University of Delaware Decision Support System: A Needs Analysis of Data Warehousing and Institutional Research and Planning

Karen A. DeMonte

University of Delaware

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Abstract

Beginning in 1998, the University of Delaware began converting its administrative computing systems from a mainframe system to PeopleSoft. When reporting responsibilities shifted from Information Technologies to functional/business areas, the university was faced with the challenge of providing departments with easily accessible and accurate reports in a timely manner. The creation of a data warehouse and web technology presents an opportunity to empower administrators and departments with the ability to create their own reports and analysis. The organizational structure, data and reporting needs, and how to disperse knowledge to the university community are explored. The purpose is to formulate the needs into a strategic plan for the university to meet the challenge of information management and decision support.
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Buzz phrases such as “distributed computing,” “decision support systems,” “business intelligence,” “information management,” and “enterprise data warehouse” are heard on college campuses with greater frequency over the past 10 to 15 years. These phrases are typically the foundation for presentations at professional conferences and are common topics in higher education journals. In the past, information technology would have been the center of these discussions. However, in recent years, institutional research has also been included in the conversations, not as an advisor, but as a partner. In an October 2007 Educause research bulletin, Rittenberg, Stiles, and Udis-Kessler described a collaborative relationship at another institution in which information technology and institutional research merged to “enhance the data, information, and insights that influence policy and planning activities” (p. 2).

What does all this mean? Decision support systems are summarized by Nemati, Steiger, Lakshmi, and Herschel (2002) as overall technology solutions used to support decision making processes. Decisions start with data. Information management, therefore, is a means to manage data for information, not just managing data. In *People, Processes, and Managing Data (2nd ed.)*, McLaughlin and Howard (2004) describe managing data for information as:

Learning about the management of data requires more than a set of technical skills and abilities. Management of data requires an understanding of the organizational processes of an institution, and an understanding of the environment in which the data are both produced and used. Dealing with this
complexity and establishing value-added niches requires an understanding of the general organizational process of adaptation. What are the basic strategies and tactics required to change the organization? What are the issues involved in the change, and what are the lessons we have learned from working to change and improve the management of data? (p. 67)

It follows that knowledge management is the next step in decision support. Knowledge management combines information with individual, group, and organizational experience and judgment. It involves making a leap from understanding patterns to guiding action (Serban & Luan, 2002). Business intelligence tools bring it together by leveraging both internal and external information assets to support decision making activities. Along with these tools, an enterprise data warehouse queries data sources with different logical data models to produce an understandable report on which to base decisions (Inmon, 1996). One example would be to query data from Student Records, Financials, and Human Resources to compare how efficiently departments operate in terms of instructional costs and productivity.

“The evolution from data to information and from information to knowledge has played a leading role in shaping how organizations develop strategies and plans for the future” (Petrides, 2002, p.70). In light of all this technology, how will the University of Delaware move forward?

Decision Support at the University of Delaware

Beginning in 1998, the University of Delaware began converting its administrative computing systems from a centrally managed mainframe based legacy system to PeopleSoft, a distributed client server based system. With the implementation of PeopleSoft systems, reporting was decentralized and put into the hands of the end-users. The PeopleSoft human
resources system was implemented in 2000, followed by the financials system in 2003, and finally the student administration system in 2006. Though functional/business units gained greater responsibility and control over their systems and business practices, they also gained the added burden of greater responsibility and control. As a result, functional/business units’ technical functions greatly increased. Employees at all levels were required to learn new skills and perform tasks that had traditionally been executed by computer programmers in Information Technologies (IT). The learning curve was slow and painful. For awhile, decision support was almost non-existent. Only the most critical reports were produced.

The university was struggling with the challenge of providing departments with easily accessible and accurate reports in a timely manner. The Office of Institutional Research and Planning (IR&P), whose function is to provide data and usable information for the institution’s planning and management needs, was also struggling. With the implementation of the student administration system and not having a central unit to manage the overall reporting needs of the university, IR&P volunteered to assist with reporting. “The effectiveness of institutional research in supporting an institution's decision making depends heavily on the availability of usable data. Usable implies that the data are sufficiently accurate, timely, and collected systematically” (McLaughlin, Howard, Balkan, & Blythe, 1998, p. 1). As a means to provide functional/business units with the ability to create reports, IR&P conducted an informal analysis of data warehousing solutions and determined that further investigation into data warehouses was warranted for PeopleSoft reporting.

According to Inmon (1996), a data mart represents organizational data from a single business process. A data warehouse, then, is the conglomeration of data marts. They represent an integrated, subject-oriented, time-variant, non-volatile database that provides
support for decision-making. To properly build a data warehouse, several issues need addressing. How to ensure that 'a single version of the truth' is shared on campus? What reporting tools are available to the university community? How to deliver information and knowledge? These and other questions require careful consideration when planning a decision support system. In order to embark upon the aforementioned issues, business practices and reporting requirements need identifying, and also who is ultimately responsible for the university’s decision support system?

PeopleSoft Reporting

PeopleSoft, like other online transaction processing (OLTP) systems is not suitable for reporting and decision support. Guan, Nunez, and Welsh (2002) note that “owing to the types of transactions an online transaction processing system supports, different kinds of data tend to be scattered in different tables. For example, in PeopleSoft software a simple class list report with class data, meeting times, building, instructor, student data may require the integration from over 30 different tables” (p. 12). They went on to say:

An OLTP environment in not suitable for decision support as they have been designed to support short transactions affecting a few records at a time. This type of data tends to reflect only the current state of the system and seldom keeps historical snapshots, which are critical for planning purposes (p. 170).

A committee of university functional/business users and IT personnel was formed to evaluate reporting software packages to improve PeopleSoft reporting difficulties. Some of the criteria used by the committee formed to select a reporting tool were web-based deployment, relative ease of use, functionality, and availability of on-line training. Cognos Business Intelligence (BI) Tools fulfilled the requirements. This new web-based reporting
package was introduced to campus in 2003 as the primary reporting tool for the University of Delaware. Though Cognos is a very powerful tool, running against a transactional database and competing with production resources resulted in limiting the functionality of the product. Cognos and the University of Delaware OLTP system did not operate as expected. It was slow, clunky, and in some instances, unresponsive. The user community was unimpressed and disappointed. As previously discussed, a relational database structure as found in data warehouses was necessary to realize the full potential of the product. IR&P and IT collaborated on contracting with a consultant to develop a student administration data mart, the precursor to the University of Delaware Enterprise Warehouse (UDEW), for Cognos reporting.

Developing a Data Warehouse

Codd introduced relational databases in the 1970s as a means to query large volumes of data. Following that, Inmon, Devlin, and Kimball promoted data warehousing as a solution for integrating data from diverse operational databases to support decision-making (Shim et al., 2002). According to Inmon (2002), the goals of a data warehouse is to make organizational information easily accessible, present the information consistently, be adaptive and secure, and serve as a foundation for improved decision making. To attend to the woes of PeopleSoft reporting, IR&P hoped that a data warehouse would help abate much of the dissatisfaction and discouragement with the Cognos BI tools.

Not withstanding the notion that a data warehouse will enhance the usability of the Cognos BI tools, there are more compelling reasons for investing the necessary time and resources. According to Nemati et al. (2002), a data warehouse is an integral part of a decision support system that provides an infrastructure to extract, cleanse, and store vast
amounts of data. The purpose is to empower workers with information that allows them to make decisions based on a solid foundation of fact. The need to provide functional/business units with the ability to create easily accessible and accurate reports in a timely manner is the primary reason for developing a data warehouse and a decision support system at the University of Delaware. Research on the evolution of decision support systems typically focuses on how information technology can improve the efficiency with which decisions are made as well as the effectiveness of that decision (Shim et al., 2002).

Getting data and information to the people who need it in a timely manner and in the form they want and can understand is central to reporting (Rittenberg, et al., 2007). The University of Delaware Report Forum (2006), a group that focused on financial reporting needs, surveyed constituents to better understand the likes and dislikes of the available reporting tools and to determine unmet reporting needs. The report found that “dislikes far outweighed likes and fell into three general categories: difficult to use and understand; poor, unintuitive user interface; and missing information” (p. 1). Their recommendation was to “develop a single, integrated data warehouse for the University’s major business systems: student administration, financial administration, and human resource administration” (p. 2). Their endorsement added support to IR&P’s decision to develop a data warehouse.

Data Warehouse Reporting

Even with a commitment to build a data warehouse, some of the same frustrations will continue to exist if not properly designed and built. A good design accounts for the differences between operational reporting needs of functional/business users and analytical reporting needs of decision makers. Understanding the differences is vital to the design. Up to this point in the data warehousing project, the operational requirements have been the
primary focus. However, to obtain knowledge management, a need to include enterprise
reporting still exists.

As stated earlier, functional/business units’ technical responsibilities increased with
the inception of PeopleSoft systems to include both ad-hoc and production reporting.
Functional users and their constituents depend heavily on reporting to perform their daily
tasks. Examples include a listing of course offerings for a specific department in a semester
for scheduling purposes, procurement information for account reconciliation, or data
verification report of recent retirees. The focus of functional/business reporting generally
tends to be at the unit record level, has a narrow focus, and rarely crosses subject areas. Frost,
Dalrymple, and Wang (1998) concluded that although it may seem easy to get initial results,
the user will find it challenging to get accurate and meaningful information.

Analytical reporting, on the other hand, covers a broader range of information. It
combines data from various subject areas, and frequently displays data at the aggregate level
to support university decision making activities. As stated by McLaughlin et al. (1998),
“Decision makers often need an integrated view of multiple operational systems” (p. 10). A
report that analyzes the cost of instruction across academic departments in relation to faculty
workload is an example of an analytical report requested by senior management. In light of
recent interest in institutional assessment and outcomes, cost containment, and strategic
planning, analytical reporting requests will likely increase.

As demonstrated, operational and analytical reports have different audiences and
purposes. Making information available using web-based platforms and utilizing powerful
tools to provide a rich source of data that can be manipulated by the user to meet individual
needs are becoming standard practice (Clarke, 2001). Determining a solution on how best to
design the warehouse to accommodate both types of reports requires careful consideration. The University of Arizona, for example, has two data warehouses; one for operational data containing daily information from payroll, finance, student, and space systems and one for analytics containing the census data from snapshots taken at specific intervals (McLaughlin et al., 2004). The University of Delaware data warehouse, on the other hand, accomplishes the same results by creating both snapshot files and operational files within a single database source. To ensure that a 'single version of the truth' is maintained, Matier, Sidle, and Hurst (1995) assert that having one source of data accessible to all relevant parties diminishes arguments about whose data are right. It is not yet known the full reporting capacity of this approach, though early indications appear positive, from both a technical and an operational perspective.

Data Warehouse Organizational Structure

The notion of including institutional research as a major participant in developing a data warehouse is supported by the information resource division at Santa Barbara City College in California (Picket & Hamre, 2002). They believe that the decision support function of information management is the primary responsibility of institutional research for several reasons. Their college needed a central department to coordinate the design and development of the decision support system. The institutional research function has a college wide perspective of information structures, reporting, and use. Also, they have the technical expertise to use data management and analytical tools effectively. This responsibility includes designing data warehouse structures, developing standard reports and query templates, as well as training management to use the tools and information effectively in
support of their respective roles. The decision support function is a primary responsibility of the office of institutional assessment, research, and planning at Santa Barbara City College.

Although a partnership exists between IT and IR&P, the question of a permanent organizational structure with a dedicated decision support team still remains. While IT possesses technical skills to build a data warehouse (i.e., hardware, software, and programs) they lack the overall university perspective and knowledge, as well as strong campus partnerships, to effectively manage decision support. Furthermore, it is important to appreciate that knowledge sharing is a process that requires an environment of trust and cooperation to work effectively (Clark, 2001). By virtue of being entrusted with official reporting and a role in university planning, IR&P regularly partners with key decision makers and business units, both administratively and academically. In an article on institutional strategy and information support from *Campus-Wide Information Systems*, Guan et al. (2002) state that “the existing information technology infrastructures at many organizations are inadequate to meet the information needs of institutional decision makers” (p. 170).

Furthermore, literature suggests that institutional research is better positioned to manage decision support systems in higher education for many reasons. Institutional research is an empirical example of how explicit knowledge management applies. Institutional research relies primarily on two sources: explicit data and existing literature. Data are either from data warehouses or quantitative or qualitative information obtained from surveys, interview, and focus groups. Institutional research has always intuitively followed the process of transforming data into information and further into knowledge (Serban, et al, 2002). In this regard, institutional research decision support staff can lead by example. In a discussion on knowledge management, Serban and Luan further assert that “offices of
institutional research are by themselves good examples of dedicated resources to the extent that they generally serve specific purposes, which are duplicated or shared by other departments and offices” (p. 10). Unlike IT, IR&P has a vested interest in developing a system for information management. Guan et al. (2002) assert that a "paradigm shift" that views information systems as critical to decision making is needed in developing effective information support for institutional decision making. Furthermore, Frost et al. (1998) suggest that it is likely the role and job responsibilities of institutional research professionals will change as institutions decentralize access of data and the culture of decision making changes.

Data Warehouse Factors of Success

By itself, a change in organizational structure for decision support from IT to IR&P at the University of Delaware will not guarantee a successful data warehouse implementation. It will require resources and a university commitment. To highlight the importance of this, Wixom and Watson’s (2001) study on data warehousing success is explored. The study included 126 survey participants who were participants of a 1996 conference sponsored by The Data Warehousing Institute. The research model uses various factors to predict implementation success, system success, and finally perceived net benefits.

Based on a seven-point Likert-type agreement scale of factors for a successful implementation, survey results are as follows. Participants were most in agreement with users working together with the development team (5.66), overall encouragement from management (5.36), and appropriate available technology (5.34). The majority of the factors are in the 4.0 and 5.0 mean ranges. There are only two factors with mean values less than 4.0, meaning participants did not agree that they are factors for success. The two factors are data
sources used for the data warehouse are from diverse and disparate applications (2.38) and the presence of numerous technical constraints imposed on the data warehouse implementation (3.86). An interesting finding is in regards to team skills; good interpersonal skills (5.19) were rated higher than technical skills (4.84). Of the 19 tested hypotheses, 12 were supported using Partial Least Squares, a structural modeling technique for predictive models. Notably, a high level of resources and a high level of user participation are both associated with a high level of organizational implementation and project implementation success. “According to the findings, having resources, appropriate people on the project team, and user participation have positive effects on the project’s outcome” (p. 36).

Conclusion

The University of Delaware has taken the first steps in initiating a decision support system for reporting PeopleSoft data with Cognos BI tools, a data warehouse, and a partnership between IT and IR&P. Despite dissatisfaction among the user community with the PeopleSoft system, it is extremely data rich. The wealth of information and possibilities for decision making are enormous. If successful, the University of Delaware Enterprise Warehouse is expected to meet the challenge of harnessing that data and providing information rich tools to the university. Initial reaction is very positive. An assessment of the needs for access, security, training, and support requires further research. However, in an environment where change is constant, ongoing needs assessment is essential. Examples such as a web site providing updates to UDEW, Cognos documentation, information resource dictionaries, and on-line training all require careful planning. Deciding the organizational structure with sufficient resources is vital in ensuring the success of the UDEW project. Wixom and Watson (2001) conclude a data warehouse is an expensive, risky undertaking. It
is estimated that one-half to two-thirds of all initial data warehousing efforts fail. The most common reasons for failure include weak sponsorship, insufficient funding, inadequate user involvement, and organizational politics. The University of Delaware community can not afford for this project to fail; they need a resounding success to fully realize the PeopleSoft investment.
References


