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Teaching Case

A Business Intelligence Class Project Combining Business Knowledge, Critical Thinking, and Data Exploration for an Online Retail Store

Jason Triche
jason.triche@umontana.edu
University of Montana
Missoula, MT 59812

Mark McDiffett
markmcdiffett@yahoo.com
Real Chemistry

David Firth
david.firth@umontana.edu

Shawn Clouse
shawn.clouse@umontana.edu

University of Montana
Missoula, MT 59812

Abstract

Teaching Business Intelligence (BI) courses comes with challenges. Unlike traditional IS courses, where the entire course focuses on a specific topic, BI courses utilize skills from several domains, including business knowledge, data analytics, problem-solving, effective communications, and critical thinking. Finding relevant assignments and projects is difficult for instructors. In this paper, we introduce a three-phased class project from a fictitious online retail store that contains different customer segmentations, product offerings, shipping options, and sales regions. Each phase has different deliverables and is geared for different audiences within the business. The project can be modified for difficulty levels, student grade levels, and different course timelines. We introduce the project, lessons learned from assigning the project for several years, and teaching tips to adapt the project for different BI courses. Teaching tips discuss the use of different technologies, BI principles like star schemas and transforming data, and updating the dataset to work in subsequent semesters. After completing the project, the feedback from the students has been positive.

Keywords: Business Intelligence, IS Curriculum, Teaching Case, Class Project

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A Business Intelligence Class Project Combining Business Knowledge, Critical Thinking, and Data Exploration for an Online Retail Store

Jason Triche, Mark McDiffett, David Firth and Shawn Clouset

1. INTRODUCTION

Given today's data-driven economy, the demand for skilled Business Intelligence (BI) professionals continues to rise and BI professionals are in high demand (Olavsrud, 2023). Higher education is responding to the growing market demand by offering new courses, programs, and degrees in the discipline (Mills et al., 2016; Romanow et al., 2020). However, this growth in course offerings comes with significant challenges for educators. For example, unlike traditional IS courses, where the entire course focuses on a specific topic (e.g., relational databases), BI utilizes skills from several domains, including business knowledge, data analytics, problem-solving, effective communications, and critical thinking. Specifically, students learning BI must learn the appropriate tools and techniques but must also learn to become data-driven decision-makers (Jeyaraj, 2019). In addition, it is difficult for instructors to cover both breadth and depth in the timeframe of a typical college course (Negash, 2004; Shi et al., 2024). Students are expected to build the skill sets of storytelling and critical thinking based on data and outputs from BI applications (Knaflic, 2015).

To address some of these challenges, we created a BI class project that incorporates a variety of BI skills, including business knowledge, data modeling, problem-solving, data visualization, effective communication, storytelling, and critical thinking. In this project, students are provided data from a fictitious online retail store that has different customer segmentations, product offerings, shipping options, and sales regions. We also ask students to find and combine external data into their data model to enhance business insights. The project is broken into three separate phases with different audiences and deliverables for each phase. Our goal in this paper is to share the project details and our experience in delivering this project over the past several years. Our hope is that other BI instructors can use some or all of this project to enhance student learning in BI.

The project has several built-in features that are beneficial for building skills in BI. The first feature is related to the type of data. Although the data is simulated, it was created and modified based on a real online retail company. Students receive seven interrelated data files and are challenged to create a cohesive data model. Another feature is that the instructor can hide insights throughout the datasets to see if the students can find them when working on the project. We outline how instructors can do this below. The last feature is that the project's complexity level can be modified based on the class schedule, topics covered in the course, or student level. For example, instructors can assign this project in an undergraduate class by using only a few of the datasets, making the hidden insights easier to find, or only assigning the first phase of the project.

In this paper, we outline the prerequisite knowledge needed for the students and the instructors to complete the project successfully. We then introduce the entire project, the datasets, and the deliverables for all three project phases. Next, we provide lessons learned from offering this project for the past several years, including a technology discussion. Lastly, we explain how to hide insights in the datasets. The grading rubrics are provided in the appendix.

2. PREREQUISITE KNOWLEDGE

The audience for this project is primarily graduate students. We assign this project in a graduate-level business intelligence class. The class is a semester-long course consisting of 3 graduate-level credits. The class meets weekly for three hours, and each class consists of lectures, readings, discussions, and technology presentations. Although we implement this project in a graduate-level course, there is enough flexibility in the project that it could be retooled for an undergraduate business intelligence class. To retool for an undergraduate class, the instructor can choose to assign fewer datasets or limit the number or scope of the deliverables.

There are several prerequisites the students need for the project to be successful. Some of this knowledge must be covered prior to the student taking the course, some knowledge can be

covered in the course but before the project is assigned, and some knowledge can be covered after the project is assigned while students are working on the first project phase. Prior to taking the course, students must be familiar with public speaking, presentation skills, basic business knowledge (e.g., marketing, management, supply chain, operations, revenue, profit), and a basic understanding of data schemas (e.g., primary/surrogate key, foreign key). Before the project is assigned, the students must learn the basic functionality of Microsoft's Power BI (or equivalent software). Microsoft's Power BI is a collection of software services, apps, and connectors that work together to turn unrelated sources of data into coherent, visually immersive, and interactive insights (Microsoft, 2024). Other prerequisite knowledge includes basic principles of extracting, transforming, and loading data, star schema principles, and visualization principles. Power BI will allow students to transform and load the data, create a star schema, create custom calculations and fields, and create visualizations using the data. Once the project is assigned, but before the second and third deliverables are due, students must understand effective dashboards and the principles behind key performance indicators (KPIs). We introduce the full project below, and the prerequisites are listed again under each deliverable.

3. PROJECT DETAILS

The project involves a fictional online retail company called Big Sky Prints. The company asks a business intelligence consultant (i.e., a graduate student) for help analyzing sales data for the last six months to determine where the company can improve its business. The expert is asked to make sense of the data, find solutions to issues, and communicate the results to different audiences in the company over three different time horizons.

Big Sky Prints is a fictional Montana-based company that sells office supplies, furniture, and tech products entirely online. They started as a small regional operation but have grown steadily over the past few years. While they have kept things simple on the surface, the company has expanded into a wide variety of products, customer types, and shipping logistics. As they continue to expand, they are trying to get a better handle on their operations through data—figuring out what is working, where they can improve, and how to make smarter decisions moving forward. Although the company is fictitious, the product data is adapted from the SuperStore Sales Dataset (Starr, 2020). The remaining data (orders, shipping, sales reps, returns) are simulated in order to provide students with different avenues of exploration.

Table 1: Dataset Details

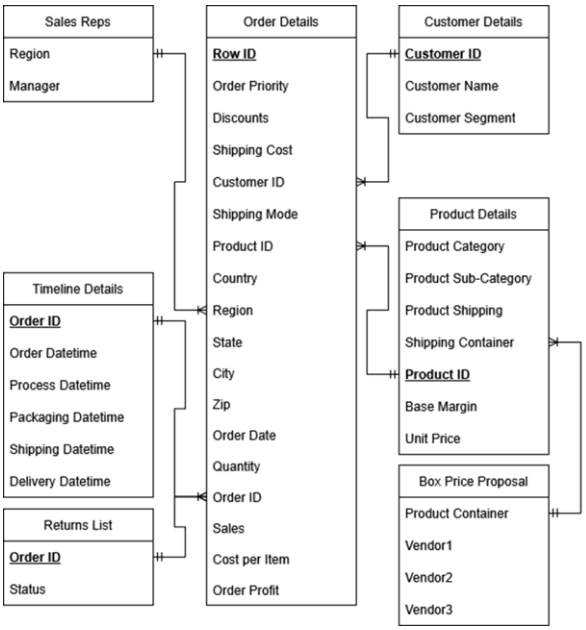
File	Explanation	Fields *primary key
Order Details	Individual records for each order.	• Row ID* • Order Priority • Discounts • Shipping Cost • Customer ID • Shipping Mode • Product ID • Country • Region • State • City • Zip • Order Date • Quantity • Order ID • Sales • Cost per Item • Order Profit
Product Details	Product category Info and product prices	• Product Category • Product Sub-Category • Product Shipping Container • Product Name • Product ID* • Base Margin • Unit Price
Customer Details	Customer Information	• Customer ID* • Customer Name • Customer Segment
Timeline Details	Detailed timestamps for processing and shipping orders	• Order ID* • Order Datetime • Process Datetime • Packaging Datetime • Shipping Datetime • Delivery Datetime
Returns List	List of returned orders	• Order ID* • Status
Box Price Proposal	Prices of seven different box types by three different vendors	• Product Container* • Vendor1 • Vendor2 • Vendor3
Sales Reps	Sales Manager names by region	• Region* • Manager

The course project is divided into three major deliverables – Past, Present, and Future. The first deliverable, Past, is a written report addressing the question, "What does all the data tell us about the company's performance?" The second deliverable, Present, is a dashboard addressing

the question, "How can we best use this data for information on a daily basis?" The third deliverable, Future, is a presentation addressing the question, "How can we use this data to improve our business?"

The students are provided with seven data files, all in the format of .csv. The datasets are explained in Table 1.

Figure 1: Entity Relationship Diagram (ERD)



Phase 1 - Past

The first phase, Past, asks for a written report to the audience of a large group of managers, accountants, and stakeholders answering the question, "What does all the data tell us about the company's performance". Defining the company's performance is up to the student, depending on their focus on the report. For example, students have used sales, revenue, profit, shipping efficiency, and customer loyalty in the past. The audience is broad on purpose, so the report can be interpreted by non-business intelligence professionals. This report requires three major sections. The first section is a summary report of five tables or charts of their choice and the importance of these tables or charts. These can all address one aspect of the business (products, processing efficiency, etc.) or be a high-level summary of the business.

The second section asks the students to find additional data and add it to the data model. The students must create at least two tables or graphs utilizing outside data in addition to the company's data. This data can be merged on timestamps (e.g., stock market data, weather, interstate closures), geography (e.g., demographic data, locations of other office supply stores, list of top ten vacation destinations for office managers), or anything else (e.g., competitor pricing).

The third section is more complex and asks the students to address three questions from management. The prompt tells the students that management would like help in organizing the data to make an informed decision. The prompts ask the students to create at least one table and one graph to summarize the data for each question below.

a. Management structure: Management is restructuring their account management team. They previously had four managers (one for each region) but have determined they need to increase the number of managers to seven. Create a chart/graph showing the number of customers and total value of accounts for each subdivision based on region (South, East, West, Central) and customer segmentation (consumer, corporate, consumer, small business) and propose the ideal way to split responsibilities between the seven managers. Alternatively, a case could be made to realign regions by comparing numbers by individual U.S. states.

b. The company has received three proposals for box suppliers for the next year. Management wants to know how much they would have paid each supplier in the last year. The company has decided to use one vendor only and cannot decide. Additionally, Vendor 3 has a promotion where small packages and wrap bags are free.

c. Management is reevaluating its complicated order priority structure and trying to simplify to only two levels - high priority and standard. Before doing so, management wants to know how each

priority level (critical, high, medium, low, not specified) is currently being processed. Determine the average process time (order to packaging) and total time (order to delivery) for each level by region. Then determine what the average times would be if these five levels were binned into two priority levels. Critical and high would be combined to high priority, and medium, low, and not specified would be combined to standard.

This phase forces students to create a story around how the business is performing. The students must weave a narrative on business performance for a wide audience.

The prerequisite knowledge to complete phase 1 of the project includes a basic understanding of basic business principles (e.g., marketing, management, supply chain, operations), Microsoft's Power BI or equivalent BI software, basic loading and transforming data, star schemas, visualization principles, and professional, business, and technical writing skills.

Phase 2 - Present

The second deliverable, Present, asks for a dashboard for the audience of a department manager or managers. The dashboard should be for a department manager to help them with a snapshot of their performance. Examples could include marketing managers, operation managers, sales managers, or supply chain managers.

The prerequisite knowledge to complete phase 2 of the project includes building an effective dashboard with effective data visualization principles.

Phase 3 – Future

The third phase, Future, asks for students to create a KPI and deliver the KPI in a presentation. The audience for this presentation is executive leadership. The prompt informs the students that the future portion will consist of a presentation to senior management proposing a KPI to use to help track and improve some aspects of the business. We ask the students to create a KPI, explain how the KPI is calculated, explain how the KPI drives results, and create a visualization used to utilize this KPI. The presentation should include the business goal, the KPI(s), how the KPI(s) is calculated, how the KPI(s) impacts the business goal, and a graph displaying the KPI(s) over the 6-month period using the data.

The prerequisite knowledge to complete phase 3 of the project includes building and tracking effective KPIs, building a presentation, and delivering a presentation to the appropriate audience.

4. LESSONS LEARNED

Teaching Tips

Before the introduction of the first phase, the students are provided with a prompt that directs them to import the data into a technology platform, create a data schema, and analyze the data. These directions are purposefully vague for several reasons. First, the project was created so students could explore different aspects of the business. For example, students could explore supply chain issues, vendor packaging optimization, delivery issues, processing delays, sales forecasts, revenue management, discounts, returns, and/or product margins. We wanted the students to choose a part of the organization that interests them. We did not want to lead the students into a specific area of the business.

Second, we did not want to limit the students to a specific technology. We encourage students to use Microsoft's Power BI. We cover several lessons in Power BI during the semester, including building star schemas, creating charts and graphs based on data visualization principles, and creating effective KPIs and dashboards. Therefore, students are familiar with Power BI. However, some students use other BI software like DataPine, Orange, KNIME, and Tableau.

The third reason for the vague instructions is for the student to explore making the star schema without any guidance from the instructor. As demonstrated in Table 1, some datasets do not have a primary key, nor does the primary key listed show the entire picture. For example, the order table contains a row ID as the primary key. The order table contains a row for each product ordered, but several rows could be tied to one order. Therefore, the order ID is repeated throughout the dataset. The proper way to tie an order to the timeline table is a combination of row ID and order ID. This happens throughout the datasets. The ERD in Figure 1 shows how the data can be connected. We would caution providing this to the students so they can try to create the data schema on their own.

Another teaching tip for instructors is spacing out the due dates for the phases. We found it useful to make the third phase due during the final

instruction week of the semester and back into the other two deliverable dates. We operate on a 16-week semester, where the 16th week is finals week. We made the first phase due during week 11 of the semester. Two weeks later, week 13, the second phase was due. Then two weeks later, week 15, the final phase and presentation was due. The disadvantage of spacing out the deliverables so early in the semester is that the instructor needs to cover all the concepts for phase 1 prior to week 11. The specific prerequisites are defined above in the project details. We found the shortened timeline was not a problem for us if we planned the course topic schedule correctly at the beginning of the semester.

An additional teaching tip is advice around the final presentation (i.e., phase 3). Each student had a strict 5-minute time limit to present their final deliverable with a 1-minute Q&A. At our university, the class was listed as a hybrid, which means students could be in-person, synchronous remote via Zoom, or completely asynchronous. We required all the asynchronous students to pre-record their presentations and upload their presentations to an unlisted YouTube link prior to class starting. During the class period, we randomly drew names to present. The students had to present either live in-person, live on Zoom, or through the prerecorded links. The 1-minute Q&A followed, and for those asynchronous, the students had to answer the question via the Teams class link the following day.

In Phase 3 – Future, students create KPIs for management. This is a difficult assignment for some students who may not have had strategic management courses previously. Some questions to help guide the students include, "What business goal are you trying to achieve," "What is being measured," "What is the timeframe," "Who is responsible for the KPI," "What are the industry benchmarks for this type of KPI." Sample KPIs could include "number of new customers" or "same-day shipping percentage."

Keeping students on schedule while delivering high quality is always a challenge for instructors. We set aside the last 15 minutes of each class period to check in with the students on their projects. We provided hints and tips to individual students who were struggling. We avoided answering individual questions to the entire class so each student could attempt to solve problems on their own. For the asynchronous students, we set up discussion boards within Microsoft Teams for students to ask questions. Again, we avoided posting possible solutions to individual problems to the entire channel to encourage individual problem-solving.

The final teaching tip involves updating the dataset so the project can be repeated every semester or year. The instructor only needs to update the dates in the Order Details and the Timeline Details files. We found the easiest way to do this is in either Power BI or Excel. In Excel, we searched for the string '2022' and changed it to '2023' or whatever year we needed. Moving the date up one year created more interesting insights since it appeared that Sunday produced a lot of sales, and shipping could fall on a Sunday accidentally. Some students caught this and suggested that the company reprioritize shipping on weekends.

Hidden Insights

One of the tenets of business intelligence is to discover hidden insights in the vast amount of business data. Teaching students to find hidden insights can be difficult. A dynamic aspect of the project is that the instructor can modify the datasets to hide business insights for the students to discover. The instructor can make these hidden insights easy to find or challenging to discover. An example of an easy insight is to change the returns dataset to only list returns for a few customers or by a specific regional sales rep. If the student discovers this insight, then the student can report suspicious activity of the sales rep if they have an extraordinary amount of returned products compared to their sales rep peers. In this example, the instructor would need to sort the order table by region, copy the order IDs in a certain region, and paste the order IDs over the order IDs in the returns table. The same procedure can be done for the customer returns but sorting the order table by customer IDs and then grabbing order IDs linked to a specific customer. Then, the instructor can paste those order IDs over the order IDs in the returns table.

A challenging insight would be if a student calculated the time difference between the order being placed, when the order is being processed, and when the order is being packaged. The students would discover that some products take an extraordinarily long time to process and package certain products. This could indicate supply chain issues for certain products or product categories/sub-categories. The instructor can modify these dates in the timeline dataset and change these dates by order ID.

Student Feedback

After completing the project, the feedback from

the students was positive. Quotes from students include, "Project Overall was a good test of knowledge and simulated real-work business expectations," "Good project, challenging," and "the final project were all great practice and helped me learn the most." There were no negative comments from the students about the project.

5. CONCLUSION

This paper introduces a graduate-level BI course project for instructors to use in their courses. The project covers a wide variety of BI skills, including business knowledge, data modeling, problem-solving, data visualization, effective communication, storytelling, and critical thinking. The project is introduced in three phases with different time horizons, deliverables, and audiences for each phase. Because of the flexibility of the project phase, datasets, and hidden insights, the project can be modified for an undergraduate class, or shortened in scope or duration to fit different BI courses.

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APPENDIX A

Grading Rubrics

Phase 1 – Past (written report)
Total: / 100

Criteria	Scale
Summary Report 5 tables or charts Explain their importance 15 pts	1 – Less than 3 reports. 2 - 3 or 4 reports or missing explanations of their importance. 3 - 5 reports with some explanations of their importance. 4 - 5 reports all with explanations of their importance. 5 – 5 reports all with clear explanations of their importance and how they are tied to the business.
Outside Data 20 pts	0 – no outside data used. 3 – outside data used, but not relevant or used correctly. 5 – outside data used correctly and relevant to address the business.
Management Structure Chart/graph with number of customers and total value of accounts per division, region, customer segment. Propose new responsibilities with 7 managers 15 points	1 – Missing graphs, evidence, and proposal is questionable. 2 - Graph is missing dimensions, and proposal is satisfactory and missing evidence and proposal is questionable. 3 - Graph is missing dimensions, or proposal is satisfactory and backed up with evidence or proposal is questionable. 4 - Contains all graphs, proposal is complete and backed up with evidence. Proposal is questionable. 5 – Contains all graphs, proposal is complete and backed up with evidence. Proposal is feasible.
Container Proposal How much was paid to each vendor Recommended vendor Contains assumptions about box per item or per order 15 points	1 – Incorrect table/chart with amount paid to vendor, recommendation is missing. Missing assumptions. 2 - Incorrect table/chart with amount paid to vendor, recommendation is unclear. Missing assumptions. 3 - Contains table/chart with amount paid to vendor, recommendation is unclear. Missing assumptions. 4 - Contains table/chart with amount paid to vendor, recommendation is clear and feasible. Missing assumptions. 5 – Contains table/chart with amount paid to vendor and recommendation is clear and feasible. All assumptions are clear.
Priority structure How each priority level is being processed Average process time (order to packaging) per region Total time (order to delivery) per region Average time with new bins 15 points	1 – Missing calculations. 2 - Contains mostly incorrect calculations. 3 - Contains half-correct calculations. 4 - Contains mostly correct calculations. 5 – Contains all correct calculations.
Professionalism/Structure/Grammar 20 points	1 - Poorly written 2 - Several errors, minimum professional 3 - Several errors, professionalism is average 4 - Few errors, written well, professional 5 – No errors, written well, professional

Phase 2 – Present (performance dashboard)
Total: / 100

Criteria	Scale
Dashboard 50 pts	1 – Dashboard does not meet data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 2 - Dashboard does not meet most data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 3 - Dashboard meets some data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 4 - Dashboard meets almost all data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 5 – Dashboard meets all data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered)
Audience 50 pts	1 – The audience for the dashboard is not clear. The graphs do not directly help the audience. Audience is not focused. 2 – The audience for the dashboard is not clear. The graphs typically do not directly help the audience. Audience is not focused. 3 – The audience for the dashboard is clear. The graphs may directly help the audience. Audience is not focused. 4 – The audience for the dashboard is clear. The graphs will directly help the audience. Audience is not focused. 5 – The audience for the dashboard is clear. The graphs will directly help the audience. Focused audience.

Phase 3 – Future
Total: / 100

Criteria	Scale
Dashboard 20 points	1 – Dashboard does not meet data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 2 - Dashboard does not meet most data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 3 - Dashboard meets some data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 4 - Dashboard meets almost all data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered) 5 – Dashboard meets all data visualization principles (all axis are labeled, use of color is correct, graphs are easy to read, uncluttered)
Business Goal 15 points	1 – No mention of business goal. 2 – The business goal is implied by not stated 3 – The business goal is defined but not clear. 4 – The business goal is defined and is somewhat clear. 5 – The business goal is defined and clear.
KPI overview & calculation What is being measured? Timeframe? 15 points	1 – The measurement is not stated (ratio, %, ranking, #), and timeframe is not stated, and benchmark is not stated. 2 – The measurement is not stated (ratio, %, ranking, #), or timeframe is not stated, or benchmark is not stated. 3 – The measurement is not clear (ratio, %, ranking, #), or timeframe is not clear, or benchmark is not clear. 4 – The measurement is stated (ratio, %, ranking, #), timeframe is stated, benchmark is stated. 5 – The measurement is clear (ratio, %, ranking, #), timeframe is clear, benchmark is clearly stated.
KPI impact on business goal Does success of this measure lead to success of the business goal? 15 points	1 – Not stated. 2 – Implied, but not stated 3 – Stated, but unclear 4 – Stated 5 – Stated and clear
KPI Graph for 6 months 15 points	1 - Not present 5 - Present
Presentation 20 points	1 - The presenter is unclear and lacks confidence, making it impossible to understand the presentation. 2 - The presenter is unclear and lacks confidence, making it difficult to understand the presentation. 3 - The presenter is hesitant and lacks confidence, making it difficult to follow the presentation. 4 - The presenter is clear and mostly confident, but could be more engaging. 5 - The presenter is engaging, confident, and delivers the presentation with enthusiasm.