

3-22-2017

Higher Education Meets Business Intelligence

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Higher Education Meets Business Intelligence

By

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A professional project submitted to Western Oregon University

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**In partial fulfillment of the requirements
for graduation from Management and Information Systems
graduate program**

March 2017

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Abstract

In an ever-changing market powered by user satisfaction and financial success, Higher Education institutions must focus on data analytics to improve student satisfaction and business processes. This project underlines the importance of using a powerful data analytics tool to accomplish these goals. Many Higher Education institutions already collect the necessary data in order to predict and determine key changes but still pull this information from multiple databases in individual reports without overlapping benefit or any level of efficiency. The previous systems increase the risk of user error and limit the ability for multiple departments to collaborate and gain insights found through the combination of reports pulled from a campus-wide data source. Through a review of case studies and hands-on use of IBM Cognos data analytics tool, this study addresses the already acknowledged, and also personally obtained, benefits of Business Intelligence in real world scenarios unique to Higher Education. Exceptional data management and accessibility create opportunities for improved student retention rates leading to stronger departments and higher graduation rates. While improving student retention, student satisfaction increases and the institution often attracts more motivated and qualified students experiencing an increase in admission rates. Many Higher Education Institutions are also using Business Intelligence (BI) tools to pull reports leading to options for overall cost reduction. These cuts come in the form of smarter buildings and also fewer professionals needed for creating the BI reports. This project includes the following sections: Introduction, Background, Statement of the Problem, Business Component, Technology Component, Results, and Conclusion.

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1.0 Introduction

Business Intelligence tools and methodologies are used in every industry whether in Banking, Education, Government, Healthcare, or Manufacturing, among others. Every organization has the need to collect and process data. The amount and quality of collected information represents the driving force of today's organizations. Companies store information about their clients, employees, transactions, organizational knowledge, and other relevant sources of data. Having the ability to quickly mine through the data to transform it into useful reports may determine who stays ahead in the business race. This project focuses on the importance of robust Business Intelligence (BI) provisions within Higher Education institutions. The intended audience of this project are representatives of Higher Education institutions in the market for ways to feasibly improve their data reporting processes.

Business Intelligence (BI) has become widely recognized as the set of tools allowing organizations to make better decisions by employing the use of fact-based computerized systems. One can say that Business Intelligence represents the commonly known terminology for Decision Support Systems (DSS) because BI tools are ultimately used to facilitate data manipulation and visualization to better support decision-making operations.

The earliest known use of the term "Business Intelligence" was recorded in 1865 found in Richard Millar Deven's encyclopedia, 'Cyclopædia of Commercial and Business Anecdotes,' to describe the way a banker was able to increase profit by making use of information built from client relationships (Devens, 1868). The use of Decision Support Systems (DSS) became a practice in the 1960s and it has continued to evolve since then as demonstrated by BI vendors such as IBM.

IBM has revolutionized the business intelligence market by creating IBM's Cognos Business Intelligence; this consists of a web-based integrated business intelligence suite that provides a toolset for reporting, analyzing, scorecarding and monitoring of events and metrics. Cognos was founded in 1969 and started as a consulting firm for the Canadian Federal Government. In January of 2008, IBM acquired Cognos (Voyer, 1994). This project includes a show-and-tell live demonstration of the use of IBM Cognos Analytics tool and therefore gives a closer look at its usability. IBM Cognos Business Intelligence includes a variety of components but this project demonstrates the usability of an IBM's Cognos Report Studio product.

Higher Education institutions face many challenges especially involving student retention and cost reduction. By employing the use of BI tools to generate useful reports some organizations are turning these difficulties into strengths. For instance, Brockenhurst College (New Forest, England) employed the use of IBM Cognos Business Intelligence to provide management with a better understanding of student performance as well as creating a private institutional social portal which allows students to obtain access to instructors, classmates, and class materials.

Brockenhurst College has also employed the use of IBM Digital Analytics to capture data from its website and social media pages to better understand the needs, the concerns, and feedback

of their visitors and better create marketing campaigns. These and other initiatives taken by Brockenhurst College correlate with a retention increase of 15% over the next five years. This project discusses the idea of having a centralized location where data can be drawn from in order to streamline the report-creating process; this way, different departments within a Higher Education institution can pull all necessary data from one place to create department-specific reports. This practice creates the potential of saving both time and money because it takes fewer hours to build such reports when compared to the older way of data spreadsheet reporting.

Business Intelligence capabilities are quickly moving to self-servicing platforms where users do not need advanced technical knowledge to have access to these reports promptly. The ability of cloud computing capabilities in combination to BI operations represents another improvement because it lowers the cost of investment and provides additional infrastructure to house the collected data.

This project discusses both business and technology components in a detailed manner. The business component section discusses the competitive advantage that was obtained by other organizations with the use of the suggested BI tool; this section also provides a suggestion regarding best practices to follow in order to ensure the firm makes the right investment while obtaining BI tools and related infrastructure. The technology component section contains the description of a test case scenario of the process of creating reports using the suggested BI tool as well as the results of this experiment and the benefits that such reports serve.

2.0 Background

The first Business Intelligence (BI) tools were developed to support decision-making processes regarding accounting and financial operations. Only large organizations could afford the purchase of powerful mainframe machines and the operating systems to make proper use of these systems. The prices for these mainframe machines ranged between \$133,000 to \$5.5 million with customers such as Bank of America, Time-Life, Allstate and NASA (Kanellos, 2004).

Currently BI vendors develop tools that are more accessible to their users in terms of pricing and deployment costs. Clients have the option of choosing from a variety of packages depending on the size of the company. They can also decide to store their data on premises as well as on the cloud. IBM represents one of the vendors offering these options. The pricing of IBM Cognos BI suite ranges from \$75 per month per user up to \$239,400 for enterprise packages and it includes options for self-service on the cloud data management (IBM Cognos Analytics on Cloud, 2017).

IBM revolutionized the decision support systems market by creating IBM's Cognos Business Intelligence, "an integrated business intelligence suite that provides a wide range of functionality to help you understand your organization's data" (IBM Cognos 8 Business Intelligence, 2008). IBM Cognos Business Intelligence can be used "to view or create business reports, analyze data, and monitor events and metrics so that they can make effective business decisions" (IBM Cognos 8 Business Intelligence, 2008). This suite developed after IBM acquired Cognos which was an Ontario, Canada-based company. Cognos, originally named Quasar Systems Inc., was

founded in 1969 by Alan Rushforth and Peter Glenister. Cognos started as a consulting firm for the Canadian Federal Government and it was not until 1972 that the company shifted their focus from consulting to software sales. Cognos products provide its users the ability to manage critical corporate data assets through analysis, reporting, and forecasting. Some of the products developed and sold by Cognos included QUIZ, Impromptu, PowerPlay, Scenario and Data Merchant (Voyer, 1994).

In November of 2007 Cognos was acquired by IBM for \$4.2 billion; this acquisition, along with others, was a step closer to placing IBM as a BI leader along with Oracle, Microsoft, and SAP (Austen, 2007). IBM has released several versions of their BI suite since its first release (in September 2005) of IBM Cognos BI 8, followed by IBM Cognos Express released in 2009, IBM Cognos 10 in 2010, and IBM Cognos 11 released in 2015.

Many organizations and businesses already benefit from access to IBM Cognos or other BI tools giving these companies real time reports and relevant comparisons while making important logistical decisions. One specific sector that still needs growth in the access and use of BI tools is that of Higher Education. These institutions are under more pressure than ever before to reduce overall costs while also increasing student retention. This pressure comes from stakeholders, especially within the public sector.

Budgets cuts frequently affect schools and they must actively use all available data to find the means to remain a strong institution while also attracting a full enrollment. Higher Education institutions still experience a decrease in state contributions, as a result of cuts made during the 2009 Great Recession. The combination of reduced funding and increased enrollment causes an even lower ratio of available funding per student. Figure 2.1 demonstrates the disparity of available funding compared to the number of enrolled students.

Higher Education institutions often counteract this financial dilemma by raising the cost of tuition. The use of BI tools demonstrates that, through the application of a sophisticated cost analysis with a more long-term focus, these same institutions may find alternative options for revenue and therefore allow for better student retention as a result (American Council on Education, 2016).

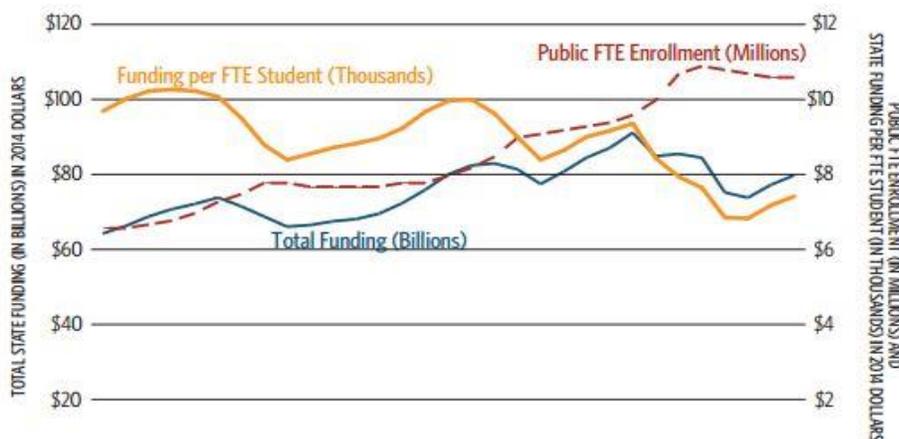


Fig. 2.1. Total and Per-Student State funding for Higher Education in 2014 Dollars and Public FTE Enrollment, 1984-85 to 2014-15 (Trends in College Pricing, 2015).

An effective way to meet both expectations and succeed within limited resources without additional funding comes from the data these schools already have. By running this information through the appropriate system or tool, the resulting detailed evaluation of current resources determines opportunities for improvement. For this reason, institutions often invest in BI tools to support this endeavor. One success story for BI tool usage comes from Tarleton State. “As a result of more targeted and personal communications, attendance at the university’s campus preview day increased 79 percent, and group tour participation grew 140 percent.” (Powers, 2011).

Higher Education Institutions find that progress tracking of students can improve student retention through student satisfaction and awareness of necessary changes to keep up and succeed as discovered by research conducted by Florida State University. This study concluded that students who earned a D or F in a class used their progress tracking system 40 percent less than those earning C or higher (Powers, 2011). This student retention then directly correlates with incoming revenue; however, schools run these reports separately, and then they do not communicate the results with other relevant departments (American Council on Education, 2015). This lack of sharing information defeats the full potential of the results and limits the benefits of the available data. When the reports are not full circle, these institutions often make financial decisions in the dark even though available information allows for fact-based change.

The improved power of these tools also requires less expertise on the part of the user than the originally available resources. One does not have to own the tools and also hire a third party to run the reports; instead, these reports automatically generate with user-friendly features. Instead of waiting 1-2 weeks to have access to a report, these are now self-service and the individual user can choose to pull a new report on the go as the need arises. Kennesaw State serves as an example regarding the self-service benefits. The request for internal generation of reports shows a drastic decrease of 30 to 40 percent now that individual users can personally access and build customizable reports through the use of SAS Enterprise Intelligence Suite for Education (Powers, 2011).

Florida State University also uses a BI tool to the school’s advantage. The CIO at Florida State believes in thorough training that allows users as much autonomy as possible. This access results in higher department usage and a better-rounded picture of each student from start to finish resulting in better retention of the most qualified students. The usability of the BI tool has also shown a decrease in overlapping software and equipment, an overall savings of about \$200,000 per year according to the CIO. Oracle BI Suite allows Florida State University these successes compared to the previous third-party legacy BI tools. (Powers, 2011).

Another example, Hope College, experiences improvements by using an Intelliworks system since 2009. Microsoft Access Solution previously offered insufficient services; the current BI system is credited for the improved communication and recruiting features. The academic

audience and college athletics both benefit from the ability to track and run an analysis during the recruiting process (Powers, 2011).

3.0 Statement of the Problem

3.1 Data Management and Accessibility

A well designed data management plan leads to improved student experiences and business operations. Currently many Higher Education institutions have access to large sets of data without meaningful interpretation or good reports. This issue affects Higher Education leaders, stakeholders, students, and parents. To improve accessibility, these institutions must create and maintain a centralized data warehouse and integrate systems to facilitate a smooth flow of data.

3.2 Student Retention Rates

Effective data analytics allows for an improved enrollment process that targets the most qualified applicants and brings focus to problems or questions that schools need to be asking regarding student satisfaction. Student drop-out rates continues to increase, especially in the public sector. Poor retention rates affect student success and available revenue for stakeholders and leaders to achieve goals for the school. A method for improving student retention is by migrating to data analytic tools that keep track of student academic progress with the capabilities for faculty members to self-create personalized dashboards for updating and sharing with the students periodically. Another option would be to add a data analytic tool that keeps track of student's feedback from social media feeds.

3.3 Cost Reduction

Data transparency leads to fact-based decisions which provide the opportunity for cost reduction strategies. Lack of available revenue leads to budget cuts and a decrease in available programs. Higher Education institutions often experience a decrease in funding with the expectation to continue offering more. Cost reduction affects Higher Education leaders, stakeholders, and students. By integrating Business Intelligence(BI) tools these institutions then generate meaningful financial reports regarding the allocation of existing resources.

3.0 Business Component

Western Oregon University (WOU) is not the exception when it comes to the issues that Higher Education institutions face; one of the problems that could apply in this case is that of data management and accessibility. Even though some improvements have come in the Business Intelligence infrastructure at WOU, there are additional better solutions. Currently, the university uses IBM Cognos 10 for the creation of reports, which shows an improvement from the previous legacy systems which relied on spreadsheets for report creation. While the current solution shows definite improvement in the reporting processes, one could argue that the improvements could even be greater by providing more access to data visualization tools. For instance, under the current BI tool system, only specific team members have the technical knowledge to take

advantage of the report creating capability of this tool. An improved self-service tool provides better business insights.

The ideal solution provides the potential for enhanced experiences and business operations through well-designed data management strategies. Currently, WOU has access to large sets of data and makes use of this data through the data analytic processes it conducts but what if an enhancement of the current data visualizations could provide even better data insights? A solution such as this has the potential of leading to discoveries of new money opportunities and available resource saving strategies.

One might ask, why is this issue so important to Western Oregon University?

As a result of the 2016 University Evaluation, the Higher Education Coordinating Commission presented five recommendations that reflect the concern of which two can be improved by providing better solutions for data transparency; the two areas of recommendation are:

“That WOU design and implement an ongoing planning and budgeting process that is broad-based, inclusive of all appropriate constituencies, data-driven, includes core theme planning, and leads to mission fulfillment” (HECC, 2016).

“That WOU engage in comprehensive, on-going, systematic assessment that leads to mission fulfillment through the evaluation of core theme objectives and support continuous improvement” (HECC, 2016).

One might argue that failure to meet minimum requirements of development within these areas might result in suspension of state funding and appropriate accreditation among other possibilities; this argument underlines the importance of the issue for data transparency to improve data management and accessibility.

An improvement of data management and accessibility has the potential of improving many areas of WOU’s business operations including the budgeting process. The term budget, as defined by Merriam-Webster, is “a statement of the financial position of an administration (as a nation) for a definite period of the time based on estimated of expenditures during the period and proposals for financing them.” (Merriam-Webster, 2017).

Budgeting is of vital importance to WOU and if better insights can be drawn through better monitoring as a result of improved data visualizations this change can then positively improve upon areas such as enrollment, retention of students, and placement after graduation.

One example of a university experiencing positive changes after improved data management comes from Portland State University (PSU). This institution previously managed its data through a legacy data warehouse using spreadsheets shared among departments. These documents floated between relevant areas, but all data required manual input each time and no centralized data location existed. With approximately 30,000 students each year and many budgets and programs to balance, this process needed drastic improvement to provide necessary feedback (Portland State University, 2016).

By adding IBM Cognos TM1 and Ellucian Banner ERP, the budgeting process became much more individualized and accessible. The access allowed each fiscal officer an environment that facilitates interactive planning. This improvement allowed PSU to successfully load budgets into the system in advance of the upcoming fiscal year, the first time to meet this expectation. The lack of manual input and processes allowed the budget office to focus on more pertinent issues and higher level demands. As a result of this improved process and accessibility to data, PSU continues to keep tuition down by 3 percent each school year. Beyond the focus of budgeting

improvements, PSU also uses reports to identify at-risk students with the use of dashboards. Basic monitoring and identification of these students allow necessary intervention and improved retention rates. These changes within the University's BI tools advance data processes and improve outcomes for PSU's programs and students (Portland State University, 2016).

Improved data accessibility not only changes potential outcomes but also reshapes business operations. According to Alexander Kurz, a data and research manager at "Thriving Together" in Phoenix, data management requires well-established data visualization and a positive environment supporting those interacting with the data. When administrators present data with the intent of detecting areas of improvement, this information can often come against resistance by those who feel their previous attempts receive criticism in the process. This concern seems to be an especially sensitive topic for educators when addressing student success and previous education performance statistics (Tableau, 2017).

One step in improving openness to change comes from being part of the change and part of the identifying process. Improved data visualization and data accessibility allow those who need to be part of this process a feeling of ownership of the data through user-friendly dashboards. Expanding the capabilities of various members of the faculty to be able to access data and create dashboards has the potential for increasing better insights and allows those involved to more openly adapt to change. Improved data accessibility also means the responsibility no longer falls on one person to create these visualizations. Instead, it becomes more of a team effort and collaboration. Multiple sets of eyes looking at the data also present a personalized approach leading to the opportunity for more ideas (Tableau, 2017).

In theory, opening availability of BI tools that allow enhanced data visualization among all departments of Western Oregon University delivers opportunities for users to draw data-driven insights from interactive real-time dashboards; this approach also improves the abilities of continued budget monitoring initiatives.

Providing enhanced real-time data visualization options that are user-friendly may also improve on the areas of concern as advised by the HECC 2016 evaluation because it provides a solution that allows fact-based data insights and monitoring solutions that can be designed to support continued improvement across all departments.

Figure 4.1 displays a screenshot of a dashboard created using Western Oregon University Financial data. The elements included in this dashboard are fully interactive and can be set to automatically update upon changes to various data items within this report. For instance, if revenue increases for the year of 2018, the data reflected in this report also automatically updates.

This dashboard allows the user to interact with the information in such a way that they can set filtering options by simply clicking on the desired widget represented on the dashboard. From this example, one can draw the conclusion that it would be easier to discover new insights and come up with smarter questions than if the report were a static presentation of limited aspects.

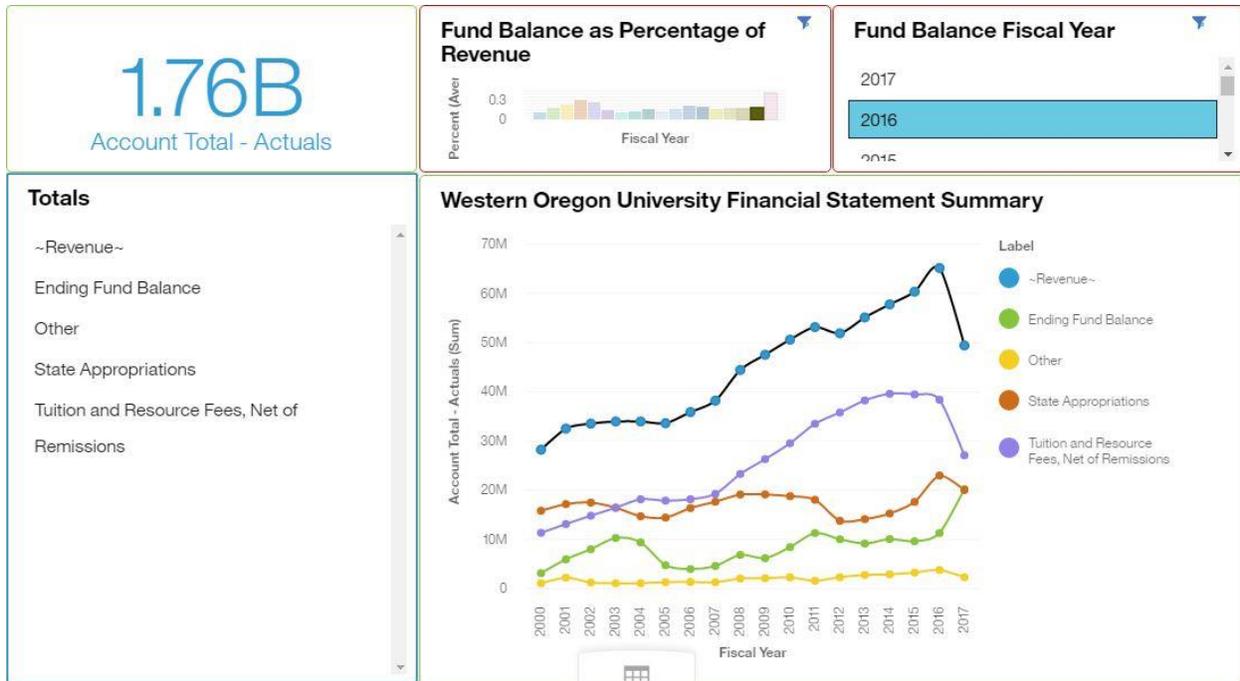


Figure 4.1: displays dashboard of Western Oregon University Financial Statement Summary; created using Cognos Analytics V11.05.

5.0 Technology Component

The focus of the features of IBM Cognos Analytics V11 is the introduction of a user-friendly interface that promotes a self-service environment. This new interface moves away from the traditional Microsoft Windows OS views, which relies on menu bars for navigation. An example of this would be the new interface of the templates and themes available for creating reports, as figure 5.1 shows. The same exists for the data visualization options; the new interface provides a user-friendly display that presents the various options and a preview window with definitions of the selected option as figure 5.2 shows.

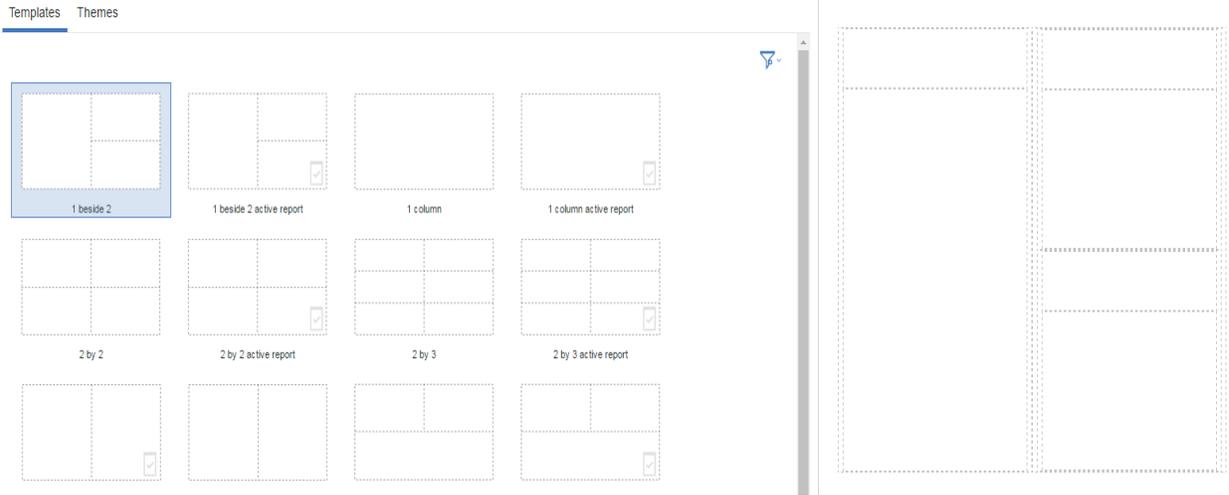


Figure 5.1: This figure shows reports templates and themes section as an example of the available options of Cognos Analytics V 11.0.5.

The same exists for the data visualization options; the new interface provides a cleaner display that presents the various options and a preview window with definitions of the selected option as figure 5.2 shows. Cognos Analytics carries the same powerful capabilities as previous versions but with added simplicity and features. Perhaps the area that has the most exciting features is that of dashboard-creating; a dashboard is an interface that combines different data items from various sources to display an integrated data presentation; this presentation has the potential to contain multiple data real-time visualizations, as opposed to the traditional static reports.

Visualization gallery

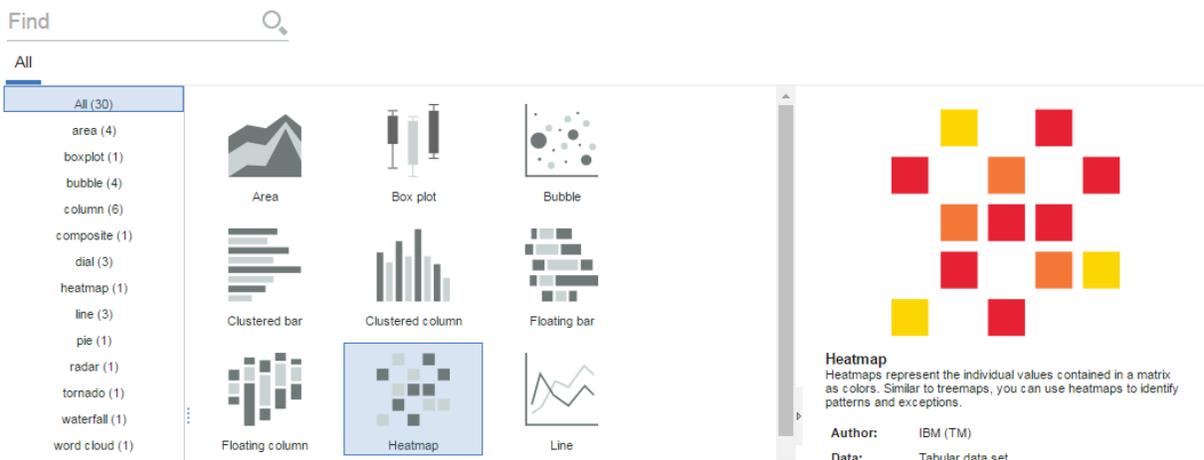


Figure 5.2: shows visualization gallery as an example of visualization options and display.

The new dashboarding capabilities provide the users the ability to create dashboards within minutes and without requiring high-level technical knowledge. The revenue widget in figure 5.3 shows an example of how a user can easily drag and drop an item into the dashboard canvas to display a summation of the data selected; the calculation inside the revenue widget took place automatically upon the dropping of the data item. Even though this data item was modeled to be presented or drilled down against various factors, if such an item is selected and dropped into the dashboard area, Cognos automatically summarizes the total amount of the data.

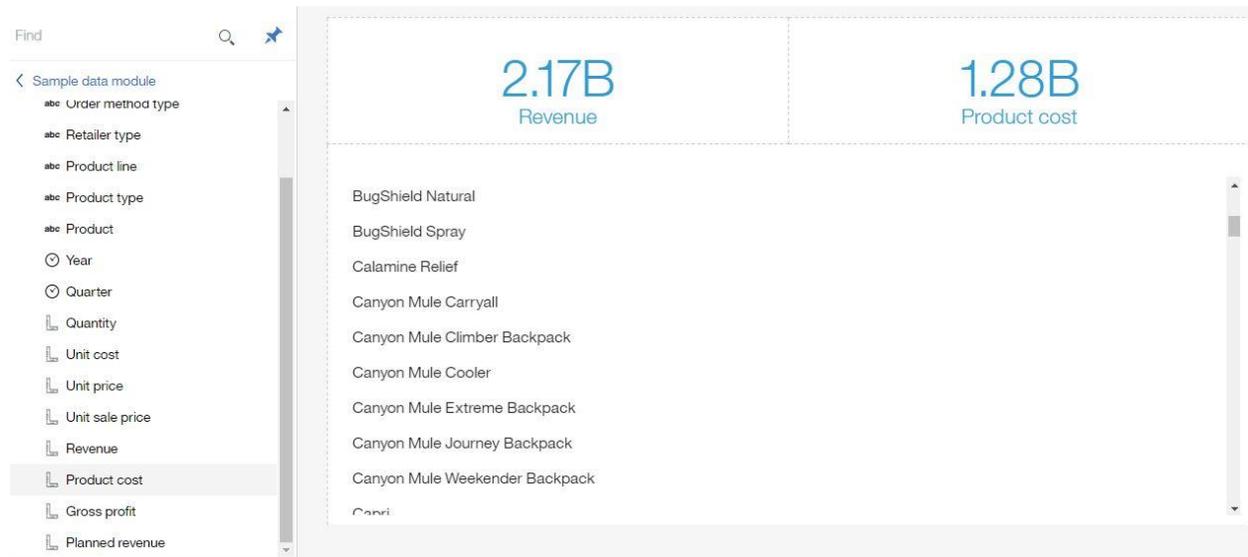


Figure 5.3: shows widget data transformation display within a dashboard.

Another interesting feature is that of automatic visualizations selection. Similar to the revenue example explained above, depending on the selected data type, Cognos automatically chooses a display to present the data. For instance, if the user drops a list item into the dashboard, Cognos automatically creates a list widget in the form of a drop-down menu as the list item shows in figure 3. Consequently, if the user drops the revenue item inside the list, Cognos then combines the list items and creates a bar visualization that displays the revenue against each list item. Also, if the data module comes dimensionally modeled, Cognos automatically enables the drill-up drill-down features as the user creates a list of items.

Due to the capability of real-time dashboarding, the total revenue widget updates as the user hovers over the different item totals; so far, these features allow the user an improved experience of self-reporting by promptly creating data presentations with minimal technical knowledge.

Another addition to the powerful features is that of map visualizations which gives users the ability to create map displays by quickly dragging and dropping map widgets or geodata, such as countries or cities; Cognos automatically generates the map visualization. The user has the option to present the Geodata as country names, state names, or city names, etc. The user also has the choice of adding pertinent data to the maps and this tool will automatically distribute the

data, as specified. Once the data exists inside the visualization, Cognos will generate colored bubbles indicating concentration rankings, as figure 5.4 shows.

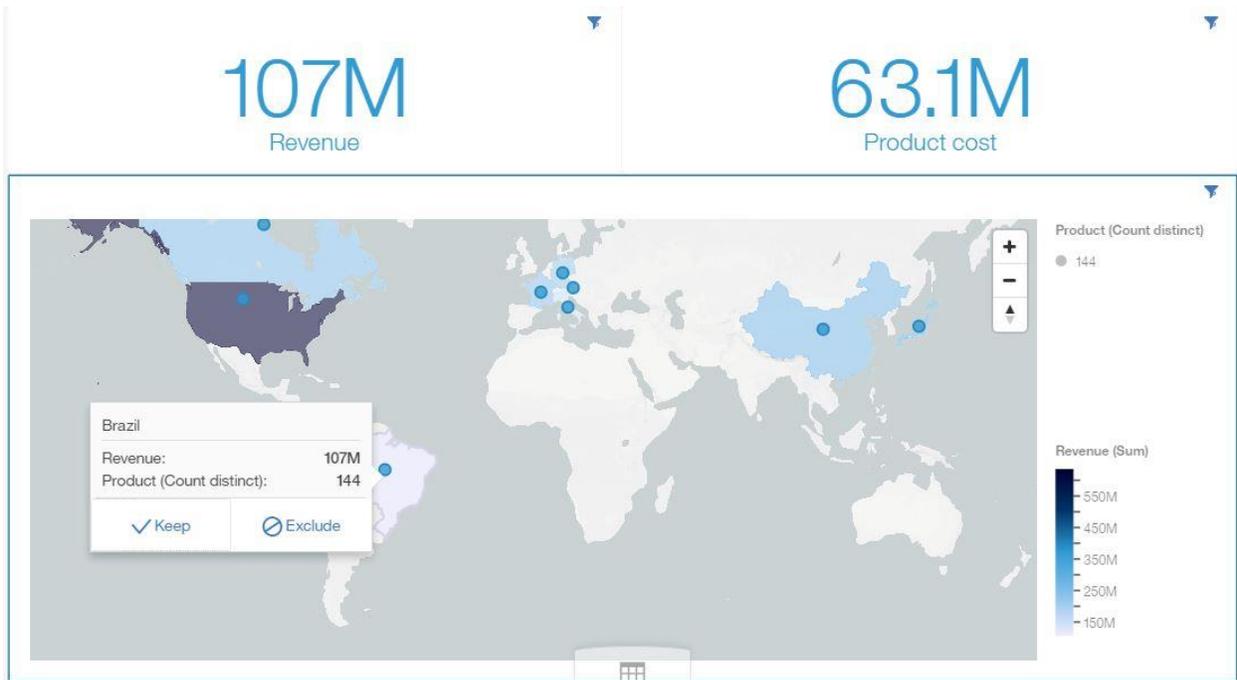


Figure 5.4: shows an example of automatic data distribution.

Hovering the mouse over the desired location allows the user to view information specific to that area, as figure 5.4 shows. The feature of map visualizations is highly valued because it provides the perfect example of self-service dashboard creation; as long as the user has a good understanding of the data modules in use, they should be able to create an insightful dashboard with little technical knowledge.

Another significant example attached to the new visualizations is the ability to zoom and pan within the visualizations to get a better look into details within a visualization. For instance, in the case of a bubble display with one or two results that are close to each other, the user can click and zoom in and out to better view desired details. A new toggle grabber icon was added to facilitate the zoom in and pan capabilities as shown in (figure 5.5).

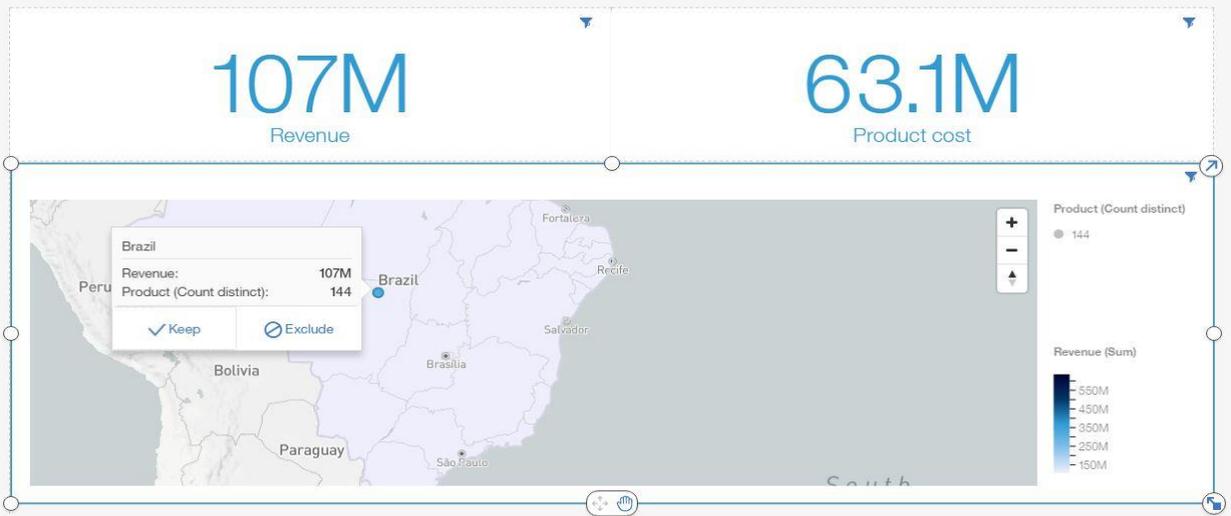


Figure 5.5: shows an example of zoom and pan feature.

Another interesting feature is the infographic summaries in which the user has the options to present percentage data in built-in images. The user has the option of using a selected measure and may show it using built-in shapes, as indicated by the user. For example, in the case that a user wishes to present percentage of revenue in an infographic summary. The total number of shapes will show as the total revenue amount, and the filled-in portion of the shapes shows as the percentage the user wishes to represent, which is 10 percent in this case (refer to figure 5.6 below).

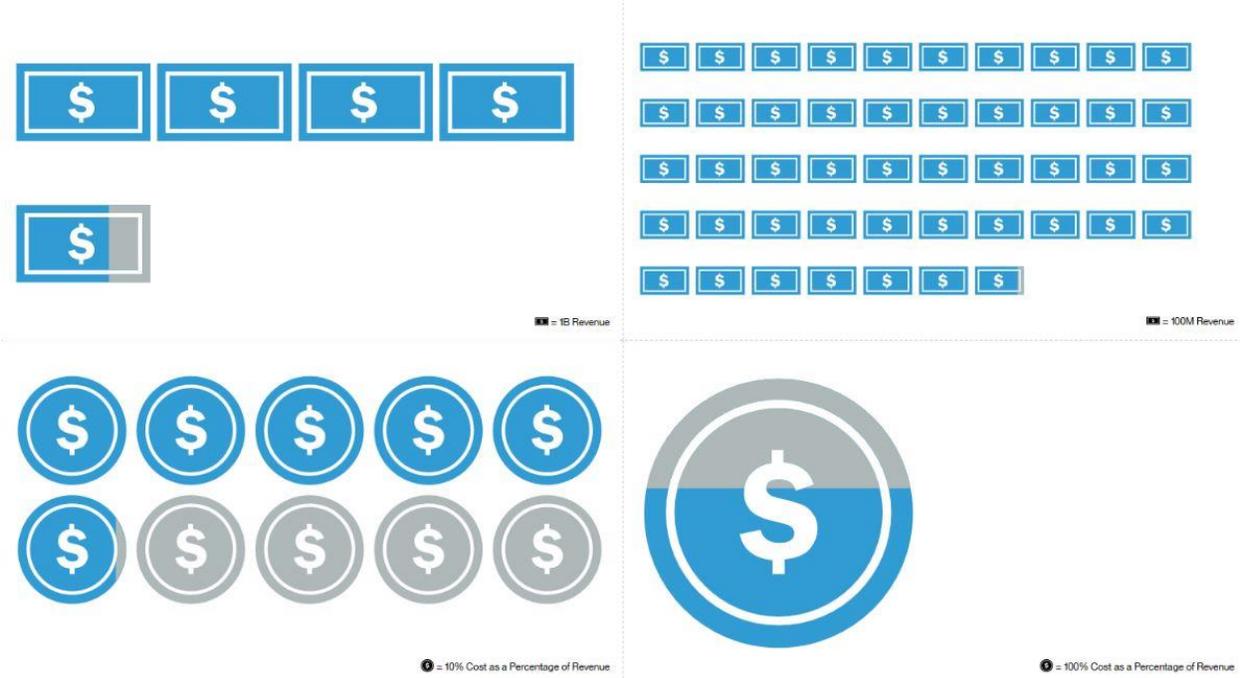


Figure 5.6: shows an example of an infographic summary.

Guided journeys come as another feature that is part of this tool which the user can use to make animated presentations of their data; with this feature, the user can make a timed short video and show different sides from the beginning to the end. The template of a guided journey comes as a page containing separate presentation blocks in which the users can drop desired graphs or data visualizations and create text items; each block within the journey page becomes a presentation slide. The user has two template options for their guided journeys; once the user chooses a template, they have the ability to place the slide contents as they wish and in the order desired by just clicking and rearranging the slides to be presented. Once the story is completed, each slide becomes a scene that is zoomed in during its presentation and automatically moves to the next slide until it reaches the end; each fraction of the presentation page becomes a slide. The user may also decide to show their data in a more traditional way, in which each slide becomes a separate page, like Microsoft's PowerPoint.

In summary, this tool provides the means for users to present their data in an easy and fast way with a user-friendly interface; Cognos embodies the capability of creating reports and dynamic data visualizations and presentations all visible from one place. The interface improvements provides the overall usability of a self-service product that allows beginner users to learn fundamental ways of creating their reports quickly. As previously described, a user can just drag and drop the desired data item into a dashboard canvas and the tool will automatically choose the best data visualization for the presentation; the value of this tool is that it can save time in report creation and delivery.

6.0 Results

6.1 Data Management and Accessibility

A well designed data management plan leads to improved student experiences and business operations. Currently many Higher Education institutions have access to large sets of data without meaningful interpretation or good report. This issue affects higher education leaders, stakeholders, students, and parents. To improve accessibility, Institutions must create and maintain a centralized data warehouse and integrate systems to facilitate a smooth flow of data.

One example of a university that now uses improved data management to the benefit of their education process is The University of Massachusetts (UMass). With five campuses and over 250 departments relying on data, proper management, and efficient accessibility are vital. Previously, UMass stored data in two separate databases that did not communicate with each other. Although the University had access to all necessary data, they needed a way to run a report with the information stored in both a space-use database and the electronic floor plan database. IBM TRIRIGA answered this dilemma by allowing UMass to manage all data with an automated process; this involves the collection of data, storage in a space-use database, and the availability of data for all relevant projects multi-campus-wide from one source. By integrating this BI tool, UMass limits duplication of work and storage of data, detects errors, automatically implements the correction for all users, and allows for an improvement of collaboration between all departments (UMASS, 2013).

On the side of the student, the availability of data through the integration of TRIRIGA improves UMass campuses' scheduling of classes, financial tracking, and web portal usability. The efficiencies resulting from the use of TRIRIGA is transforming project delivery rates with a reduced time rate of 67 percent. In one example, this changes the outcome of a project from three years to one year. The University of Massachusetts now has space-saving, money-saving, and time-saving options through improved management and accessibility of data methods (UMASS, 2013).

The appropriate set up through a BI tool has the potential to completely revamp the success of a University as an efficient business with plans and attainable goals. The University of Adelaide located in Australia needed a way to reorganize information to accelerate the budget creation process and determine appropriate changes. Annual budgets became difficult to predict with a new report available only every six months. This practice made it almost impossible to find areas needing improvement with such infrequent data. For the University, salaries make up the most expensive portion of the budget, but without any way to predict future changes, forecasting became risky. The University of Adelaide replaced the manual approach that included multiple spreadsheets with an investment in IBM Analytics, specifically IBM Cognos® Business Intelligence and IBM Cognos® TM1 software. Already, this approach allows individuals to identify areas that need improvement and creates a sense of responsibility among all staff. This solution also allows for identification of departments with successful budgets and these methods then transfer to other areas within the University. Although continued work may improve outcomes even more, the timeframe for the annual budget has adjusted to reports every three months instead of six months. This BI tool also eliminates a significant amount of time for running reports and allows budget owners to focus more time on additional ways to add efficiency to survive in the education market (IBM University of Adelaide, 2015).

Another example of how the integration of systems and data accessibility improves the student's experience comes from DeVry University's Keller Graduate School of Management. As one of the largest graduate management schools in the U.S., Keller Graduate School has over 50,000 alumni and an enrollment rate of 45,633 as of early 2017. These students come from more than 55 campuses across North America. The implemented solution prioritizes the importance of student satisfaction and provides a personalized experience for each student's learning style.

Keller Graduate School of Management focuses on different aspects that lead to student success and then targets ways to implement improvements. Part of what this solution introduced was the integration of information from various data sources including multiple databases involving admissions, school classes, and financial affairs. Previously, each of the school databases worked separately. By overcoming this obstacle, they now integrate this information to create a 360-degree profile of each student that delivers pertinent details attributing to the overall student experience including awareness of one's progress and placement in the program, class standing, scholarship qualifications, and current electives enrollment (IBM Keller University, 2015).

These 360-degree profiles now help identify students who are at risk of quitting the program at

an early enough stage to offer assistance and keep these students engaged and successful. This solution has increased overall student satisfaction by 2 percent and a short term improved rate of student retention by 2 percent as well (IBM Keller University, 2015).

The University of Kentucky (UK) uses the SAP HANA platform and this benefits the employees, students, and the institution as a whole. As a University offering both graduate and undergraduate programs in various degrees for a total of 28,000 students, any margin of improvement in education services creates a substantial impact. Previously, to create reports, the school pulled data from multiple sources. The University administrators discovered that they spent most of their time moving data around rather than using the data. This practice proved to be a significant waste of time. Since upgrading to the SAP HANA platform, UK now has more IT staff available for more relevant projects and has projected a 250 thousand dollar savings in IT costs alone each year. With an efficient BI tool, the University now reduces the expected timeframe for extracting, transforming, and loading data by 87 percent. A great portion of the University's data, 80 percent, automatically updates in real-time. This solution allows appropriate staff to pull reports anywhere from campus, even on mobile devices, combining information from five different systems for time-sensitive business decisions (SAP University of Kentucky, 2017).

Now, instead of using all available time to move and collect data, UK focuses on how this information can lead to better decisions and an improved student experience. Part of this goal is to improve the student retention rate and ensure optimization of available University resources. Appropriate classroom utilization affects the availability of classes and directly impacts student success and satisfaction. This solution also affects school finances when considering the need for new buildings on campus. The University of Kentucky found that a 10 percent improvement in using all available classrooms allows hundreds of additional students to enroll in classes with the open space. With improved data management, UK is also tracking aspects of student participation, both in attending class, and taking advantage of school functions, and tutoring resources to predict future graduation success. By keeping track of these factors, they hope to assist current students toward completion of their selected degree and in turn make graduation an attainable reality for more of their students. Long term, UK would like to see an increase in retention by 10 percent. An improvement of even 1 percent correlates to increased revenue of \$1.1 million for the school (SAP University of Kentucky, 2017).

Arizona State University (ASU) revamped school budget planning by replacing spreadsheets with IBM® Cognos® TM1® on Cloud. This solution allows ASU to make more empowered and foreseeable decisions for better future revenue rather than betting on what-if scenarios. The new platform replaced over 90 individual spreadsheets which became more and more unrealistic to use to run reports. Not only can ASU obtain all data from one platform, but as expected, ASU also creates more efficient reports with an improvement in time by 50 percent for the monthly budget. Instead of waiting for an annual budget for any modifications, planning, and adjustments, they can automatically alter the budget frequently based on new insights and opportunities for growth. The improved frequency of reports gives ASU control of the budget and this allows administrators to catch money saving options and also allocate available monies

for creating additional student opportunities. A monthly budget allows adjustments based on actual spending rather than projected planning. With minimal training, the financial team inputs data into the system and personally runs reports without adding work to the IT load (IBM Arizona State University, 2016).

6.2 Student Retention Rates

Effective data analytics allows for an improved enrollment process that targets the most qualified applicants and brings focus to problems or questions that schools need to be asking regarding student satisfaction. Student drop-out rates continues to increase, especially in the public sector. Poor retention rates affect student success and available revenue for stakeholders and leaders to achieve goals for the school. A method for improving student retention is by migrating to data analytic tools that keep track of student academic progress with the capability of faculty members to self-create personalized dashboards for updating and sharing with the students periodically. Another option would be to add a data analytic tool that keeps track of student's feedback from social media feeds.

First-year students do not all fall into the same category or classification, such as coming straight from high school, being a full-time student, knowing the determined major, or attending the given school as a freshman versus a transfer student. With so many variables, Universities must run a sophisticated predictive analysis to determine possible strategies for improvement in retention. Not only does low student retention decrease the likelihood of success for the individual student, but it also encourages other students to reconsider their decision to remain enrolled and takes away from the overall reputation of the program (OVUM, 2015).

Routinely, Higher Education Institutions experience low student retention rates. This problem reflects both on the satisfaction of the individual student and also causes a large loss of revenue for the school. Valdosta State University (VSU) located in Georgia initiated an intentional project in 2012 for improving these rates. Up until this point, they lost an average of \$6.5 million annually because of the high percentage of one-year students. To run predictive analytics, VSU used a BI tool, Oracle Business Intelligence Enterprise Edition. They also included Oracle Endeca Information Discovery in the process to collect information from student surveys and data connected from the student ID cards. One of the first observations Valdosta State University made correlated to eating breakfast on campus for first-year students with an increased retention rate of 10 percent. As a result, VSU now offers more on-campus food options and promotes those options, especially to specific demographics. VSU also found that first-year students with on-campus jobs had an increased likelihood of 30 percent to continue the program. To provide more opportunities for success for the students, \$200,000 went towards creating additional jobs. Although this costs VSU money upfront, the school expects to recover \$2 million over the course of four years because of the improved student retention rate (Campus Technology Valdosta State, 2014).

Western Sydney University uses IBM SPSS with the objective to run predictive analytics. This tool allows the administration to find correlations between specific student characteristics and the equivalent level of risk. Although still in the beginning phases of implementing a plan to

improve retention, the BI tool already provided increased awareness of the different categories of students that do not complete their selected program. These risks include lack of preparedness for college, personal issues involving family or finances, and a desire to switch to another University. Another category that came as a surprise risk is those students who frequently change registered courses. Instead of determining student success based purely on high school grades, data analytics with a BI tool allows for a thorough understanding of the problem. Beyond predicting different risks, the University also focuses on the motive behind the behavior or risk. The next step in improving student retention comes from acting on the data. Western Sydney University plans to implement this new knowledge in each student portal, offering resources for identified students, and tracking closely any improvements or changes in risk status (Western Sydney University, 2014).

Another example comes from The Hamilton County Department of Education (HCDE) in Tennessee, who focuses on student retention in the sense of successful completion and graduation. They achieved a record high graduation rate in 2013 with 84.5 percent. They accomplished this with the assistance of IBM analytics technology involving many different software components. This BI tool allows the school system to watch for satisfactory performance and then the appropriate individuals receive proactive intervention in trouble areas. HCDE's graduation rate increased 13.6 percent after the initiation of analytic tracking. Data analysis allows teachers to implement particular teaching styles to then watch for a resulting growth markers. Teachers quickly learn which strategies work and which do not contribute to an improvement in understanding. This data reflects both the strong style of learning and the particular course to best track any correlations. At the end of this focused study, the data revealed students learn best from instructional behavior. HCDE uses student tracking and integrates new information reflected in data analytics to improve student retention and graduation rates, and after five years, the results show obvious benefits (IBM Hamilton County Department of Education, 2014).

The University of Dayton in Ohio addresses student retention from the very first step, recruitment. As a private university with more than 80 different programs, they attract students from all over the country and internationally. A high application rate allows them, even more control in the enrollment process and recently they have an acceptance rate of 57 percent. The University now uses BI tools to analyze data successfully this is an improvement from previously having to collect and analyzing data through the use of multiple excel spreadsheets or having to import data through the use of SQL query language tools, which took significantly longer. (Reed, 2016).

By using Alteryx and Tableau, the University of Dayton has improved their student enrollment process by running reports to determine which students have the right qualifications and criteria to succeed. The University does so by collecting and analyzing data elements such as high school academic records, college entrance exams, transcript data, among others. Alteryx allows the university to collect and access data almost instantly while Tableau serves as a data visualization tool (Alteryx, 2016). The University also considers it their responsibility to make sure these students succeed throughout their entire college career; therefore, they continue to

analyze data including student grades and class registration history (Reed, 2016).

The University of Dayton continues to focus on ways to guarantee that they provide the appropriate opportunities for students to pursue their programs, graduate, and succeed after graduation. The University of Dayton analyzes data involving many aspects of student life including housing, dining, athletics, and financial status. Each of the correlating departments uses reports to detect factors or potential red flags contributing to student success and retention (Alteryx, 2016). The University of Dayton assigns a particular group in charge of monitoring for students at risks as determined by the data and they then find creative solutions for improvement through changes in the current processes. This group, the Student Success and Persistence Team (SSPT), focuses specifically on student retention in the sense of students returning for the second year and also completing a degree within six years. Through research, the University of Dayton found that students without a declared major pose a higher risk of transferring. With this information, they now offer a Freshman course titled "Discover Arts and Sciences." This class takes place two days per week. The teacher assistants for this course then become mentors for the attending students until they declare a major. As a result of this solution, the retention rate specifically for students between first and second years increased to 85.6 percent from 78.8 percent. This improvement took place over the course of 5 years (University of Dayton, 2016).

In an interview with Jason Reinoehl, the Vice President of Enrollment Management and Marketing at the University of Dayton, he discusses a two-step process for improving student retention. The first step requires creating a tool for risk assessment that includes any characteristics that may affect students. This process includes both quantitative and qualitative data. The quantitative details include data regarding income status, undecided majors, and distance of the school from home. The qualitative side addresses the actions taken by the faculty members regarding any concerning signs from high-risk students. The second step involves building an intervention process for the students that reflect risk. One such example, according to Reinoehl, happens when a student enrolls in too many challenging classes at the same time. Ideally, the advisor should address a concern with the student and ensure they know the level of difficulty that may come from this particular combination of courses (Reed, 2016).

According to Reinoehl, the ability to organize the data in a meaningful way and then visualize it through dashboards in real-time, allowed him to advocate for the need of increased funding in regards to student retention. Without this input from the data interpretation, this change in money allocation would not have been possible. As a result, the school focused on the first year students as mentioned above with the "Discover Arts and Sciences" program and student success continues to improve. Through the use of these tools, Alteryx and Tableau, as well as the creative strategies of a devoted team, the overall student retention rate has increased by 3 percent (Alteryx, 2016).

An example of how an institution uses data analytics to attract the best students comes from the University of Oregon. They use the SAS Enterprise Miner to determine how alterations in

financial aid packages, specifically award packages, attract the most qualified students. By using SAS predictive data analytics, they manipulated different scholarship packages to watch how this directly affects the students who apply. They found that a higher award package for students coming from out of state did not correlate to higher enrollment, however, offering an increased amount to qualified students coming from in state did attract these students. The data details they evaluated for this study included specifically first-year students who qualified for scholarships. They also determined that high school GPA data alone, which is what they were using for previous models, does not provide enough information for qualification of a merit package. By adding SAT score data to the model equation, they can now better determine the most qualified students. The exact process included logistical regression combined with neural network modeling. To attract the most qualified students, they increased first-year merit scholarship from \$2,000 to \$5,000 for students with the necessary criteria, which includes having a 3.8 High School GPA score and a SAT score above 1200 (SAS, 2016).

The University of California (UC) campuses also work to store and analyze useful data for student success. UC compares data analytics to preventative health. The proper indicators allow advisors to connect with students who are at risk of falling behind or are experiencing barriers that limit the probability of success. UC stresses that each student receives resources but not a label; the indicators of need do not reflect any stigma or intention of causing a student to feel called out for school related difficulties. The factors that they track mainly determine the expected timeframe to graduation. Robert Musial, a UC San Diego data scientist, created the statistical tool they use and it includes 250 categories related to graduation prospect. Many expected details contribute to student retention and completion of a program: good high school grades, good SAT scores, and graduation from a scholastically sound high school. However, the location of the University in regards to home also contributes to success. The reports show that living too close to home creates a distraction whereas living too far away leads to homesickness and longer trips home that interfere with school work and routines. UC has high graduation rates of 85 percent of students graduating within 6 years and 62 percent of students graduating within 4 years. UC believes the monitoring program they now use contributes to a continually improving graduation rate as they track student status and success (University of California, 2016).

6.3 Cost Reduction

Data transparency leads to fact-based decisions which provide the opportunity for cost reduction strategies. Lack of available revenue leads to budget cuts and a decrease in available programs. Higher Education institutions often experience a decrease in funding with the expectation to continue offering more. Cost reduction affects Higher Education leaders, stakeholders, and students. By integrating Business Intelligence(BI) tools these institutions then generate meaningful financial reports regarding the allocation of existing resources.

The cost of education includes much more than the obvious costs of professors, equipment, and supplies. Carnegie Mellon University found a way through data analytics for creating a substantial reduction in utility costs. Facilities management requires more than individual building sensors to decrease over usage of services. When measuring the need for electricity

and temperature control automatically, one obtains even more accurate results when all systems run together. Even with data collection of individual settings, the lack of a unified system limits the efficiency. For example, to keep a building at the desired temperature, both the air conditioning and heat may run at the same time. A smart system detects these idiocracies and tracks any issues that suggest future problems (Carnegie Mellon University, 2015).

This solution saves time when any repairs become necessary because the system already identifies the source of the problem therefore cutting out any research time and replacing it with a printed, detailed report. By integrating a unified system and incorporating the SoftLayer platform and TRIRIGA through IBM, Carnegie expects a decreased utility bill of 10% or 2 million dollars per year. This projection pays off the cost of the improvements in 2 years and then allows for many additional years of increased revenue for the school (Carnegie Mellon University, 2015).

Marist College found a way to save funds through the proper allocation of assets by delivering data analytics through the cloud which helped them save time and lower costs. Marist College already had a reputation for combining technology and education. However, they wanted to make this solution more widely available for students and teachers. Marist College already used the cloud, as a service, so IBM combined the previous cloud setup into the final IBM SmartCloud product. The software from IBM includes IBM Cognos® Business Intelligence version 8, IBM SPSS® Modeler, and IBM DB2® for Kunus among others. By using the cloud for providing analytics, the college saved \$350,000 in the area of the production environment (Marist College, 2012).

Marist College's main struggle originated from the increased amount of time members of their faculty team spent running BI systems before delivering any results. By investing in IBM BI tools, professors' schedules opened up to focus on teaching rather than providing IT support. Marist College also allows students access to the data on the cloud; regardless of the program focus. Marist College asked themselves many questions when selecting the appropriate BI tools, but the end results prove the benefits of centralized data analytics (Marist College, 2012).

The Miami-Dade County Public Schools found a way to use smart lighting to reduce energy consumption. Cisco's Digital Ceiling uses network powered over Ethernet for lighting, air-conditioning, and other facilities' systems. Tests show this technology to improve student productivity by 16 percent through lighting that mimics natural light. In one classroom, the use of energy dropped from 750 watts to 350 watts for a 50 percent savings. This solution proves to be effective because each light communicates with the others and determines appropriate settings regarding available light. Through an attempt to improve student focus throughout all times of the day, this school district also decreased power costs substantially (Cisco, 2016).

The Cisco Digital Ceiling works as follows; all buildings connect through a single IP network. This central Internet of Things (IoT) based network controls electricity usage as suggested above as well as other systems such as the security system and HVAC. The digital ceiling powers with the use of LED lights and works as the central connection site for additional

features through multiple sensors. The lights turn off and on based on presence detection and allow for communication through visual light such as different colors to act as an alert system across campuses. Temperature and carbon dioxide also interact with these sensors. Initially the Cisco Digital Ceiling responds only to current building status while collecting data, however, in the long-run, this data translates into valuable information for predictive analytics for a smart IoT system allowing for smarter, more comprehensive decision-making processes (Network World, 2016).

7.0 Conclusion

Business Intelligence benefits every industry and this value to business has an ongoing history. BI tools help organizations transform their data into interpretable and relevant information they can use to improve their business outcomes. Even though most industries are successfully using the use of Business Intelligence tools, there is a slower growth in the adoption of updated BI systems within the higher education industry. It is important for BI tools to be fully adopted by Higher Education Institutions because, now more than ever, these institutions are under a lot of pressure to deliver the best services under a shrinking budget and this is true especially for universities in the public sector within the United States. There are several issues that Higher education institutions always face that other organizations are addressing through the use of BI tools.

Through the review of case studies at many Universities across the nation, Business Intelligence tools, and the necessary knowledge to use these tools for creative planning and pulling fact-based reports prove to improve various issues drastically. One issue that Higher Education institutions address is that of data management and accessibility. Without a user-friendly database and easily visualized data, the other larger issues are left unresolved. However, with dashboards and fact-based reports, more members of the team can create reports and contribute personalized views and ideas for improvement. This solution creates a sense of ownership for all relevant staff and increases the opportunities for team collaboration.

Another issue that universities in the US address with well-managed data analytics are that of student retention. Multiple layers lead to improved retention of students, and a tracking system that catches early signs of decreased student satisfaction or risk of dropping out can reverse this pattern. Many education institutions now create dashboards to monitor variables that contribute to a lower student success level and then intervene whenever a risk factor presents itself in the student population. This monitoring allows students to receive help when needed and in turn, the increased student retention helps build stronger programs and attract more qualified students in the future.

An important issue for all higher education institutions comes from the budgeting process. Previously, financial advisors attempted to make long-term goals and budget changes without a clear picture of how this change would affect all other factors. This blind budgeting delayed the process because of lack of information. Therefore changes then took place only occasionally because opportunities remained unidentified. With the use of BI tools, these same institutions

now create several budget plans, automatically updating with the available data, and running reports to find areas for change. Budgeting offices can now focus on higher level demands while the system does the majority of the work regarding creating the reports. These higher education institutions are saving time, decreasing costs, and finding opportunities to keep tuition lower for their students.

Through this review of issues and available case studies, it is clear that Higher Education institutions cannot keep up with all of the demands of remaining successful businesses, from a financial standpoint for the success of their students, without well-managed data. This data must be accessible, it must have the necessary features for visualization that allow all relevant parties to weigh in on decisions, and it must drive the decision process for significant changes. Many changes have already taken place in regards to the way business intelligence tools influence this particular industry, but more progress needs to follow. With the right data warehouse and efficient data architecture, these available BI tools will shape the way universities create their programs and moreover educate the next generation of highly trained individuals.

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