delivery?

Other examples …

Doubtless you have had your own opportunity to observe scalability in action, or in failure, either due to the COVID-19 virus, or due to other factors.

- Document the system or process that needed to scale, perhaps with a diagram.
- What were the critical points that had to scale well?
- Where did problems crop up?
- How were the problems resolved?

6. CONCLUSIONS

Scalability is an important factor to consider in building any system, and there are often many components that need to interact efficiently to achieve scalability. This applies not just to technological systems but to all organizational functions, to ensure that the system can handle sudden increases in demand, as well as cost-effectively handle sudden or steady decreases in demand. It is instructive for business and information technology students to study the scalability of systems in order to prepare their organizations, and their technology, for these inevitable (though sometimes unprecedented) changes.

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Appendices and Annexures

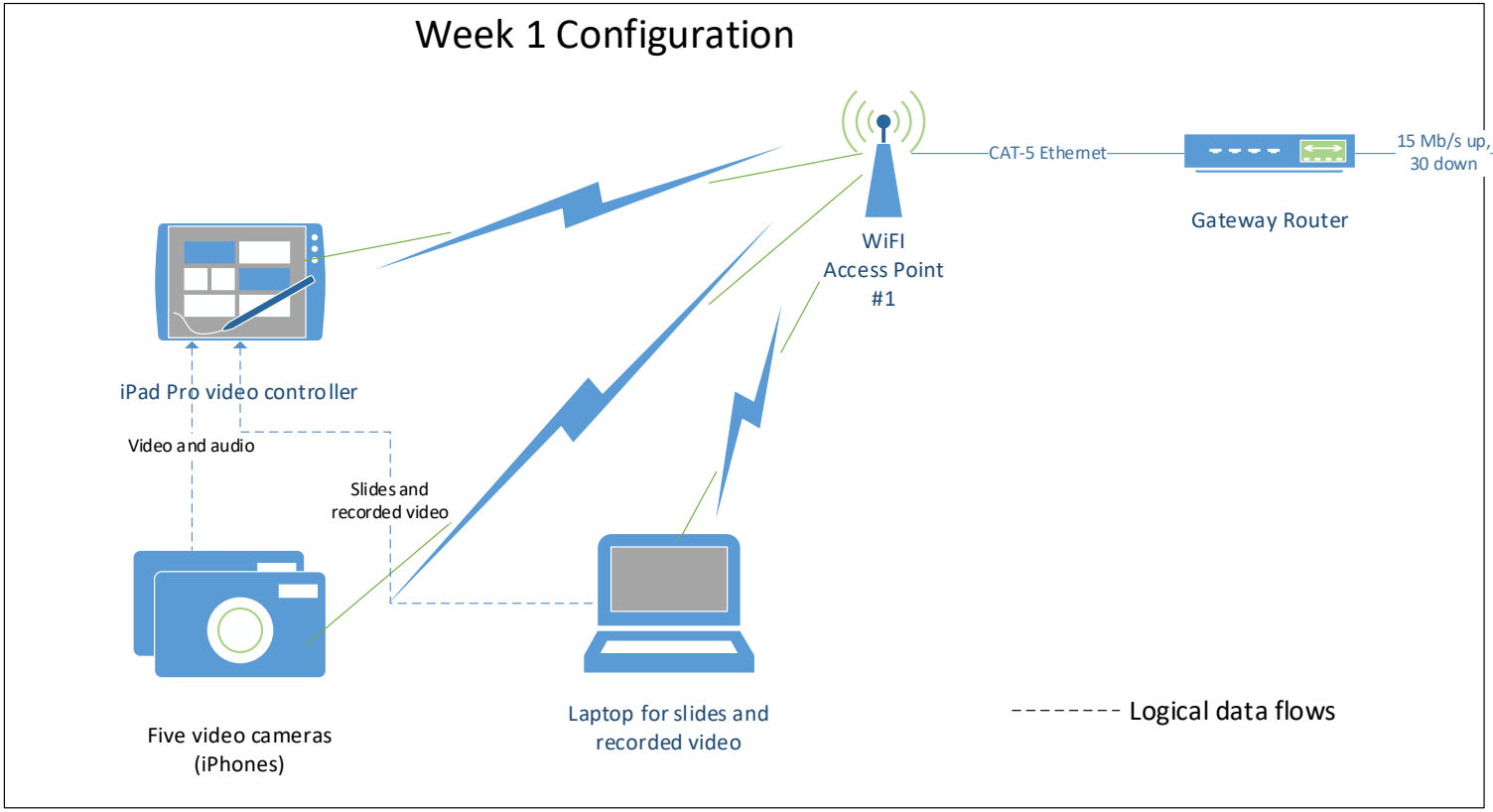

Figure 1 – Church's live-streaming setup, Week 1

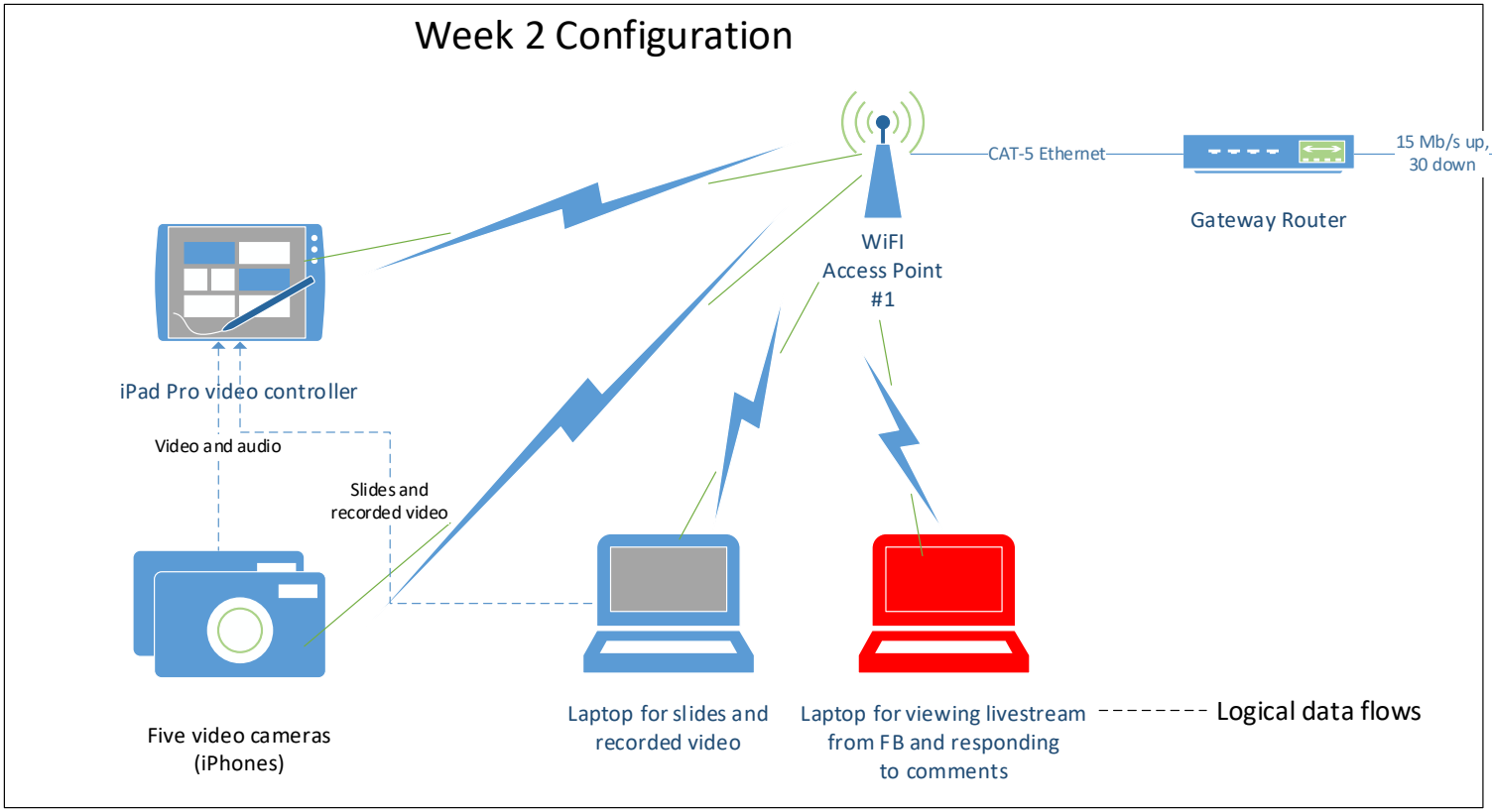

Figure 2 – Church's live-streaming setup, Week 2

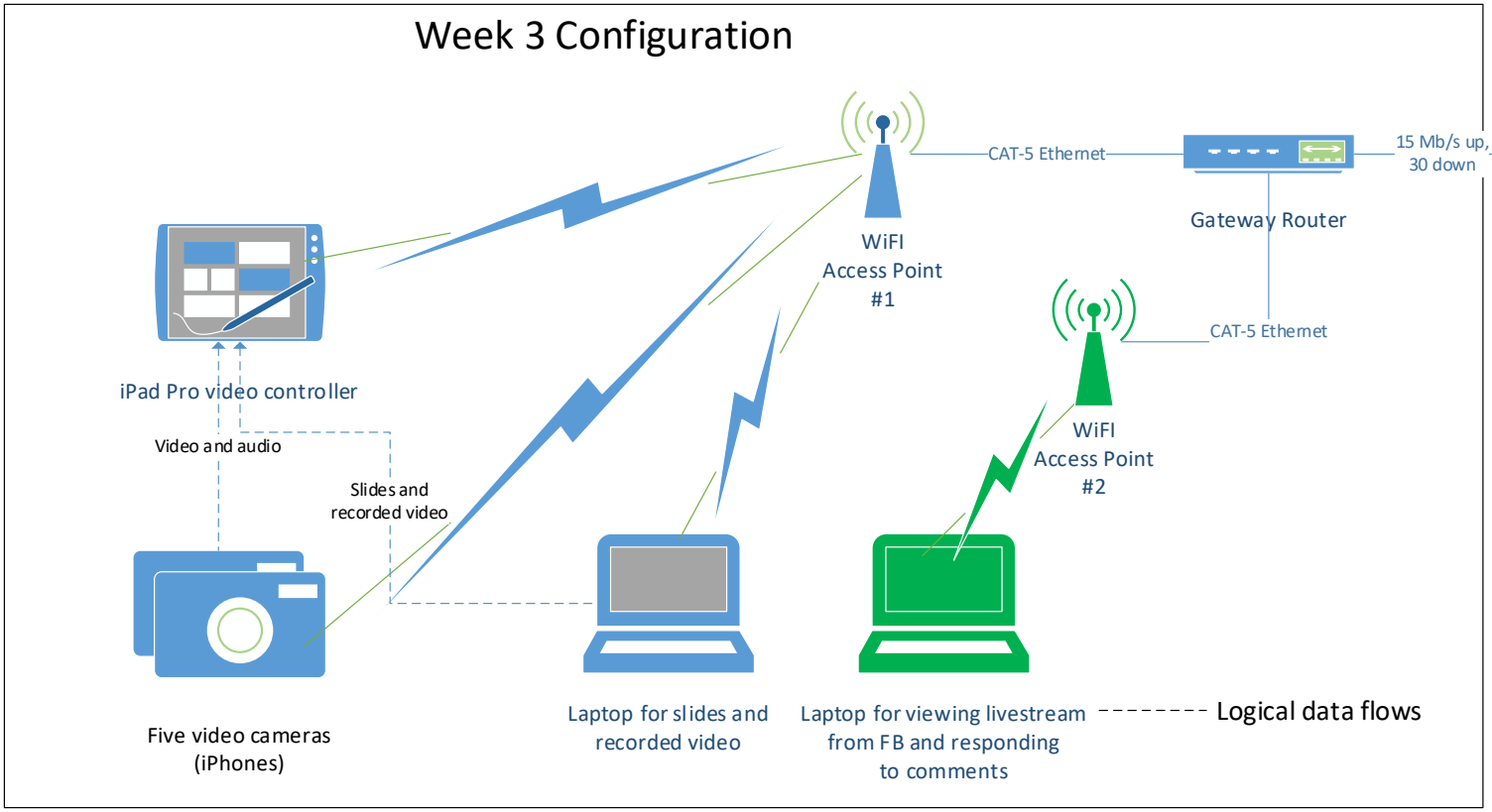

Figure 3 – Church's live-streaming setup, Week 3