

**DATA-INFORMED DECISION-MAKING:
DESIGNING A DECISION SUPPORT SYSTEM FOR COLLEGE
LEADERSHIP**

by

Rachel A. Mroz

An education leadership portfolio submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Education in Educational Leadership

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ABSTRACT

Having access to accurate and reliable data is essential in decision-making. A wealth of data is spread across the University of Delaware (UD). These data include, but are not limited to, financial information, budget information, student enrollment, credit hours taught, and numerous metrics about faculty, staff, and sponsored programs. These data are mined from various resources on campus, including PeopleSoft, Cognos, the Central Analytics Platform, and individual data sets kept on administrator computers. In the College of Education and Human Development (CEHD) at UD, the dean, chairs, and directors of college departments often lack convenient access to consistent and reliable metrics related to faculty, staff, students, sponsored programs, and finances to aid in their decision making or answer general inquiries. If leaders can have more convenient access to these data, combined with their professional judgment, experience, and theory, they may be able to make more informed decisions for their units.

This Education Leadership Portfolio (ELP) provides an evidence-based solution in the design, development, and deployment of a decision support system (DSS) solution to address the problem of access to data to inform decision-making. To develop a solution to the identified problem, surveys and interviews were conducted to understand end-user needs. Results of the research conducted for this ELP suggest that

CEHD leaders want and need access to data. The research also suggested that a DSS is a desired approach to getting access to data. Using those data, the first version of the CEHD decision support system (CEHD-DSS) was designed, developed, and deployed as a case study. Materials including a CEHD-DSS User Manual, a Budget Support Handbook, a data inventory, and a frequently asked questions document were developed to provide users with resources to navigate and use the data provided by the CEHD-DSS.

Chapter 1

INTRODUCTION

Leaders in every industry make numerous decisions every day. While some are trivial, others may dictate the fate of their organization. Higher education is no different. Higher education leaders decide how large an incoming class should be, what tuition rates should be, how many new faculty can be hired, what new buildings to develop, and how to allocate funds across the organization. At the college and department levels, deans and chairpersons make decisions to ensure student and faculty success, raise donations from alumni, evaluate existing programs, and investigate new programs.

The requests for data in higher education seem to increase exponentially every year (Williamson, 2018). Some of the requests are internal. How many students are in a particular major? How many faculty are in a department? How is the department spending its funds? How much has our research portfolio grown in the past five years? Pressure from internal and external stakeholders adds to the need for data. Prospective students (and their parents), lawmakers, donors, rating agencies, and others often seek data to inform their decision to support a particular college or university. What are the graduation rates for specific majors? How successful are graduates in finding jobs in their desired fields? What is the financial health of the institution? What financial aid

can the institution provide? Answers to these questions require reliable, up-to-date, and accessible data.

While data are becoming more widely demanded in higher education, their use is not as systematic as one would presume (Green et al., 2011; Siemens & Long, 2011). Intuition, anecdotes, and traditions have long been staples in decision making in higher education. While relying on instinct is typical human nature, such an approach can lead to groupthink, a failure to see alternative solutions, and missed opportunities (Bonabeau, 2003). Campbell and Oblinger (2007) argue that decision makers need to use data in higher education to identify trends and test potential solutions to problems and that intuition is not sufficient for important decisions. A 2011 *Inside Higher Ed* survey found that only 36% of college presidents and 31% of provosts said their institutions were very effective at using data to inform decision-making (Green et al., 2011). In the 2017 American College President study, only 11% of college presidents ranked using data to inform decision-making in their top five concerns for the future (Gagliardi et al., 2018).

Current trends in higher education have long been in the making. Nearly 20 years ago, Goldstein and colleagues (2003) described the then-current state of higher education: decreasing enrollments, lower state support, increasing financial aid, and other pressures facing the industry. Twenty years later, the headlines are similar. We see downward trends, whether from a global pandemic, political pressure to document the value of higher education, shifting student demographics, and the rising costs of post-secondary education pricing many out of the market (Daniel, 2015; Sharvashidze

et al., 2023). Higher education in the United States was sharply criticized in the 2006 Spellings Commission Report as failing to respond to globalization pressures, changing technology, changes in demographics, and significant changes in the higher education marketplace (Miller et al., 2006). With enrollment and retention pressures, leaders in higher education must react quickly -- not a trait they are typically known for.

Access to reliable, up-to-date, and accessible data could be essential in decision-making, but reviewing data is easier said than done. Chairs and directors of academic units and centers may lack convenient access to data about faculty, staff, students, and budgets to aid in their decision-making, answer general inquiries, or add to marketing materials. At the University of Delaware (UD), leaders, business officers, and financial analysts are often forced to search several data sources or reach out to multiple people to get the data they need to help inform their decisions. To deal with this reality, leaders create their own workarounds. In many cases, the data they use are housed on individual computers and nearly impossible for others to access. Unfortunately, in too many cases, the data do not exist in formats that allow easy reporting.

A system capable of on-demand data access would allow leaders in UD's College of Education and Human Development (CEHD) to access data to inform their decision making. While having this type of reporting system seems like a simple ask in 2023, literature (Campbell & Oblinger, 2007; Mandinach et al., 2015; Modh et al., 2010) has suggested that higher education has been slow to adopt these types of

systems for a myriad of reasons. Furthermore, institutions that have adopted systems have experienced multiple barriers in the design, implementation, adoption, and use of these systems. Mandinach and colleagues (2015) describe the skepticism of focusing on data and that educators are often concerned about how those data will be used. Their experiences can inform ours as we move forward.

As CEHD's Senior Business Officer, part of my job is providing data to CEHD and UD leadership to make decisions. These data include many distinct types: financial, budget, student enrollment, credit hours taught, sponsored programs, and faculty and staff metrics. These data are stored in multiple resources on campus, including PeopleSoft (a university enterprise resource planning system), Cognos (a data reporting system), the Central Analytics Platform, and shadow systems kept on individual desktops. For example, suppose a unit wants student enrollment combined with courses taken by those students and data for the revenue generated by those students. In that case, multiple queries must be run from three different data sources, and then complex Excel formulas must be written to merge and analyze the data. This process is time consuming, and the information retrieval and subsequent analysis may be delayed depending on staff members' available time. Furthermore, the data analysis may be flawed depending on the users' knowledge of the data.

This Education Leadership Portfolio focuses on providing data access to CEHD leadership through a dynamic cloud-based decision support system (DSS) that will allow Chairs and Directors to log in to a secure site and select the data they want to use to inform decisions for their units. The target users of the DSS are the dean of

the college, two academic unit leaders, and the directors of the research and service centers in CEHD. My role as CEHD's Senior Business Officer allows me access to the data, access to the tools to address the problem, and networks of individuals across UD and at other institutions of higher education to assist in developing solutions to address the problem. As I report directly to the CEHD dean, this ELP is significant to that individual. The dean regularly relies on me to be able to provide data. Having a DSS will allow the dean on-demand data access. The DSS aims to be user-friendly, contain relevant and current information, and be available on demand.

There are several easily identified benefits to implementing a DSS in CEHD. Benefits include improved access to data, the ability to quickly identify trends in data by using visualizations, incorporating new data and creating relationships across data sources, housing multiple data sets in one location improves efficiency, and providing on-demand access to previously unavailable data to CEHD leaders. If these benefits are realized in the CEHD-DSS, there may be an opportunity to improve decision making across the institution.

Throughout this document, I refer to *data-informed* decision-making. This implies that the proposed DSS and data contained in the DSS are not the only inputs in the decision-making process. There are numerous factors to be considered that are not necessarily reflected in the data. Because of this issue, I will use the term *data-informed* decision-making instead of *data-driven* decision making.

The following chapters and appendices document the approaches taken to implement a DSS in CEHD to address the problem that too few leaders in CEHD have

consistent access to reliable, up-to-date data to inform their decisions. Understanding the current landscape of data usage in higher education and learning about the needs of the CEHD end users informed my design, development, and deployment of the CEHD-DSS. In addition, I developed resources, including a budget support handbook, a CEHD-DSS User Guide, and a frequently asked questions document to support the end user. Chapter 2 explores the problem in detail, including my organizational role and context. Chapter 3 provides an in-depth review of the improvement strategies and the theory of change that I used to guide this work. Chapter 4 describes the improvement strategies' results and the improvement goal's implementation. Chapter 5 reflects on the outcomes of the improvement strategies and if the intended goals were achieved. Finally, Chapter 6 is a reflection of my growth as a leader, partner, and scholar as they relate to my pursuit of the Ed.D.

Chapter 2

PROBLEM ADDRESSED

Data are used for a variety of purposes in higher education. Learning analytics data may lead to improved interventions to support student success. Academic analytics may help an institution pivot resource allocations to meet changing student demographics or meet the demands of the workforce that their students will be entering. Data may be used to inform education leaders on the need to implement a new curriculum or revise existing curriculum to better meet the needs of students. Data may be used to better predict attributes of incoming classes or how to recruit diverse students.

To use data to address those issues, leaders must first gain access to those data. At UD, data access is challenging. Data are not located in an easily accessible system for leaders to quickly find what they need. This ELP aims to provide leaders in CEHD with the data needed to begin to address the issues they face.

Organizational Context

The University of Delaware (UD) is an institution of higher education located in Newark, Delaware, in the mid-Atlantic region of the United States. In Fall 2022, UD had an undergraduate enrollment of 18,618 and a graduate enrollment of 4,285

(“UD Facts & Figures,” n.d.). UD includes 10 academic colleges, including CEHD, the college where I have worked for over five years.

On paper, CEHD may appear to be a small college; compared to other UD Colleges, it is. However, with two academic departments and multiple research and service centers, the college is far more complex than its size suggests. CEHD houses the School of Education (SOE), the academic department of Human Development and Family Sciences (HDFS), multiple research, education, and service centers, and three children’s learning centers. The complexity of CEHD is highlighted in the organizational chart (Figure 1).

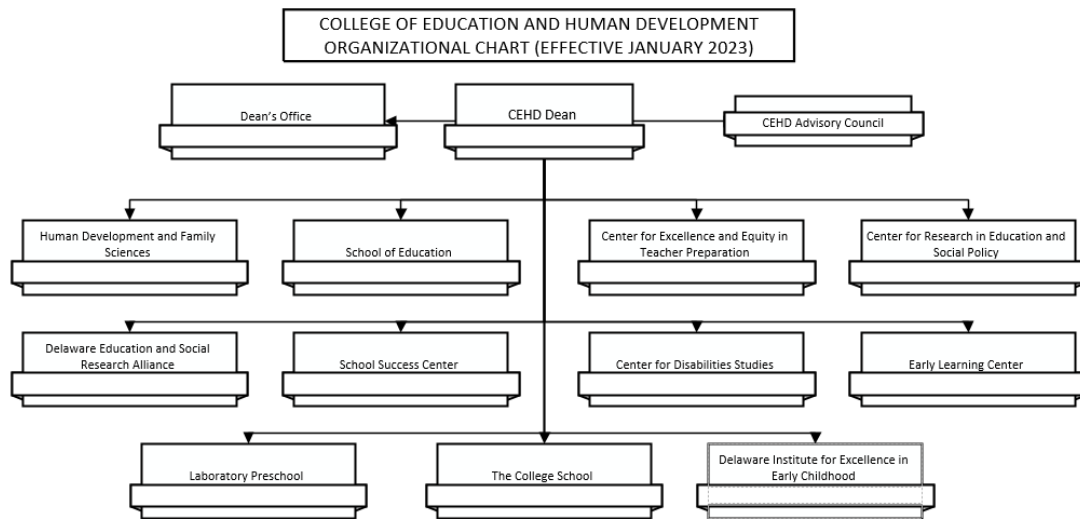


Figure 1 University of Delaware College of Education and Human Development Organizational Chart

The college has an all-funds budget (FY2022) of \$53 million. This budget includes the base budget (\$20M), sponsored programs (\$26M), state restricted funds (\$3M), gifts & endowments (\$600k), self-supporting operations (\$3M), and other funds (\$400k). In FY2022, CEHD had an average of 320 full-time benefitted employees and over 250 part-time employees. In the fall of 2022, CEHD had five undergraduate majors and six minors serving approximately 1,004 undergraduate students (“UD Facts & Figures,” n.d.). CEHD has 12 graduate programs serving 384 (Fall 2022) graduate students (“UD Facts & Figures,” n.d.). CEHD has a robust sponsored programs portfolio with over 60 unique researchers (e.g., faculty, staff) who receive funding from various sponsors, including the U.S. federal government, the State of Delaware, industry partners, and foundations. Sponsored program expenditures have averaged approximately \$26 million annually over the past three fiscal years (FY). There are currently 89 faculty members in the college between the two academic departments. The SOE has one of the largest faculties on campus when compared to other departments at UD.

This organizational context is essential to understand in how it relates to the problem I engaged with for this ELP. Unit leaders often need to know enrollments, sponsored program activity, budget balances, and personnel information and then use these data to inform their decision-making. These data are essential for a number of reasons including successfully managing their unit budgets. To understand how these data are connected to the budget, I will next provide an overview of the budget models of UD.

A Brief History of Budget Models at UD

College financial decisions are part of the larger system of UD finances. UD budget models have taken different formats whether centralized, decentralized, or a hybrid of centralized and decentralized. Over the 26 years that I have been at UD, I have seen three primary budget models: block budgeting, responsibility-based budgeting (RBB), and the most recent, a hybrid of RBB and block budgeting called the UD Budget Model (UDBM).

Block budgeting, a form of incremental budgeting, was by far the simplest model. This was a highly predictable budget model in place from 1998-2008. Colleges simply received the same funding as the previous year save for incremental increases in salary (merit, structural) and new position funding if approved by the provost. Data needs were not very intense, as most of the variables were managed by UD central administration. Printed reports were delivered monthly, and specialized, custom reports could be requested through a central office. Colleges built financial reserves based on how much they underspent their block based on vacant positions or underspending other funds (e.g., travel, supply).

Responsibility-based budgeting (RBB), implemented in 2008, was a significant shift in UD's budgeting philosophy. RBB was designed to incentivize UD colleges to grow programs and increase sponsored activity. Under RBB, revenues and expenses were distributed through 18 algorithms. These algorithms were based on student headcounts, credits taught, assignable square footage, faculty/staff headcounts, sponsored program activity, and building occupancy. College data needs increased

exponentially for colleges, and many standard reports were written by central administration for average users. College Business Officers were given “super-user” status to create queries and download data in PeopleSoft and Cognos. While there was less predictability in RBB compared to block budgeting, the structure of the model allowed colleges to know their resources and plan for the upcoming year since resource distribution was based on past data. Under RBB, many colleges were able to accumulate financial reserves to fund new college initiatives. While colleges were by and large successful under RBB, UD central administration was limited in building reserves and having funds to develop and implement strategic initiatives. As such, they looked to develop a new budget model.

After engaging multiple University stakeholders for two years of planning, in FY2020, the University of Delaware Budget Model (UDBM) was implemented. The UDBM is the budget model in place at the time of the writing of this document. UDBM is often described as a hybrid model utilizing elements of both centralized (block budgeting) and decentralized (RBB) budget models. According to the UDBM Paper, the purpose of the model is to “provide transparency, clarity, and predictability at all levels” (“University of Delaware Budget Model,” 2021, p. 28). The following sections provide more details of resource distribution in the UDBM.

Resource Distribution Under the UDBM

In this model, each college begins with a predictable base which is calculated from FY2017 base budget activity. The base budget is the primary operational budget of the academic units. The predictable base is distributed by the UD Budget Office at

the beginning of the fiscal year. All current fiscal year metrics such as undergraduate tuition, graduate tuition, special session tuition, and indirect costs are compared to the FY2017 base year. The difference in metrics (e.g., credits taught, student head counts) since FY2017 is called incremental growth or incremental change. Revenues are distributed based on incremental growth in enrollments and credits taught over FY2017, less a 50% revenue share on the incremental growth. Revenues are shared with central administration, but all expenses related to the incremental growth are borne by the college. Facilities and Administrative (F&A) recovery from sponsored program activity is also distributed using the incremental mechanism less 50% revenue share which supports central activities.

Resource distribution under UDBM is complex and is primarily dependent on student credit hours taught and student enrollments. Before any resources are distributed to colleges, the Associate of Arts program revenue, continuing education revenue, and financial aid are subtracted from the total UD undergraduate revenues. Once those adjustments are made, a per-credit amount is calculated for undergraduate revenue distribution purposes. Revenues are then divided based on enrollment growth and an inflation factor to account for tuition price increases. There are four algorithms for resource distribution in the UDBM: undergraduate headcount and credits taught; graduate credits taught; special session (winter/summer) credits taught; and F&A recovery. Of the four resource distribution algorithms in the UDBM, only one (F&A recovery) does not rely on student metrics.

If enrollments and credit hours have increased as compared to FY2017, the college receives more resources. If enrollments and credits taught have decreased as compared to FY2017, the college must reduce expenses or college reserves must cover any shortfall. Colleges do not know their final resources until the end of the current fiscal year. This leads to challenges in planning how to utilize resources since it is unknown how much the college will have to spend. Mid-year changes to the model can cause large fluctuations in available resources.

Figure 2 summarizes the CEHD’s UDBM metrics and the incremental growth from FY2017 to FY2022.

Metric	FY2017	FY2022	Incremental Growth
Undergraduate Enrollment	880.6	904.3	24
Undergraduate credits taught	13,717	13,634	-83
Graduate credits taught	5,544	6,768	1,224
Facilities & Administrative (Indirect Costs)	\$3,110,741	\$3,784,192	\$673,451

Figure 2 CEHD Metrics and Incremental Growth in the UD Budget Model

Incremental growth in CEHD can be attributed to several factors. Growth in undergraduate programs can be traced to annual increases in enrollments in both the Elementary Teacher Education program and the Early Childhood Education program. In FY2020 (fall 2019), the Associate of Arts program was expanded to add a Wilmington program. In FY2019 (Fall 2018), HDFS started the Human Relations Administration major. Despite modest growth in the enrollment of these two

programs, the incremental change in credits taught has declined. It is not clear why there is a decrease in credits taught.

Growth in CEHD graduate programs comes from the introduction of several new programs from FY2018 to FY2022. In FY2018, SOE introduced the online Master's in Literacy and the Master's in Exceptional Children and Youth programs. In FY2019, HDFS started the Master's in Early Childhood Development and Programming. In FY2020, SOE started the Educational Statistics and Research Methods Ph.D. program. In addition to the new programs, in FY2020, the Teaching English as a Second Language Master's program was expanded under an agreement with Hunan Normal University in China significantly increasing the program's enrollment.

Growth in the CEHD research portfolio, and the resulting increase in F&A, is attributed to the effort to recruit experienced and promising researchers in both SOE and HDFS. From FY2017 to FY2022, there has not only been an increase in the number of active awards, but there has also been an increase in the number of federal awards carrying the highest F&A rate. The combination of more active researchers, more federal awards, and the higher F&A rate has led to a nearly 22% increase in F&A generated in CEHD.

While the growth in academic programs and F&A is desirable for CEHD, under the UDBM, only 50% of the resulting revenues are available to the college. In the case of undergraduate growth, there are other factors, beyond the 50% revenue share, that have contributed to the per credit dollar amount remaining flat since FY17.

In FY2017, the value of a credit taught was \$675 and in FY2022, despite growth University-wide, the value of a credit taught is \$672. This is primarily due to the marked increase in financial aid (a 93% increase since FY2017) which is deducted from total UD revenues before calculating the per credit rate. To reduce confusion, the per-credit rate does not reflect the rate students pay to the University, rather the discounted rate for the revenues distributed to colleges in the budget model.

The Need for Data in the UDBM

While the UDBM Paper identifies a goal of predictability, this has not yet been achieved (“University of Delaware Budget Model,” 2021). Data needs have increased substantially to develop college-level models to assist the dean and department leaders with making decisions in the UDBM. UDBM’s complexity requires business officers to navigate complex relationships between data sets to advise their dean and unit leaders on strategies. For example, the distribution of student tuition revenue requires knowledge of student headcounts by major, credits taught at the instructor level, and credits taught at the course ownership level to assign revenue to a specific unit. Distribution of F&A revenue requires data on the researchers who generated the revenue and how much they generated. Once this information is known, data must then be compared to the FY2017 data to determine what revenue will flow to the colleges.

In addition to UDBM’s complexity, the roll-out has not been smooth. UDBM is being implemented using Excel which relies on individuals in the Budget Office to input data. This has led to multiple errors that require business officers in each college

to reconcile reports. For example, I discovered one Budget Office formula error that led to a \$1.1 million swing in CEHD's projected year-end financial outcome. Business officers like me must reconcile the model each time a new iteration is released.

While UD's Office of Institutional Research and Effectiveness (UD-IRE) is working to develop data sets for colleges to use to navigate the UDBM, these solutions may be years away. Colleges need the information now to develop strategies to succeed in the UDBM. The model has evolved over the three years it has been implemented (including several mid-year changes), causing additional complexity in developing strategies to be successful. What has not changed, though, are the primary metrics used to distribute resources: student enrollments, academic credits taught, and F&A generated. Consistent access to these metrics, the primary focus of the CHED-DSS, strengthens my ability to adapt quickly to changes in the model and provide CEHD leadership with necessary data.

In addition to the UDBM, there has been an increased focus on the all-funds budget. The all-funds budget includes the base budget, reserves, self-supporting operations (i.e., units that require revenue generation to cover expenses), gifts, endowments, restricted state funds, and sponsored program funds. Colleges are being scrutinized for the amounts they are holding in reserves, gifts, faculty start-ups, and endowments. Bringing these financial data into the DSS would bring more explicit awareness of the balances to the unit decision-makers to better utilize the funds more strategically.

Data Sources at UD

Both the UDBM and the strategic use of all other available funds require attention to data. At UD, data are housed in multiple systems and locations. This lack of centralized data creates a problem when leaders need to summarize and use data. Financial data are housed in one system, human resources data in another, and student information data in yet another. Bringing together these different data sources is cumbersome.

Most employees can easily request access to UDataGlance, which is a homegrown Internet program that allows quick access to financial data. This system is like a personal bank account where users can click on the account they want to view and then examine the transactions. While this system is excellent for getting information quickly, it is limited when needing to view data for multiple units or downloading large datasets for analysis. There are a few pre-written reports available to specific users within the program, but UDataGlance is limited in usefulness for leaders.

PeopleSoft is UD's current enterprise resource planning (ERP) software. The PeopleSoft ERP is a centralized system and includes modules for financials, contract and grant management, human resources, asset management, and student financials. Within the PeopleSoft ERP is a query tool that allows users to run queries to obtain data. I often use the PeopleSoft query tool to download large sets of both financial and human resources data. Multiple years of data can be queried at once, making it a highly efficient tool. Writing ad hoc queries, however, is not intuitive. Multiple tables must often be linked to obtain the necessary fields, or multiple queries run and then

combined to answer the questions. Data are downloaded as Excel files making them easy to analyze and import into data visualization tools like Tableau or Power BI.

While the PeopleSoft ERP has some very useful functions, it will be replaced (successor yet to be determined) within the next 10 years, which will require a new solution to retrieve these data.

Cognos is an IBM Business Intelligence software package also available to me. Cognos is a data repository system that includes financial data, sponsored programs data, student data, and human resources data. I use Cognos to download student data (e.g., enrollments, schedule of classes, credits taken, and graduation rates) and sponsored program information (e.g., proposals submitted, award attributes). To say that Cognos is not user-friendly is an understatement, and due to its complexity in developing custom reports, I tend only to run pre-written reports. UD is starting to sunset Cognos, meaning these data also will need to be made available in another platform for users.

VGER is the recently released central analytic platform powered by Tableau. VGER, a Star Trek reference, allows users to explore data and export to Excel. VGER is bringing multiple data sources (referred to as data models) together to create reports for select users. These data models are imported into VGER by centralized personnel according to an established schedule. These data come from the largest systems on campus including PeopleSoft Human Resources, PeopleSoft Financials, UDSIS, and UD Slate. Due to license costs, the VGER and Tableau systems are not available as widely as other data sources.

Finally, data are often stored individually at the user or department level. These data are maintained by individual users who either do not have access to system data, do not know that the data are in a central system, or recognize that data are not stored centrally.

Decision Support System Tools

Without the proper tools, the vision of providing transparent access to data to CEHD leaders cannot be realized. The UD provides three primary tools for me to use to design and implement the DSS: Excel, Power BI, and Tableau.

The most fundamental is Excel, a Microsoft product, widely available to all UD employees. Excel is a standard financial analysis tool capable of producing a DSS, yet this option would require significant maintenance and be a cumbersome way to pull together multiple data sources. I envisioned that Excel would have a role in the CEHD-DSS to collect and upload certain data but would not be used as the data visualization tool for the CEHD-DSS. The second option for CEHD-DSS creation was Power BI. Power BI is a Microsoft product that ramps up the data visualization capabilities found in Excel and combines it with the financial analysis of Excel but is not widely used on UD's campus. If not for UD implementing Tableau (discussed next), Power BI would have been a logical option for the CEHD-DSS.

The third and most robust tool available to me to design and develop the CEHD-DSS is Tableau. Tableau, a powerful data visualization program recently implemented at UD as part of the Central Analytic Platform (CAP), utilizes published data sources to analyze data and create visualizations. Tableau's drag-and-drop

interface makes DSS report design more user-friendly and intuitive. The introduction of the CAP allows multiple data sources to be housed in one location and easily updated by data stewards. Once the data connections are made within Tableau, certain Tableau license holders can create relationships between data sets allowing for a very comprehensive analysis of available data. The rollout of Tableau Creator and Explorer licenses has been limited, but I have been granted a Creator license which allows me to create the CEHD-DSS and upload data that is not yet in the CAP. Before I began that work, I needed to learn about the experiences of others from published works in this area.

Analytics and Decision Support Systems in the Literature

Literature specific to DSSs use in higher education has been increasing over the past 10 years but is still somewhat limited. Modh and colleagues (2010) found that there is wide adoption of DSSs in many non-education industries but use in higher education remains limited. More recently, McCoy and Rosenbaum (2019) noted the lack of empirical research on DSSs in higher education. To get an understanding of research undertaken to date, I included broader search terms such as data dashboards, decision support systems, and data visualization both with and without including the term “higher education.”

Higher education has not quickly implemented these DSSs for several reasons including a hesitancy to adopt innovation, barriers in data literacy of users, availability of resources, and the existing culture of the institution (Cook, 2002; Davis, 1989; De Laet et al., 2020; Gagliardi et al., 2018; Isik et al., 2012; Kayanda et al., 2020; McCoy

& Rosenbaum, 2019). In addition, factors that contribute to successful adoption include perceived usefulness, adequate training, expert support, end user involvement in the design, and inclusion of data that is necessary to complete their jobs. (Cook, 2002; Davis, 1989; De Laet et al., 2020; Kayanda et al., 2020; McCoy & Rosenbaum, 2019). Failure to consider these factors may result in rejection of the system by end users.

Learning Analytics and Academic Analytics

While learning analytics and academic analytics share some similarities in their goals of analyzing educational data to improve outcomes, they are distinct in their focus and scope.

Learning analytics (LA) focuses on the learner with the goal of gaining insights into the learning process and identifying areas where improvements can be made. Learning analytics uses data analysis techniques and tools to understand and improve learning and educational outcomes and focuses on data at the course and departmental levels (Lawson et al., 2016; Siemens & Long, 2011). It involves the collection, analysis, and interpretation of data generated from educational systems, such as student information systems, learning management systems, and online learning platforms. This includes analyzing data on student behavior and performance, as well as identifying patterns and trends in student learning. Learning analytics can also be used to personalize and adapt learning experiences to individual students' needs, abilities, and interests. Lawson and colleagues (2016) suggested that while LA has potential for improving student outcomes, they warn of three potential ethical

concerns: ownership, surveillance, and labeling of students. Learning analytics has the potential to transform education by providing educators with valuable insights into the learning process and enabling them to make data-informed decisions to improve student outcomes.

On the other hand, academic analytics focuses on analyzing data related to academic performance and outcomes in higher education at the institution level. Academic analytics involves using data to analyze and improve enterprise-wide activities including administrative, research, student success, and resource management (Campbell & Oblinger, 2007; Siemens & Long, 2011; Tulasi, 2013). Academic analytics may be used to determine the size of the incoming freshmen class, improve student retention, and identify at-risk students (Campbell et al., 2007). The use of academic analytics can identify areas where improvements can be made in curriculum, instruction, and support services. At the institution level, academic analytics can be used to track student performance, identify patterns and trends in student success and retention, and determine factors that contribute to student outcomes such as grades, graduation rates, and career readiness. By analyzing these data, institutions can make data-informed decisions to improve student outcomes and support student success. While there may be many benefits to academic analytics, Campbell and Oblinger (2007) warn of three primary concerns in the use of academic analytics. They point out the potential for privacy, security, and accuracy issues when using these data.

While both learning analytics and academic analytics can be used to identify students who may be at risk of struggling academically or dropping out, academic analytics is typically more narrowly focused on predicting and improving academic outcomes. Learning analytics, on the other hand, is focused on improving learning outcomes more broadly, including both academic and non-academic aspects of the learning experience.

Data Literacy

In creating a DSS, it is important to understand the data literacy of the end users to develop the most appropriate DSS. Wolff and colleagues (2016), following an extensive review of data literacy definitions, offer the following as their definition data literacy:

Data literacy is the ability to ask and answer real-world questions from large and small data sets through an inquiry process, with consideration of ethical use of data. It is based on core practical and creative skills... These include the abilities to select, clean, analyze, visualize, critique and interpret data, as well as to communicate stories from data and to use data as part of a design process. (p. 23)

Other definitions of data literacy include the use of data to inform decisions, transform data into actionable knowledge, interpreting and evaluating data, and using data to support arguments (Deahl, 2014; Mandinach & Gummer, 2013; Vahey et al., 2006).

The Need for Data Visualization

One element of data literacy is how data are visually presented. Humans have used pictures to convey messages for thousands of years. Choosing the best visual representation of the data requires understanding the data and the audience who will consume the data. Today's technology allows for millions of rows of data to be quickly analyzed and a visualization created to better understand those data.

An adequately designed visualization will make data easier to comprehend. However, if the presentation of data is overly complex, end users may misinterpret the data and run the risk of making an ill-informed or incorrect decision or misusing the data (Gill et al., 2014; Harel & Sitko, 2003). Design options are endless, but simplicity is essential in clearly conveying the intended message, especially considering the amount of data that are generated daily. According to D'Agostin (2022) 2.5 quintillion bytes of data are created every day which equates to each person on the planet generating 1.7 megabytes of data every second. That is an astonishing amount of data to comprehend. That is where data visualization can help a user understand and make sense of those data. When done properly, visualizations allow for large amounts of data to be easily understood and discover insights into those data. Trends in the data can be quickly identified with the use of visualizations.

Technology and Data Visualizations

Technology has evolved to make it much easier to create visualizations. Tableau, Power BI, Plotly, QlikView, and Visme amongst dozens of others allows a user to easily drag and drop elements to create a visualization. These programs also allow a user to choose from a library of templates to quickly create visualizations for

data insight. While it may be tempting to demonstrate expertise in creating a complex chart with lots of colors and data points, the story of the data may be lost, or worse, misunderstood and possibly misused. But what is the right chart to use to convey information accurately to reduce the chance of misinterpretation? Is a bar or line chart the best visualization? Should data be represented with a scatter plot, area, or bubble chart? There are library and online resources publicly available to help assess how to select the best chart design to convey the data. Tools like the Visual Vocabulary website designed by the Financial Times provide a starting point to determine what type of visualization to use. This resource shows suggested charts grouped by categories including deviation, correlation, ranking, distribution, change over time, and magnitude. The Big Book of Dashboards (Wexler et al., 2017) provides a practical guide for developing visualizations for dashboard use with examples (good and bad) from different industries.

Utilizing the literature and best practices for the design and development of the DSS is essential. To further enhance the DSS's design and development, seeing how other institutions of higher education have created DSSs is also valuable.

What Have Other Colleges and Universities Done?

Many colleges and universities have made data available to the public in a dashboard format. For example, the University of North Carolina (UNC) System provides an interactive dashboard tool where anyone can look at student enrollment trends, explore information related to transfer students, view degrees awarded over the past ten years, and examine the performance of North Carolina's educators

(“Interactive Data Dashboards, n.d.). Created in Tableau, these dashboards allow the user to filter on what UNC institution they are interested in as well as the academic years to drill down on specific information.

The University of Louisiana System also provides open-access dashboards for the public to filter and view data (“Dashboards,” n.d.). These dashboards, powered by Tableau, include information on student enrollments, student success, faculty and staff metrics, budget and financial aid, and comparisons to peer institutions. This dashboard is easy to interact with and provides the user with easy-to-understand visualizations.

While there are numerous examples, the last one I will highlight is the University of Texas (UT) System. The UT dashboards, much like the two previous examples, include data on student enrollments, student success, faculty productivity, finances, healthcare, and research (“UT System Dashboard,” n.d.). These dashboards are powered by Microsoft Power BI and give user’s simple, yet effective, visualizations to easily understand and interact with the data.

These examples may provide models for the development and design of the CEHD-DSS. The dashboards highlighted above are public-facing and provide high-level information about the institutions. Many other college and university websites that I have visited keep these data behind a log-in screen, which may keep sensitive data from public view or may reflect the institution’s attitude toward data transparency. I conducted a systematic review of UD comparator institutions’ websites as part of the ELP, and those results can be found in Chapter 3.

Organizational Role

I have worked at UD for nearly 27 years. I have held four positions during this time, and each helped develop a toolbox of skills, knowledge, and abilities to prepare me to tackle this problem. In the CEHD dean's office, I currently work under the direction of the Dean of the College as the Senior College Business Officer and Chief of Staff (see Figure 3). I have served in my current role for over five years. In this role, I am responsible for planning and monitoring the budget and finances of the college, oversight of college facilities, oversight of the Office of Education Technology, the Financial Services Unit, and the Children's Campus, which serves children in the Early Learning Center, the Lab School, and the College School.

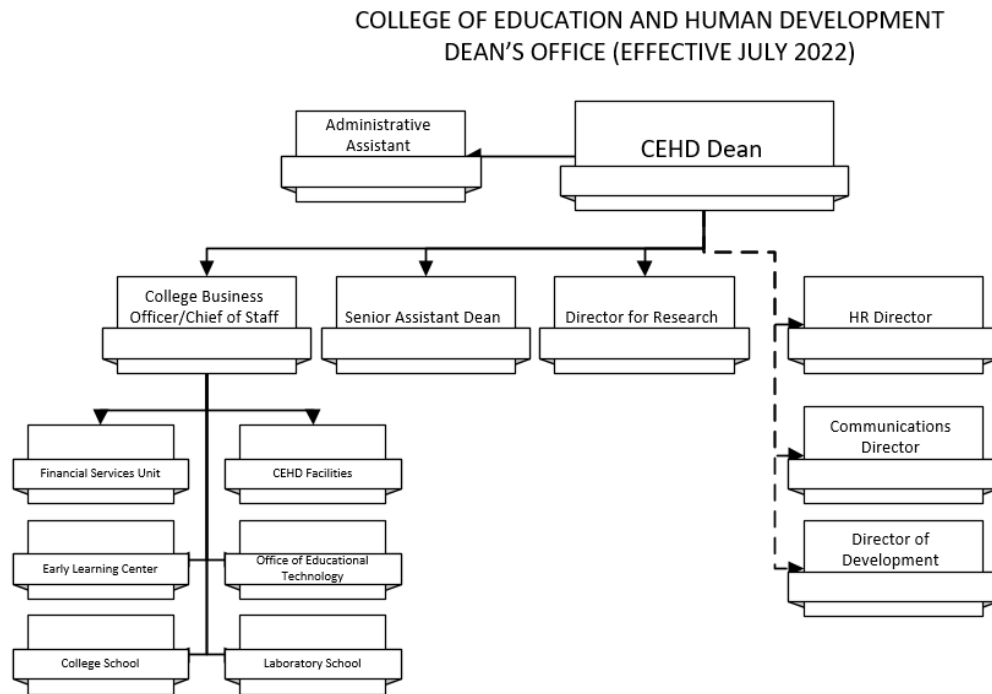


Figure 3 College of Education and Human Development Dean's Office Organizational Chart

A primary requirement of a college business officer is the need to analyze large datasets, including financial, enrollment, sponsored programs, and human resources data. I am a member of the college leadership team and provide strategic counsel to the Dean and other college leadership. Additionally, I work closely with the CEHD Human Resources Director to develop solutions to human resource concerns.

The CEHD Dean has steadily increased my leadership responsibilities over the past three years. I currently have six direct reports who lead very different units, from financial services to information technology to early childhood education. He has also assigned several interim director roles to me while we conduct searches for permanent directors. New challenges arise almost daily and present the opportunity to develop and demonstrate my leadership. Whether solving financial issues or listening to parents' concerns at the Children's Campus, each deserves a thoughtful and careful response as a leader. With nearly 27 years of UD experience, many of my peers and colleagues come to me for advice and counsel, leading me to believe that I am viewed as a trusted leader and colleague.

In my role as the CEHD business officer, I have had a relatively large sphere of influence over developing the CEHD-DSS. I have had access to significant amounts of data in CEHD and, to some extent, UD-wide data to engage in this work. I have colleagues across UD who have assisted with some of the technical aspects of Tableau when I could not solve a problem. I also have colleagues at other institutions of higher education who have provided information about their data systems, data accessibility, data governance, and how leaders obtain and use data.

In addition to having access to the data and the necessary tools to accomplish the task, I have had the dean's full endorsement to pursue this work. As an avid data user, the dean is highly interested in having a system to access data at any time. The dean frequently needs data to present to various stakeholders, including elected officials (e.g., State of Delaware Governor, Delaware State Representatives), the Dean's Advisory Council, the UD Provost and President, CEHD leadership, and faculty and staff. Having reliable, up-to-date information will enable him to respond to inquiries more rapidly.

Statement of the Problem

People in CEHD want and need data. Leaders in CEHD do not have convenient and consistent access to up-to-date, reliable data to help inform decision making. The increase in demand for data requires increased ad-hoc reporting and I often have difficulty keeping up with queries and providing data and analysis quickly. Not having access to a centralized DSS is a challenge in that users often must pull together multiple data sources or wait for others to get answers to their questions. Data are spread across multiple systems and often require numerous queries to access. Leadership in CEHD cannot access data often needed to inform time-sensitive decisions.

Despite the critical need to access data, as a Senior College Business Officer, I encounter daily logistical issues retrieving data needed to inform decision-making. This is likely due to several reasons: data are not readily available; data are housed in

multiple systems; data are not structured in an easily accessible way for reporting; data integrity is often in question, and some data are not available. Compounding these problems, many leaders rely on individual systems developed locally in their department or program. For a user to find the data needed to answer a question or make a decision often requires cobbling together these multiple data sources. This is time-consuming and prone to errors if the data are not up-to-date, or if the user's analytic skills are weak.

Implementation of the UDBM makes the need for fast and accurate reports more compelling. The UDBM is the most complex budget model implemented in my 27-year tenure at UD. The model forces business officers of each academic college to design data models to develop financial success strategies and having data readily available aids in modeling.

Another critical need for data lies in the implementation and monitoring of the CEHD Strategic Plan. In early 2021, the dean embarked on creating a new five-year strategic plan for CEHD. Bringing together thought leaders from across the college, a new strategic plan was finalized and implemented in the summer of 2021. This new strategic plan contains goals related to increasing enrollments, raising awareness of our research programs, increasing diversity in the student body and across the faculty and staff, and working to meet the needs of our stakeholders. These goals require access to data to measure progress.

The problem I addressed in this ELP is this: How can I use evidence-based methods and current best practices to design, develop, and deploy a DSS that CEHD leadership can access on-demand data to aid in decision making for their units?

Chapter 3

IMPROVEMENT STRATEGIES

In CEHD, there is no mechanism to easily obtain data from across multiple enterprise-wide systems. These systems include PeopleSoft, Cognos, VGER, UDSIS, and UD Slate. As such, this ELP's improvement goal is the design, development, and deployment of a DSS that meets user's needs and is accessible on demand, all while using evidence-based methods and current industry best practices. Ultimately, this DSS should increase the accessibility to data to inform decision making. Wrapped within this overall goal are specific sub-goals, including improved data accessibility, enhanced data literacy, and increased data usage.

Transparent Access to CEHD Data - Theory of Change

The vision of the CEHD-DSS is to implement a user-friendly system to access central data sources that is consistent, reliable, and built on evidence-based theory and industry best practices. The intended influence of the CEHD-DSS is to reduce the burdens of ad-hoc reporting and provide on-demand access to data for users. Figure 4 represents the proposed theory of change.

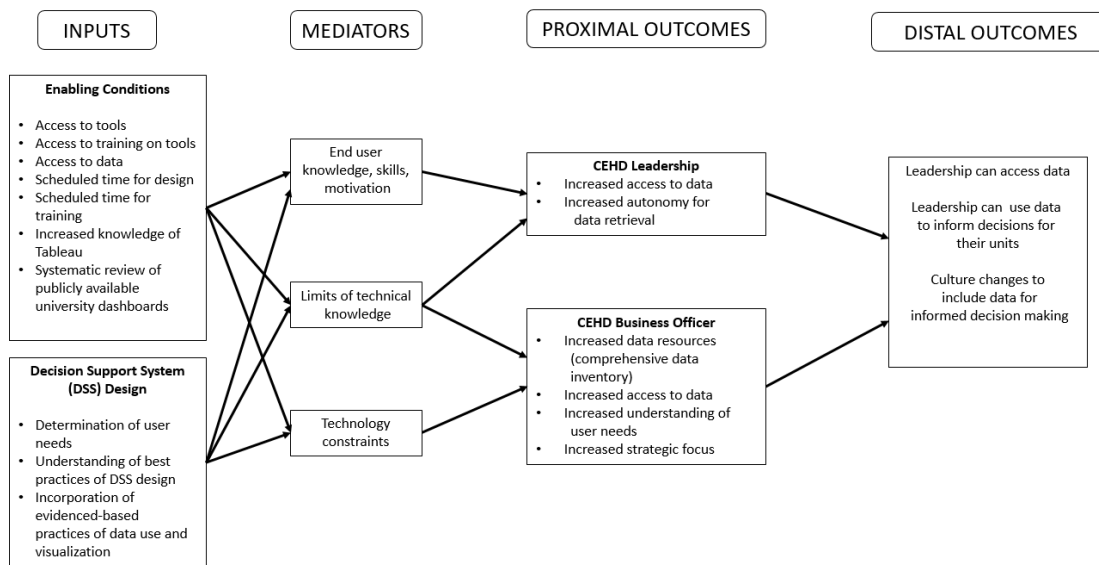


Figure 4 Transparent Access to CEHD Data – Theory of Change

The theory of change represents my hypothesis about the steps needed to provide CEHD leadership with transparent access to data.

Improvement Strategies

To develop a solution to the problem, I considered the improvement strategies needed. I chose nine improvement strategies that (a) describe the current state of data usage and DSSs in higher education, (b) determine user needs and analyze how other regional universities use data to support decision-making; (c) build the required infrastructures using industry best practices and (d) deploy a DSS to CEHD leadership along with policies and tools for using the data. These strategies are intended to lead to a culture of informed decision making that includes the use of data.

Improvement Strategy 1: Learn the Current State of Research

Before embarking on an effort to design the CEHD-DSS, the first improvement strategy was to better understand the current state of data-informed decision-making in higher education. I conducted a literature review (see Appendix A). The results of that literature review provided an overview of the current state of data use in higher education along with existing research as to why DSSs are likely not widely used in higher education. The literature reviewed highlighted three primary themes around data informed decision making in higher education. Those themes are data use in higher education, why data are not widely used in higher education, and the barriers to data use.

Improvement Strategy 2: Understanding User Needs

To understand user needs, I conducted two studies. The first was a single-group qualitative study. In this study, I engaged three business officers from other higher education institutions in the mid-Atlantic region. I knew these business officers through various networking opportunities. This study aimed to determine how data are used, accessed, and disseminated at the sample institutions (see Appendix B). For this study, there were three key questions that I asked the participants. The key questions were (1) What are your top 3-5 business questions that you or your leadership team need data to answer on a regular basis? (2) Are you able to access the data that you need? If so, how? (3) Can you describe what the ideal decision support system would

look like and what data it would include? Interviews were conducted over Zoom and were in a semi-structured format.

To encourage college-wide use of the CEHD-DSS, it must be designed with the needs of the end users front and center. Literature has suggested that technology projects deployed without end-user participation and input have a higher failure rate versus the collaborative, end-user focused approach took (Alvertis et al., 2016; Cavaye, 1995; McCoy & Rosenbaum 2019). To engage the CEHD leaders, I conducted a mixed-methods study using a Qualtrics survey and semi-structured interviews (see Appendix D). This study investigated what data are needed for the CEHD leadership, how they currently use data, and the extent to which an interactive dashboard system would be useful. I asked the 10 leaders nine questions including five key questions. Those key questions were (1) What are the primary business questions that you need data to answer on a regular basis? (2) Are you able to access the data you need, and are you satisfied with those data? (3) Do you maintain shadow systems? (4) If a data system could provide an interactive dashboard where you could filter on multiple variables, would that be helpful? and (5) How many years of data do you need? The interviews were conducted via Zoom and in-person based on the user's preference.

Improvement Strategy 3: A Review of Publicly Available Dashboards

Learning how other higher education institutions disseminate data may help inform on the types of data to include and overall dashboard design for the CEHD-

DSS. To understand how other institutions present outward facing data, I engaged in a systematic review of publicly available university dashboards. Using the list of UD comparator institutions (“University of Delaware Comparator Institutions As of September 2016,” 2023) and the list of HelioCampus clients available on their website (HelioCampus, 2023), I reviewed 10 websites including five that are clients of HelioCampus (like UD) that had publicly available dashboards. If the only publicly available dashboards were COVID-19 pandemic tracing and statistics, I did not include those due to the temporary nature of the dashboard and the relevance to this ELP. Figure 5 documents the institutions that I reviewed.

Institution
Boston University
Case Western Reserve University
North Carolina State University at Raleigh
University of Arizona
University of Michigan – Ann Arbor
Pennsylvania State University – Main Campus
University of Pittsburgh
Purdue University – Main Campus
Stony Brook University
Virginia Polytechnic Institute and State University

Figure 5 UD Comparator Institutions Dashboard Review

Improvement Strategy 4: Networking

Engaging with national and international networks enhanced my understanding of data use in higher education. These networks provided expertise in the design of a DSS and best practices in data visualizations. A valuable resource was the extensive global Tableau user network which was available to assist with some of the more

complex Tableau challenges. The monthly Tableau User Groups (TUGs) were a mechanism to connect with users around the world. I engaged primarily with three TUGs: Tableau Newbies TUG, Higher Education TUG, and Analytics TUG. Each TUG provided opportunities to both learn how Tableau could be used to solve problems and interact with other Tableau users. Figure 6 documents the TUGs that I engaged with over the course of this project.

Group name	Meeting frequency	Audience members
UD Tableau Users Group	Biweekly	UD Tableau Users across campus.
Higher Education Tableau User Group	Monthly	Worldwide Tableau users interested in data solutions for higher education.
Newbies Tableau User Group	Monthly	Worldwide Tableau users new to the Tableau software.
Analytics Tableau User Group	Monthly	Worldwide Tableau users interested in using Tableau to design innovative analytics solutions.

Figure 6 Tableau User Groups

According to Tableau, there are over 400 TUGs including regional (e.g., Sydney, Cairo, Baltimore), area of business (e.g., public sector, marketing, veterans’ advocacy), best practices (e.g., accessibility), and special interests (e.g., Women + Data, Blacks in Analytics, LGBTQ+).

Another network that I engaged with was the Higher Education Data Warehousing (HEDW) Forum. This forum brings together experts grappling with

similar issues and provides resources to assist with problem solving. The HEDW website has a searchable archive of conference presentations available to members. The archives contain presentations, videos, recorded webinars, data models and templates, technology tips, and a data visualization library. Over the course of this project, I watched several presentations from past conferences along with videos from their archives. The videos supported CEHD-DSS design ideas and the use of best practices.

Attending conferences was a networking strategy utilized to understand how other institutions of higher education are managing their data and to learn best practices. With the ongoing COVID-19 pandemic, more conferences have transitioned to online formats, making it easier to attend with a reduced cost of travel. Figure 7 outlines the conferences that I attended over the course of this project. The virtual format also allowed registrants to replay sessions to reinforce the topic and see other sessions that may have been missed in person.

Conference name	Modality	Dates
Higher Education Data Warehouse Annual Conference 2020	Virtual	April 26-29, 2020
National Association of College and University Business Officers Annual Meeting 2022	Virtual	July 17-19, 2022
Tableau Conference 2020	Virtual	October 5-8, 2020
Tableau Conference 2021	Virtual	May 9-11, 2021
Tableau Conference 2022	Virtual	May 17-18, 2022

Figure 7 Conference Attendance

Improvement Strategy 5: Tableau Training

Access to the tools, training, and data is essential in the design, development, and deployment of the CEHD-DSS. UD-IRE granted me a Tableau Creator license in the summer of 2022, an upgrade from the Tableau Viewer license that I previously had. The Creator license provides the most freedom in creating content as compared to the Tableau Explorer or Tableau Viewer licenses. Extensive, no-cost training was available from the Tableau website, YouTube videos, LinkedIn Learning, and UD experts.

Directly tied to access to training was scheduling the time to take the trainings and develop the skills in Tableau. I scheduled regular meetings with on-campus Tableau experts to work through any challenging aspects in the design of the CEHD-DSS. UD-IRE holds a bi-weekly user group session on data needs, usage, and working with Tableau. These sessions were valuable in working with on-campus colleagues, who use the same data sets to discover solutions to problems in Tableau. In addition, four hours per week were reserved on my calendar to focus on learning Tableau and an undocumented number of hours during nights and weekends.

In addition to the biweekly and monthly structured meetings listed in Figure 7, there is a vast array of training videos and blog posts available to provide support. Since a large portion of the CEHD-DSS was developed after regular business hours, finding online, on-demand training resources was essential to self-solve problems. Figure 8 describes some of these unstructured, independent opportunities to learn Tableau and solve problems I encountered during the development of the CEHD-DSS.

Platform	Sample of learning opportunities
Tableau.com	Free, on-demand videos; listservs with user posted questions and solutions; detailed pages with instructions on using the software.
YouTube.com	Free, on-demand videos from creators including Penguin Analytics, Tableau Tim, edureka!, Simon Sez IT, and Alex the Analyst.
LinkedIn Learning	Free (based on UD subscription), on-demand courses including Creating Interactive Tableau Dashboards; Tableau Essential Training; From Excel to Tableau; and Using Tableau to Discover Powerful Business Insights
Tableau Desktop Specialist course	Learned Tableau fundamentals including connecting to data, using filters, parameters, formulas, charts, and how to join, union, and blend tables.

Figure 8 Independent Tableau Training Opportunities

Improvement Strategy 6: Document Resources

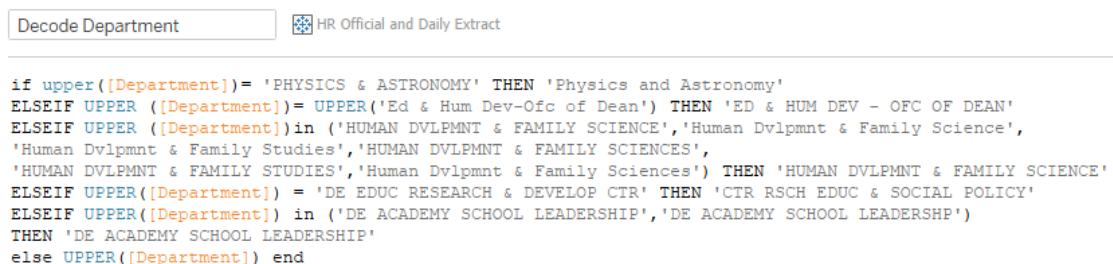
Having a solid understanding of the available data and resources was a strategy that provided insight into the types and breadth of data available for the CEHD-DSS. In January 2023, I was granted access to nine centrally published data sources. When this project was first proposed in October 2022, access to those resources was not permitted, and I was planning to secure the data manually. The access to the centrally published data sources was game changing as I would now have access to verified, centrally-maintained data.

As tempting as it was to immediately start creating visualizations with the newly obtained data, I first had to learn what data I had. To have a thorough


understanding of the available data, I conducted a careful documentation process. Appendix C provides the summary of the documentation. Having a thorough understanding of the available data elements made development of the CEHD-DSS far more efficient.

Another reason to have a thorough understanding of the data sources is that some of the data elements are not consistent across all the published data sources. For example, the data sets have multiple versions of HDFS including Human Development and Family Studies, Human Development & Family Sciences, Human Dvlpmnt and Famly Studies, and Human Dvlpmnt & Family Science. To ensure all the data are included across the data sources, the data had to be cleaned. To clean the data, I wrote a decode formula to set all versions of HDFS to one consistent name.

Figure 9 provides an example of a decode statement.



The screenshot shows a Tableau formula editor with a text box containing the following code:

```
Decode Department  HR Official and Daily Extract
```

```
if upper([Department])= 'PHYSICS & ASTRONOMY' THEN 'Physics and Astronomy'  
ELSEIF UPPER ([Department])= UPPER('Ed & Hum Dev-Ofc of Dean') THEN 'ED & HUM DEV - OFC OF DEAN'  
ELSEIF UPPER ([Department])in ('HUMAN DVLPMNT & FAMILY SCIENCE','Human Dvlpmnt & Family Science',  
'Human Dvlpmnt & Family Studies','HUMAN DVLPMNT & FAMILY SCIENCES',  
'HUMAN DVLPMNT & FAMILY STUDIES','Human Dvlpmnt & Family Sciences') THEN 'HUMAN DVLPMNT & FAMILY SCIENCE'  
ELSEIF UPPER([Department]) = 'DE EDUC RESEARCH & DEVELOP CTR' THEN 'CTR RSCH EDUC & SOCIAL POLICY'  
ELSEIF UPPER([Department]) in ('DE ACADEMY SCHOOL LEADERSHIP','DE ACADEMY SCHOOL LEADERSHP')  
THEN 'DE ACADEMY SCHOOL LEADERSHIP'  
else UPPER([Department]) end
```

Figure 9 Tableau Decode Statement Example

Validating the Data

Having valid and reliable data is a cornerstone goal of the CEHD-DSS as there is a greater chance of use by CEHD leaders if they trust the accuracy of the data. To

determine if my work in Tableau was accurate, the data were compared to other validated UD data sets. For example, the financials data set, which I must upload manually, was compared to UDataGlance, a university-wide validated data source. Enrollment and credits taught data were validated against reports from Cognos and VGER reports. Other data were compared to UD's Facts and Figures website.

As I validated data, there were some inconsistencies between the published data sources, my dashboards, and the validation sources. In many cases, those inconsistencies were resolved by fixing incorrect formulas, correcting decode statements, or removing inappropriate filters from worksheets in Tableau. In other words, the inconsistencies were usually created by me as I was building the dashboards through trial-and-error processes. As the CEHD-DSS continues to evolve and data sources are fully validated, a notice is posted on all dashboards to use the data for internal purposes only.

Improvement Strategy 7: Data Visualization Best Practices

Understanding best practices of data visualizations is a key strategy for success. Data visualization can be simply defined as graphical representation of data to make the data easier to understand (Sadiku et al., 2016). Why are data visualization best practices necessary? Selecting the visualization to correctly depict the data is essential for the user to be able to draw accurate conclusions. Visualizing data provides a more engaging opportunity to simplify large complex data sets. Trends in data can be easily seen if the visualization is done correctly and adheres to best

practices. Some of the strategies that can be used to improve clarity, accuracy, and effectiveness of visualizations are color usage, data to ink ratio, understanding pre-attentive attributes, and choosing the appropriate visualization.

Care must be taken to create visualizations that use appropriate shapes and colors, especially if the visualizations are widely distributed. For users who may have color vision deficiency (CVD), choosing a CVD-friendly color palette may enhance the user’s experience. Excessive use of color should be minimized to avoid confusion and misinterpretation (Wexler et al., 2017). Well-designed visualizations must contain labels (e.g., titles, axis labels, legends) to help the user understand the meaning of the visualization.

To learn data visualization best practices, I engaged with several learning platforms. Figure 10 summarizes several of the learning opportunities used while designing the CEHD-DSS.

Platform	Sample of learning opportunities
LinkedIn Learning	Courses completed include: Learning Data Visualization; Picking the Right Chart for Your Data; Excel Data Visualization: Mastering 20+ Charts and Graphs; Data Visualization: Storytelling; Data Fluency: Exploring and Describing Data (2019)
YouTube.com	Data Visualization for Beginners (SimpliLearn); Data Visualization 101: Design Principles (UN Innovation Network); Data Visualization 101: Representing Data (UN Innovation Network); The Data Visualization Design Methodology (Andy Kriebel); Data Visualization in 2022 (Visme)
HEDW.org	The Art of Analysis: Using Dashboards that Tell the Right Story; Data Visualization – How to use it for good & evil; Data-Driven Decision Making: Empowering Business Through Data Visualization and Self-Service

Figure 10 Data Visualization Design Resources Used in the Development of the CEHD-DSS

Improvement Strategy 8: Develop Resources to Support End Users

Having access to data is important. Using those data to support decision-making is even more important. Once the data are available in the CEHD-DSS, end users may wonder how to engage with the data. Davis (1989) describes how users are more likely to accept technology if they believe it will help them improve their job performance and how much effort it will take them to use the technology. This improvement strategy aimed to improve the end user experience by creating resources to reduce the amount of effort needed to use the CEHD-DSS. Using data collected in the two studies of end users and information learned from my experience on campus, I created three resources for CEHD end users. These resources are the CEHD Budget Support Handbook, the CEHD-DSS User Manual, and the Frequently Asked Questions document.

The first resource that was created for end users was the CEHD-DSS User Manual (see Appendix E). Since most of the end users will not be familiar with the Tableau interface, the user manual will help guide them to locate the data they are looking for. Data governance is essential in establishing this DSS to ensure the data are used responsibly. Included in the CEHD-DSS User Manual is a link to the data use policies of UD. The CEHD-DSS contains highly sensitive data. Individual student level data are never identified but certain staff and faculty data are identifiable. These data are included since there is a business need to have them. With that, CEHD-DSS users recognize that they must abide by all the UD data governance policies.

Leaders in CEHD often ask questions like: Can I use these funds to buy this item? Do I need to spend these funds by a certain date? What is the difference between this purpose code and this purpose code? The CEHD Budget Support Handbook (Appendix F) was developed as a reference to assist leaders in having a better understanding of the budget model, fund types, and the budgeting calendar. The handbook provides a convenient place to have those questions answered.

The final resource that was created was a Frequently Asked Questions (FAQs) document (Appendix G). The results of the surveys (Appendices B and D) of CEHD leaders and non-UD business officers were combined to create this document by combining their top business questions and the data needed to answer those questions. The FAQs provide the answer to those questions, and in several cases, provide navigation to the CEHD-DSS to allow the user to easily find the data they may be seeking.

Improvement Strategy 9: Case Study

The prior eight improvement strategies led to the final improvement strategy – the case study. To design and develop a DSS that the end user would find useful, I reached out to the chairperson of one of the CEHD academic units to see if they would participate in a case study. Once the invitation to participate was accepted, meetings were held from December 2022 through March 2023. Over the course of those four months, we reviewed multiple versions of the CEHD-DSS. The chairperson provided feedback to improve the dashboards and over time, and I developed a series of

dashboards to meet their needs. These meetings, as documented in Appendix H, led to the development of the first version of the CEHD-DSS.

When combined, these nine improvement strategies led to the design, development, and deployment of the first version of the CEHD-DSS. The next chapter describes the extent to which these strategies were successful.

Chapter 4

IMPROVEMENT STRATEGIES RESULTS

Implementation of the Initiative

Using the improvement strategies described in Chapter 3, I designed, developed, and deployed the CEHD-DSS in the spring of 2023. The first version creates a centralized data system to allow end users to access and interact with data. This chapter describes the results of the improvement strategies.

Understanding User Needs

In order to design a system that end users would want to use, I wanted to know what they needed. The results of the two studies (see Appendices 2 and 4) that I conducted demonstrated the desire for a system that would provide data to end users. Like UD, the three external institutions included in one study do not have DSSs, yet all three indicated that they would like to implement something in the future. The majority of CEHD leaders (70%) indicated they do not have access to the data they need. Moreover, 90% of CEHD leaders did not think it was easy to access data at UD. These results indicate a strong desire to have an easily accessible, user-friendly system for data. Despite the desire and need for a DSS, none of the respondents were aware of initiatives at their institutions to create one.

CEHD leaders expressed interest in five primary data categories: financial, student, sponsored programs, human resources, and courses/credits taught. Eighty percent of CEHD leaders indicated that financial data was the top priority followed by sponsored program data, student data, courses data, and human resources data. The CEHD leaders would like to have quick access to see financial balances and view prior expenditures. CEHD has a robust sponsored programs portfolio and having access to these data was a high priority for 40% of the respondents. CEHD leaders would like to have five to ten years of data available in the system. The CEHD leaders rated their proficiency with the four identified data types (student, human resources, sponsored programs, financial) from good to very good. The CEHD leaders also expressed interest in having their locally-kept systems incorporated into the CEHD-DSS. Business Officers from the three external institutions indicated the top three data priorities were student, financial, and human resources.

Data accessibility, reliability, and satisfaction were common themes in the interviews and surveys for both study groups. External business officers described the inefficient systems for accessing data. All respondents expressed the need to run multiple reports to get the data they needed. The CEHD leaders reported not having access to the needed data with 70% “somewhat disagreed” or “strongly disagreed” to adequate data accessibility. All participants “strongly agreed” or “somewhat agreed” that they would like to have data accessible in a dashboard format.

Data satisfaction was a common theme across CEHD leaders. They expressed frustration with having to rely on others to get data and having to look in multiple

places. The CEHD leaders were also concerned about data reliability. One participant noted, “I feel like we’re being judged on incorrect data.”

The CEHD-DSS immediately addresses two of those themes: accessibility and reliability. In terms of accessibility, prior to the CEHD-DSS, I would often need to download data from different systems across the UD enterprise. With the CEHD-DSS, those data are now available in one place. With regards to reliability, I have access to nine published and validated UD data sources which gives the user more confidence in the data being presented.

The results of these two studies, when combined with evidence-based design solutions, were used as the foundation for the CEHD-DSS. The results of these two studies also created the Frequently Asked Questions document (Appendix G).

A Review of UD Comparator Institutions

The systematic review of 10 UD comparator schools contributed the design of the CEHD-DSS. Seeing what data other institutions included along with the presentation of data provided inspiration for the CEHD dashboards. Figure 11 shows the counts of dashboard categories that were on the publicly facing website of 10 UD comparator institutions.

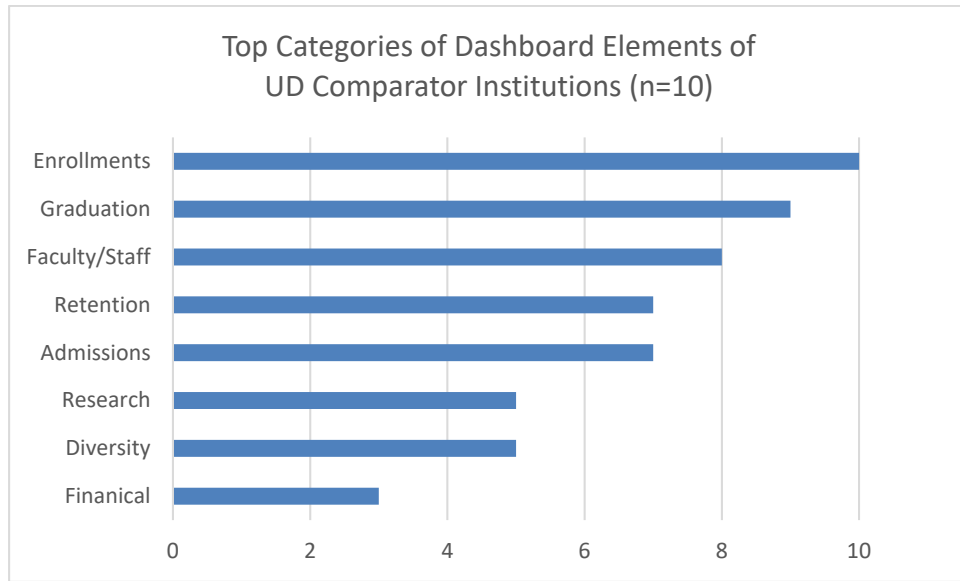


Figure 11 Top Dashboard Categories from UD Comparator Institutions

These categories were in alignment with many of the data types that CEHD leaders indicated they needed, suggesting that many universities have similar data needs. Using this information, I included those elements into the CEHD-DSS. The majority (80%) of the reviewed UD comparator institutions had interactive dashboards and 50% are using Tableau as the visualization tool.

Creating the CEHD-DSS

Understanding the literature, the end user needs, the basics of Tableau, and documentation of the available resources, I created the first version of the CEHD-DSS. In December 2022, I submitted a request to UD-IRE to obtain access to central data sources. The process of obtaining this access was likely going to take months, so I decided to move forward with the process of collecting these data sources manually

from the multiple systems. In January 2023, as I was in the process of manually downloading data, I unexpectedly received dashboard templates from the UD College of Arts and Sciences (CAS) and access to nine centrally published data sources. These events led to the more rapid development of the CEHD-DSS. Not only did I have a starting point on dashboard design with the CAS templates, but I also had access to centrally prepared and validated data. Except for the financials data, I no longer had to manually go to multiple data systems on campus to retrieve and upload the data. Although I had the CAS templates, I still engaged with an exercise called wire framing where I took pencil to paper to draw the desired state. Starting with the FAQs (Appendix G), I sketched dashboards to answer those questions. I reviewed the CAS templates to determine if any existing visualizations would answer the questions. After that review, I utilized the documentation of the data resources (see Chapter 3: Improvement Strategy 6) that I had created, along with my Tableau training to create the CEHD-DSS.

As I continued learning Tableau, my confidence in dashboard design increased. There were many try, fail, and try again efforts throughout the process of designing the CHED-DSS. The ‘undo’ button in Tableau was often used when I would try and fail at a new visualization or add in the incorrect data element. Knowing that I could easily undo actions gave me the confidence that I could not break the system and I could take more chances as I was learning.

The case study is the reason why the CEHD-DSS was able to be designed, developed, and deployed in such a short period of time. Our meetings started in

December of 2022 and a fully operational version of the CEHD-DSS was launched by the end of March 2023. Aided by the collaboration with the CAS in providing templates, and the collaboration with UD-IRE to gain access to the central published data sources, the first version of the CEHD-DSS was quickly developed.

There were several benefits gained by including an end user in the early phases of the design and development of the CEHD-DSS. First, by involving an end user in the design, I was able to ensure that the system was satisfying their needs and requirements. I was able to personally demonstrate the features of the system. Obtaining the end user's feedback in real time provided an opportunity to see if the system was user friendly. The case study also provided insight into items that needed to be explained in the user manual. The Tableau interface will be new to nearly all of the end users; therefore, determining usability during the case study was essential.

Second, working on the design and development through a case study with a future end user was efficient. We were able to meet on a frequent basis and quickly review dashboards to remove or revise unnecessary features or visualizations. Third, involving a highly respected end user in the design process may increase the acceptance of the CEHD-DSS across the college. When I begin to deploy the system to the other CEHD leaders, I can describe the process I undertook with HDFS which may result in broad acceptance and commitment to use the system.

Implementation of the CEHD-DSS

In April 2023, once access issues were resolved, the first version of the CEHD-DSS was given to the chairperson of HDFS and the interim director of SOE. Figure 12 shows the landing page that users will first see. Using this page, they can explore data in categories including financials, enrollments, courses and credits taught, faculty metrics, human resources, student success, and retention. A feedback button is available on the landing page, enabling the user to easily provide feedback through a Google form.



Figure 12 CEHD-DSS Landing Page

From the landing page, users select their department from the department selector dropdown menu. Considering the sensitivity of the included data in the CEHD-DSS, the data will only be accessible by CEHD leadership. The CEHD-DSS has department level security and user can only see data for which they have been given permission. If they select a department that they haven't been provided access to, the dashboards will be blank. This department level security was tested with the

two initial department users and was successful. As new users are added, the dashboards will be tested before deployment to ensure users only see their data.

The dean of the college will have a similar set of dashboards but instead of choosing one department on the landing page, the dean will have the option to select multiple departments at a time using filters on each dashboard. This will allow the dean, who has access to all data, to easily compare departments or see the whole college.

To interact with the data, users click on an icon (e.g., financials, human resources, department summary) on the landing page and they are taken to a dashboard with their department metrics. There are currently 13 active dashboards in the CEHD-DSS. Two of the dashboards are highlighted here. Figure 13 provides a redacted version of the financials dashboard. The CHED-DSS User Manual (Appendix E) provides detailed information regarding each dashboard.

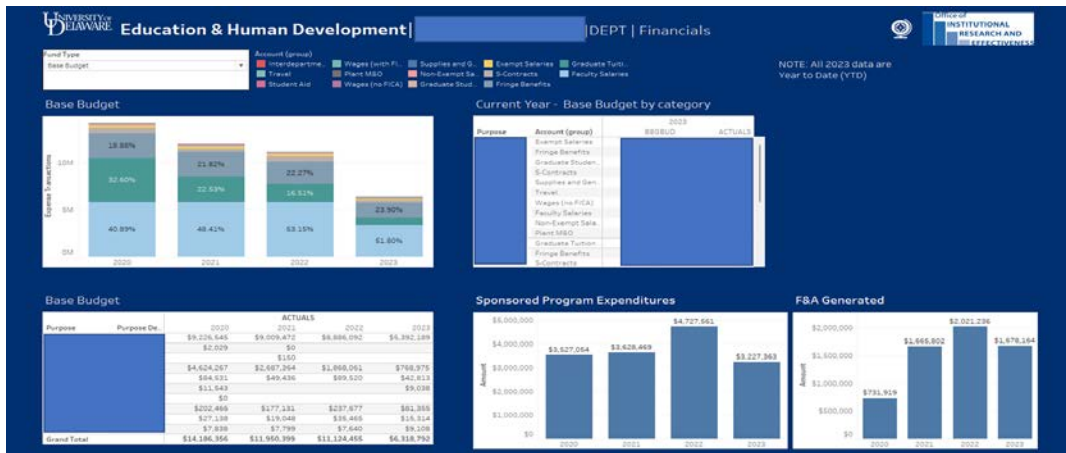


Figure 13 CEHD-DSS Financials Dashboard

CEHD-DSS users can select what fund type (e.g., base budget, gifts, endowments) that they want information on and then they can see trends in those data for the past four years. Tool tips, a Tableau navigation feature, are enabled on some visualizations where users can hover over data points to learn additional information. Each dashboard provides a navigation icon in the top right corner to return to the landing page.

CEHD leaders were interested in having certain human resources data in the CEHD-DSS. Figure 14 provides a redacted screenshot of the requested data.

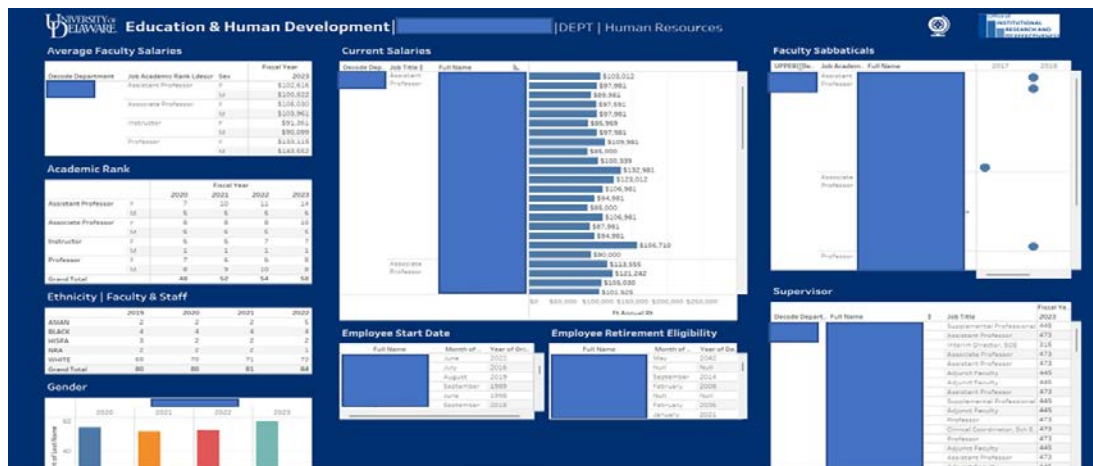


Figure 14 CEHD-DSS Human Resources Dashboard

CEHD leaders can see data including average faculty salaries by rank and gender, ethnicity, last sabbatical year, start date, and retirement eligibility date.

As a result of the research conducted and utilizing best practices, the first version of the CEHD-DSS was designed and developed to meet most of the needs of the end users. Some data requests cannot be accommodated in the CEHD-DSS since

they are not housed centrally. The second version of the CEHD-DSS will include the option to download data which the end user can then combine with local data for analysis. Other data requests (e.g., paid time off banks, labor allocations) cannot be accommodated at this time since those data are not yet available in the centralized systems. As the data models in UD-IRE continue to mature, more data will be added to the CEHD-DSS. Finally, the dashboards in the CEHD-DSS provide tables of stand-alone data. For example, a table of credit hours taught by rank or the total sponsored program expenses are already available. As my Tableau skills improve, more relational analyses across data sources will be added to the CEHD-DSS.

Chapter 5

REFLECTION ON IMPROVEMENT EFFORT

The approach taken was successful in meeting the improvement goal. By starting with an understanding of data use in higher education combined with an understanding of end user needs, I built a system that was not ‘just for me.’

Value Added

The CEHD-DSS, when compared to the prior state, adds significant value to CEHD. There are immediate and noticeable efficiency gains using the CEHD-DSS. Prior to development of the DSS, I had to go to multiple systems to get the data that I needed for myself or others. With the CEHD-DSS, those data are in one place which leads to improved efficiency. Prior to having access to the published data sources, there may have been data reliability issues. Did I use the right parameters when querying the data? Did I write the correct formula when analyzing the raw data? Using validated, centralized data, most of those concerns are erased.

I have reason to believe this improvement effort will bring value to end users based on comments already received. As the system access issues were being resolved for the initial users, the chairperson of HDFS sent me an email asking for data and said “I wish I had access to your system right now to get this information!”

Current Capabilities

The first version of the CEHD-DSS meets as many of the CEHD leader's data needs as possible. The CEHD-DSS provides financial data, courses and credits taught, human resources, and student data. Of the top five data needs, the only one that is not fully met is the sponsored programs data. I am able to provide the financial aspect of sponsored programs, but some of the other requested data (e.g., proposal and award attributes) are in a data set that has yet to be validated.

When I say that I have provided the requested data, this is true. Are those data presented in a way that is useful to the user? Time will tell. I suspect that once users spend time with the current data, additional needs will arise. I have added a feedback button to the landing page of the CEHD-DSS for users to provide information about what they like, do not like, and would like to have added. As I receive feedback, I will evaluate it to see if the requests can be met. As enhancements are made to the CEHD-DSS, they are simple to deploy by simply uploading a new version to the VGER platform. Changes will be announced to users via email, or a notification within the CEHD-DSS.

Next Steps

The first version of CEHD-DSS was launched in the spring of 2023 and while it begins to answer questions that the CEHD leaders have, by no means is

development complete. I am planning enhancements as my Tableau skills develop and as more data become available. Some of the planned enhancements are discussed next.

For the second version of the CEHD-DSS, I will begin relating (combining) multiple data sources within VGER so more insights can be gained. For example, IDOR and the sponsored programs data sets can be linked through a relationship to produce a scatterplot analysis of credits taught and sponsored program expenses generated by faculty. Another planned enhancement includes a US News and World Report dashboard to include as many data points as possible to aid in the preparation of the annual report.

There are three data sources that remain a priority to incorporate into the CEHD-DSS: publications, sponsored programs, and a centralized financials data source. The current version of the CEHD-DSS includes faculty metrics including rank, credits and courses taught, sponsored program expenses generated, and human resources data. One significant data element that is missing is publications and that is recognized on the dashboard with a “under construction” placeholder. As publications are evidence of fulfillment of faculty workload, I need to continue to seek a reliable and comprehensive data source for publications. UD subscribes to *Academic Analytics* but I have been told that the publication data are not complete. Once a comprehensive data set is identified and validated, it will be incorporated into the CEHD-DSS.

The second data source that is important to incorporate into the CEHD-DSS is the sponsored programs data. At the time of this writing, those data were not validated and therefore not included in the first version. The sponsored programs financial data

is currently included since those data are in the financials data set. What is missing are the proposal and award attributes. Having those data will allow the CEHD leader to assess the success rate of proposals and see active awards for their faculty. An ‘under construction’ placeholder is currently on the dashboards to indicate these data will be added once available.

The current version of the CEHD-DSS requires me to manually upload and validate the financials data set every month. I have to also manually upload a separate file for financial obligations. UD-IRE is working on curating and publishing a financials data set and the obligations data are expected to be included. With the user-friendly nature of Tableau, it will be a simple switch from using my manually uploaded data set to connect to the centrally published data set once it is available.

Deployment of the CEHD-DSS

Designing a DSS for the whole college is a significant undertaking. For this ELP, the scope of the DSS was limited to the two academic units in CEHD. Limiting the scope to two units provided the opportunity to test and evaluate a proof of concept but also allowed for the management of prototypes to reach the final product. Feedback from the initial three users will be used to develop the next version of the CEHD-DSS which will be rolled out to all CEHD units.

When I was determining the problem that I would engage with for this ELP, I was originally focused on solving my data access issues to improve my own work

efficiency. I assumed that leaders had access to the data they needed and were satisfied with how to get those data. I was wrong. Throughout the development of the CEHD-DSS, I received many comments about how long overdue a system like this was and how users could not wait to gain access. As I shared the concept of the CEHD-DSS with CEHD leaders there was a buzz generated about the product. Seeing how transformative this solution may be created an energy and excitement for me to deliver a useful product to CEHD leaders.

Lessons Learned

I learned many lessons through this work. Lesson one is that a project like this one is more efficient when collaborating with others. Having access to the CAS framework saved many hours (and perhaps significant frustration) in not having to develop these templates from scratch. Obtaining access to the central published data sources was also a game changer and made the first version of the CEHD-DSS more robust. Identifying early in the process who I could collaborate with made those events happen.

Lesson two is to get the end users involved early and develop partnerships with them to meet their needs. Talking to the end users to determine what they need and to continuously seek feedback to improve the product is essential.

Lesson three is to be a continuous learner. Continuing to learn new techniques improved the product. Attend webinars, conferences, and user group meetings.

Continue to read literature on best practices. My hope is that UD-IRE will provide access to the other UD colleges to this system, and I would encourage my colleagues to not simply settle for the design that I created, but to learn what their users need and want and then implement those changes.

Lesson four is to be resilient. I learned to celebrate the small wins and not dwell on the failures. Development of the CEHD-DSS included many “you have to see what I was able to do!” moments as well as many fist-pounding on the desk “why won’t this work?” moments. Success and failure are part of the learning process and only lead to better outcomes.

Conclusions About Effective Decision Support Systems

Higher education institutions are slowly embracing data to inform their decision-making. The benefits of using data to *inform*, not *drive*, decisions range from consistency, accessibility, and the ability to predict future states of the organization. With DSSs, higher education institutions can analyze data to help control costs, manage enrollments, attract and retain students, and develop future planning efforts.

A DSS can provide numerous benefits for end-users with solid data governance structures, support of leadership, systems designed in conjunction with end-users, and consistent data quality monitoring. Special care should be taken to introduce a DSS to alleviate fears of hidden motives, such as program elimination based on low enrollments, and ensure users that the data are accurate. Proper

investments in resources can allow the institution to make the best use of data to make the most informed decisions. Providing an environment where users feel comfortable asking questions and improving their data literacy will likely lead to better outcomes.

Chapter 6

REFLECTIONS ON LEADERSHIP DEVELOPMENT

The Ed.D. program and this ELP taught me to grow as a scholar, a partner, and a leader. Course work developed critical thinking skills and the ability to evaluate literature. Feedback throughout my academic program improved my writing and communication skills. This ELP project provided opportunities to enhance my professional networks across campus and provided an opportunity to enhance my knowledge of the subject.

Growth as a Scholar

Over the course of this program, I developed a skill set to think like a scholar. I have embraced the concepts of continuous learning and gaining deeper understandings of the subject matter. Even as I am wrapping up this ELP, I continue to read articles that are delivered weekly from my Google Scholar alerts. I continue to attend bi-weekly and monthly Tableau User Groups to learn more about data analytics. This program has encouraged strong research skills. As I have developed those skills over the duration of this program, I have learned to develop evidence-based solutions for everyday problems. Applying evidence-based solutions to everyday problems can help to ensure that the solutions are effective, efficient, and sustainable. I have gained an appreciation of testing and evaluating solutions. The case study (Appendix H)

demonstrated how taking the time to design, test, redesign, and retest can lead to a product that provides a useful solution.

This work contributes to the field by applying current research and data visualization best practices to solve a common problem. I think of this whole project as an in-depth case study that was solved using a structured, scientific approach. This work was conducted using the following steps: understanding the current state through the existing literature, conducting mixed-methods research, analyzing the results, drawing conclusions, and communicating the findings. This ELP documents the steps that a future researcher or data analyst may use as an example of solving a similar problem.

Growth as a Partner

In the past, embarking on a project like the CEHD-DSS likely would have been done in isolation. Instead of asking users what they were interested in, I simply would have designed a system based on my needs and assumed everyone would want the same thing. Strong partnerships are powerful in achieving professional goals and this was especially true in the design, development, and deployment of the CEHD-DSS. Early on, I identified partners who had similar goals, expertise, and complementary skillsets. Networking on campus as well as off campus provided access to expert resources and skills. Bringing people together with different skills and expertise allowed for the development of a product that was stronger than I could have achieved solo.

Collaborative partnerships were essential to the success of launching the first version of the CEHD-DSS. My case study (Appendix H) collaboration with the chair of HDFS on the development of the CEHD-DSS led to a stronger product for college-wide distribution. The feedback provided during the case study not only improved the CEHD-DSS but also improved my knowledge about CEHD. I learned more about what data the CEHD leaders' value and how they intend to use those data.

My partnership with UD-IRE was critical to the success of this project. Building trust is the foundation of a successful partnership. UD-IRE granted access to nine published data sources with the firm understanding that I would only use CEHD data and that I would only use data that was needed for business purposes. I immediately agreed to these terms and never considered violating that trust. The partnership with UD-IRE also led to the sharing of the CAS dashboard templates. Receipt of the templates saved hours of time in the creation of the CEHD-DSS and had I not collaborated with UD-IRE, I may never have received the templates. Finally, the partnership with UD-IRE improved problem-solving skills and innovation. Working as a team, we discovered new things about Tableau and brainstormed new ways to improve the CEHD-DSS.

Throughout the development of the CEHD-DSS, I often provided a sneak peek for my UD Business Officer colleagues. The purpose of this was to get their insights into the design and at the same time, increase the reach and impact of the system. Ultimately, I would like to share the DSS infrastructure with the other UD colleges. Being able to have the DSS distributed across campus increases my visibility as a

leader, positively enhances my credibility and reputation, and expands my influence at UD. Sharing my knowledge, expertise, and resources may lead to new initiatives and partnerships across campus.

Growth as a Leader

This ELP required me to lead an important change initiative in CEHD. Leaders understand the current landscape and can see how to alter it for future success (Ulrich et al., 2009). An effective leader can get others to see the vision and engage them on the path to the future. Leaders form relationships to solve common problems. Looking back at the work done to create the CEHD-DSS, I believe that I demonstrated these qualities of a leader. I was able to envision a compelling solution to the problem and build a coalition of people to support the proposed solution. Early on I demonstrated what the benefits of the proposed solution could be and worked hard to realize those benefits. Together, we built a system that I am proud of and that end users seem to be eager to use.

Being confident and leading with conviction while also recognizing I am not perfect provided an opportunity to learn and grow. At the onset of this project, I knew that I had a steep learning curve to gain proficiency in Tableau. I promised myself to exhaust as many resources as I could to self-solve the issues I was having before asking for help. I quickly learned that failure is not a weakness and over time, those failures built up my confidence. Multiple failures during the CEHD-DSS design and development led to better solutions.

The CEHD-DSS will help move me from a reactive to a proactive leadership state when it comes to data. Constantly being in a reactive stressful state can be detrimental to both physical and mental health (Hay & Deal, 2010; Neupert, 2022). The COVID-19 global pandemic and staffing shortages have put considerable pressure on me to be in a very reactive decision-making space. Having the CEHD-DSS operational will take some of that pressure off as the CEHD leaders will be able to access data on-demand and not wait for me or others to compile data for them. Reducing some of the reactive pressures will allow me to be more strategic by identifying potential challenges and areas of concern in CEHD.

There is no finish line for leadership development. To continue to grow as a leader, one must focus on continual improvement. Over the course of the past few years, I have been working on having the courage to say ‘no’ and delegate more. This has been very difficult for me throughout my career. Saying ‘yes’ all the time may seem like what is required of a team player and I find this can quickly lead to over commitment. Drescher’s (2016) research suggested that there are effects on leaders who delegate responsibilities including positive perceptions of ability, performance, and likability. Drescher (2016) also found delegation has a positive impact on the subordinate’s job satisfaction – a win for both the leader and employee. I am focusing on ensuring that I am delegating to the correct person and being very explicit in my instructions as to how to accomplish the task. Delegating tasks will allow me to focus on more strategic initiatives for CEHD.

Final Thoughts

The work contained in this ELP allowed me to design, develop, and deploy the first version of the CEHD-DSS. The CEHD-DSS was designed using an evidence-based approach while working directly with end users to produce a system that can be deployed immediately. I am proud of the CEHD-DSS, and I am excited to continue developing it to increase its capabilities. I am proud of my development as a leader, partner, and scholar over the course of the Ed.D. program. I have gained knowledge, new skills, and new campus partnerships because of this work which will strengthen my leadership in CEHD.

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APPENDIX A

LITERATURE SYNTHESIS: THE EVIDENCE-BASED RATIONALE FOR IMPLEMENTING A DECISION SUPPORT SYSTEM

Introduction

Decision-making can be complex in any industry, and higher education is no different. Some decisions are routine while others may have long-term consequences. At the University level, decisions are made around how large the incoming class should be, what the tuition rates should be, how many new faculty can be hired, how much financial aid to award, and how to allocate funds across the organization. At the college and department level, Deans and Chairpersons make decisions to ensure student and faculty success, raise donations from alumni, evaluate existing programs and investigate new and exciting majors.

As more leaders start to focus on data, the requests to provide those data continue to grow annually. Internal stakeholders are interested in obtaining data that may impact their decisions from incoming class size, faculty hiring, space allocations, new program development, and tenure-related decisions. External stakeholders including families, lawmakers, and donors are looking for data to inform them ahead of making a commitment to enroll or invest resources.

Access to accurate and reliable data could be essential in decision-making, but having that access is not guaranteed. Data to make both simple and complex decisions

are often located across multiple sources and may require multiple people in order to retrieve the information. These hurdles often force Chairs and Directors of academic units to create shadow systems and other workarounds. These alternate systems typically do not allow for easy reporting or integration with other data.

Having a system capable of on-demand access to data would allow leaders in CEHD at the university a method to more readily access data to support their decision-making. Literature has suggested that higher education has been slow to adopt these types of systems for several reasons including resource allocation, culture, data literacy, and concerns over adopting innovations. Furthermore, those institutions that have adopted systems have experienced multiple barriers in their design, implementation, adoption, and use. Their experiences can inform ours as we move forward.

Data-Informed or Data-Driven Decision-Making?

Initially, I searched for literature on data-driven decision-making, but I found researchers describing systems for data-informed decision-making. For the purposes of this paper, I will use the term “data-informed” as it evokes the concept of using data as a piece of the decision-making process where “data-driven” suggests (at least to me) that decisions are made purely based on the data.

Decision-Making in Higher Education

With the sheer number of decisions that need to be made in an organization as complex as an institution of higher education, a reasonable assumption would be that leaders in those organizations routinely rely on data to inform their decisions.

Research has suggested that data are becoming more widely used in higher education, but not to the level one would assume in 2022. Higher education is steeped in long-standing traditions and intuition, history, and anecdotes have long been staples in decision-making. Bonabeau (2003) found that despite the uncertainty of relying on instinct, especially in high stress situations, 45% of higher education leaders still rely on instinct over data. And while relying on instinct is typical human nature, there lies a significant level of risk and can lead to groupthink, failure to see alternative solutions and missed opportunities. As Green and colleagues (2011) found, the 2011 *Inside Higher Ed* survey found that only 36% of college presidents and 31% of provosts reported that their institutions were very effective at using data to inform decision-making. More recently, the 2017 American College President study revealed that only 11% of college presidents ranked using data to inform decision-making in their top five concerns for the future (Gagliardi et al., 2018).

Goldstein and colleagues (2003) described several factors impacting higher education including declining enrollments, decreased state support, and increased financial aid. Almost twenty years later, the headlines are similar. Higher education is faced with enormous challenges from the COVID pandemic, rising costs, political pressure, and affordability, and these pressures are forcing leaders to be more proactive. Higher education in America was sharply criticized in the 2006 Spellings Commission Report as failing to respond to globalization pressures, changing technology, changes in demographics and significant changes in the marketplace (Miller et al., 2006).

Having data to inform decision-making is not only important for administrators, but also prospective students. Students searching for a college or university to attend have thousands of choices available to visit online. Not presenting the necessary data to support a prospective student's decision may send that prospective student to another website within seconds. When deciding which higher education institutions to consider, students and their parents are looking to purchase (or incur significant levels of debt to purchase) an expensive service. Having as much information as possible when making that decision is essential.

Research by Moogan and colleagues (1999) found that since these higher education services are intangible, the quantity and quality of data available to the students and parents was often disappointing or non-existent. Participants stated the number of choices of universities, the issues of living away from home for the first time, the social life at the university and the lack of assistance in making these decisions made the process extremely difficult. Their research found that 55% of participants found gathering information to make their decision was complicated.

The Moogan et al. (1999) work was done nearly twenty years ago. Since then, advances of the Internet have significantly changed the way prospective students seek information and make decisions around higher education. More recent research by Meyer and colleagues (2021) explores the concept of choice sets and the importance of having information available to students as they form these choice sets. Their findings reveal perceived quality of the education, cost, prestige, and availability of financial aid were all important factors in their decision-making.

Postsecondary institutions were called out in the Spellings Commission report in 2006, for the lack of accountability mechanisms and the failure to provide accurate information regarding the cost of and quality of higher education. The report highlights that in the consumer-driven environment, students and their families are most concerned with outcomes, not the status, prestige or reputation of the institution (Miller et al., 2006). Despite this, the 2017 American College President Study revealed that only 12% of higher education presidents saw the use of data at their institutions as a top priority (Soares et al., 2018).

Facing declining enrollments and increased competition for students, all these data points can easily be presented on college websites to support prospective student's decision-making. A more informed *prospective* student may one day become an *enrolled* student at an institution who was able to provide the data and information that was needed to make a choice.

Data Analytics in Higher Education

Although briefly defined in the definitions section at the end of this paper, I think it's important to expand on the differences and similarities of the terms learning analytics and academic analytics. These terms on the surface may seem to be describing the same thing, but literature suggests they are distinct terms that are all connected and for the purposes of this work, it's important to understand the differences.

Learning analytics in the broad sense is the use of data and analytics to focus on the learner and the learning process. The data collected includes information about the learners, the teaching materials, and the learning context. To put it succinctly, learning analytics uses data analysis for the purpose of enhancing learning and teaching (Nguyen et al., 2020). The Society for Learning Analytics Research (“What is Learning Analytics,” n.d.) lists several goals of learning analytics in order to provide some context around the concept. These goals include supporting student development; personalized learning and feedback; skill development; and supporting quality learning. Data sources for learning analytics include educational background, student characteristics, and academic performance and uses this data to support decision-making around teaching, learning and management.

First defined in 2005 by Goldstein and Katz, academic analytics (often referred to as business intelligence in the corporate world), uses data to guide decision-making in higher education institutions. The use of academic analytics provides administrators and policy makers data to help with larger institutional issues including strategic planning, operational key performance indicators and financial planning. Academic analytics provides data to inform both internal and external stakeholders and can give insights on metrics such as student success, operational efficiencies, and overall institutional management.

Research in the area of tools for financial and operational data-informed decision-making in higher education is limited. There is a wealth of research done in

the field of learning analytics - the data that comes from systems like Canvas, Sakai, 360Learning among others. Some of the common variables in learning analytics include student grades, attendance data, level of participation and engagement, student progress, and course enrollment. These data can inform faculty and department leaders on how students are doing and whether changes in curriculum are needed. The research surrounding academic analytics is more limited.

Data Dashboards and Decision Support Systems

Data dashboards and other decision support systems are becoming more widely used in higher education. The data dashboard, a type of decision support system, is a business intelligence tool that typically displays key performance indicators (KPIs) for a given organization. Dashboards usually include the ability to drill down to more granular levels of data, have visualizations (e.g., charts, graphics, gauges) for easier understanding of the data, and allow users to take large data sets and make them more navigable and useful. These dashboards are typically built on data warehouses which bring together data from numerous sources throughout the organization allowing users to combine data from different areas. These dashboards are intended to allow the user to filter out extraneous data and get to the data they need to help support their decisions. Furthermore, these dashboards are often able to be customized to further enhance the user's experience. Dashboards can be designed to not only reflect current and historical data but can also include simulations of what-if scenarios for predicting future states. Having systems to enable leadership to run

multiple scenarios will support a nimble organization when dealing with changes in the environment.

Data dashboards and data visualization are used widely in numerous industries including business, entertainment, medicine, and engineering but their use in higher education seems to be less frequent (Modh et al., 2010). With the increasing need to make quick decisions that often require up-to-date data, using dashboards in higher education might improve efficiencies. However, McCoy and Rosenbaum (2018) noted the lack of empirical research on the impacts of using dashboards in higher education.

Harel and Sitko (2003) provide a useful analogy: you wouldn't drive a car without looking at the dashboard to gain valuable information about how the car is operating. Leaders should have easy access to data to assist in 'driving' their units. They outline multiple reasons why digital dashboards are essential including: setting performance goals and tracking indicators, spotting trends, identifying, and correcting problems, and identifying operational efficiencies.

With these seemingly obvious benefits, why aren't dashboards used more in higher education? Dashboards are typically being designed by central Information Technology and Institutional Research departments, and not necessarily with the end users' needs in mind. This causes the end users to either not use the dashboards at all, or they tend to create personal systems to meet their data needs (McCoy & Rosenbaum, 2018).

Creating a dashboard is not as simple as putting five charts on a screen and declaring the project completed. The Institutional Research and Information Technology departments are key in the design and implementation of the dashboard. McCoy and Rosenbaum (2018) found that despite the attempt to provide end users with real-time data based on institutional metrics, users often employed personal systems to track and report unit level performance. In their study, participants reported that the dashboard data wasn't always accurate, and they didn't trust the data. This led to non- or limited use of the centrally-designed systems for decision-making purposes.

Some institutions of higher education who have provided externally facing dashboards for public use include Cornell University, Purdue University, University of New Mexico, and University of Texas at Austin. These sites provide external users with admissions and enrollment information, student body composition, workforce information, research awards and expenditures, and in some cases, high level budget data among other data points. These dashboards enable the user to filter by year, by campus and other metrics to drill down to the desired information. Management dashboards which provide more specific information require University logins. The University of Delaware provides external users with some static pages on research expenditures, enrollments, and a high-level overview of finances. None of these pages are interactive to provide a more robust experience for the user including the ability to answer questions on their own.

Barriers to Data-informed Decision-Making in Higher Education

The research has been consistent in describing multiple barriers to using data to inform decision-making in higher education. Four main barriers have emerged from the literature reviewed: adoption of innovation, data literacy, resources (technology, financial, personnel, training), and organizational culture.

Adoption of Innovation

Use of decision support systems to inform decision-making is an innovation and may represent a significant change in the way end users perform their jobs. Many factors go into determining whether innovation will be adopted. Is there value? Will this make the organization better? Will it be too difficult to learn? Will it work with my existing practices, or do I have to start from scratch? Researchers who have studied the adoption of data support systems have found mixed results on the adoption of the innovation.

Gagliardi and colleagues (2018) employ the term “harnessing” when considering the vast amount of data available to higher education institutions and how they can effectively use it to better meet the needs of students, faculty and staff. They state that institutions can achieve benefits if the data are accurate, timely, relevant, secure and well-integrated. Isik and colleagues (2012) reached a slightly different conclusion. While user access and integration with other systems was essential for success, they found that the quality of the data was not as important as they hypothesized. Participants in their study suggested that data is “good enough” and when there’s a focus on data quality, users felt the flexibility was diminished. In other

words, to maintain levels of flexibility in the system, they would tolerate less accurate data.

Researchers have explored factors that lead to the adoption or rejection of data support systems. They found that when these systems are designed by central offices without end user input, there was a lack of trust in the data, department level data was missing or inaccurate, or the system didn't align with their current practices. However, due to external constraints (i.e., funding) many users felt they had to use the system whether they agreed with the utility of it or not. Users may also choose to adopt the innovation based on their levels of perceived usefulness and how easy (or difficult) the system is to use. Users will adopt a new system even if it's difficult to use if it provides significant usefulness, however, even if the system is easy to use, if users don't find it useful, they will reject it. Adoption of a new system will be hindered if users receive inadequate training, little or no support, or the system lacks the necessary data. Finally, adoption of innovation may rest upon how involved the end users were in the development and implementation and how much support they receive once they begin to use the system. (Cook, 2002; Davis, 1989; De Laet et al., 2020; Kayanda et al., 2020; McCoy & Rosenbaum, 2018).

The literature shows that a haphazard approach to introducing a new decision support system will likely lead to unwanted outcomes. Listening to end user's specific needs, providing proper training support and following up with users after system implementation may lead to a more successful outcome.

Data Literacy

Data literacy describes a user's ability to read, understand, analyze and interpret data. The data can be presented in many formats including raw data, tables, charts, graphs, and infographics. Presenting data to an audience in a format that can be easily understood is both a science and an art. To avoid intimidating the end user, getting it right can be difficult. Data can be intimidating to users and can be difficult to navigate. Leadership may not know what data is available, what data they need or how to access the data. Assessing the level of data literacy of the user is essential in creating a data support system. Data given to end users with low levels of data literacy may be misinterpreted or misunderstood and can lead to severe consequences.

One element of data literacy is the visual presentation of data. There are thousands of ways in which one can represent data. Bar charts, line graphs, column charts, pie charts, scatter plots are just a few common visualizations. Choosing the correct visualization is an essential skill to give the end user the best opportunity to interpret the data. Ensuring the user of the data visualization truly understands what the graph or chart represents is imperative to avoiding misinterpretation of the data. If the visualization is developed using poor logic, there's a high risk of making poor decisions (Harel & Sitko, 2003). Donohoe and Costello (2020) suggest the ability to interpret data visualizations is just as important as reading and writing. They concluded that users often felt data visualizations were useful, but they didn't always know what the purpose of the visualization was.

With the billions of data points that are available, it is important to know what the data mean and how to use them. If users do not understand the types of data

available, benefits and limitations of the data, and the relevance of the data, they may use the data to make incorrect decisions (Gill et al., 2014). Mueller (2018, p.3) describes the “gaming of metrics” and “metric dysfunction” and how just because something can be measured, it’s not always worth measuring nor does it necessarily answer the question at hand. He also warns that focusing on the numbers can lead to simplification if the context and meaning are not also considered. Comparing two entirely different academic departments (for example Art History and Engineering) purely based on the head count of students and faculty and the number of credit hours taught can lead to distorted conclusions.

Donohoe and Costello (2020) conducted a study to understand perceived and actual data literacy of the users of a decision support dashboard at a higher education institution in Ireland. In their mixed methods approach, they tested participants' perceived data literacy skills compared to actual data literacy skills, the perceived usefulness of the dashboard tool and perception of their peer’s ability to interpret the data visualizations.

If everyone looks at the same simple line chart, they will all come to the same conclusion, right? Researchers have found that this is not the case as we all have cognitive biases that shape how we view the world. We are influenced by several factors when viewing that line chart. Our level of education, experience in interpreting graphs, perceived usefulness of the chart, and other cognitive biases all contribute to the conclusions we may draw from the chart. Human nature also relies on heuristics

and approximations when making decisions and those may be influenced by our cognitive biases (Donohoe and Costello, 2020; Dimara et al., 2018).

Overcoming the data literacy barrier will depend on many factors including the willingness of the users to learn and understand the data, the resources available to navigate the system, and the level of empathy of system designers and experts to guide new users.

Resources

Whether or not researchers agree with the need for a data-informed decision support system, one thing that is consistent is the need for proper resources to design and implement the system. These resources include personnel to design and implement, the cost of purchasing and maintaining software, and the cost of training end users.

In the 1990's higher education institutions collectively spent \$5 billion on implementing enterprise resource planning (ERP) systems in the areas of student, finance, and human resources. Despite the extraordinary amount of money spent on these implementations and the expectations of what the system could provide, the systems failed to deliver the reporting capabilities desired by the users resulting in the need for additional infrastructure (Kvavik et al., 2002)

Researchers found that many institutions have significant stores of data, but they don't optimize this resource. They note that the data are not well connected and suggest the lack of infrastructure is at fault. This poorly connected data leads to inefficiencies and data analysis errors. They argue that the proper investment in data

infrastructure and the personnel to implement and maintain it is essential, yet many campuses fail to do so. They argue that the development and maintenance of hardware and software is essential as is the initial design of the system. Research highlights the need to establish linkages between data sources, create simplified data collection mechanisms, provide training, and ensure data integrity are critical to the success of data-informed decision- making (Gagliardi et al., 2018; Gill et al., 2014; Gagliardi and Turk, 2017).

Another tangible resource to be considered is the Office of Institutional Research and the Office of Institutional Effectiveness. Leimer's (2012) research found that there was a considerable growth of these campus offices over the period from 1995 to 2010 and that there was no consistency in the naming of the offices. For reference, at the University of Delaware, we have the Office of Institutional Research and Effectiveness. Leimer found that these offices are essential in analyzing and interpreting the multiple data sources at a higher education institution, but they also serve a culture-change function. Despite the need to have expertise in institutional research to analyze these large, disparate data sets, in her research she found the offices to be largely understaffed and underfunded.

While many would consider the tangible resources needed for success of a decision support system, there are intangible resources that should be considered as well. The culture of an organization is an intangible resource that is often overlooked but Gill and colleagues (2014) stress the importance of strong leadership, accountability, and promotion of data sharing and use as part of the culture is as

essential as the system itself. They argue that being in a data-driven environment is not just having effective infrastructure but also the ability to provide data that is relevant and useful to the decision maker.

Having a strong data governance structure is another critical intangible resource that is often overlooked or not properly utilized. Data that is misused due to poor data governance often leads to mistrust in data and the adoption of systems. Misused data can also lead to false reporting to stakeholders, claims of propaganda (e.g., subjectively reporting admissions data to raise a profile) and the use of data for unintended purposes. Poor data governance opens the institution to data breaches which can expose sensitive data of thousands of students and employees to hackers (Mathies, 2018).

Tackling the resource barrier will take commitment from multiple stakeholders in the institution. Leadership will need to embrace the use of data in making decisions and provide the proper resources in the form of personnel and technology. Recognizing that users have different needs, resources will need to be invested in possibly providing multiple learning aids like on-demand videos, reference manuals with screenshots of the system and data dictionaries. Skimping on these training resources will cause frustration throughout the organization and lead to rejection of using data.

Culture

Even if an institution has the interest in adopting an innovation, has an adequate level of data literacy, and has committed to the proper level of resources, if

the culture of the organization is not ready to make the change to a data informed environment, leadership will face an uphill battle. “Culture eats strategy for breakfast,” often attributed to management consultant Peter Drucker (Wokurka et al., 2017), is a widely-used phrase suggesting that the culture of the organization is going to be the driving force for success regardless of the strategies taken by the organization. While strategy should not be considered unimportant, it’s imperative to consider the culture of the organization when implementing a data-informed decision-making system. Research in the area of data-driven decision-making is revealing the importance of the culture of the institution in whether the tools provided will be accepted or rejected.

The 2017 American College President Study revealed that only 12% of higher education presidents saw the use of data as a top priority (Soares et al., 2018). However, the same report also found that innovative higher education leaders embrace decision-making based on empirical evidence rather than anecdotal evidence. Researchers emphasize the impact of culture when introducing data-informed decision-making. They stress the importance of leadership to embrace the use of data and to create a collaborative model of using data in the decision-making process. Using empirical evidence allows leadership to better determine how to strategically move the institution forward. Researchers also suggest that when the culture of the organization is of an evidenced-based mindset, they instinctively seek out data to help support decisions, but it takes strong leadership to instill this type of culture (Gagliardi et. al., 2018; Leimer, 2012).

In a large study conducted by Goldstein and Katz in 2005, they found that most participants agreed that the use of academic analytics was beneficial to the organization. They reported that there seemed to be a sense of providing a competitive advantage, improving decision-making, and helping meet strategic objectives. So why aren't all higher education institutions actively embracing the use of data in making decisions? Mueller (2018) describes the suspicion that comes from metrics and the concern that relying on numbers will replace the subjectivity and experience-based judgement used for decades. Gagliardi and Turk (2017) found similar results around the fears of misuse of data leading to rejection or delay in implementing data systems. They noted that the demand for data has "revealed some inconvenient truths" in higher education institutions but despite the demand for information, data-informed decision processes are often met with skepticism and concern. Faculty and other administrators question the use of data and the underlying motives. Are administrators trying to cut my program? Will the data reveal something that will lead to job cuts? Will they use the data to significantly change how I teach my courses?

Mueller's (2018) *The Tyranny of Metrics* describes "metric fixation" and quotes Tom Peters' motto "What gets measured gets done." He notes that despite the unintended negative consequences that may follow, these beliefs may permeate organizations. Those negative consequences include the fact that data can replace judgement if too heavily relied upon, making data available to the public automatically makes an institution accountable and transparent, and data may motivate people to seek rewards or avoid penalties.

Understanding concerns that users may have with the use of data will need to be addressed prior to the development of the system. Being empathetic to the user's concerns will help shape the culture to see the benefits of how using data can strengthen their decision-making. Having insight to any hesitation around using data will allow the design of a system that will be more widely accepted. Without buy in from all levels in the organization, the project may be doomed before it even starts.

Reasons to Consider a Decision Support System

While these barriers may seem insurmountable at first, with careful consideration put into planning and implementation of a data-informed decision support system, many of these hurdles can be cleared. The benefits of introducing a decision support system include on-demand access to data, consistency and trustworthiness in the data, more efficient decision-making, and the ability to more easily monitor daily operations of the unit. And for any one of these benefits - it's worth overcoming the potential barriers.

At the University of Delaware, the data are available. Unfortunately, they are not in one place that is easily accessible to college leadership. Data are housed formally in multiple systems across campus and informally on desktops. The challenge moving forward is to determine what system (e.g., Excel, Power BI, Tableau) will be the most effective way to access the data while maintaining confidentiality. At the University of Delaware, we are currently implementing Tableau, a data analytics platform and data visualization tool that allows users to see and understand data pulled from multiple sources. Tableau, once more data is

available and users are given training opportunities, will be a powerful tool for having data at the fingertips of the users.

The introduction of a new decision support system to college leadership is a unique opportunity to design a system from the bottom up that is customized to the needs of the college. With that, it will be essential to determine the needs and wants of leaders in the college and find the best way to deliver. Leaders will need to determine if they simply want a snapshot of the data or whether they want the power of predictive analytics. Do they want a self-service model where they can go into a system and run the data or simply have a report delivered to them?

I have an overall vision for this system in mind. The snapshot will be as it sounds, a static dataset (or picture) that is easy to produce and will not change over time. It can be an ad-hoc report, a scheduled report on the first of every month, a report compiled after month-end processes are completed, or a cumulative report of multiple years. The data provided can be summarized in a chart or table and provided quickly to leadership. Depending on the availability of the data, these reports can be created in a relatively short time with a minimal level of effort by a college data analyst. This snapshot approach is something that can be done easily assuming leadership agrees upon the timing of the reports, data needed, and that the data are readily available. The technology needs are minimal, and they are easily accessible by nearly all campus employees.

If multiple snapshots are needed, we can create a data dashboard. This dashboard can be a combination of multiple static visualizations to allow the leader to

have a tool to quickly see the data. These visualizations could include data such as year-to-date research expenditures, year-to-date student applications and admissions or department budget data. This report could be produced monthly and simply requires the college data analyst to run data, update pivot tables and share the report. The report can then be delivered to each unit's leader. The technology, like the individual snapshots, can be as simple as excel and is easily accessible.

If static dashboard snapshots are not adequate for leadership, the next step would be the development of a dynamic dashboard. This adds a layer of complexity as data security and data literacy must be considered, but with proper planning, these complexities can be managed. These dynamic dashboards can be created in a tool such as Microsoft Excel and can be housed on a shared drive. The college data analyst can update the underlying data tables at the determined time intervals and the user can access the shared drive to use the dashboard. The adoption of the dynamic dashboard will depend on the tolerance of the user of this more complex tool. Understanding the data literacy of the users will be essential in the design of the dynamic dashboard. This will help ensure the data is being interpreted correctly.

The balance between complexity and flexibility will be essential in determining the best system to implement. Regardless of the method chosen, it will be important to balance reporting needs along with the technology that is available and accessible. Tableau will allow the users to access multiple data sets in a highly sophisticated tool. Until Tableau is more widely available, there will be limitations due to the systems (e.g., Excel, Power BI) that are currently available to most users.

Development of a system in the college should not be delayed until Tableau is more widely available as it is uncertain when leaders will gain access. Developing snapshots and static or dynamic dashboards now will allow us to determine data needs and build data literacy and then be able to harness the power of Tableau in the future.

In implementing the chosen method, it will be critical to accurately understand the data needs of the users. We would not want to get into a situation where we have developed a solution that does not help answer the questions being asked. In other words, let's not define a solution and then try to find a problem to apply it to. At the University of Delaware, there are hundreds of data categories available. In the design of the reports, end users should understand the potential limitations in either accessing the data or linking the data and should resist the temptation to ask for all the data.

Attempting to link unlike data or having too much data may lead to incorrect reports or conclusions. A resource manual including a data dictionary will be critical for the users. The resource manual should include screenshots on how to access the data to ensure users can be somewhat self-sufficient. The data dictionary will give users a reference guide to what each data point means. Without the data dictionary, a user may struggle to understand the meaning of the data and make inaccurate decisions.

Lastly, when designing the snapshot, static, or dynamic dashboards, it is essential to consider the following questions: How do you choose the correct chart or visualization? What steps will be taken to ensure the charts are conveying an accurate message? What is the preferred tool for users to access the data and charts? Are the

visualizations/data being used to make a decision or are they being used to support an already-made decision?

As our data use matures, the data modeling can become more sophisticated. Early versions will likely focus on descriptive and diagnostic analytics. These data are retrospective in nature and while they can provide information on trends and point-in-time metrics, they are limited in how they can be used. Descriptive statistics will give us the facts: How many students enrolled in EDUC100 in Fall 2020? What percentage of HDFS students are from Delaware? What has been the enrollment trend over the past 5 years? How has our research portfolio changed over the last five years? Once the college is comfortable with descriptive and diagnostic analytics, efforts should be made to move to using predictive and prescriptive analytics. These types of data analytics provide insight and foresight to help the organization move toward strategic goals and help answer questions like: What factors increase a student's chance at success? Which students have the best chance of graduating in four years? Which students are at risk for dropping out? Which students are most likely to enroll in our programs? A data informed system combining descriptive statistics with predictive analytics has the potential to lead to deeper insights and more informed decision-making.

Implications for the College of Education and Human Development

The discussion above gives a general landscape of data informed decision-making in higher education institutions, but it is also important to see how the College of Education and Human Development can utilize data informed decision-making.

The University of Delaware implemented a new budget model in FY2020. This budget model is complex and navigating it relies heavily on being able to digest and analyze a large amount of data. While most of the budget model work for the college will be in my role as the College Business Officer, being able to provide access to the data to chairs and directors will make the annual budgeting and projections process more streamlined. Ensuring chairs and directors having the data literacy to understand the financial data will be critical.

Among the numerous certifications held in the College of Education and Human Development, is the Council for the Accreditation of Educator Preparation (CAEP) at both the initial- and advanced-level standards in the School of Education. Holding accreditations signals that the programs have undergone both self-study and external review to assure quality of the programs. Students, faculty, state agencies and other stakeholders look for accreditations to bolster confidence in the programs (“Why It Matters,” n.d.). The reason I introduce accreditation in a paper about data informed decision-making is the fact that the CAEP advanced-level standards include numerous mentions of data use, data analysis and data literacy. CAEP Standard A.5.3 addresses the requirement of the provider to regularly assess progress toward goals and improving processes. CAEP Standard A.5.4 especially highlights the need for using data. It requires that the provider (CEHD) measures outcomes, benchmarks and analyzes the data. The standard also states that the outcomes should be shared widely which would be an opportunity to utilize an external-facing dashboard. Finally, Standard A.5.5 requires that a variety of stakeholders are involved in program

evaluation and improvement. (CAEP, “2013 CAEP Standards,” n.d.). All these standards could likely be supported by a data support system. Not only would a data support system aid internal staff and faculty in the completion of accreditation paperwork, but the system could have an external component to share outcomes with a broader audience and aid external stakeholders in their participation in program evaluation and improvement.

The School of Education is also accredited by the National Association of School Psychologists (NASP). Like CAEP accreditation, having NASP accreditation is a strong signal to potential applicants, faculty and other external stakeholders when assessing the quality of the program. As part of the ongoing improvement and annual data reports process, accredited schools are required to provide several metrics including student financial support, applications, enrollments, and internship data (“National Certification,” n.d.). A lot of these data are available in UD systems, but it is possible that personal systems are kept to avoid using the various reporting tools to access the information. This is another example of how the School of Education may benefit from having a data support system.

At the time of writing this paper, the University of Delaware is undergoing the self-study phase of the Middle States Accreditation process. Under Standard 6: Planning, Resources & Institutional Improvement, draft recommendations include expanding data access and improving data management to be used in decision-making and policy development. While this document is still in draft form, considering that data is not mentioned in the current strategic plan, this is a step in the right direction.

As the tools (e.g., Tableau) and data become more accessible, I will be able to lead the college in mining the data to aid in decision-making.

External stakeholders have easy access to find out information online and can choose to rely on one or multiple resources in making decisions. One resource they can use is the Delaware Department of Education (DDOE) scorecard (“Educational Data for Delaware Citizens,” n.d.). This resource gives a score to teacher preparation programs in the state of Delaware. Looking at the UD Bachelors in Elementary Teacher Education program, a stakeholder may perceive UD in a negative light considering the scores provided by DDOE. However, the source of the data used is not clear and the user has to assume that the data are correct. Developing an outward facing dashboard on the UD School of Education website with similar metrics could allow stakeholders to have multiple perspectives to assist in making conclusions about a program.

Conclusion

While higher education institutions may be implementing decision support systems slowly, there are still barriers to their use. The benefits of using data provide a compelling reason to implement these systems to *inform* (not *drive*) stronger decisions around enrollment management, streamlining operations, employing predictive analytics, and a number of other critical areas. Designing, developing, and deploying a decision support system where end users are comfortable understanding and using the data will ultimately lead to more informed decision-making.

Definitions

For the purposes of this description, I will use the following terms.

Academic analytics: data analytics to support operational and financial decision-making in higher education (van Barneveld et al., 2012).

Academic Information Systems (AISs): the use of systems and infrastructure to organize and process information in higher education (Kayanda et al., 2020).

Analytics: using data and analysis to inform on complex issues (Reeves & Pearlman, 2016; van Barneveld et al., 2012).

Business Intelligence (BI): combinations of data, infrastructure (organizational and technology) and best practice to support and improve decision-making using fact-based systems and increase organizational performance (Donohoe & Costello, 2020; Drake & Walz, 2018; Isik et al., 2013).

Cognitive bias: systematic and involuntary attempt by the human brain to simplify information processing often deviating from reality (Dimara et al., 2020).

Data dashboards: collection of data visualizations and other data formats (e.g., tables) to highlight critical institutional information for decision makers and external stakeholders. These dashboards may be static or dynamic (McCoy & Rosenbaum, 2018).

Data governance: the processes, policies and people responsible for ensuring data quality and integrity (Mathies, 2018).

Data literacy: the ability to understand and use data to critically examine a problem and make a decision (Lasater, 2020).

Data visualization: a display of data in a graphical format to communicate information to the user (Drake et al., 2018).

Data warehouse: centralized database bringing together multiple data sources

Decision support systems (DSS): systems built to capture, store and analyze data to assist in the decision-making process and resolve problems (Bresfelean & Ghisoiu, 2010).

Learning analytics: using data analytics targeting instruction and curriculum to understand and enhance learning and teaching (Nguyen et al., 2020; van Barneveld et al., 2012)

Predictive analytics: using data to find relationships and patterns to predict future events (van Barneveld et al., 2012)

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APPENDIX B

COMPARISON OF DATA USAGE AND DECISION SUPPORT SYSTEMS ACROSS FOUR INSTITUTIONS OF HIGHER EDUCATION

Artifact Purpose and Place in Broader ELP

The purpose of this artifact is to report the results of a qualitative study to explore data usage, data systems, and data accessibility in three higher education institutions in the mid-Atlantic region. The results of this study may inform the design, development, and deployment of the College of Education and Human Development Decision Support System (CEHD-DSS).

Introduction

Access to data can enable leaders to make more informed decisions. On-demand access to these data can bring a sense of autonomy for the leaders with less reliance on others to provide the data. Once leaders have access to these data, they can use them for many reasons, from understanding trends in student enrollments, research activity, reporting key metrics to stakeholders, or developing marketing materials for prospective students. The College of Education and Human Development (CEHD) does not have a simple way for leaders to access data. Our data are spread across multiple systems and are cumbersome to bring together. My education leadership portfolio (ELP) aims to develop a Tableau-based decision support system to allow end users easy, on-demand access to data. The purpose of this study was to query three

academic institutions in the mid-Atlantic region of the United States to understand how they access, deliver, and disseminate data to leadership and consider whether those methods will yield ideas for the CEHD-DSS.

Key Questions

This study aimed to determine how data are used, accessed, and disseminated at the sample institutions. For this study, there were three key questions that I asked the participants. The key questions were (1) What are your top 3-5 business questions that you or your leadership team need data to answer on a regular basis? (2) Are you able to access the data that you need? If so, how? (3) Can you describe what the ideal decision support system would look like and what data it would include?

Methodology

A sample (n=3) of college business officers from three mid-Atlantic universities were recruited to participate in this single-group qualitative study to answer the key questions. The research was a cross-sectional study conducted in October 2022.

Sample of Participants

This study's purposive, convenience sample included three college business officers from three mid-Atlantic universities (n=3) who were known to me through business networks and have similar positions to mine. An email was sent to each individual with a brief description of the study and a request to participate in a semi-structured interview. All three business officers accepted the invitation to participate. The participants have an average of 13 years of experience in higher education and

have been in a business officer role for an average of seven years. Each business officer works in a college which is part of a larger university. The participant's job duties are like mine in that they oversee the business operations of their colleges and include oversight of financials, facilities, information technology, contracts and grants, and other units in the college. The selected sample institutions operate under decentralized budget models. All participants report directly to the dean of their respective colleges.

The University of Delaware (UD) has engaged HelioCampus as a partner in the development of our business intelligence enterprise, and from the sample institutions, one is also partnering with HelioCampus (HelioCampus, 2022). This comparison is made to understand similarities in the approaches to business intelligence solutions under the same consultant compared to institutions not using HelioCampus.

Data Sources and Data Collection Procedures

After accepting the invitation to participate, each participant was contacted via email to schedule a 45-minute interview via Zoom and provided with a consent form. A Zoom link was sent once an interview date and time were established. A semi-structured interview was conducted over Zoom, with each participant answering the same 12 interview questions are listed below.

- In broad terms, what data systems do you use at your institution?
- How do you utilize these systems?
- How do you get data to leaders in your organization?

- What are your top 3-5 business questions that you or your leadership team or supervisor needs data to answer on a regular basis?
- What specific types of data do you or your leadership team or supervisor need to make decisions in your area?
- Are you able to get the data you need? How?
- Are you satisfied with the data and reports that are available?
- Are the data you have access to complete, reliable, and current? How do you know?
- Do you primarily use data for internal reporting needs, or do you also report to external stakeholders? Are there differences in the amount or type of data you need?
- Do you have data dashboards in your college? And if so, who has access to them and who maintains them (central or college)?
- A decision support system would be a computer-based system which brings together multiple sources of data to assist with more informed decision making. These decision support systems may include data visualizations and the ability to download data for additional analysis. Can you describe what the ideal decision support system would look like and what data it would include?
- Are there any current initiatives at your institution to make data easier to gather and use?

The average length of the interviews was 42 minutes. The semi-structured interview method was chosen so each participant could answer the question posed and add additional information as desired. The additional information could provide insights that I had not considered when constructing the questions. The two-way

communication of the interview allowed for a back-and-forth conversation to delve deeper into decision support systems and data usage at their institutions.

Data Analysis

Once the interviews were completed, the responses from each participant were transcribed into an Excel document with each statement on a separate row. The responses were read to ensure familiarity with the data. The data that were not focused on the questions asked were deleted. An integrated approach of inductive and deductive coding was used to categorize the data. Five deductive codes were established based on previously reviewed literature. The deductive codes were data accessibility, satisfaction, reliability, dissemination, and usage. The transcribed data were first reviewed, and all possible data were coded into the deductive codes. For data that could not be included in the deductive codes, inductive codes were added and defined. All transcribed lines of data were reviewed and sorted into the combination of inductive and deductive codes. After the second round of coding, all the responses were reevaluated to see if any additional inductive codes applied to the response. Finally, each line of data was reviewed one final time to ensure the coding was thorough. Excel was used to aggregate the number of responses for each code and pivot tables were created to show the frequency of the responses. A thematic analysis method was adopted to identify patterns in the data. The deductive and inductive codes were grouped into themes to aid in the data analysis. Six themes evolved from the analysis of the interview data: technology, reporting, data types, data accessibility, data reliability, and data satisfaction.

Methodological Limitations

There are potential limitations to consider for this study. One limitation of the study is the sample size. The small sample size provides me with a manageable sample considering time limitations. However, a future study should include a larger sample to make the findings more generalizable. A second limitation is the nature of the participant's job duties. A future study should consider including representatives from institutional research offices or information technology as they are often the departments that establish decision support systems on campuses. A third limitation was that the analysis was conducted solely by me without another research team member coding the same data and without member checking. This limitation may lead to reliability concerns. A future study should utilize triangulation methods to increase reliability. Finally, after analyzing the data, I realized I should have included a question on data literacy. One respondent mentioned the end user's data literacy and having that information from all respondents would have made for a richer data set.

Findings

Six themes evolved from the analysis of the interview data: technology, reporting, data types, data accessibility, data reliability, and data satisfaction. The findings for each theme are discussed in this section.

Technology

UD uses PeopleSoft enterprise resource planning (ERP) products (Financials, Contracts & Grants, Human Resources), and the study participants use combinations of Banner, SAP, Workday, and Hyperion for their ERP. Like PeopleSoft at UD, the

ERPs can produce standard and ad hoc reports and the respondents indicated that they rely on the ERP query tools. Two of the interviewees indicated that they have data warehouses that include data from the ERPs to be able to run queries. The frequency distribution of software and other technologies mentioned in the interviews is show below.

Software/technology	Frequency
Other software	21
Dashboards	12
Tableau	4

Like CEHD, none of the respondents have college-specific online dashboards or other on-demand systems for leadership to access data. Those with access to centralized dashboards had concerns, including irrelevant data, no input on what data are contained in the dashboard, and the inability to get dashboards at the department level. All the respondents indicated that they have access to Tableau to create dashboards but have not had the opportunity to do so.

Data types

Participants reported a need for financial and student-related data according to these interviews. These data are used to determine current financial status, available funds for new initiatives, student success measures (retention, graduation), revenue projections, financial aid and scholarship planning, progress toward strategic planning initiatives, cost of instruction, and cost of education. Other data types mentioned, but less frequently, were facilities and human resources data. The frequency of these data types is shown below.

Data Types	Frequency
Student	27
Financial	22
Human Resources	15
Courses	5
Facilities	5
Research/contracts & grants	2

While the respondents noted some challenges in getting these data, they suggested that the data they needed were available.

Reporting

To get the required data, all respondents use a combination of standard and ad hoc reports to pull data from various systems (e.g., Banner, SAP, Hyperion). The frequency distribution for reporting methods is shown below.

Reporting method	Frequency
Standard reports	17
Ad hoc reports	16

Those data are then used to populate a template or analyze it in a spreadsheet before presenting it to college leadership. One respondent described the robustness of their financial system, but the reporting mechanism could have been more user-friendly, and there were few pre-written reports available. With this, they often had to rely on others to provide the data. One participant described standard financial reports from the central budget office and the need to review and verify any variances indicated on the report. One participant described needing to run multiple reports to validate data. None of the respondents suggested that they have an optimal reporting

system, and all expressed a desire for significant process improvements. Two of the respondents indicated that they have access to data warehouses for a more centralized repository for data.

The data are used for both internal and external reporting. Internal reporting was primarily for college and university leadership. External reporting included accreditation reports, surveys from professional organizations, and reports to donors. One respondent mentioned a college facts and figures page for external users, while another said there no data are available for prospective students unless those data were required for compliance with regulations or accreditation requirements.

Data accessibility

Data accessibility elicited many responses (n=28) during the interviews. One participant described the difficulty accessing data and the specificity needed when requesting data from central sources. Another respondent discussed the “time and pain” involved in getting the needed data and that it is more burdensome than it should be. While two of the three respondents described considerable challenges with accessibility, the final respondent indicated that they were satisfied with the accessibility at their institution but also noted that they have a staff of data experts who provide most of the information.

Data reliability

Opinions were mixed about data reliability and there were 16 responses that contained data reliability terms. One respondent described a scenario where data for a group of students was allocated to an incorrect cost center. However, fortunately, they

had the proper access to see the error and have it corrected. Absent proper access, those students may have remained allocated to the incorrect cost center resulting in data integrity issues. Others reported reliability issues, including data integrity with transitioning to a new system and the need to run multiple reports to validate the data. Concerns about the accuracy and consistency of some data were mentioned in the interviews. Two participants discussed the need to review student data with program directors to validate the data are in the system and added that it took a lot of work to know which data source was accurate. Despite the need to validate data, there seemed to be consistency in some reports which provided confidence in some of the data.

Data satisfaction

Most of the business officers were not satisfied with the data they could get, nor were they satisfied with the accessibility or reliability of the data. The interviewees mentioned data satisfaction 29 times in their responses. Two respondents discussed the difficulty of finding training on what the data mean and how to interpret it. They expressed concern about how the data may be misused without proper training. One participant who has access to a centralized dashboard described that the data were irrelevant and that there were no campus initiatives to provide relevant information.

Discussion of Findings and Application to ELP

The thematic analysis of the interview data aligns with the processes, issues, and concerns I have in CEHD. The reliance on reports from multiple systems, the need for financial and student-related data, the accessibility of certain data, the questions

over the reliability of data, and the general dissatisfaction with the data are seen at the three sample institutions as well as in CEHD which highlights the need for better systems. On the one hand, I was disappointed that the research findings did not reveal a “magic bullet” system that I could replicate. On the other hand, I felt some relief knowing that it was not “just me” experiencing these issues with data accessibility, reporting, reliability, and satisfaction.

While the findings do not provide a system for me to base the CEHD-DSS, they provide a better understanding of the state of data usage at other institutions and their desire to have a decision support system in the future.

References

Helio Campus. (2022, November 27). Our Clients. <https://www.heliocampus.com/clients>

Appendix C

DATA INVENTORY

The data inventory provides the end users with a description of the data assets that are available for the College of Education and Human Development decision support system (CEHD-DSS). This data inventory is not a complete data set for the University of Delaware (UD) or the College of Education and Human Development (CEHD). It reflects the data sources available for the first iteration of the CEHD-DSS at the time of this writing.

The data inventory was used to design the first version of the CEHD-DSS based on the business questions and data needs identified in the data collection activities of this ELP (see Artifacts 2 and 4). All data models have been filtered to only allow access to CEHD data.

Data Model	Data Availability	Description of Data
Financials	FY2013-current	The PeopleSoft Financial system contains all transactions for all funds (e.g., base budget, supplemental funds, etc.). The transactions can be aggregated based on different time periods (e.g., month, fiscal year). Transactions can be summed or averaged by type of expense, department, purpose code, program type, and fund. Every transaction has a separate line item to allow reporting at a granular level. Line-item transactions include the amount, date,

		reference number, fiscal year, accounting month, account code, purpose code, and other reference details.
Class Enrollment Success Extract	FY2011-present	<p>This data source includes course enrollments, class grades (to capture grades of D, F, and W (DFW)) rates, and credit hours.</p> <p>Sensitive student data will not be made available in the CEHD-DSS. Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p> <p>For example, DFW rates will only be reported in aggregate (not at the individual student level) for courses with more than 10 students.</p>
Cohort Extract	FY2017-present	<p>This data source contains information regarding each cohort of students admitted to UD. Data include applications, retention, term to term persistence, completions, and trajectory of Associate in Arts students pursuing BS/BA degrees. These data are for undergraduate students.</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p>
Faculty Workload	FY2017-present	<p>This data source contains information pertaining to a faculty members workload including a count of courses taught (onload and offload), counts of students taught (onload and offload), counts of credits, students, and courses by term, tuition, and load factors.</p>
HR Official	FY2017-present	This data source includes information

and Daily Extract		<p>about employees including salary, job titles, contract data, demographics, sabbatical history, and tenure information.</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual faculty data will not be provided.</p>
IDOR (Instructor Department of Record)	FY2017-present	<p>This data source includes information about credits taught. The data include academic program, term, year, class number/section, course owner, faculty employee identification number, department that owns the course, student majors, s-contract flag, subject, study abroad flag, and number of credits.</p>
Long Majors	FY2017-present	<p>This data source contains information about students including academic career, demographics, and majors.</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p>
Official Enrollment Extract	FY2017-present	<p>This data set includes student related information. Data include admissions, demographics, and academic program information (e.g., expected graduation term, major(s), minor(s)).</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p>
UD Admissions	FY2017-present	<p>This data set contains information regarding admissions of students. Data include application terms and status, demographics, enrollment status, and calculated yield rates.</p>

		Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.
UD Completions	FY2017-present	<p>This data set contains information related to students including admissions, advisor, degree, enrollment, demographics, academic plans, retention, and GPA.</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p>
UD Course Registrations	FY2017-present	This data source contains details about course registrations including meeting time, course number/section, and faculty employee identification number.
Research Budget/Actuals	FY2017-present	<p>This data source contains information related to sponsored programs. Data include award begin and end dates, department, principal investigator name, budget periods, contract number, sponsor name, proposal identification number, budget, and expenses.</p> <p>These data are not yet validated and will be included in the CEHD-DSS once validated.</p>
Student Degree by Term	FY2017-present	<p>This data source contains information related to student majors, degree(s), demographics, academic career, and ACT/SAT scores.</p> <p>Only aggregate data will be available in the CEHD-DSS. Individual student level data will not be provided.</p>

Appendix D

SURVEY OF COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT LEADERSHIP

Artifact Purpose and Place in Broader ELP

The purpose of this artifact is to report the results of a mixed-methods study of the College of Education and Human Development (CEHD) leadership to explore their data needs and preferences, proficiency with using data, access to data, and data satisfaction. The results of this study, when combined with evidence-based design solutions, will be used as the foundation for the College of Education and Human Development Decision Support System (CEHD-DSS). The initial design of the CEHD-DSS, based on the results of this study, will then be evaluated and refined as a case study as part of this ELP.

Introduction

At the University of Delaware (UD), there is an abundance of data available for leaders to use for decision-making. These data are needed for operational, tactical, and strategic decisions at all levels at the university. Swing and Ross (2016) described the increased demand to get data into the hands of academic department leaders. They suggest that engaging multiple stakeholders across campus in the use of data is critical for success of the institution. However, these data are currently housed in multiple systems making access difficult and time-consuming, and, in many cases, the data are

inaccessible. Bresfelean et al. (2009) described the data environment at higher education institutions and suggested the development of decision support systems to better enable leaders to have efficient access to data. Determining what data leaders need to make decisions is a critical component of designing a decision support system. Converting these data into an organized, user-friendly system may allow users to gain meaningful insights which may then inform more effective decision making within CEHD.

Understanding the data needs of end users is the foundation for designing, developing, and deploying the CEHD-DSS. Success of the CEHD-DSS should be judged by its ability to meet the expectations of those users. Literature has suggested that technology projects deployed without end-user participation and input have a higher failure rate versus the collaborative, end-user focused approach I am taking (Alvertis et al., 2016; Cavaye, 1995; McCoy & Rosenbaum 2019; Wastell & Seward 1995). The purpose of this study was to engage the end users and determine what their needs are before designing, developing, and deploying the CEHD-DSS.

Key Questions

This study investigated what data are needed for the CEHD leadership, how they currently use data, and the extent to which an interactive dashboard system would be useful. There were five key questions. (1) What are the primary business questions that you need data to answer on a regular basis? (2) Are you able to access the data you need, and are you satisfied with those data? (3) Do you maintain shadow systems? (4) If a data system could provide an interactive dashboard where you could filter on

multiple variables, would that be helpful? and (5) How many years of data do you need?

Methodology

To understand the data needs of the CEHD leaders, I conducted a non-experimental, single group, mixed-methods study design. I administered an 11-item on-line Qualtrics survey followed by a nine-item semi-structured interview. The Qualtrics survey provided insights into the end user's proficiency with data, the most important data to them, the preferred availability (in years) of data, their opinion on data accessibility, and what systems (e.g., Concur, UDataGlance, Cognos) they currently use. The semi-structured interviews allowed for an opportunity to gather more precise information around the data needs of the individual and discuss what components the CEHD-DSS may have once designed.

Sample of Participants

The sample for this study included all CEHD units that had a leader in place at the time of the survey (n=10) and was a purposive sample. Some CEHD departments had interim leaders at the time of the survey and those interim leaders were either part of the study in their primary role, or I was serving as the interim leader. The sample included the dean, academic department leaders, and leaders from research and service centers across the college. Years in their current positions ranged from 2 months to 14 years and the average was 4.33 years.

Data Sources and Data Collection Procedures

I sent an email was sent to all the CEHD leaders with a brief description of the study along with a link to an on-line, 11-item Qualtrics survey. The survey included a link to the full consent to participate and was open for two weeks. Since respondents provided their names for follow-up purposes, I was able to determine who had completed the survey and sent email reminders as the closing date of the survey approached. There was a 100% response rate on the Qualtrics survey by the end of the survey open period. The 11-items included in the Qualtrics survey are listed below. All 10 CEHD leaders completed the Qualtrics survey.

	Question	Possible responses
1.	Name	N/A
2.	What is your affiliation in the College of Education and Human Development (CEHD)?	<ul style="list-style-type: none"> - Chair or Director of an academic unit - Director of a CEHD Center - Dean, Associate Dean, Assistant Dean - Other (please specify)
3.	What CEHD unit do you lead?	N/A
4.	<p>How would you rate your proficiency in understanding and interpreting data in the following categories?</p> <p>Categories:</p> <ul style="list-style-type: none"> - Financial/budget - Contract & Grants (proposals, research expenditures) - Human Resources (faculty/staff metrics) - Student (enrollments, credit hours, diversity, etc.) 	<ul style="list-style-type: none"> - Excellent - Very good - Good - Fair - Poor - Not Sure
5.	Please rank the following data groups in terms of data you need	<p>1 – highest priority</p> <p>2 – second highest priority</p>

	<p>Data groups:</p> <ul style="list-style-type: none"> - Financial/budget - Contract & Grants (proposals, research expenditures) - Human Resources (faculty/staff metrics) - Student (enrollments, credit hours, diversity, etc.) 	<p>3 – third highest priority 4 – fourth highest priority 5 – lowest priority</p>
6.	<p>For the following data groups, how many years of data would be useful to have available?</p> <p>Data groups:</p> <ul style="list-style-type: none"> - Financial/budget - Contract & Grants (proposals, research expenditures) - Human Resources (faculty/staff metrics) - Student (enrollments, credit hours, diversity, etc.) 	<ul style="list-style-type: none"> - Less than 5 years - 5-10 years - 11-20 years - Greater than 20 years
7.	<p>Thinking about the data you need to make decisions that impact your unit, would you say you have access to those data?</p>	<ul style="list-style-type: none"> - Always - Most of the time - Sometimes - Rarely - Never
8.	<p>Thinking about the data you need to make decisions about your department, to what extent do you agree or disagree with the following statements?</p> <ul style="list-style-type: none"> - I have access to all of the data I need to manage my unit - My data are reliable and up to date - I am comfortable combining multiple data sources 	<ul style="list-style-type: none"> - Strongly agree - Somewhat agree - Somewhat disagree - Strongly disagree

	<ul style="list-style-type: none"> - It is easy to access the data I need - All of the data I need can be accessed from a single system 	
9.	<p>To what extent do you agree or disagree with the following statements?</p> <ul style="list-style-type: none"> - I enjoy analyzing data - I would like to have access to raw data to do my own reports - I would prefer to have reports designed by the College Business Officer that have already been prepared and the data summarized for me - I would prefer to have access to data customized for me in an electronic dashboard format 	<ul style="list-style-type: none"> - Strongly agree - Somewhat agree - Somewhat disagree - Strongly disagree
10.	<p>What UD systems do you currently use to access data?</p>	<ul style="list-style-type: none"> - PeopleSoft Financials (FIRPT) - PeopleSoft Human Resources (HRRPT) - Concur - UD Exchange - Cognos - Other (please specify)
11.	<p>What data analysis tools do you currently use?</p>	<ul style="list-style-type: none"> - Excel - Tableau - Power BI - SPSS - Other (please specify):

Once I received the Qualtrics survey responses, the CEHD leader was contacted via email to participate in a 45-minute semi-structured interview. All 10 leaders participated in the interview portion of the study either via Zoom or in person. The one-on-one semi-structured interviews were scheduled based on the leader's

availability and preference. The interviews were conducted between October 24, 2022 and November 15, 2022. The interview duration averaged 39 minutes. Each participant answered the same nine questions as shown below.

- What are your top 3-5 business questions that you need data to answer on a regular basis?
- What specific types of data do you need to make decisions in your area?
- Are you able to get the data you need? How?
- Are you satisfied with the data and reports that are available?
- Do you feel that the data you have access to are complete, reliable, and current?
- Shadow systems can be defined as a data repository that is not governed by the institution. For example, a spreadsheet on your desktop that keeps track of data is a shadow system. Do you keep data in shadow systems? If yes, what kind of data is kept in these systems?
- Do you primarily use data for internal reporting needs or do you also report to key external stakeholders?
- If a data system could provide an interactive dashboard where you could filter on multiple variables (e.g., fiscal year, faculty member, student major) would that be helpful?
- Are there other data needs that you can think of that we didn't already discuss?

Data Analysis

Qualtrics survey data were downloaded to Excel and analyzed using basic descriptive statistics including mean, median, and mode. Frequency charts were also developed based on the nature of the question.

Semi-structured interviews were analyzed using both inductive and deductive coding approaches. The first step in analyzing the data was to transcribe all responses into an Excel sheet. Each line of data was reviewed to ensure familiarity with the data. Responses that were not focused on the question asked were deleted. Five deductive

codes were determined based on literature and included data accessibility, satisfaction, reliability, dissemination, and usage. The next step was to apply deductive codes and their definitions to each line of transcribed data. Deductive coding allowed for an analysis of data as they related to the literature on decision support systems in higher education. All lines of transcribed data were reviewed, and all possible data were coded in the deductive codes. The next step was to employ inductive coding methods for data that were not included in the deductive coding. Inductive coding methods were used to draw meaning from the data themselves and determine what themes emerged from the participants. Each transcribed line of data was reviewed, and inductive codes were established based on the response. Inductive codes were added to the spreadsheet until all data were reviewed and coded into a combination of inductive and deductive codes. The data were then thoroughly reviewed again to ensure all inductive codes had been applied and to determine if additional codes were needed. A third and final review of all data and inductive and deductive codes to ensure a thorough review of the data had been completed. Excel was used to aggregate the number of responses for each code and pivot tables were created to determine frequencies of the codes. A thematic analysis method was adopted to identify patterns in the data. The deductive and inductive codes were grouped into themes to aid in the data analysis. Five themes evolved from the analysis of the interview data: data types, data accessibility, data reliability, data usage, and data satisfaction.

Methodological Limitations

The single group design may be a threat to internal validity but since the purpose of this study was to determine user preferences in the design of a college-specific system, I feel that threat is minimal. A common limitation to qualitative studies is the small sample size. However, I was able to sample the entire population which eliminated that limitation. Nonetheless, the population size (n=10) is still small, and the results should not be generalized to other academic units. A third limitation was that the analysis was conducted solely by me without another research team member coding the same data and without another member checking. This limitation may lead to reliability concerns. A future study should utilize triangulation methods to increase reliability. Another possible limitation is the working relationship that I have with each participant. Some participants I work with on an almost daily basis and most participants I interact with weekly. These relationships may introduce bias. A future study could be conducted by a neutral research team member to reduce this bias.

Findings

In this section I present the findings of this study which suggest there is an unmet need in CEHD for data and that having an accessible decision support system may meet that need. Based on the frequency distribution of the inductive and deductive coding process, five themes evolved from the analysis of the interview data: data types, data accessibility, data reliability, data usage, and data satisfaction. Qualtrics data were also analyzed with respect to the five themes. The findings for each theme are discussed in this section.

Data types

Seven data types were identified in the study: financial, contract and grant (i.e., sponsored programs), student, courses, human resources, ‘other data,’ and non-UD data. The frequency distribution of the major data types mentioned in the semi-structured interviews along with the rankings of priority (in terms of number of people ranking it their number one priority), and number of years of data that are needed is shown below. Course data and non-UD data were not options in the Qualtrics survey for priority ranking.

Data Types	Frequency	Top Priority	Number of Years
Financial data	46	4	5-10
Contract & Grant data	34	2	5-10
Student data	26	2	5-10
Courses data	24	N/A	N/A
Human Resources data	24	1	5-10
Other data	17	1	N/A
Non-UD data	9	N/A	N/A

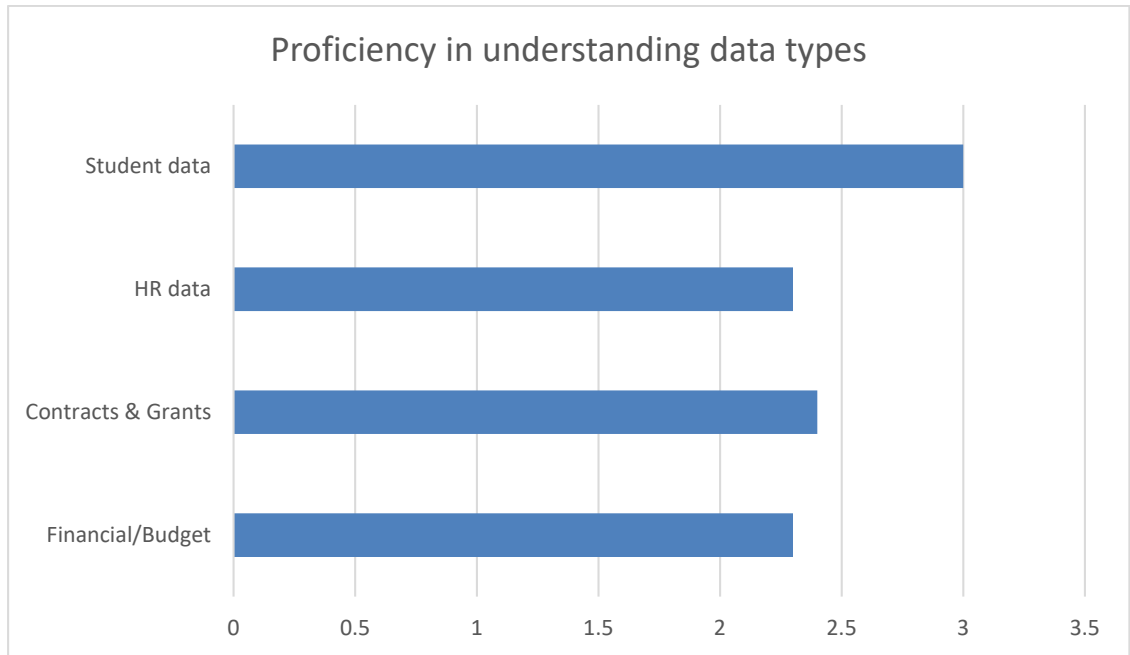
Access to financial data was the most frequent topic (n = 46) discussed during the interviews and the Qualtrics survey showed that 80 percent of participants ranked financial data as their number one or number two priority. Participants are interested in an easy way to access balances, view prior expenditures, understand how much items cost, and determine whether they can afford to purchase items. There was also a desire to understand how much revenue a course can generate. The next most frequently discussed data type in the interviews was contract and grant data (n = 34). The Qualtrics survey showed that contract and grant data was a number one or number two priority for 40 percent of the respondents. This is not surprising considering the

number of research and services centers in CEHD that rely on external funding. The participants want access to proposal data, effort percentages of personnel (both planned and actual), proposal versus award success rates, and expenditures.

Student (n = 26) and course-related (n = 24) data were the next most discussed data types during the study. Twenty percent of participants ranked student data as their top priority. Study participants were interested in accessing data related to student demographics, metrics around specific academic programs, credit hours taught, number of sections offered, and course teaching capacity of the faculty. The final data type discussed was human resources data (n = 24). The CEHD leadership is interested in access to data such as number of faculty and their rank, faculty sabbatical history, the ability to group personnel based on job title, the number of part-time hours paid, diversity statistics, and faculty/staff demographics.

The 'other data' type category includes certification status of employees, contract program data, enrollment/wait lists, child outcome data, and family conversation tracking. These data are not housed in central UD systems but kept in-house and were therefore labeled 'other data.' Non-UD data mainly included data coming from systems outside of UD systems including ProCare, State of Delaware Purchase of Care, and information from external contract and grant sponsors.

A survey question asked the participants to rate their proficiency with understanding the data in the categories of: financial, student, human resources, and contracts and grants. Their mean scores in each data category ranged from good to very good as shown in the figure below.



Data accessibility

Data accessibility was a common theme after analyzing the Qualtrics and interview data. The word “accessibility” or closely related terms was used repeatedly (n = 37) in the interviews. Analysis of the Qualtrics results found that 70 percent of participants ‘somewhat’ or ‘strongly disagreed’ when asked if they have access to all the data they need to make decision for their units. In addition, 90 percent of respondents ‘somewhat’ or ‘strongly disagreed’ when asked if they thought it was easy to access the data they need. In terms of the ease of access from a single system, 90 percent of respondents ‘somewhat disagreed’ in the survey. All participants ‘strongly’ or ‘somewhat agreed’ that they would like to have data in an electronic dashboard format.

The Qualtrics survey asked participants to select the UD systems that they use to access data. The frequency distribution of the UD systems that the respondents use to access data is shown below.

UD System	Type of System	Frequency
Concur	Enterprise-wide purchasing card system	7
HR Report	PeopleSoft query tool	2
UD Exchange	Enterprise-wide procurement system	2
UDataGlance	UD developed financial system to look at financial data by single purpose codes	2
Financials Report	PeopleSoft query tool	1
ProCare	Software package used on the Children's Campus primarily for billing purposes	1
Cognos	Enterprise-wide query tool	0

Concur is the current enterprise-wide credit card management system at UD. Travel, services, and other goods that are purchased using an individual's corporate credit card flow through this system. Concur was the most frequently (n = 7) used UD system to access data by the respondents. It should be noted that the respondents are required to use Concur to approve expenses. The PeopleSoft query tool HR Report (HRRPT) was selected by two survey participants as a UD system for data access. This query tool is part of the PeopleSoft enterprise system and allows the user to retrieve human resources data. UD Exchange (UDX) is the new procurement system introduced to UD in 2020 and two respondents said they access data from UDX. UDataGlance is a homegrown UD system developed in 2010 as a user-friendly interface to access financial data. This system was selected by two respondents as a system to access data. Similar to HRRPT, Financials Report (FIRPT) is a PeopleSoft query tool which allows the user to run pre-written queries or write ad hoc queries to

access data. Only one respondent selected FIRPT as a means to access data. The final system selected for data access was ProCare which is a specialty software used at the UD Children's Campus primarily for billing. None of the respondents selected Cognos as a tool for data access.

Data reliability

Data reliability was included in 23 of the coded responses. The Qualtrics data reveals that 60 percent of respondents 'somewhat agree' that their data is reliable and up to date. When asked in the interviews if they felt their data were reliable, I received responses including "I don't know, I want to believe they are, but I don't know" and "I just have to trust the process." There were a few comments which spoke to data inconsistencies including "We get different numbers from different people," "I feel like we're being judged on incorrect data," and "There are data mismatches and no source to validate the data."

Data usage

All of the participants stated that they use data for external reporting purposes including accreditation, addressing donor inquiries, preparing reports to external funders, reporting to Delaware governing agencies, and providing information to education stakeholders in the state and region. Six respondents also mentioned using data for internal reporting to the Dean and Provost. Opinions regarding the comfort of combining multiple data sources was evenly split with 50 percent saying they somewhat or strongly disagreed and 50 percent saying they somewhat agree or agreed. The respondents were also equally split on wanting access to the raw data to do their

own reports with 50 percent saying they would like access to the raw data. Seventy percent of respondents 'strongly agree' that they would like the College Business Officer to prepare and summarize data for them. Finally, the most common data analysis tool used among respondents is Excel with 90 percent reporting using this tool.

Data satisfaction

The theme of data satisfaction was the most frequent theme observed in the data with 52 responses coded with data satisfaction. When asked in the interviews "Are you able to get the data you need?" the majority of answers were "no," "not without assistance," "not easily," and "have to look in multiple places." Respondents also stated that they want a system that is easily understood and all in one place to satisfy their data needs.

Discussion of Findings and Application to ELP

The results of this study indicate that there is an unmet need in terms of access to data. CEHD leadership also indicated that an electronic decision support system is highly desired and will be useful to them. Having this understanding of the end user's needs will allow the design, development, and deployment of a system to move forward and hopefully produce a system that will be a useful resource for CEHD leaders.

The data that the leaders indicated needing are, for the most part, available now and can be used in the first iteration of the CEHD-DSS. These include financials, enrollments, student success, courses taught, credits taught, human resources, and

some contract and grant data. As the CEHD-DSS matures, additional data sources can be introduced to the CEHD-DSS model to meet more of the end user's needs. Using the data collected in this study, the design and development of the first iteration of the CEHD-DSS will be underway and will be the focus of a case study with an academic unit in CEHD.

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<https://doi.org/10.1177/02683962950100>

Appendix E

**COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT DECISION
SUPPORT SYSTEM USER MANUAL**



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College of Education and Human Development
Decision Support System User Manual

April 2023

EDUCATION & HUMAN DEVELOPMENT

www.cehd.udel.edu

REVISION HISTORY

Date	Revision	Description	Author
April 1, 2023	1.0	Initial document	Rachel Mroz

OVERVIEW

The purpose of this document is to provide the reader with a guide to navigate the College of Education and Human Development Decision Support System (CEHD-DSS). This manual is a living document and is intended to be reviewed and updated as the CEHD-DSS is modified.

Implemented in FY2023, the CHED-DSS is a computer-based information system that will help CEHD leadership access certain college and department metrics to aid in decision-making. The CEHD-DSS brings together data from multiple sources into a convenient, easy-to-access system for CEHD leadership.

The CEHD-DSS contains the following dashboards:

- Financials
- Gifts and Endowments
- Enrollments (graduate and undergraduate)
- Courses and Credits
- Faculty
- Undergraduate Recruitment
- Human Resources
- Graduate College Dashboards
- Retention and Graduation
- Academic Programs
- Student Success
- Faculty metrics (individual)
- Department at a Glance
- Key Performance Indicators (under construction)
- Research (under construction)

RESPONSIBLE DATA USE

The CEHD-DSS uses data from multiple sources and some of those data are in various stages of validation. Given this fact, it is essential for users to understand the data governance roles and responsibilities at the University of Delaware.

By using the CEHD-DSS, you agree to abide by the policies and procedures of UD found at this link: <https://www1.udel.edu/security/policies/>

Furthermore, you agree to use data for **internal purposes only** until the data sets are fully validated. That means that no external reports or calculations can be generated from the CEHD-DSS at this time.

ACRONYMS & DEFINITIONS

CEHD-DSS: College of Education and Human Development Decision Support System

Crosstab: Display of data in a table format

Dashboard: Visualization of data

DFW grades: Student grades below a “C” and Withdrawals

Filters: Allow the user to refine data shown on the dashboards.

IDOR: Instructor Department of Record

LOD: Level of detail

SCH: Student Credit Hour

SCH prorated: Reflects the SCH if credits are split. For example, if a faculty member in SOE teaches 1.5 credits of EDUC100 and a faculty member from HDFS teaches the other 1.5 credits of the 3-credit course, the credits are prorated across the departments.

Tableau: The interface that the CEHD-DSS uses to display information.

VGER: UD platform for accessing the CEHD-DSS.

ACCESS TO THE CEHD-DSS

To use the CEHD-DSS, user must have the Tableau Viewer license, with the permission level of Interactor. If you are not able to access the CEHD-DSS, please contact Rachel Mroz.

Supported browsers: Firefox, Chrome

The CEHD-DSS can be accessed using the following URL: vger.udel.edu/

The CEHD-DSS uses row level security to restrict data that you can see. Your row level security is initially set to only view data in your department. If there is a need to see other data, please contact Rachel Mroz.

COMMON NAVIGATION TOOLS



This icon will take you back to the main landing page.

A vertical sidebar with a dark blue background and white text. It contains several filter sections: 'IDOR Student Type' with checkboxes for (All), AA, CE, GRAD, and UGRD; 'College Selector' with a dropdown menu showing 'Education & Human D...'; 'Term Type group' with checkboxes for (All), Fall, and Spring; and a list of years from 2023 down to 2012, each with a corresponding numerical value to its left.

This is an example of filters you can use to interact with the data.

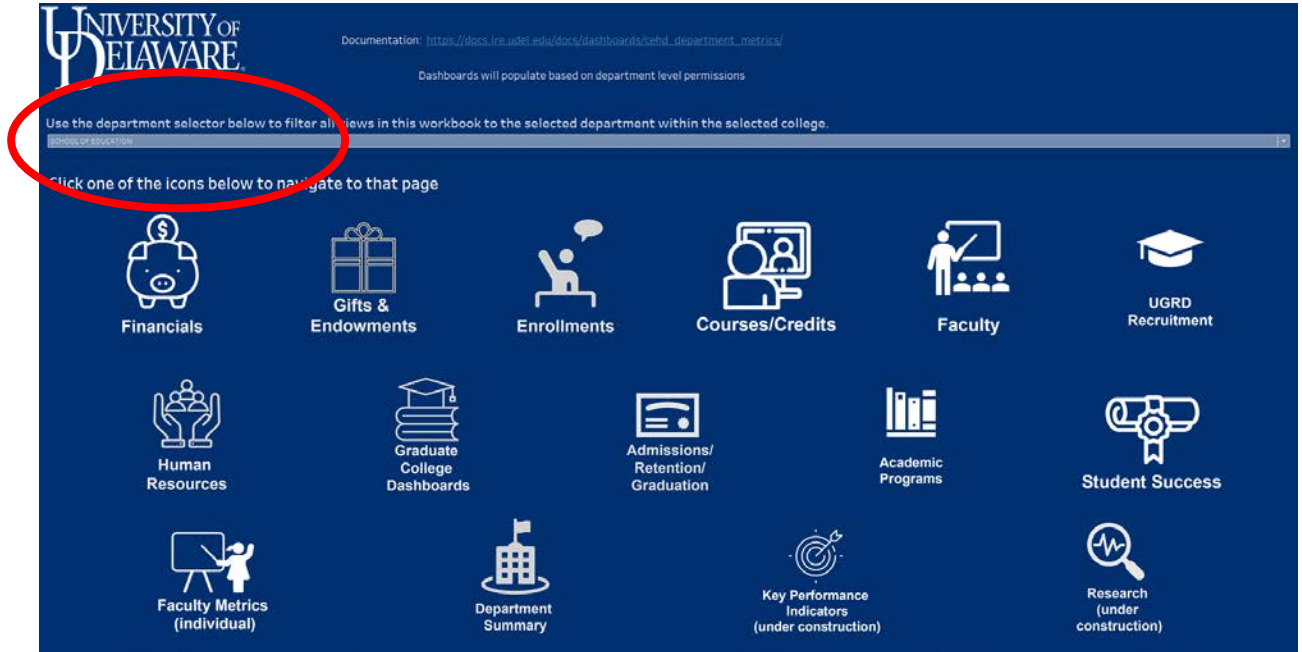
Some dashboard elements have a scroll bar on the right side or at the bottom to see more data.



USING THE CEHD-DSS

LANDING PAGE

After logging into the CEHD-DSS, you are directed to the landing page. The landing page is a navigation tool to assist you in accessing the dashboards.



Department selector: Select your department from the dropdown list. Dashboards will populate based on department-level permissions. If you select a department to which you do not have access, the dashboards will be blank.

Dashboard Icons: There are 15 icons representing the dashboards that make up the CEHD-DSS. Clicking any of the icons will direct you to the associated dashboard.

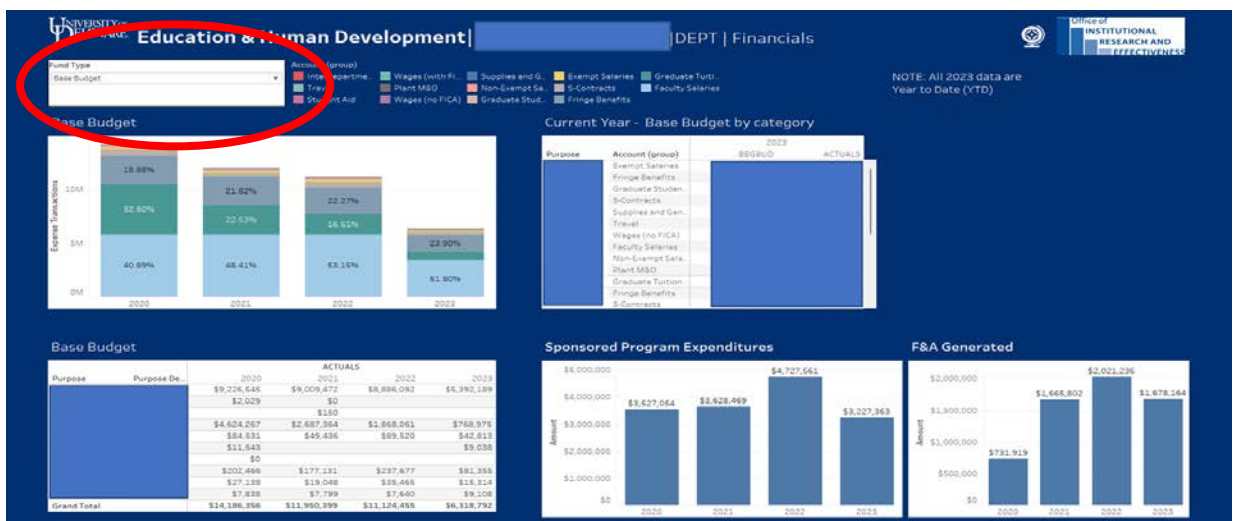
NOTE: The following screen shots have department identifier information redacted.

FINANCIALS

This dashboard allows the user to view financial data by fund type.

Elements include:

- Expenses by category
- Current budget by category with beginning budget, actuals to date, obligations (salary only), and available balance
- Annual expenses by fund type
- Sponsored program expenses
- F&A generated
- Budget expenses by month



Choose the fund type from the dropdown box in the upper left (circled in red above). Visuals will change based on fund type selected.

Note: Not all fund types have budgets. Therefore, “Current Year – Budget by Category” will have a blank BEGBUD column depending on the fund type selected.

Note: The Sponsored Program Expenditures and F&A generated are included in this dashboard while the Research page is constructed. Those two views do not change based on fund type selected.

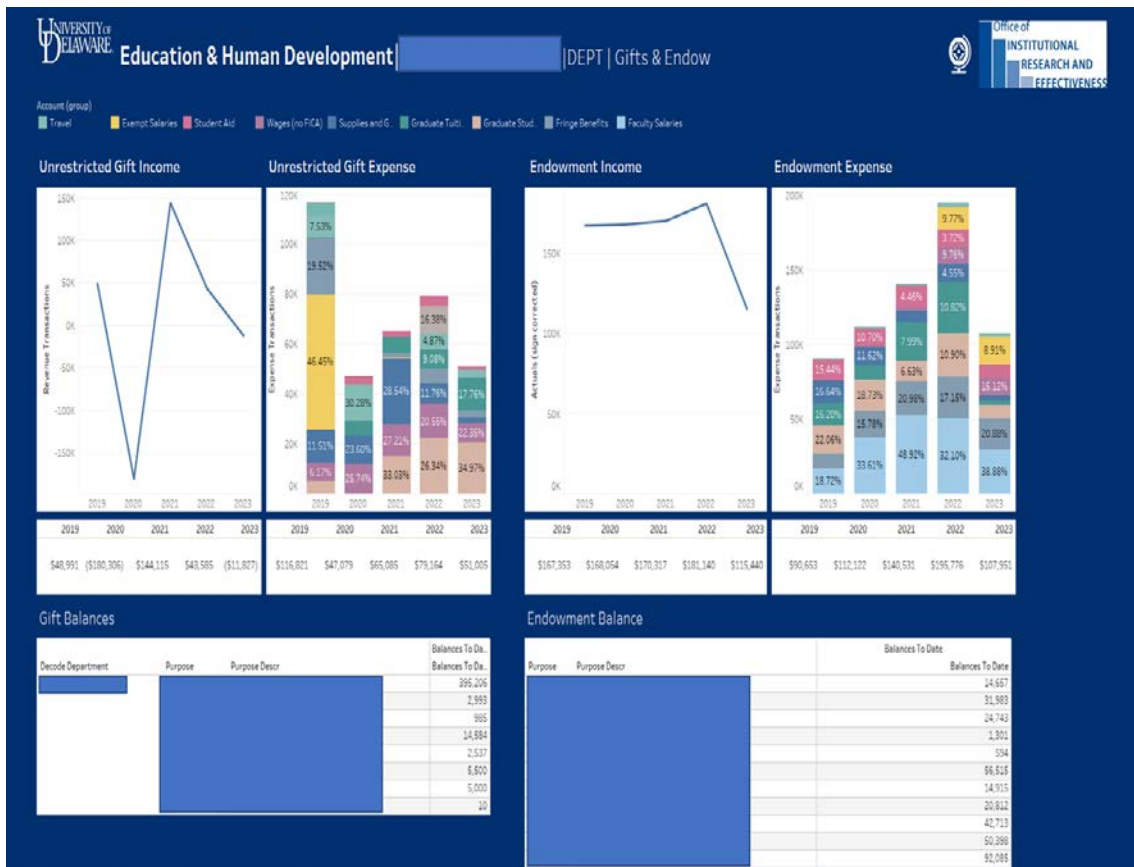
Hover over visuals to get additional information in the tool tips.

GIFTS AND ENDOWMENTS

This dashboard allows the user to view financial data related to gifts and endowments. You can see trends in income and how you are spending the income. The current fiscal year is year to date. For example, in the screen shot below, 2023 reflects income, expense, balances through January 2023.

Elements include:

- Income
- Expenses by category
- Current balances



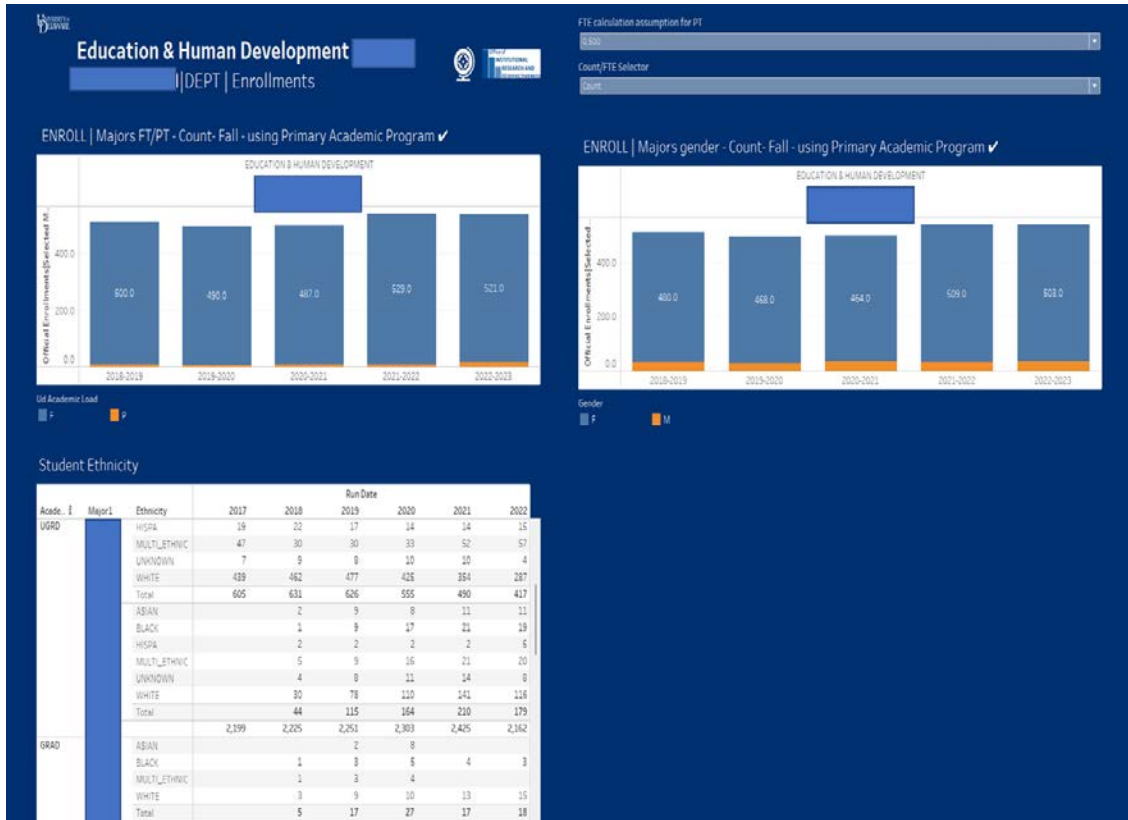
There are currently no filters included in this view.

ENROLLMENTS

This dashboard allows the user to view data related to student enrollments.

Elements include:

- Enrollment by major by full-time or part-time status
- Enrollment by major by gender status
- Enrollment by major by ethnicity – graduate and undergraduate



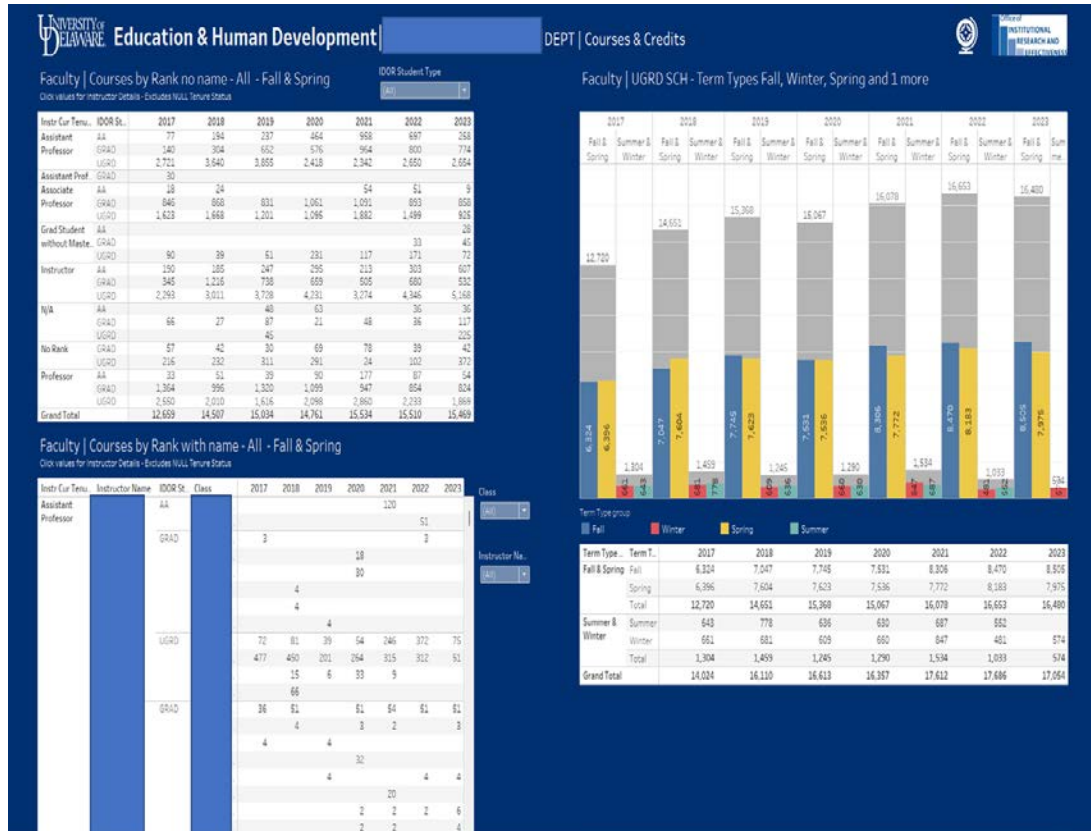
There are currently no filters included in this view. Filters in the top left should not be changed.

COURSES/CREDITS

This dashboard allows the user to view data related to credits taught.

Elements include:

- Credits by rank
- Credits by rank including instructor name
- Credits taught by semester



Credits by rank can be filtered on IDOR student type. The filter is to the top right of the visualization.

Credits by rank with name can be filtered by instructor name and course. The filters are to the right of the visualization.

FACULTY

This dashboard allows the user to view data related to faculty teaching.

Elements include:

- Count of faculty by academic rank for the selected department
- Count of faculty by tenure status for the selected department
- Credits taught by tenure status
- Credits taught by rank for the selected department

The dashboard displays the following data tables:

		Fiscal Year			
		2020	2021	2022	2023
Assistant Professor	F	7	10	11	14
	M	5	6	6	6
Associate Professor	F	8	8	8	10
	M	5	6	5	5
Instructor	F	5	6	7	7
	M	1	1	1	1
Professor	F	7	6	6	8
	M	8	9	10	8
Grand Total		48	52	54	58

Tenure Status Leader	2017	2018	2019	2020	2021	2022	2023
Tenured	31	31	30	31	34	33	32
Non Tenure On Track	5	4	7	10	12	13	12
Non Tenure Continuing	15	9	15	15	15	16	17
Non-Tenure Temporary	1	5	5	3	1	1	1
S Contract Status Only	122	133	145	157	167	110	115
N/A	2	2	3	4	4	4	6
Grand Total	176	184	208	202	173	177	175

Instr Cur Tenure Status	2017	2018	2019	2020	2021	2022	2023
Tenured	Prorated Cred.	5,816	5,374	4,456	4,997	6,389	5,365
	SCH	5,877	5,431	4,508	5,072	6,520	5,709
	LOD/AVG SCH	184	175	150	164	214	190
Non Tenure On Track	Prorated Cred.	40	55	340	773	1,082	1,174
	SCH	40	55	386	773	1,082	1,551
	LOD/AVG SCH	40	55	97	120	108	145
Non Tenure Continuing	Prorated Cred.	3,689	3,713	4,092	4,109	5,507	5,153
	SCH	3,683	3,713	4,092	4,104	5,740	5,540
	LOD/AVG SCH	284	286	282	299	411	396
Non-Tenure Temporary	Prorated Cred.	891	273	21	97	12	12
	SCH	891	273	21	97	12	12
	LOD/AVG SCH	223	273	21	97	12	12

Instr Cur Te.	2017	2018	2019	2020	2021	2022	2023
Assistant Professor	Prorated Cred.	2,938	4,133	4,744	3,458	4,264	4,247
	SCH	2,938	4,138	4,815	3,533	4,505	4,951
	LOD/AVG SCH	184	253	219	154	180	206
	Distinct count.	15	15	22	23	25	24
Associate Professor	Prorated Cred.	2,487	2,560	2,032	2,156	3,027	2,443
	SCH	2,487	2,566	2,082	2,156	3,027	2,488
	LOD/AVG SCH	178	171	146	154	202	176
	Distinct count.	14	15	14	14	15	14
Professor	Prorated Cred.	3,947	3,057	2,975	3,287	3,984	3,174
	SCH	4,008	3,108	3,027	3,362	4,215	3,483
	LOD/AVG SCH	182	148	144	153	211	174
	Distinct count.	22	21	21	22	20	20

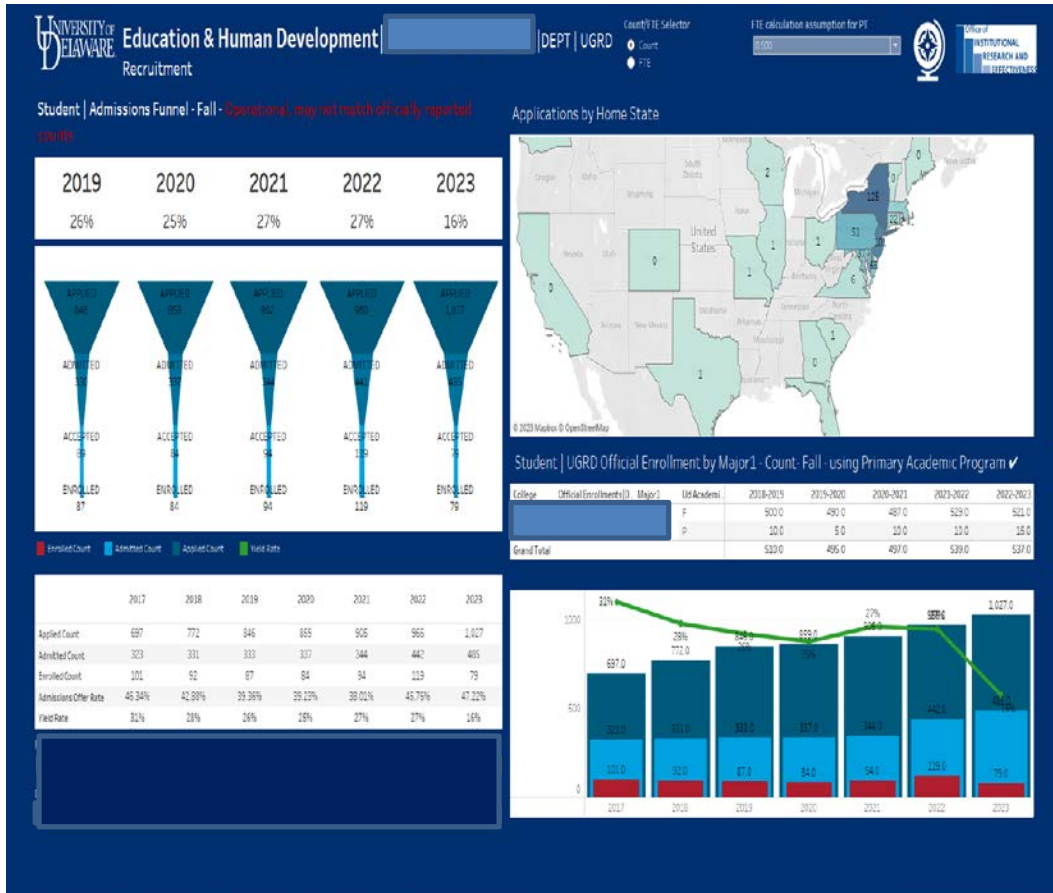
The two tables on the right can be filtered using the IDOR Student Type and the Term Type group filters.

UNDERGRADUATE RECRUITMENT

This dashboard allows the user to view data related to undergraduate recruitment.

Elements include:

- Applied, admitted, accepted, and enrolled rates
- Yield rates
- Applications by home state



There are currently no filters included in this view.

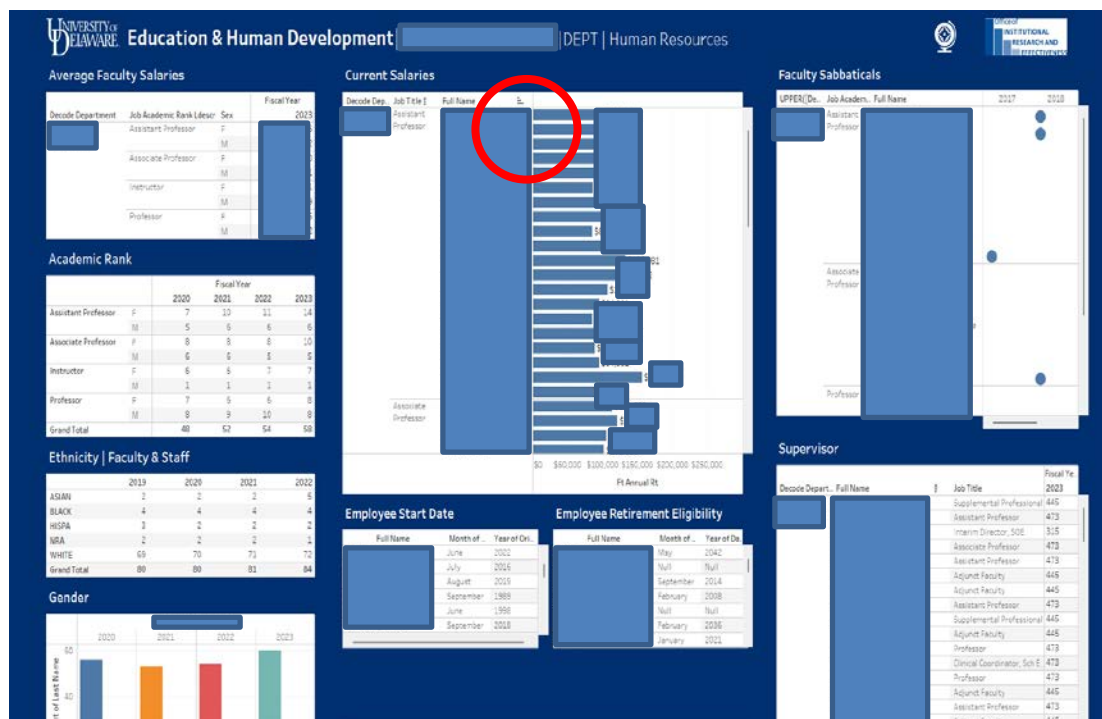
HUMAN RESOURCES

This dashboard allows the user to view data related to human resources.

Elements include:

- Average faculty salaries
- Count of faculty by academic rank
- Current salaries of faculty and staff
- Ethnicity of faculty and staff
- Faculty start date
- Faculty retirement eligibility year
- Faculty sabbatical – last time a faculty member took sabbatical
- Supervisor name of faculty and staff

PLEASE NOTE: The HR dashboard contains sensitive salary information and cannot be shared with anyone.



The “current salaries” view can be sorted by name, position, or salary by using the sort filter circled in red.

Some views have scroll bars on the right and bottom to see additional information.

GRADUATE COLLEGE DASHBOARDS

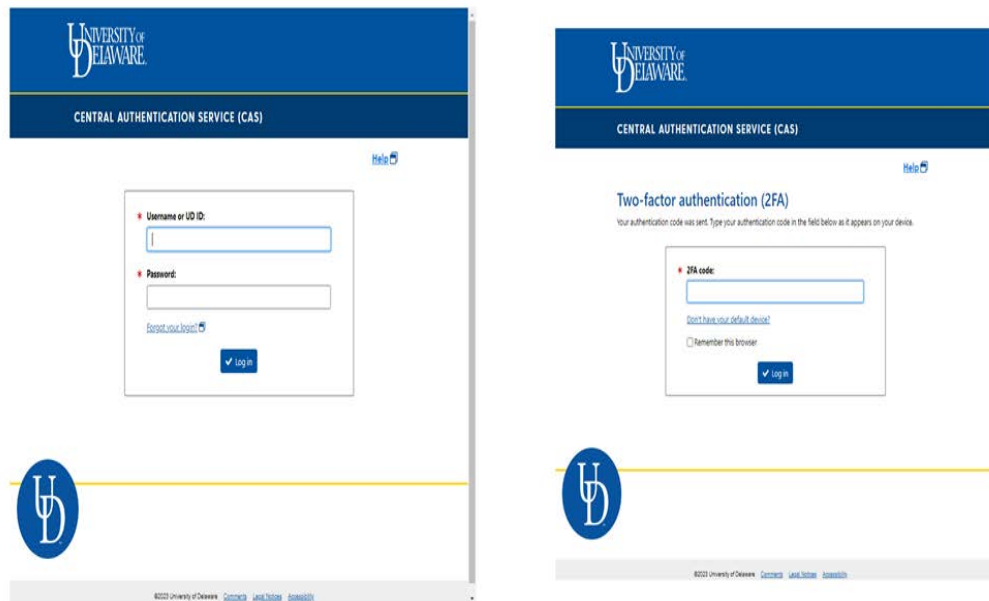
This dashboard allows the user to view data related to graduate students. This dashboard is linked to the Graduate College dashboards and all views were created by the Graduate College. CEHD does not have the ability to modify these dashboards. If you need other graduate student data, please reach out to Rachel Mroz.

Elements include:

- Summary of key graduate college metrics
- Enrollments
- Diversity
- Graduate contracts and sustaining status
- Degrees
- Admissions

You will only be able to see data if you have been granted permissions to the Graduate College dashboards.

Begin by logging into the Central Authentication System (CAS) with your UD credentials. Two factor authentication (2FA) may be needed.



The image displays two screenshots of the University of Delaware Central Authentication Service (CAS) login process. The left screenshot shows the initial login page with fields for Username or UD ID and Password, and a login button. The right screenshot shows the Two-factor authentication (2FA) page, which prompts the user to enter a 2FA code and includes a checkbox for 'Remember this browser'.

You will be directed to this page:

Explore / College - Graduate / Graduate Dashboard

Search for views, metrics, workbooks, and more

Graduate Dashboard

Owner William Barnett Modified Nov 11, 2022, 5:05 PM

GRAD dashboard v1.0b

Views 6 Data Sources 4 Connected Metrics 0 Custom Views 0 Subscriptions 0

Select All Sort By: Sheet (first-last) ↑

Type	Name	Actions	Views (all-time)	Sheet
<input type="checkbox"/> ☆	Summary Dashboard	...	862	1
<input type="checkbox"/> ☆	Enrollment Dashboard	...	240	2
<input type="checkbox"/> ☆	Diversity Dashboard	...	358	3
<input type="checkbox"/> ☆	Graduate Contracts/Sustaining	...	402	4
<input type="checkbox"/> ☆	Degrees Dashboard	...	215	5
<input type="checkbox"/> ☆	Admissions Dashboard	...	181	6

Click on any of the items or start with the summary dashboard.



Explore the data using the filters circled on the left side of the above image.

The summary dashboard shows the whole University.

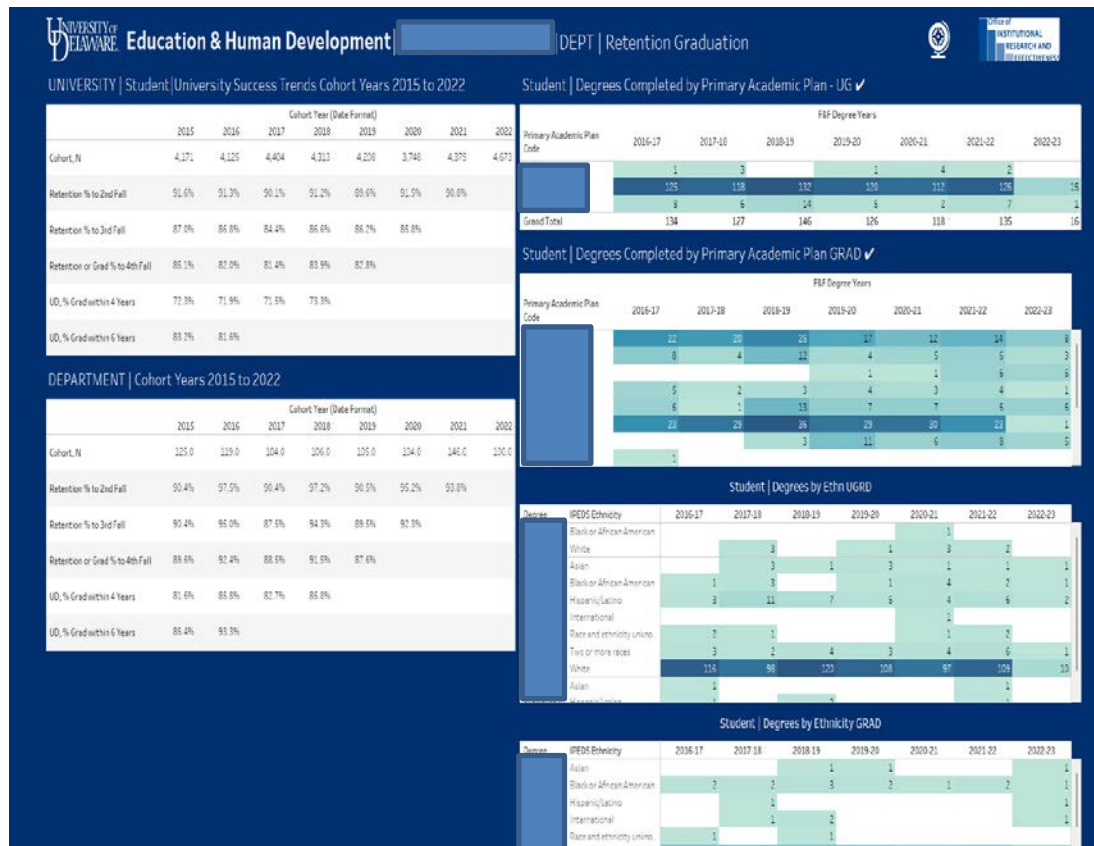
Navigate to other Graduate College dashboards using the tabs circled at the top of the above image. The other Graduate College dashboards can be filtered to CEHD data.

RETENTION/GRADUATION

This dashboard allows the user to view data related to student retention and graduation.

Elements include:

- University retention rates
- Department retention rates
- Degrees completed by major – graduate and undergraduate
- Degrees completed by ethnicity – graduate and undergraduate



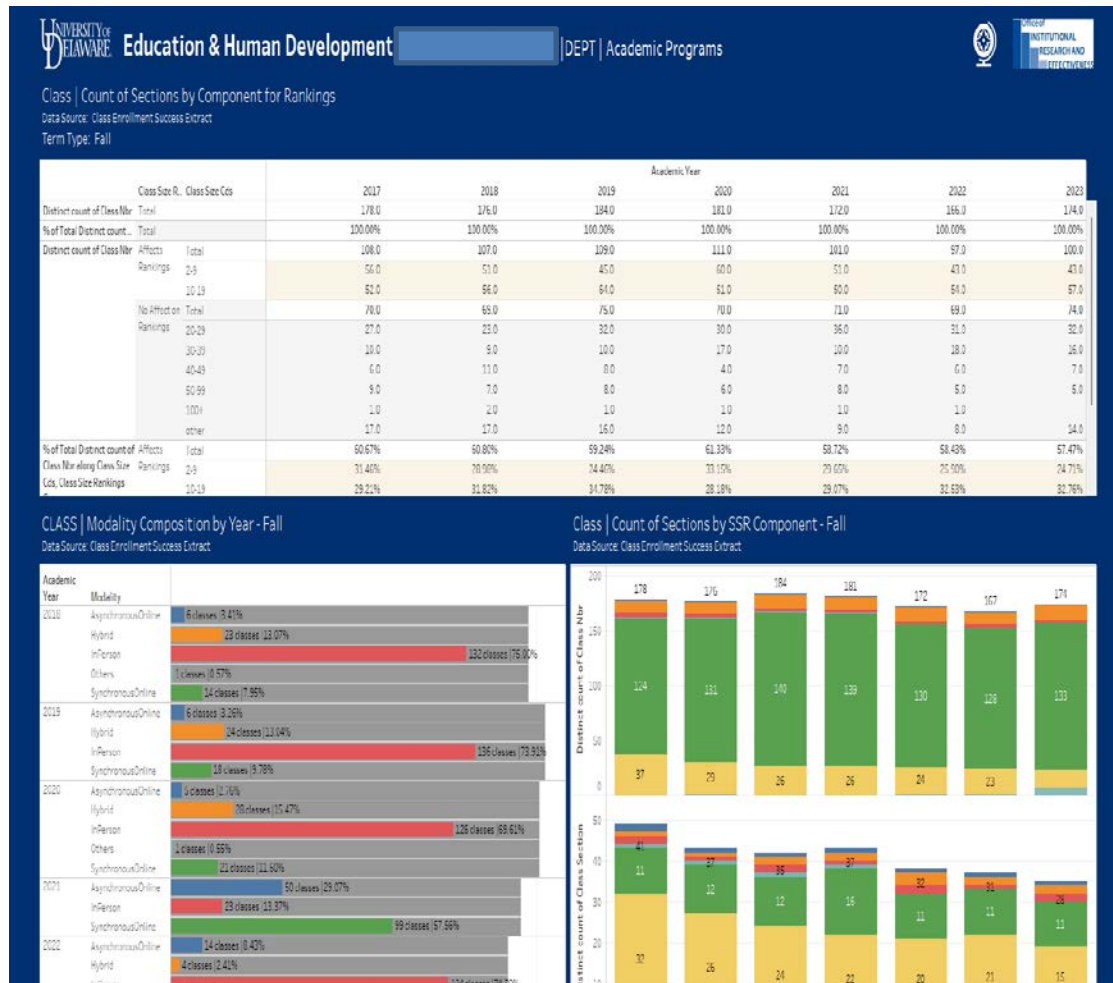
There are currently no filters included in this view.

ACADEMIC PROGRAMS

This dashboard allows the user to view data related to academic programs.

Elements include:

- Count and percentage of course sections by class size.
- Course modality
- Count of course sections by component (e.g., lab, lecture, discussion)



There are currently no filters included in this view.

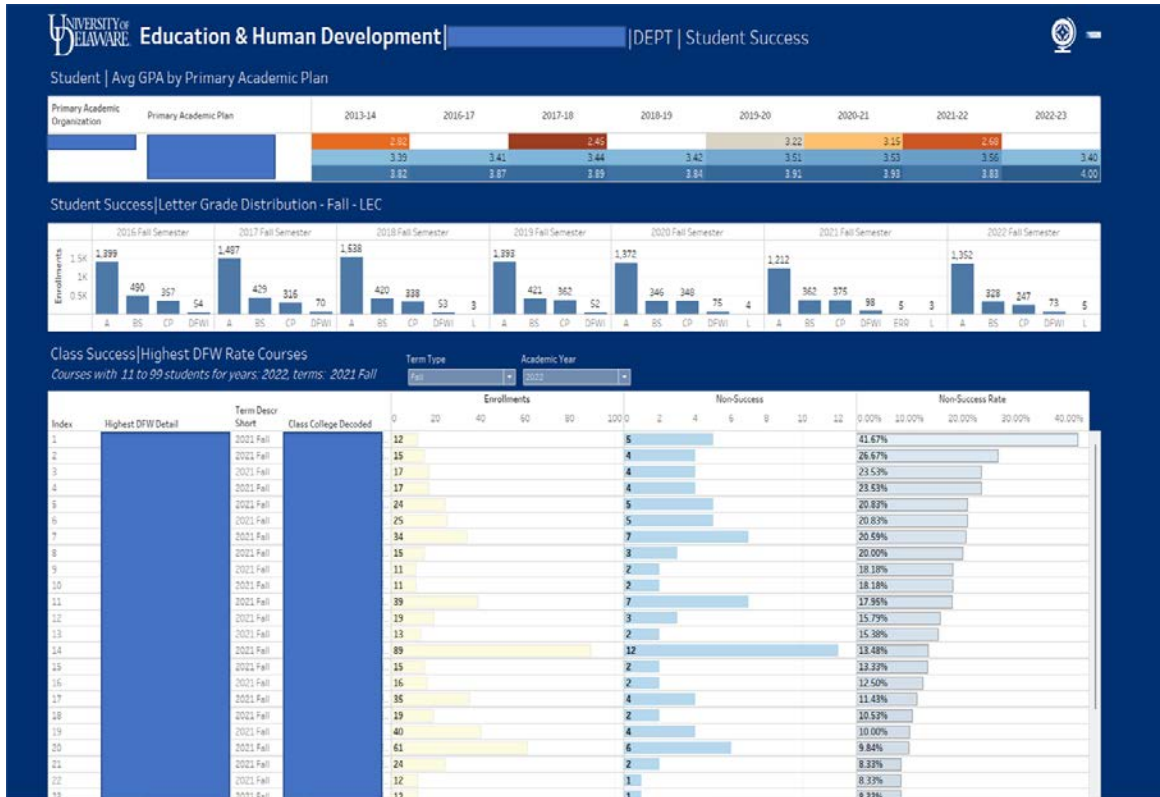
The count of sections by component shows the number (and percentage) of courses by number of seats. These data impact rankings. Courses taught with fewer than 30 students impact rankings positively.

STUDENT SUCCESS

This dashboard allows the user to view data related to student success.

Elements include:

- Average GPA by primary academic plan
- Letter grade distribution
- Highest DFW rates



Highest DFW rates can be filtered by year and term type.

FACULTY METRICS (INDIVIDUAL)

This dashboard allows the user to view data related to an individual faculty member.

Elements include:

- Salary
- Rank
- Employee ID
- Years in rank
- Years tenured
- Year of retirement eligibility
- Sponsored program expenses for the selected individual
- F&A generated by the selected individual
- Courses and credits taught by the selected individual
- Research and teaching metric for the selected individual
- Proposals and awards – under construction
- Publications – under construction



Select the name of the faculty member from the dropdown in the top left corner and the dashboard elements will update based on the person selected.

Proposals, awards, and publications: Once a verified data source is available, these views will be populated.

DEPARTMENT SUMMARY

This dashboard allows the user to view data related to their department by bringing key elements from other dashboards to one view.

Elements include:

- Count by gender by rank
- Ethnicity – faculty and staff
- Sponsored program expenditures
- F&A generated
- Undergraduate student admissions
- Student enrollment by ethnicity
- Credits by major
- Proposals and awards – under construction



Credits by major can be filtered by term and student type.

RESEARCH

This dashboard is under construction.

KEY PERFORMANCE INDICATORS

This dashboard is under construction.

AD HOC REPORTING

This dashboard is under construction.

TROUBLESHOOTING

Issue	Potential solution
My dashboards are blank!	Check that you selected the correct department from the landing page. Check that you have not accidentally filtered out all the data. Check that you are logged into the VGER system.
The Graduate College dashboards will not load for me.	Contact Rachel Mroz. She will find out if you have been granted access to those dashboards. If you are not in an academic department, you likely haven't been granted access.
These data do not seem correct to me!	Data have been validated, but since we are in the beginning phases of development, some data may not be filtered properly. Contact Rachel Mroz, and she will investigate the concern.
These dashboards are great, but I want more information.	Let Rachel Mroz know what data you need, and she will investigate the possibility of adding additional views.

<p>I can't see specific student information.</p>	<p>That is correct! To protect student identities, data in the CEHD-DSS are only reported in aggregate. In some cases, if the number of students is fewer than 10, the data are not shown as individuals may be able to be identified.</p>
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Appendix F

**COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT BUDGET
SUPPORT HANDBOOK**



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College of Education and Human Development
Budget Support Handbook

EDUCATION & HUMAN DEVELOPMENT

www.cehd.udel.edu

REVISION HISTORY

Date	Revision	Description	Author
March 1, 2023	1.0	Initial document	Rachel Mroz

INTRODUCTION

The purpose of this document is to provide stakeholders with an overview of the budget model and budget processes at the University of Delaware and the College of Education and Human Development (CEHD). This handbook is a living document and is intended to be reviewed and updated annually.

UNIVERSITY OF DELAWARE BUDGET MODEL (UDBM)

Implemented in FY2020, the University of Delaware Budget Model (UDBM) is a hybrid model consisting of elements of both centralized and decentralized budgeting. The UDBM combines elements of two former budget models – the block budgeting system and the responsibility-based budgeting (RBB) system. The primary objectives of the model include creating incentives for growth, creating central resources for university-wide investments, and strategies for building central cash reserves for the University.

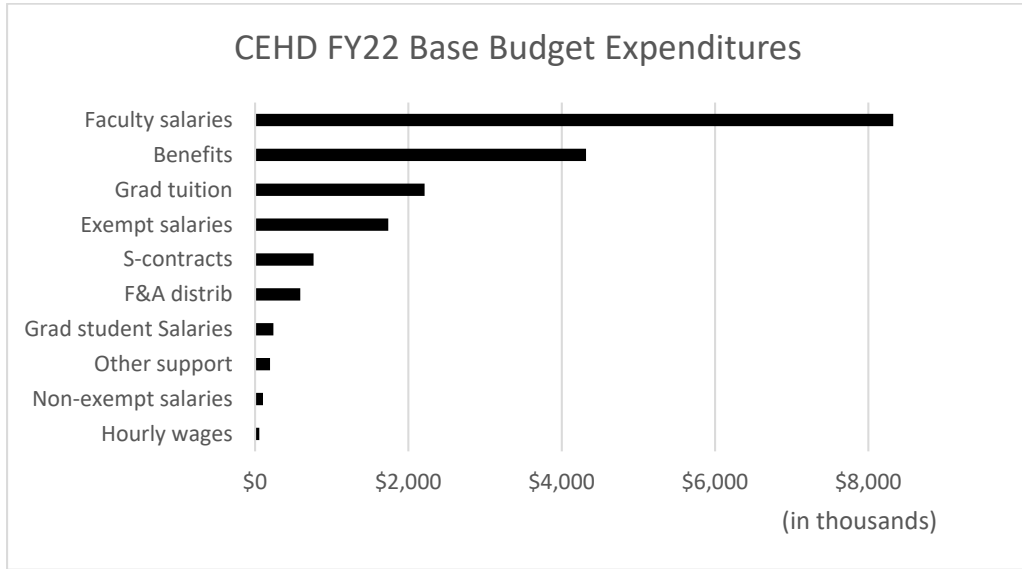
FY2017 was chosen as the budget model's base year and is reflective of President Assanis' first year at the University of Delaware.

The UDBM begins with a predictable base for each college along with FY2017 graduate tuition revenue and FY2017 F&A recovery to initially resource units. Additional resources are provided based on incremental growth at the end of the fiscal year. If a college's resources are greater than their expenses, the surplus is returned to the college's reserve funds. If a college's expenses exceed the resources generated, the college reserves must fund the deficit.

More detailed descriptions of the elements of the UDBM are included below.

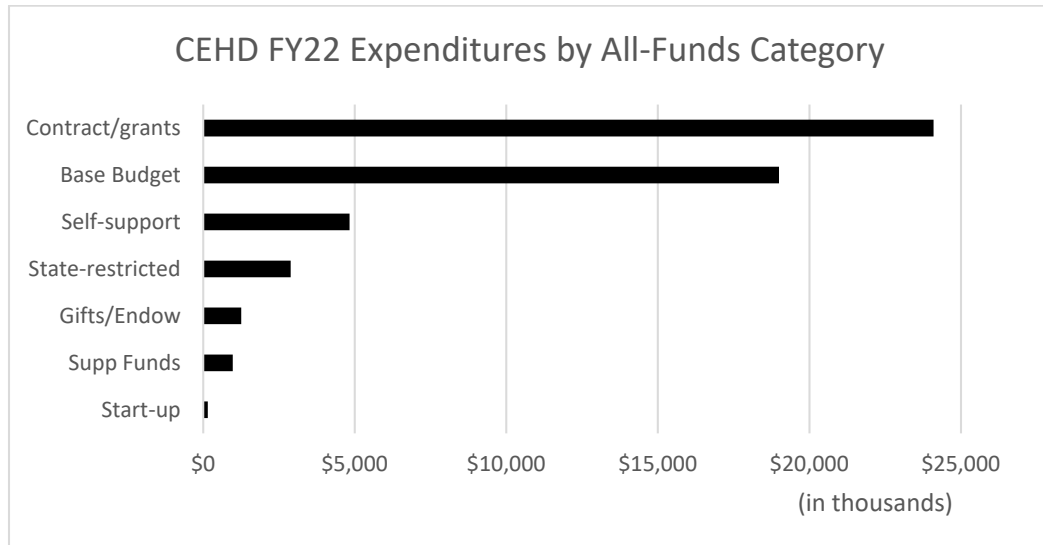
CEHD IN THE UDBM

The following chart shows the distribution of expenses for the FY2022 CEHD base budget.



CEHD Distribution of Expenses – FY2022

The following chart shows the distribution of expenses for FY2022 in CEHD based on the all-funds model.



ALL-FUNDS BUDGETING

The **all-funds budget** refers to the structure of the overall budget at the University of Delaware and forms a framework to account for multiple sources of funds received by the University. Seven funds make up the all-funds budget: base budget, supplemental/reserve funds, self-supporting funds, gifts/endowments, start-up funds, state-restricted funds, and externally sponsored contracts & grants.

Base budget: The base budget, also called the 1-book and operating budget, is the primary budget for the College. This budget contains permanent funded positions (faculty, staff (non-contract/grant funded)), s-contracts, supplies, travel, and other operating costs related to the academic unit. The base budget relies on the predictable base, incremental tuition revenue, and incremental indirect cost return. Funds that are not spent by the end of the fiscal year are not carried over to the next fiscal year.

The way to recognize a base budget purpose code is that digits 5 and 6 are **11**. For example, EDUC110000 and IFST112117 are base budget accounts.

Supplemental/reserve funds: Supplemental funds are funds that can be used to pay for expenses that are not allowable on the base budget or if the base budget has been exhausted (e.g., the department spent the full allocation of travel). For example, supplemental/reserve funds are used for the department's holiday gathering, all alcohol, travel for faculty members, renovations, or guest speakers. The supplemental fund codes grow based on return of indirect costs at the end of the academic year. Funds that are not spent by the end of the fiscal year are carried over to the next fiscal year.

The way to recognize a supplemental funds purpose code is that digits 5 and 6 are **17**. For example, EDUC17S513 and IFST172117 are supplemental/reserve funds.

Self-supporting funds: Self-supporting units, also known as 2-book operations, are units which are required to generate revenues to support their operations. These operations do not collect revenue from credit-bearing courses. They may receive revenue from families in the case of the Early Learning Center or revenue from ARTC students taking seminars. Examples of self-supporting operations in CEHD include the Early Learning Center, the College School, the Lab School, and the CLSC Certificate Program.

The way to recognize a supplemental funds purpose code is that digits 5 and 6 are **21**. For example, EDUC212111 and IFST212114 are self-supporting funds.

Gifts/endowments: Gifts can be defined in two ways – unrestricted and restricted. Endowments represent large donations (\$50,000 and above) that earn interest in perpetuity.

Unrestricted gifts are monies given to a department where the donor may say, “Here is \$50, do whatever you need with it to make the Human Development and Family Sciences department better.” The funds from multiple donors are comingled and the department is free to use those funds to support student activities, guest lectures, faculty travel, renovations, and other expenses.

Restricted gifts are monies given to a department where the donor may say, “Here’s \$15,000 to support graduate student travel to conferences.” The department can only use those funds to support graduate student travel. Restricted gifts may also be generated from campaigns including “I Heart UD Day” where departments identify a specific fundraising activity (e.g., HDFS study abroad support) and donors are invited to contribute to that initiative.

The way to recognize a gift (restricted and unrestricted) purpose code is that digits 5 and 6 are **41**. For example, EDUC**41**2111 and IFST**41**2164 are both gift accounts. To help distinguish restricted from unrestricted accounts, the title of the purpose code will include DF (discretionary funds) for unrestricted and the purpose code title for restricted will include a short description of the fund’s restrictions (e.g., Study Abroad Sppt).

Endowments are monies donated to a department where the principal (the amount donated) is invested by the University and the interest earned from that investment is distributed to the department. For example, a donor may give the University \$1,000,000 to support tuition for graduate students in the School of Education. The \$1,000,000 is invested by a fund manager and a portion of the interest is distributed and a portion is reinvested. For FY22, 4% was distributed to departments as “spendable” revenue. In this example, the department would have \$40,000 annually (4% of \$1,000,000) to fund expenses according to the donor’s wishes. The \$1,000,000 initial donation remains invested and is never spent. The amount distributed to the department may vary annually depending on financial market conditions.

The way to recognize an endowment’s “spendable” purpose code is that digits 5 and 6 are **46**. For example, EDUC**46**2158 and IFST**46**2155 are endowments. The principal is kept in a purpose code that begins with XM.

Start-up funds: Start-up funds are available to faculty members based on their offer letters. The Dean’s office transfers funds to these codes for the faculty member to spend. Allowable expenses include things that are necessary to get the faculty member’s research started (e.g., a pilot study), conference travel, graduate student support, and lab equipment, among other things. These funds typically have an expiration date five years from the faculty member’s start date.

The way to recognize a start-up fund purpose code is that digits 5 and 6 are **19**. For example, EDUC**19**7158 and IFST**19**7155.

State-restricted funds: State-restricted funds, or state appropriations, are funds given to the College from the State of Delaware. These funds have specific uses and are reported on annually. The funds can only be used to support activities/expenses that have a direct benefit to the state of Delaware. For example, expenses associated with student teaching in Delaware schools are allowable. Expenses associated with making classes more accessible to students in downstate Delaware are allowable. State-restricted funds are audited annually, and all expenses must be easily defended if chosen for audit. State-restricted funds have a strict end date and must be fully spent by June 30. The state lines are not supplemental funds.

The way to recognize a state-restricted purpose code is that digits 5 and 6 are **22**. For example, EDUC**22**2111 and IFST**22**2111 are state-restricted funds.

Externally sponsored contracts & grants: Externally sponsored contracts and grants are funds received by the University to conduct research or provide services. Allowable expenses are based on the approved sponsor budget. These funds are project-to-date funds and follow the sponsor's timeline.

The way to recognize a contract and grant purpose code is that digits 5 and 6 come from this list: **31, 32, 33, 34, 35, 37, 42, 43**. For example, EDUC**43**2156 and IFST**34**2168 are externally supported contracts and grants. In this case, digits 5 and 6 identify a particular external sponsor. For example, **31** are funds from the National Science Foundation, **33** are Department of Defense funds, and **42** are State of Delaware.

For the most up-to-date policies and procedures regarding the use of university funds, please contact your Business Administrator, College Business Officer, Grants Analyst, or consult the Procurement Services website:
<https://www1.udel.edu/procurement/>

BUDGET/FINANCE RESOURCES

Hybrid Budget Model information: <https://sites.udel.edu/budget/budget-model/>

Budget Office FAQs: <https://sites.udel.edu/budget/home/2434-2/>

Tuition, Fees, and Charges Policy:

<https://sites.udel.edu/generalcounsel/policies/tuition-fees-and-charges-policy/>

Travel policy: <https://sites.udel.edu/generalcounsel/policies/travel-and-business-hosting-policy/>

Procurement policy: <https://sites.udel.edu/generalcounsel/policies/procurement-policy/>

Credit card policy: <https://sites.udel.edu/generalcounsel/policies/credit-card-policy/>

BUDGET PROCESS AND TIMELINE

Timeframe	Activity
July 1	Start of the University fiscal year
October	College Business Officer quarterly budget review with Chair/Director and unit Business Administrator
January	College Business Officer quarterly budget review with Chair/Director and unit Business Administrator
January-March	College Business Officer meets with Chair/Director of academic units to begin planning for upcoming fiscal year
February	College Dean solicits input from academic departments for faculty searches for the next fiscal year
March	College Dean and College Business Officer meet with the Provost and Budget Office to present the proposed budget
April	College Business Officer quarterly budget review with Chair/Director and unit Business Administrator
April-May	College Business Officer enters planned budget into Axiom
May - June	College budgets are reviewed by the central University Budget Office
May	College Business Officer reviews balances in State-restricted codes to ensure funds are spent by June 30
May-June	College Business Officer quarterly budget review with Chair/Director and unit Business Administrator
July	Budgets are uploaded into PeopleSoft and available in UDataGlance
July-October	Fiscal Year end closes. Period 12 closes mid-June, period 991 closes mid-July, period 992 (final close) closes in October

UNIVERSITY OF DELAWARE BUDGET MODEL (UDBM) METRICS

There are six metrics driving the University of Delaware Budget Model (UDBM) that produce the revenue distributed to colleges.

1. **Undergraduate enrollment:** Current year full- and part-time undergraduate enrollments are compared to the FY2017 enrollments and multiplied by the net tuition per enrollment figure. This comparison is the incremental growth in enrollments. The total incremental revenue is divided evenly (50/50) between central administration and the college. Enrollments contribute 25% of the undergraduate tuition distribution.
2. **Undergraduate credit hours:** Credits taken by undergraduate students are compared to the FY2017 undergraduate credits and multiplied by the net tuition per credit figure. This comparison is the incremental growth in credits. The total incremental revenue is divided evenly (50/50) between central administration and the college. Credit hours taught contribute 75% of the undergraduate tuition distribution.

For both the undergraduate enrollment and credit hours, there is a revenue distribution based on growth and another revenue distribution based on inflation (cost of tuition increases) over the years.

3. **Graduate credits based on instructor of record:** Credits taken by graduate students based on the instructor of record are compared to the FY2017 metric and 50% of incremental revenues are distributed to the college. If there is negative growth, the 50% is deducted from other college incremental revenues. If overall incremental revenues for the college are negative, the college's reserve funds must cover the deficit.
4. **Graduate credits based on course owner:** Credits taken by graduate students based on the course owner are compared to the FY2017 metric and 50% of incremental revenues are distributed to the college. If there is negative growth, the 50% is deducted from other college incremental revenues. If overall incremental revenues for the college are negative, the college's reserve funds must cover the deficit.
5. **Undergraduate tuition special sessions:** Revenue for undergraduate credits taken during the special sessions (winter, summer) are distributed to the college after a 50% allocation to central funds. Special sessions revenue is not based on incremental growth.

6. **Facilities and Administrative (F&A) recovery:** F&A in the current year is compared to the FY2017 base and 50% of the incremental growth is distributed to the colleges. If there is negative incremental growth, 50% of the decrease is deducted from other college incremental revenues. If overall incremental revenues for the college are negative, the college's reserve funds must cover the deficit.

EXPENSES

Personnel

Salaries

Salaries may be adjusted annually through two methods, or a combination of those methods.

1. **Structural increases:** Structural increases for faculty are defined in the Collective Bargaining Agreement and are based on the rank of the faculty member.
2. **Merit increases:** Merit increases for faculty and staff are based on performance. For faculty, the percentage is based on the unit's merit metric policy. For staff, the percentage is based on the prior year's performance.

Staff salary increases are effective on July 1, except for a few special circumstances. Faculty salary increases are effective on September 1.

Fringe Benefits

Fringe benefits are applied to purpose codes based on the account code. Fringe benefits are charged at the same rate regardless of the benefits package that an employee selects. The fringe benefit rates fluctuate annually and include the following primary costs:

- Healthcare
- Life insurance
- Vision/dental plan
- Retiree benefits
- Worker's compensation
- FICA tax
- Vacation payout (paid upon separation from UD)
- Parental leave
- Faculty retirement payout

There is a fringe rate for internal funding sources and external funding sources as shown in the following table.

Fringe rates for FY2023 (July 1, 2022 – June 30, 2023)

Category	Internal Fringe Rate	External Fringe Rate
Exempt/Faculty	42.7%	39.1%
Non-Exempt	70.3%	75.1%
Graduate Students	9.0%	13.1%
Miscellaneous Wage	8.0%	7.9%

Travel

The base budget has a limited amount of funds designated for travel. Most travel expenses in CEHD are paid from supplemental funds, start-up funds, or contracts & grants.

Supplies and other support

Certain supplies and other support costs are allowable in the base budget. Typical expenses include routine office supplies, telephone expenses, and routine maintenance. Due to limited resources in the budget model, the base budget has a limited amount of funds designated for supplies. Once this budget is exhausted, units are expected to use supplemental funds to cover expenses. Non-routine maintenance (e.g., office renovations), furniture, guest speakers, and food expense are expected to be charged to supplemental funds.

DEFINITIONS

Account code: An account code is a six-digit code used to identify a revenue or expense transaction. Revenue account codes begin with the letter R and expense codes begin with the number 1. Examples include 141000 for office supplies, 121100 for faculty academic salaries, and R04600 for federal sponsored program revenue.

Accounting period: Accounting periods are based on the fiscal year with July being period 1 and June being period 12. There are special accounting periods based on year-end close. Period 991 is the first close where units complete final transactions for the fiscal year. Period 992 is only used by central offices to finalize fiscal year transactions.

Department identification (Dept ID) number: The Dept ID is a four-digit code that identifies a department on campus. Sometimes this number is represented in five digits depending on the system. For example, the School of Education is DeptID 2922, but you may see it as 02922.

Exempt salaries: Staff salaries that are exempt from federal overtime regulations. Formerly known as “professional salaries,” these salaries have an account code of 120200. Job titles in this category include College Business Officer, Grants Analyst, Business Administrator, and Academic Program Coordinator, among others.

Facilities & Administrative (F&A) Costs: Also known as indirect costs, these are expenses charged to contracts & grants. The purpose of F&A recovery is to cover administrative costs associated with conducting research. F&A is a revenue source in the UDBM.

Fiscal year: The University of Delaware's fiscal year begins on July 1 and ends on June 30.

Incremental revenue: In the University of Delaware Budget Model (UDBM), the incremental revenue is the difference between revenues generated in fiscal year 2017 (the base year) and the current year based on student enrollments and credits taught. For example, if in FY2017, the College had 950 undergraduate students and in FY2022 the College has 975 undergraduate students, there is increment growth of 25 students. Revenues are distributed to the College based on the incremental growth.

Non-exempt salaries: Staff salaries that are subject to federal overtime regulations beyond 40 hours per week are non-exempt salaries. Formerly known as "salaried staff," these salaries have an account code of 123000. Job titles in this category include Administrative Assistants (I-IV), Research Associate I, Limited Term Researcher, among others.

Predictable base: The predictable base is the fiscal year 2017 actual expenditures less graduate tuition revenue and F&A recovery.

Purpose code: The purpose code identifies a revenue or expense allocation source. The code is typically 10 digits in length. The purpose code is made up of the unit's four-character acronym (e.g., EDUC, IFST, CEHD). The fifth and sixth digits reflect the source of the funds (e.g., 11=base budget, 22 = state restricted funds, 34 = federal Department of Education funds). The last four digits are sequential to differentiate codes that have the same six starting characters.

FREQUENTLY ASKED QUESTIONS

BUDGET MODEL

Q: What are the primary drivers of the budget model and what do I have control over?

A: The primary drivers of the budget model are revenues and expenses.

Revenues: Undergraduate revenues are based on two metrics: enrollments (based on major) and student credit hours (based on the college of the individual who teaches the course). Graduate revenues are based on the college of the individual who teaches the course (total credit hours) and the college that owns the course (total credit hours). Enrollments and credits taught are compared to FY17 enrollments and credits taught. Any incremental growth is then “taxed” 50%. If there is a reduction in the enrollment or credits taught as compared to FY17, the College must absorb the full reduction in resources.

Expenses: A unit can have control of expenses by being good stewards of the funds and staying within budget.

Q: What is incentivized in the new UD Budget Model?

A: Increases in student enrollment, credit hours taught, and new programs are incentivized. New programs, since they are not part of the FY17 base, must be carefully planned since all of the revenue would be considered incremental growth and subject to the 50% central tax. Special session (winter and summer) teaching is also incentivized. We receive 50% of the revenue, and those revenues are not subject to the incremental growth calculation.

Q: How do funds flow in the UD Budget Model (UDBM)?

A: At the beginning of the year, the central Budget Office distributes the base allocation to each college. This is the net of FY17 expenses, less FY17 graduate tuition generated, less FY17 F&A generated. The result is called the predictable base.

The next calculation is for incremental growth. For undergraduate tuition, there is a complex formula to determine how revenues flow in the UDBM. The University calculates total tuition, and then reduces that pool of funds to account for the Associate in Arts program and undergraduate continuing education revenue. The pool of tuition is then reduced by the cost of financial aid. This leaves the amount available for distribution to the colleges and a calculation is done for net per credit amount and net enrollment amounts. Those calculations are then compared to incremental growth, and resources are then distributed to the colleges.

For graduate tuition, incremental growth is based on the instructor of record and the college that owns the course. For example, if CEHD owns the course and one of our instructors teaches the course, we are allocated the revenue. If CEHD owns the course, but a faculty member from another UD college teaches it on-load, the revenue is shared. All incremental graduate tuition revenue is subject to a 50% ‘tax’ from central administration.

Special sessions revenue is not subject to a comparison back to FY2017. Colleges receive 50% of the special sessions’ revenue.

Indirect costs (F&A) revenue is compared to FY2017 and any incremental growth is shared with central. In the case of negative growth, that is fully borne by the college.

Q: Do you have any tips on managing my budgets in this model?

A: Here are a few tips.

Tip 1: Since our expenses are currently outpacing the incremental revenues, we need to remain fiscally responsible in this model. If there are base budget expenses that can be covered by supplemental funds or unrestricted gift funds, that is strongly encouraged. If there are expenses that can be deferred until our financial position improves, that is also encouraged. The CEHD-DSS will help you see balances in funds outside of the base budget to consider for some expenses.

Tip 2: Use the CEHD-DSS to monitor your budget and expenses monthly and stay within the budget allotted. If you have to spend more than allotted, please use your supplemental funds.

Tip 3: Think creatively. Are you offering a course just because it’s always been offered despite low enrollments? Perhaps there is a new course that would attract more students that can replace the old course.

Tip 4: Use the [calculator](#) to determine the revenue generated from special sessions.

Tip 5: Are there new winter or summer courses that may attract students from outside of CEHD? Since the special sessions revenue is not subject to the incremental growth calculation, this is an opportunity to generate revenue.

GENERAL FINANCIALS

Q: I keep hearing the phrase “All funds” – what is a fund?

A: “All Funds” refers to the complete financial framework of the University. It provides a full view of all sources of funding and includes the base budget (aka “1-

book”), supplemental funds, gifts and endowments, start-up funds, state restricted lines, contracts and grants, and self-supporting operations (aka “2-book”). A detailed description of “all funds” is provided in an earlier section of this document.

Q: Help me understand fringe benefits. What is included and why do I have to pay them?

A: The benefits package at the University includes:

- Insurance costs (medical, life, vision, dental)
- Worker’s compensation
- Retirement benefits
- Pension
- Federal FICA tax
- Fee waivers
- Faculty retirement payouts
- Vacation payout
- Unemployment insurance
- Parental leave

These expenses are distributed as a cost to a unit that has salary or wage expenses based on the salary/wage account code. The rates change annually and for FY23 the rates are:

Fringe rates for FY2023 (July 1, 2022 – June 30, 2023)

Category	Internal Fringe Rate	External Fringe Rate
Exempt/Faculty	42.7%	39.1%
Non-Exempt	70.3%	75.1%
Graduate Students	9.0%	13.1%
Miscellaneous Wage	8.0%	7.9%

Q: Can I carry over base budget funds to next year?

A: No, base budget funds are only available for the period July 1 through June 30. At that time, budgets are closed, and a new budget period will open.

Q: I see an expense that I don’t think is correct. How can I get more information about this expense and who can fix it?

A: Your department business administrator is your first stop. If the expense is on a contract/grant, please contact your FSU support person. If they are not able to assist you, please contact Rachel Mroz at rs@udel.edu and she will be able to help you.

Q: What is the difference between account codes and purpose codes?

A: Account codes are used to identify an expense. For example, the account code 141000 is used for office supplies. The account code 121100 is for faculty salaries. The account code 130100 is used for travel.

Purpose codes identify a source of funds. For example, EDUC342115 identifies a grant in the School of Education. IFST110000 identifies the base budget for HDFS. CHEP17S000 identifies supplemental funds.

Q: Help me understand the difference between unrestricted and restricted funds?

A: Restricted funds have a specific purpose and unrestricted funds can be used for general expenses. It's important to know if your fund is restricted or not. For example, CEHD has several restricted scholarship funds, and those funds can only be used for specific students. We would be in violation of the donor's intent if we charged something other than scholarships for specific students to those codes.

Unrestricted funds are given to the University to support general costs. They can be used for whatever the receiving unit desires; however, the unit leader should ask themselves "Would a donor be happy to hear that I spent the funds this way if I were telling them how we used their gift?"

Q: How do I request a change in the budget?

A: We don't typically do budget revisions, but please contact Rachel Mroz (rs@udel.edu) to discuss.

Q: I'm considering developing a new program in my department. How do I get budget information to see if the program is financially viable?

A: Reach out to Rachel Mroz to begin the planning. Start thinking about the number of students you think you can attract to the program, if additional faculty need to be hired to teach, how many new courses would be offered, and whether this new program attract new students or pull from existing programs?

Q: What if I overspend my base budget?

A: Expenses will need to be moved to your supplemental funds before year end.

Q: My question hasn't been answered, where do I go for help?

A: Contact Rachel Mroz (rs@udel.edu).

Appendix G

FREQUENTLY ASKED QUESTIONS TO SUPPORT COLLEGE LEADERSHIP

Artifact Purpose and Place in Broader ELP

The purpose of this artifact is to provide a frequently asked questions document (FAQ) for College of Education and Human Development (CHED) leadership. This FAQ document will provide answers to questions that I routinely answer and that were identified by end users during the semi-structured interviews (see Appendix B and Appendix D). It is intended to be a companion document to the CEHD Budget Support Handbook (Appendix F) and will help end users understand how the CEHD Decision Support System (CEHD-DSS) can help them.

The data collected during the semi-structured interviews were reviewed and placed into 10 categories. The categories are:

- Financial
- Student Enrollments (including demographics)
- Human Resources
- Courses/Credits taught
- Contracts & Grants
- Admissions/Retention/Graduation
- Labor Allocation Module (LAM)
- Shadow systems
- External data
- Miscellaneous

The following FAQs group the questions into the above categories.

FINANCIAL

Q: How can I easily and quickly see how much money I have left in my budget?

A: The CEHD-DSS and UDataGlance are perfect tools to answer this question. Here's how you navigate to the dashboard:

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile

The visual titled "Current Year – Base Budget by Category" provides a balance by budget category.

NOTE: The obligations are currently only capturing salary obligations. If you have obligations in non-salary categories, they are not shown yet in the CEHD-DSS.

[UDataGlance](#) can be used at this time to access all obligations.

Q: How much does it cost to run a course? How can I calculate the cost of instruction?

A: The basic calculation is simple and can be computed by going to this [calculator](#). This calculation only takes into consideration the faculty member's salary and fringe.

The true cost to run a course (factoring in all associated expenses) is more complex, since we would need to factor in other costs including administrative and facilities costs.

As the CEHD-DSS matures and definitions for administrative and facilities costs are established and agreed upon, this calculation may become more complete. For now, consider the number generated by the calculator to be a rough, and incomplete, estimate of costs.

Q: How much revenue is generated for a winter or summer session course?

A: The basic calculation is simple and can be computed by going to this [calculator](#). Although the calculation is rather simple, this should still be considered an estimate since all expenses cannot be adequately captured.

Q: How much revenue is generated for an undergraduate course? How about a graduate course?

A: The basic calculation is simple and can be computed by going to this [calculator](#). The calculation and the calculator provide a rough estimation. In the UD Budget Model, there are multiple factors that go into calculating the final revenue that the college will receive.

Q: Do any of my programs generate a surplus?

A: This is a complex, yet important, calculation. In this budget model, we have to account for base revenues and expenses combined with incremental revenues and expenses. Currently, we do not calculate revenues and expenses at the specific program level. While it is relatively easy to calculate direct costs for programs, allocating administrative and indirect costs is complicated and allocation methods (e.g., distribute administrative costs by enrollment in the program) have not been established.

Q: I would like to drill down to see specific expenses – will the CEHD-DSS support that?

A: Yes, the CEHD-DSS will allow you to see line-item expenses.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile
- Click on any item in the ACTUALS column

As the CEHD-DSS matures, an option to download the data will be provided.

Alternatively, accessing [UDataGlance](#) is another option to get line-item detail for expenses.

Q: I'm interested in seeing monies available in gifts, endowments, supplemental funds – does the CEHD-DSS provide this information?

A: Yes, the CEHD-DSS can provide this.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Gifts and Endowments tile

The views on the left side provide information regarding unrestricted gifts and the views on the right side provide information regarding endowments.

For supplemental fund balances:

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile

NOTE: Currently, these data are manually updated monthly and the current fiscal year reflect year-to-date (YTD) figures.

Q: Can I see how much I'm spending on facilities?

A: Yes, the CEHD-DSS can filter the data on facility specific expenses in terms of UD shop (e.g., painting, signs, electrical) expenses. The expense group for these expenses is "Plant M&O." If an expense is in your supplies categories, the system doesn't know if those expenses are for facilities or general supplies. Here's how you navigate to the dashboard:

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile
- Select the fund type (e.g., base budget, supplemental) you are interested in seeing

- From the Expense Group filter, select “Plant M&O” and the visualizations will reflect Facilities charges

Q: Is there a report that I can run to see Facilities & Administrative (F&A) return over time? Any chance I can also see what faculty members generated the F&A?

A: Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Department Summary tile
- F&A Generated is one of the views on this tile
- Hover over any of the columns and a tool tip will give a breakdown of faculty name and the amount and percentage contributed

Q: Can I see several years of expenses by month for planning purposes?

A: The CEHD-DSS contains 10 years of expenses.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile
- The visual at the bottom of the dashboard allows for viewing aggregated expenses by year or month. Use the filter on the right to choose the level of detail (month, quarter, annual).

Q: I’m interested in seeing the trends of sponsored program expenses over the past 5 years. Do you have a report for that?

A: The CEHD-DSS contains 10 years of expenses. The default view is for five complete years of data and the year-to-date expenses of the current year.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile
- Select Sponsored Programs from the Fund Type dropdown menu in the top left corner
- The views will update to reflect sponsored program expenses

STUDENT ENROLLMENTS

Q: How can I see the number of students in a major over time?

A: Yes, the CEHD-DSS provides that information.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Enrollments tile
- Views are provided for majors over the past five years

Q: Can I see student demographic data? I'm interested in things like race/ethnicity and non-traditional students as it may help inform future academic programs.

A: Yes, certain student demographic data available in the CEHD-DSS, but you cannot get data at the student level to protect individual student privacy. Non-traditional students require a complex calculation, but it's on the list for a future enhancement.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Enrollments tile
- Views are available reflecting ethnicity, full- and part-time status, residency, and gender

If you need additional demographic data, please contact Rachel Mroz or click on the "Feedback" button on the landing page and see if those data are available.

Q: I would like to see individual student level demographic data, is that possible?

A: No. To protect individual student privacy, the data are rolled up to non-identifiable information.

Q: I'm interested in seeing student retention data. Is that available to me?

A: Yes. Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Retention/Graduation tile
- University wide retention data and the selected department retention are displayed on the left side of the dashboard

HUMAN RESOURCES

Q: Can I run a report to see salaries and job titles in my department?

A: Yes. Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile
- This view can be sorted by title, name, and salary

Q: Can I run a report that shows the faculty in my department and what rank they are?

A: Yes.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile

Q: I'm interested in knowing how much of the growth in personnel expense is from merit increases, structural increases, promotional increases, adding new positions, or fringe benefits. How can I find that information?

A: These calculations are complicated since the reasons for the increase (e.g., structural, promotion, merit) are all allocated to the same account code. For example, all faculty related increases are coded under 121100. If a faculty member receives an increase of \$9,425 the components may be explained as follows:

2% merit: \$1,800

Structural: \$1,125

Promotion: \$6,500

The entire increase of \$9,425 is coded under 121100 and the individual components are not identifiable. Unfortunately, with the data in the system, it is not possible to

break down the three components. This request is important, and we will continue to seek data resources (or develop a calculation) to answer the question.

Q: Can I run a report that shows the faculty and staff demographics in my department?

A: Yes, the CEHD-DSS provides that information but to protect sensitive information, the data are limited and, in most cases, aggregated to further protect privacy.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile or the Department at a Glance tile

If you need additional demographics, please contact Rachel Mroz to discuss if these data are available and what the business need is.

Q: Can I run a report that shows all employees and their supervisors?

A: Yes.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile

Q: What personnel data are available to me?

A: Due to the sensitivity of personnel data, the CEHD-DSS contains limited information to protect employees. Currently, these data include:

- Salary
- Title
- Employee ID
- Years in rank (for faculty)
- Years tenured (for faculty)
- Date of retirement eligibility

If you need other personnel data, click the “Feedback” button from the landing page and send in your suggestions for enhancements or additional data. Please include the business need when requesting personnel data.

Q: Does the CEHD-DSS contain a list of the voting faculty members in my department?

A: Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Department Summary tile and there is a view titled “Voting Members.”
- You can filter on this view to only see the eligible members based on the type of vote being taken.

Q: I am interested in knowing how much and from what sources I’m paying miscellaneous wage employees. Where can I find that information?

A: Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile

Q: Can I see a sabbatical history for the faculty in my department?

A: Yes. Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Human Resources tile

Q: I am the Principal Investigator of a large grant and need to group the personnel by functional area within the grant. These data are stored in a spreadsheet on my desktop and the assignments change frequently. How can I bring these data into the CEHD-DSS?

A: Since these data are not included in central data sources, we would need to incorporate a shadow system. The CEHD-DSS is limited to centralized published data models. The second version of the CEHD-DSS will include the ability to download data from the system and you can then combine with your local data.

Q: Does the CEHD-DSS provide a resource to see time banks for employees?

A: Currently, those data are not accessible in the CEHD-DSS. This request will be on a planned enhancements list. You can find this information in the UD Workforce system.

COURSES/CREDITS TAUGHT

Q: Can I see the courses and the number of credits that the faculty are teaching?

Can I also see how many credits are taught by adjuncts and courses on overload?

A: The CEHD-DSS has this information.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Courses and Credits tile

Q: Is there a way to see a five-year history of courses taught and the number of sections? Can those courses be sorted by academic program (e.g., Special Education, Human Services)?

A: The CEHD-DSS has the history of courses taught and the number of sections, but the courses do not include what program/major they are in. For example, HDFS100 may be a required course in three different majors.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Courses and Credits tile

The next version of the CEHD-DSS will allow you to download those data and you can add the column for major.

Q: I'd like to see a snapshot of what my faculty are teaching this semester. Is there a visual for that?

A: Yes.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Courses and Credits tile

Q: What are some of the deciding factors in determining if we should add another course section? Should I ask people to teach larger classes or open another section?

A: There are several factors to consider when deciding to open a new section or increase the cap in a current open section. Some of those factors include:

- Faculty availability
- Course demand
- When will the course be available again?
- Do you have enough in your budget to cover the expense?

Asking people to teach larger classes depends on the type of class and if the space is available to increase the class size.

Q: Who has course releases in my department and why?

A: Since these data are not included in central data sources, we would need to incorporate a shadow system. The CEHD-DSS is limited to centralized published data models. The second version of the CEHD-DSS will include the ability to download data from the system and you can then combine with your local data.

Q: Is there a report that shows me average credits taught by rank? This information would be helpful for assigning workload and faculty appraisals.

A: Yes.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Courses and Credits tile

CONTRACT & GRANTS

Q: Where can I find data on how successful my department has been with proposals and awards?

A: At this time, the data set to answer this question is not validated and therefore not included in the CEHD-DSS. As the data sources are verified and added to the Central Analytics Platform, the CEHD-DSS will be updated to include this information.

Q: Is there a system that compiles my current and pending documentation?

A: [SciENcv](#) is a tool to assist with current and pending as well as your biosketch. These data are not included in the CEHD-DSS.

Q: Can I use the CEHD-DSS to see research expenditures over time and what level of detail is available?

A: The CEHD-DSS currently provides research expenditures for the past 10 years at the major account group (e.g., salaries, travel, supplies) level.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Financials tile
- Select Sponsored Programs from the drop-down menu in the top
- The view on the right “Current Year” provides the categories
- The view is currently limited to five years of data

Views are being developed to provide additional levels of detail.

Q: If I have funding as part of a larger grant in another UD College – can I see the whole award or just my piece?

A: Currently, permissions default to only seeing your part of the award. You can reach out to the primary award holder and ask for view access on other codes, and they will determine if access is possible.

Q: I have specific program data for my grant at the functional level that I store in a database on my shared drive. Can these data be brought into the CEHD-DSS?

A: Since these data are not included in central data sources, we would need to incorporate a shadow system. The CEHD-DSS is limited to centralized published data models. The second version of the CEHD-DSS will include the ability to download data from the system and you can then combine with your local data.

Q: I need to be more strategic in planning for spending on my sponsored program awards. Can the CEHD-DSS provide a place for what-if scenarios?

A: Currently, the CEHD-DSS does not support what-if scenarios. This is a planned enhancement for future versions.

STUDENT ADMISSIONS/RETENTION/GRADUATION

Q: Can I see the admissions data for my programs?

A: Yes. If you navigate to the CEHD-DSS, you will be able to see the admissions funnel for the selected department. This funnel will show applied, admitted, accepted, and enrolled.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Undergraduate Recruitment tile

There is also a table below the funnel diagram with the data.

These data are currently at the department level. Additional options to drill down to the program level will be added soon.

Q: I'm interested in seeing the graduation rates over time for my programs. Are those data available?

A: Yes.

Navigate to the CEHD-DSS: <http://vger.udel.edu/>

- Click on the Retention/Graduation tile

- Graduation data by academic career and by ethnicity are available

If you need additional graduation information, click the “Feedback” button from the landing page and send in your suggestions for enhancements.

LABOR ALLOCATION MODULE

Q: I need to see the planned workload/effort for employees. Where can I find this information?

A: Unfortunately, those data are not available in the CEHD-DSS at this time, but there are reports that can be run from other sources. Please reach out to your Grant Analyst in the Financial Services Unit for support. The reports that are available to the Grant Analysts are based on data keyed into the Labor Allocation Module.

SHADOW SYSTEMS

Q: I have an Excel document on my desktop that I update each quarter. Can that be integrated into the CEHD-DSS?

A: Since these data are not included in central data sources, we would need to incorporate a shadow system. The CEHD-DSS is limited to centralized published data models. The second version of the CEHD-DSS will include the ability to download data from the system and you can then combine with your local data.

EXTERNAL DATA

Q: Can I see the data from the ProCare system in the CEHD-DSS including child data (medical needs, food allergies), Purchase of Care (POC) data, and child program data?

A: At this time, the CEHD-DSS is limited to central published data models and the ProCare data are external. Future versions of the CEHD-DSS may allow data from external sources to be incorporated. In some cases, we need to determine if special permissions (e.g., IRB) are needed before a data set can be tied to the CEHD-DSS.

Q: I have access to a state of Delaware system that provides teacher certification information. Can I bring that into the CEHD-DSS?

A: At this time, the CEHD-DSS is limited to internal UD data and those data are external. Future versions of the CEHD-DSS may allow data from external sources to be incorporated. In some cases, we need to determine if special permissions (e.g., IRB) are needed before a data set can be tied to the CEHD-DSS.

Q: It would be helpful if the CEHD-DSS would show current funding opportunities from external funders. Can you do that?

A: These data come from numerous sources and it would be difficult to bring those external data in at this time. A future enhancement may allow for the CEHD-DSS to connect to those sources or at minimum connect to the major sources like grants.gov.

MISCELLANEOUS

Q: Is there any data available about the physical space that my department occupies?

A: Currently, these data are not available in the CEHD-DSS, but they are on the plans for future versions of the CEHD-DSS.

Q: I would like to see more relationships between some of the data. For example, I would like to see sponsored program expenses compared to student credit hours taught. Can you add this?

A: Yes. Additional views are being planned and developed. Click the “Feedback” button from the landing page and send in your suggestions for enhancements.

Q: The CEHD-DSS is awesome – can I post this data on my website or send out in my next newsletter?

A: Currently, all the data from the CEHD-DSS is for **internal use only**. If you need to publish any of the CEHD-DSS data, please discuss with the College Business Officer first.

Appendix H

A CASE STUDY ON THE DESIGN, DEVELOPMENT, AND DEPLOYMENT OF THE COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT DECISION SUPPORT SYSTEM

Artifact Purpose and Place in Broader ELP

The purpose of this artifact is to report the results of a case study on the design, development, and deployment of the College of Education and Human Development Decision Support System (CEHS-DSS).

Introduction

Human Development and Family Sciences (HDFS) is an academic unit in the College of Education and Human Development (CEHD) at the University of Delaware (UD). HDFS was selected for this case study for two reasons. First, the department business administrator position is currently vacant. This person would typically provide data to the chairperson, and with the vacancy, the chairperson needs a convenient method for getting data. Second, the current chairperson will begin their retirement leave year soon. Designing and developing the CEHD-DSS while they are still in the position will allow for their expertise in validating department data and deploying a system to support the next chairperson.

The Process

This case study documents the iterative process of developing meaningful and useful dashboards for HDFS. Meetings with the HDFS chairperson were held from

December 2022 to March 2023. The agendas and the decisions made during those meetings are provided below.

Meeting date	Agenda	Decisions
December 12, 2022	<ul style="list-style-type: none"> • Introduction of the CEHD-DSS concept • Discussion of available data • Preliminary selection of dashboard elements 	<ul style="list-style-type: none"> • Explore options to pull faculty publications into the CEHD-DSS. • Create a faculty metrics page including courses, credits, grant activity, and publications. • Create a department snapshot with key metrics. • Link out to other dashboards (e.g., Graduate College). • Next meeting: January 16
January 16, 2023	<ul style="list-style-type: none"> • Progress to date • CEHD-DSS framework • Review of CEHD-DSS Version 1 • Feedback • Design enhancements • Next steps • Schedule next meeting 	<ul style="list-style-type: none"> • Seek a reliable source for faculty publications. Do not use Academic Analytics. • Develop link for course cost/revenue calculators. • Include balances for gifts and endowments. • Next meeting: February 6
February 6, 2023	<ul style="list-style-type: none"> • Progress to date • Incorporating requested changes • Review of revised visualizations • Feedback • Design enhancements • Next steps • Schedule next meeting 	<ul style="list-style-type: none"> • Keep working on current data requests. • Figure out why some dashboards fail to populate for HDFS (but work for SOE). • Continue to develop link for course cost/revenue calculators. • Next meeting March 6

<p>March 6, 2023</p>	<ul style="list-style-type: none"> • Progress to date • Review of revised visualizations • Feedback • Design enhancements • Next steps • Schedule next meeting 	<ul style="list-style-type: none"> • Change some visualizations to tables. • Discussed the possibility of bringing in external data sources in a future version. • Figure out why some dashboards fail to populate for HDFS (but work for SOE). • Add some additional data to the Department at a Glance dashboard. • Next meeting: March 16
<p>March 16, 2023</p>	<ul style="list-style-type: none"> • Review of requested changes • Discuss requested changes • Deployment steps • Schedule next meeting 	<ul style="list-style-type: none"> • Reviewed requested suggestions from prior meeting. No additional revisions requested. • User manual reviewed and sent via email. • Chairperson will access the system to explore data and provide feedback on any issues. • Next meeting: as needed

The first meeting in December of 2022 with the department chairperson included defining the problem and discussing the proposed solutions. The chairperson agreed that the need for more convenient access to data was a problem and was excited about the proposed solution. We discussed the available data and brainstormed potential visualizations that would be useful in supporting decision making in the department. We also discussed the potential uses of the dashboard, including the

ability to have data readily available for inquiries as well as having data to support faculty appraisals.

Unexpectedly, in early January of 2023, I received the framework for UD's College of Arts & Sciences (CAS) dashboard, which was under construction. UD's Office of Institutional Research & Effectiveness (UD-IRE) worked with CAS to secure the framework sharing with the explicit understanding that CAS data would not be shared. This sharing not only saved a significant amount of time in developing the CEHD-DSS by having pre-built templates but also provided an opportunity for collaboration across two UD academic colleges and UD-IRE. This framework included the connections to the centralized published data sources but did not allow access to CAS data. Access to these templates provided a significant jump-start to the CEHD-DSS.

A week after receiving the CAS templates, I received access to nine centralized published data sources, including student enrollments, student credit hours, human resources, graduation, courses, cohort metrics, and admissions. Access to central published data sources was a true game changer. This unexpected development allowed access to verified, centralized data which are centrally loaded and frequently updated. It eliminated my need to source these data for manual uploading. It also created a sense of validity and trust with the data since centralized, verified data were being used to populate the CEHD-DSS. The only data source not included in the centralized sources was financials. However, this is one of the most accessible data sets for me to download directly from PeopleSoft queries, and therefore did not create

an issue in the continued design and development of the CEHD-DSS. The financial data will need to be updated manually by me monthly, whereas the other data sets are refreshed centrally regularly. Working closely with IRE, we were able to connect to CEHD data to be able to use the CAS dashboard framework. These two developments, the use of the CAS framework and access to centralized data, were instrumental in the development of the CEHD-DSS.

The second meeting with the HDFS chairperson provided an opportunity to review the recently obtained CAS dashboard and get feedback on the data and visualizations included. As the dashboards were also relatively new to me, we explored the system together. Several visualizations were useful, and a few were not helpful for HDFS. Many of the chairperson's questions could not be answered with the existing CAS dashboards. The chairperson noted that some of the data presented, primarily those included in large tables, were too busy or complicated to digest. They also noted that some acronyms (e.g., SCH, LOD) needed to be defined, especially for new users. This feedback was valuable in understanding how to improve the dashboards for ease of use.

Using the feedback from the second meeting and the frequently asked questions in Appendix G, I began constructing the first version of the CEHD-DSS. The first step was to understand the available data. Tableau makes data exploration relatively simple with the drag-and-drop interface. However, with the vast amount of data available, this still took several days to explore. Once the data were better understood, I added new visualizations using the CAS template. I modified existing

visualizations to better answer the questions that CEHD leadership needed answered for decision making.

Our third meeting was in February of 2023. At that time, the chairperson asked for two specific dashboards. The first one was a dashboard with the most important department metrics in one place. The second request was for a faculty-specific dashboard where the chairperson could filter on a specific faculty member to see key metrics, including courses taught, sponsored program activity, and publications. The chairperson suggested that this would be very helpful during the appraisal process by having the available metrics easily accessible. The requested data are in various stages of being validated or available in the system. Courses and credits taught are available, as are the sponsored programs financial data. The count of proposals and awards data are still being validated and, therefore, not included in this first version of the CEHD-DSS. The only data requested that are entirely unavailable are publications data. The chairperson described issues with using Academic Analytics and cautioned against using it as a data source. Until a reliable, comprehensive data source for publications is made available, this request must remain unmet.

For the fourth meeting in early March 2023, I presented the faculty metrics and department summary dashboards as requested in the previous meeting. From the data available from the central published data sources, I created a dashboard that included the requested metrics, including courses and credits taught, research expenses, and indirect costs generated. The dashboard also includes time in rank, retirement eligibility year, hire date, current rank, and current salary. We discussed a possible

future enhancement of a split screen where an administrator could view metrics for a specific professor in one screen and for all others at the same rank in another screen. We also discussed changing some of the visualizations from graphs to data tables. The chairperson was highly impressed with the system and said, “I am jealous that I will not get to use this!” considering her retirement date is rapidly approaching.

I presented the revised dashboards for our final design and development meeting in mid-March 2023. The chairperson deemed them meeting her needs. Later that day, I sent her the link to the system and the user manual to allow her to begin exploring the dashboards independently. We immediately ran into some access issues, but the Office of Institutional Research and Effectiveness resolved within a few days. We agreed that the mid-March meeting would be the last formal meeting, and they would email, stop by my office, or use the feedback button in the system to request changes or enhancements.

Conclusion

Working with the chairperson of HDFS on this project was an invaluable experience. Their insights and knowledge were instrumental in developing and designing the first version of the CEHD-DSS. Together, we explored data and created dashboards that would be useful in answering the questions they are often asked and providing meaningful visualizations for them to explore data for their department. The chairperson and I had several meaningful conversations to dig deeper into their data needs and determine if they could be met with the CEHD-DSS.

One limitation to this case study that should be noted is that I am new user of the Tableau software. To an expert Tableau user, the dashboard design may violate some best practices in dashboard design. This first version of the CEHD-DSS is primarily a proof-of-concept. The CEHD-DSS is simply the start of a data revolution in CEHD that brings data to leadership that they have never been able to access on their own. Enhancements are already being planned, along with more relationships between data sources to gain additional insights into the CEHD data.

Since I am not an expert in Tableau, this dashboard creation exercise had many successes and failures. The successes led to many “you have to see this!” moments with my collaborators and colleagues. The failures were often very frustrating but forced me to seek solutions and figure out how to make it work. The online resources are invaluable, especially for a new Tableau user, to self-solve and work through solutions. There were a few problems during development that, despite my self-solve efforts, I could not resolve. To solve these problems, I accessed my network of Tableau experts for advice and troubleshooting. The Tableau community is loaded with experts willing to help solve problems.

The key takeaway from this case study is the power of collaboration and persistence to create a meaningful product for the end user. This case study demonstrates the outcomes of working closely with an end user to design, develop, and deploy the first version of the CHED-DSS. As the CEHD-DSS is rolled out to more users in the college, the insights gained during this process will strengthen future versions.

Appendix I
IRB/HUMAN SUBJECTS APPROVAL



Institutional Review Board
210H Hullihen Hall
Newark, DE 19716
Phone: 302-831-2137
Fax: 302-831-2828

DATE: September 20, 2022

TO: Rachel Mroz
FROM: University of Delaware IRB

STUDY TITLE: [1942408-1] College of Education and Human Development Decision Support System for Leadership - Needs Assessment

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF EXEMPT STATUS

EFFECTIVE DATE: September 20, 2022

REVIEW CATEGORY: Exemption category (2 (ii))

Thank you for your New Project submission to the University of Delaware Institutional Review Board (UD IRB). According to the pertinent regulations, the UD IRB has determined this project is EXEMPT from most federal policy requirements for the protection of human subjects. The privacy of subjects and the confidentiality of participants must be safeguarded as prescribed in the reviewed protocol form.

This exempt determination is valid for the research study as described by the documents in this submission. Proposed revisions to previously approved procedures and documents that may affect this exempt determination must be reviewed and approved by this office prior to initiation. The UD amendment form must be used to request the review of changes that may substantially change the study design or data collected.

Unanticipated problems and serious adverse events involving risk to participants must be reported to this office in a timely fashion according with the UD requirements for reportable events.

A copy of this correspondence will be kept on file by our office. If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.

INSTITUTIONAL REVIEW BOARD

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