

The Good, The Bad, What HBCUs Wish They Had: The Benefit of Data Warehouse Technology

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Abstract: In the middle of a technological revolution, we are working in a global market where organizations are all competing to survive. As these organizations try to develop strategies, many have determined that the solution is data. Planning, development, and implementation of data warehouses will provide the infrastructure for organizations to integrate decision support systems and business tools to generate reporting and data visualizations to assist in decision-making. Many organizations are taking advantage of this technology, but many are lagging; one example is Historical Black Colleges and Universities (HBCU). HBCUs serve a unique population of students that other institutions may not offer an opportunity to. Due to low enrollment and a harsh economy, many institutions struggle with recruitment and retention, and HBCUs struggle more than others. HBCUs lack the data warehouse and decision support systems as their peers. HBCUs would benefit in the area of retention and recruitment if given data warehouse and decision support system technology.

Keywords: Data warehouse, Decision support systems, Retention, Recruitment, HBCU

Introduction

System analysts and business decision-makers do modern-day data analysis and reporting with confidence in the data stored in data warehouses (DW). DW could store an enormous amount of data, making it capable of organizing unstructured and structured data from several internal and external data sources and generating information rapidly. DW creates an environment for the integration of data, which is ideal for business intelligence. According to Garani et al. (2019), the study mentions that business intelligence is a technology-driven process for collecting, integrating, analyzing, and presenting business information. DW is an essential component of business intelligence tools needed for reporting and data visualizations for analysis and decision-making. According to the National Center for Education Statistics (2020), the design of an efficient DW is based on the data sources, integration, and end-user requirements. Designing and implementing a DW requires a committee with the ability to develop standards and developers with the knowledge to create and maintain the infrastructure. Various organizations would profit from DW, but due to some circumstances, many organizations are not able to benefit from this technology. One example of an organization is Historical Black Colleges and Universities (HBCU).

Background

HBCUs are institutions are higher education with the goal of serving the African American communities. The

establishment of HBCUs was necessary because African Americans could not attend existing colleges and universities due to racial discrimination. With the first HBCU founded in 1837, many HBCUs were founded after the civil war and primarily located in the South. Prior to the Higher Education Act of 1965, HBCUs did not receive federal funding. Currently, there are over one hundred HBCUs in the United States, some remain two-year institutions, and many are four-year institutions. While some stayed focused on specific vocations, many have developed into major research institutions.

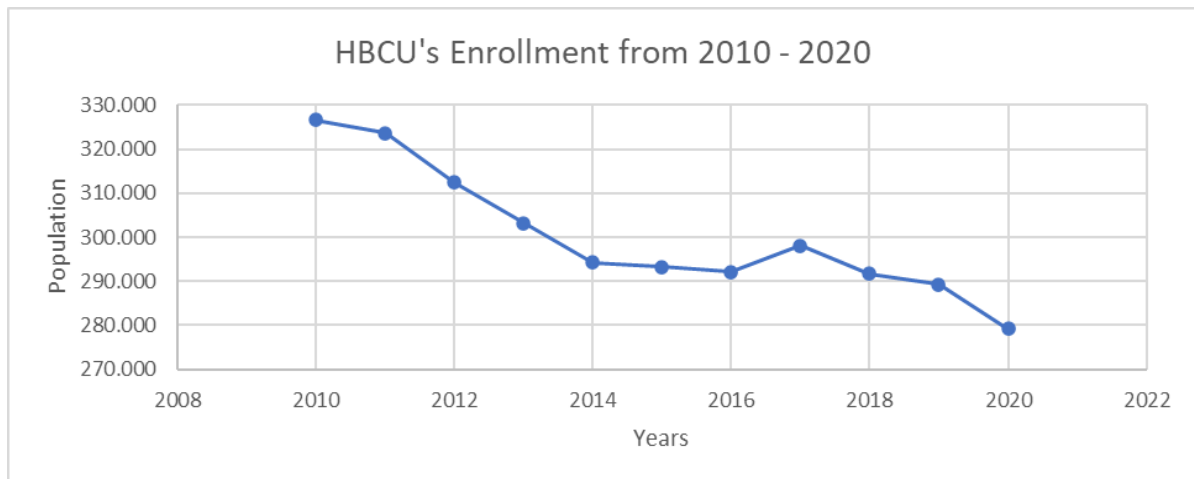


Figure 1. HBCU Enrollment Between 2010 – 2020 (Source: Digest of Education Statistics, 2021)

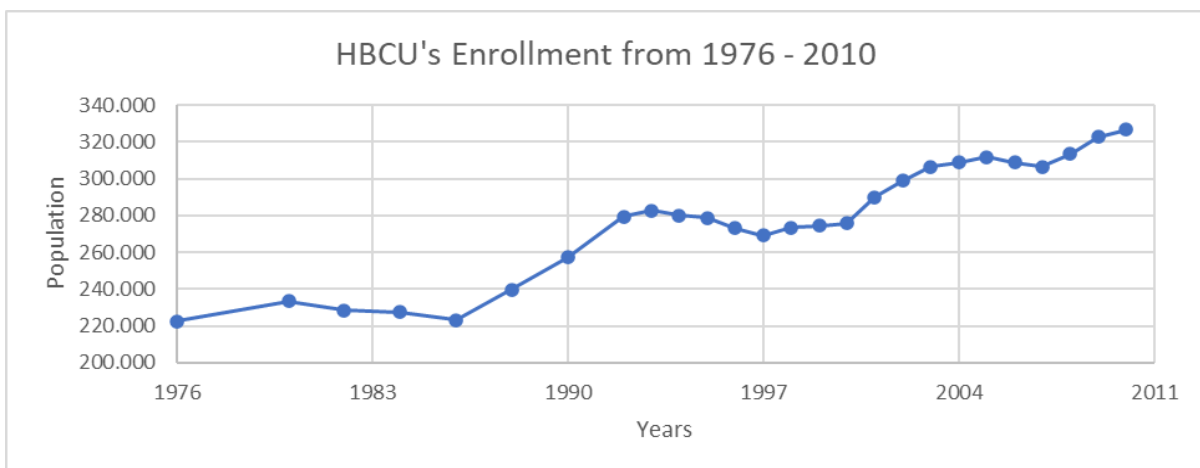


Figure 2. HBCU Enrollment Between 1976 – 2010 (Source: Digest of Education Statistics, 2021)

According to a 2020 National Center for Education Statistics report, HBCU enrollment increased by 47 percent from 1976 to 2010, but from 2010 to 2020, the enrollment dropped by 15 percent (See Figures 1 and 2). This is compared to all institutions' enrollment increased by 91 percent from 1976 to 2010, and between 2010 to 2020, enrollment only dropped 10 percent. According to Oancea, Dragoescu, and Ciucu (2013), preventing students from dropping out of school is a high priority for colleges and universities. Due to the decrease in enrollment, one of the serious issues for HBCUs is retention.

The retention rate for colleges and universities is the percentage of students retained over enrollment. HBCUs'

mission is to educate all students, producing a wide variety of students. There are many considerations that cause a low retention rate at the majority of HBCUs. According to a 2014 report from the United Negro College Fund (UNCF) on Understanding HBCU Retention and Completion, there are many pre-college factors that play a part in students successfully completing their higher education degree. These factors contribute to students' experiences before college being equal to their experiences during college.

Socioeconomic

Students that attend HBCUs come from a lower socioeconomic environment than their counterparts at non-HBCUs. This type of environment makes it difficult for recruitment at HBCUs. Research by Magolda and Astin (1993) supports that students with a lower socioeconomic status compared to their peers are likely to have little aspirations toward education, are less likely to attend college, and have less persistence to earn a degree. Elements such as low income and high tuition are leading sponsors to this situation. Another factor that contributes to the retention rate at HBCUs is the academic background of students.

Due to the lower socioeconomic, students are coming to college under-prepared because of the low level of elementary, middle, and high school preparation. This lack of preparation makes students score poorly on standardized tests, which causes discouragement. These same students also lack a support system. Many students do not come from a traditional household; parents work multiple jobs, students have parental duties for their siblings, and generally are first-generation college students.

The Reason for HBCUs

There is a need for HBCUs for these subsets of students to have the opportunity to earn a college degree. According to Zigerell (2020), African Americans have lower than average test scores than White Americans, and only 41% of United States adults are aware of the gap in these test score averages. Due to low standardized test scores and high-test score requirements for non-HBCU institutions, these students would not have the chance to prove their ability to compete without HBCUs. Research by Swail, Redd, and Perna (2003) provides evidence that minority students could complete rigorous programs if given a chance, even if standardized test scores are lower than their peers. While HBCUs count for 3% of all the colleges and universities in the United States, they produce the following:

- 14% of the total number of African American college graduate degrees
- 25% of African American STEM bachelor's degrees
- 50% of African American teaching degrees
- 50% of all African American female STEM PhDs
- 70% of African American medical and dentistry degrees

According to Toldson et al. (2021), HBCUs accept a diverse background of students with various levels of pre-college academic training but are more likely to earn degrees in a STEM discipline. All these African American

graduates and professions will be lost if HBCUs cannot increase their retention rate.

Data Warehouse

A solution for interrupting the decline in retention rate is providing resources and assistance to students. Proper advising and guidance are essential to the success of a collegiate student, which is usually done by early prediction. Early prediction refers to the forecasting of historical datasets for the likelihood of a particular outcome. Creating predictive models would be effective to address the declining retention rate at HBCUs. According to Tryfona, Busborg, and Christiansen (1999), the goal of a model is to improve the concept the model represents, encouraging the delivery and acceptance of the system information to its users, use a guide or reference to developers and provide documentation on the system. These models can help determine what key factors are impacting students and causing a negative effect on retention rate. As Alkhasawneh (2011) mentions, identifying at-risk first-year students and developing intervention programs can enhance student performance, and improve retention, thus generating student success. The success of these models is reflected by the data provided, strongly suggesting the need for a DW.

According to Garani et al. (2019), DW is a central repository where data from several data sources are collected and stored. The benefits of having a DW are the removal of multi-databases and the improvement of the transmission of information. This repository allows data analysis to happen in a more effective and efficient way. Business and System Analysts can access reports that were not capable when the data was not centralized. DW also allows business intelligence tools to connect to one source to improve an organization's operations. Decision Support Systems (DSS) examine through and analyze the data stored in a DW. Models are created to take the data that can produce comprehensive information. This information is used to solve problems at an organization while increasing and improving decision-making.

Strategy

Data Warehouse Strategy (DWS) is centralized on a streamlined process for internalizing and managing data from varied sources to provide constructive business insights. According to Rifaie, Alhaji, and Ridley (2009), developing DWS processes to develop data repositories for efficient reporting and DSS is equally as important as maintaining the quality of the DW. A DW consists of a database, ETL, metadata, and access tools. The database is the foundation because all the data resides in it. The ETL (extract, transform, load) is the integration. This process retrieves the data from all its sources, converts the data into the correct format, and inserts the data into the database. Metadata is the data about the data. It describes how to access the data, and provides access tools, which give the users the ability to access the data in the data warehouse. These tools can vary from SQL queries to OLAP tools.

Decision Support Systems Strategy (DSSS) allows users to interact with information systems that analyze large volumes of data for informing business decisions. Akhloufi et al. (2022) suggest that DSSS can link several data sources, such as data, rules, and guidelines, to improve decision-making. DSS integrates with DW giving it the

ability to access a large amount of data. According to Miklosik and Evans (2020), intelligence systems will use models to make decisions by analyzing data with little human interaction. Data-driven DSS access manipulates a large amount of structured data. Model-driven DSS models are designed by analytical tools to perform complex analyses of data. Knowledge-driven DSS provides specialized outcomes based on a particular problem. Document-driven DSS retrieves and analyzes documents. Communication-driven DSS analyzes data but focuses on communicating and collaborating with a team for decision-making.

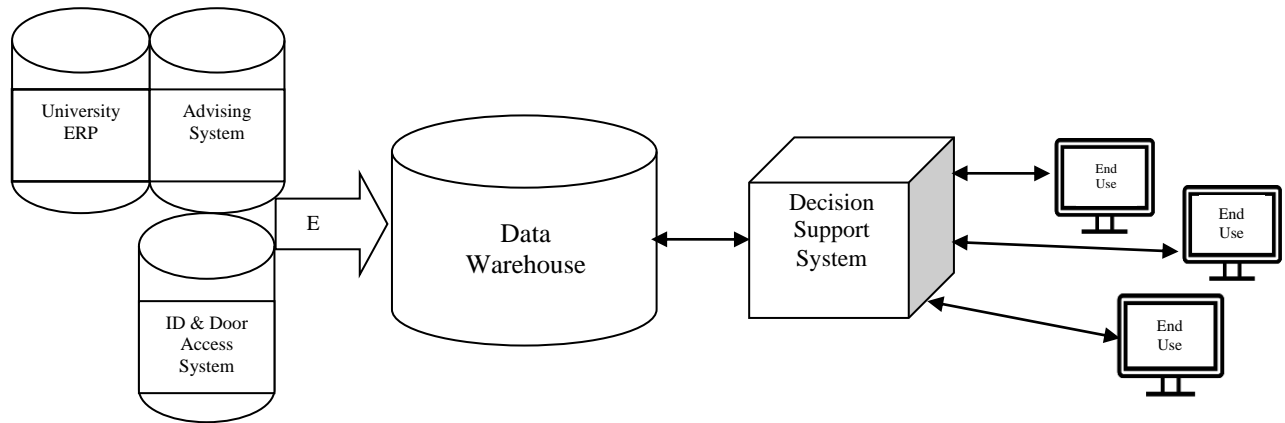


Figure 3. University Data Warehouse and Decision System Architecture

Having a DW and DSS strategy can improve any type of organization. DW strategy has more advantages than disadvantages. Having all the data in one source versus several sources has a Speedy Data Retrieval, which in return creates a faster decision-making process. Kurpanik (2017) mentions that today decision-making is done by specialized computer systems which analyze data collected and stored in a centralized location. One central location allows for the data to be structured and allow easy integration, multiple data sources and structured and unstructured data are almost impossible to fully integrate.

To keep the DW effective and efficient, maintenance is required, which can be costly at times. Just like DW, DSS has its advantages and disadvantages. Integrating the DSS into the DW allows overall improved efficiency. Having complete and structured data allows the DSS to process the information faster and more dependably, which increases decision-making. An issue that may occur is information overload. This is caused by information systems deliberate all pieces of the problem.

Benefits of Data Warehouse

HBCUs are institutions of higher learning, and their main focus is to educate students; however, the university is also a business as well. Even when the semesters are over, the university is still open and operating. Some examples are the office of auxiliary services which manages non-academic entities of the university and property management which manages the investment properties that the university owns. Since education is the primary focus of a university and the DW and DSS are important to the recruitment and retention of students,

the admission office becomes an essential department as it is responsible for the recruitment of students for the university.

The students are the lifeline of the university and are needed in order for the doors to stay open. Research by Vohra Das (2011) supports that the decision process is not a single task rather it can be defined as a collection of correlated tasks that include: gathering, interpreting, and exchanging information; creating and identifying scenarios choosing among alternatives and implementing and monitoring a choice. The admission office can use a DW in several ways to improve and increase the number of students admitted to the university. Collecting data on students who were “accepted and attended” can hold valuable information on what did work. Collecting data on students who were “accepted and did not attend” can hold valuable information on what did not work. Data from these data sources can be analyzed and used on the data collected for prospective students. Collecting this data on students and storing it in a DW, will allow DSS to analyze the successes and failures of the university, providing the opportunity to make decisions to improve the recruitment process and increase enrollment.

Once the students attend the university, the goal is to keep students. The retention of students has two major roles, keeping the number of students needed so that the university can operate in the black and keep the university at a high rating. According to Linden (2021), collecting a combination of student data and upload into a centralized system improves monitoring and assessment. DW can collect current student data, data from the student advisement system, data from the electronic attendance system, and the ID card and door access system (See Figure 3). Once all this data is centralized in the DW, DSS can be used to help students before it is too late. For example, early alerts can be sent to advisors and department chairs to provide students with the necessary help to finish the semester successfully. Also, student grades can be compared to historical student data to correctly advise students in their major or direct students to a major that will fit them.

Conclusion

DW provides the ability to integrate tools to identify and retrieve information from every data type and data source, including structured data, found in databases, as well as unstructured data that comes in a variety of file formats, such as social media posts, email, chats, and Internet of Things (IoT) sensor data. The ability to integrate business tools gives organizations the equipment needs to stay competitive. The flexibility also allows for improvement in recruitment and retention.

Planning and developing a DW provide several advantages versus having data stored in several different systems and trying to access them all. Predictive models provide the layout and interaction between the entities and give information to both users and developers of the system. HBCUs c improves than their recruitment and retention by developing and alignment between their business plan and DW to provide the highest competitive outcomes and services. Academics and other departments can improve their processes and procedures by the alignment of their business plan and the flexibility of their data warehouse. This technique allows the data analysis of millions of rows of data from several data sources to improve operations and student success and satisfaction.

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