

Teradata University Network: A No Cost Web-Portal for Teaching Database, Data Warehousing, and Data-Related Subjects

Nenad Jukic

School of Business Administration
Loyola University Chicago
Chicago, Illinois 60611-2196, USA
njukic@luc.edu

Paul Gray

School of Information Systems and Technology
Claremont Graduate University
Claremont, California 91711, USA
paul.gray@cgu.edu

ABSTRACT

This paper describes the value that information systems faculty and students in classes dealing with database management, data warehousing, decision support systems, and related topics, could derive from the use of the Teradata University Network (TUN), a free comprehensive web-portal. A detailed overview of TUN functionalities and content is given. Freely available resources, such as software tools, large corporate data sets, case studies, and exercises are detailed. Various ways in which the TUN resources can facilitate teaching and learning processes are discussed. The zero-installation, zero-maintenance, zero-cost TUN paradigm is explained.

Keywords: Teradata University Network (TUN), Database Management, Data Warehousing, Business Intelligence, Software as a Service, Reach of Data, Educational Web-Portal

1. INTRODUCTION

Database management, one of the standard subjects taught worldwide in Information systems (IS) curricula, is an expanding field. New topics are continually being added, including data warehousing, large-scale databases, on-line analytical processing (OLAP), business intelligence (BI), and data mining. These additions recognize and facilitate the use of data to support decision-making. Although each of these topics could merit a course of its own, most colleges and universities are able to add at most one elective in these new areas. On the other hand, graduates are increasingly expected to demonstrate not only knowledge of established and routinely used database concepts but also the new data management and analysis methods.

In this paper we describe and discuss a comprehensive academic initiative, the Teradata University Network (TUN), that gives IS faculty access to resources for providing their students with needed knowledge. As shown in the sidebar, what is unique about this initiative is that it is without cost to the institution, the faculty, and the students.

What makes TUN valuable and viable is that an academic working group, representing the faculties in over 850 universities in 69 countries that use the network, implements TUN's mission statement: "To be a premier academic resource for knowledge about data warehousing, DSS/BI, and data. To build an international community whose members share their ideas, experiences, and resources with one another. To serve as a bridge between academia and the world of practice."

This paper is organized as follows. To put the capabilities of TUN into context, we provide a brief overview of traditional and emerging data management and analysis topics being covered in contemporary IS related education in Section 2. In Section 3 we introduce resources available in the Teradata University Network in both traditional and emerging areas. Section 4 explains the capabilities available to students in the Teradata Student Network. Section 5 examines the benefits and value of using the portal for various constituencies within the IS education process. The major differences between TUN and other initiatives in this area are highlighted in the concluding

section (Section 6). In addition, Appendix 1 explains how simple it is for faculty to join the TUN network.

THE ECONOMICS OF THE TERADATA UNIVERSITY NETWORK

Most, if not all of us, usually ignore “no cost” offers from software vendors because we learned long ago that there is no “free lunch”. But the Teradata University Network is an exception. In 2001, Teradata agreed to a proposal from Prof. Jeff Hoffer of the University of Dayton, Prof. Hugh Watson of the University of Georgia, and Prof. Barbara Wixom of the University of Virginia to allow faculty and students access to their large database computing resources. Access was a remarkable gift to academia. In the years since then, other firms such as MicroStrategy, with its business intelligence capabilities, also made their software available at no cost.

Not only are access to the software and use of teaching materials provided, no other costs are incurred. Because access is through the World Wide Web in a “Software as a Service” arrangement, no installation, updating, administering, and maintenance costs are incurred by schools. Multi-million record data sets are made available by Teradata’s partner-organizations. Teaching aids and materials, including student exercises, homework assignments, articles, and cases are contributed by faculty who use the network. No storage is used at the institution’s data center for the software or the databases.

2. THE REACH OF DATA

There’s much more to teaching about data than just defining databases as relational, hierarchical, or flat. This section describes data subjects that can occupy from a single class session to one or more full courses. The descriptions are brief and the list is not exhaustive.

2.1 Database Management

Because the database is at the heart of all contemporary information systems, a database management course is one of the foundations of virtually every undergraduate or graduate IS program. A typical organization maintains and uses many operational data sources. Most operational data sources are implemented in terms of the traditional relational databases used to support the organization’s day-to-day operations. Designing and using operational databases based on the relational model has been (and still is) the focus of the vast majority of contemporary database courses at universities worldwide. They are also at the core of most of the widely used academic database-related texts, such as (Elmasri & Navathe 2007; Hoffer, Prescott, Topi, 2008)

2.2 SQL

SQL, which stands for Structured Query Language, is a standard language for creating, modifying, populating, and retrieving from relational databases. With minor variations and proprietary extensions SQL is used by every contemporary RDBMS (such as Oracle, IBM DB2, Sybase, MS SQL Server, Teradata). Learning SQL is an integral and vital part of any IS curriculum, often as a part of the database

management course. Every academic database-related text contains a detailed section (or multiple sections) on SQL. SQL competency, proficiency and hands-on experience is one of the most basic IS skills graduating IS students are expected to possess.

2.3 Data Warehouse

A *data warehouse* is a particular way to organize a database. It is created within an organization as a separate data store whose primary purpose is data analysis for the support of management’s decision making processes (Kimball et al., 1998). Often the same fact is used for both operational and analytical purposes, and hence is stored in both an operational data store and the data warehouse. For example, data describing that the product A was bought by the customer B in the store C can be stored in an operational data store to support business processes, such as financial transaction record keeping or inventory monitoring. That same fact can also be stored in a data warehouse where, combined with vast numbers of similar facts accumulated over a time period, it is used to analyze business trends, such as sales patterns or customer behavior.

The two main reasons for creating a data warehouse as a separate analytical data store are (Jukic, 2006):

1. The performance of queries differs in the two contexts. Operational queries are mostly short and require little computing time whereas analytical queries are complex and consume significant computing time. The performance of operational queries can be severely diminished if they have to compete for computing resources with analytical queries.
2. Even if performance is not an issue, it is often impossible to structure a database which can be used in a straightforward manner for both operational and analytical purposes. Therefore, a data warehouse is created as a separate data store, designed for accommodating analytical queries.

A typical data warehouse periodically retrieves selected analytically useful data from the operational data sources. The process and the infrastructure that facilitate the retrieval of the data from the operational databases is known as *Extraction, Transformation and Load (ETL)*.

A *data mart* is a data store based on the same principles as a data warehouse, but more limited in scope. Unlike a data warehouse, which combines data from operational databases across an entire enterprise, a data mart typically focuses on a particular department or subject. Data warehouses and data marts are accessed by the users through the front-end business intelligence (BI) applications that provide a convenient way for retrieving and analyzing their information. Most often BI applications are based on OLAP tools.

2.4 Business Intelligence

Business intelligence refers to the process of analyzing the business implications of data stored in data warehouses, data marts and other repositories. The business intelligence process typically uncovers and organizes additional (previously unknown) knowledge within the data that organizations own. This knowledge is often actionable in a

way that creates new value for the organizations and positively impacts both day-to-day operations and strategic planning. The methods for uncovering such knowledge include the use of On-Line Analytic Processing (OLAP) tools, statistical methods, and data mining.

2.5 Data Mining

Data mining is at the intersection of database management, machine learning and statistics. The goal of data mining is to examine large amounts of data and uncover hidden patterns and associations that are accurate, meaningful, understandable, and actionable. The large databases available in TUN and TSN can serve as the input to data mining software. Although data mining software is not included in TUN at this time, there are plans for including it in the near future.

3. TERADATA UNIVERSITY NETWORK CAPABILITIES

Teradata Corporation is a multi-billion dollar company (a member of S&P 500 index) whose principal product Teradata Database is a high-speed Relational Database Management Software (RDBMS) using the standard Structured Query Language (SQL). Due to its fast performance, Teradata Database is considered to be the premier provider of platforms for high-end data warehouses. In 2001 Teradata teamed with a group of academics from around the world to create the Teradata University Network (TUN) for faculty and the Teradata Student Network (TSN) for students. TSN is a subset of TUN that includes all TUN capabilities except for material designed for faculty only (see Section 4)

The Teradata University Network is accessed through the portal shown in Figures 1 (the log-in screen) and 2 (the

home screen). The Teradata University Network portal leads to Teradata’s and other software (in addition to many teaching related materials provided by member-faculty and other TUN supporters). The result is Software as a Service (SaaS) that assists faculty in teaching and students in learning about database management, SQL, data warehousing, and other contemporary data management and analysis topics. Over the years this portal grew to provide a large portfolio of content. Its user population increased steadily each year. As described in Appendix 1, any faculty member teaching IS or IS-related courses, broadly defined, can become a member of TUN at no cost as shown on the left-hand side of Figure 1, TUN is steered and managed by an advisory board composed almost entirely of university professors. While Teradata Corporation as well as MicroStrategy provide the budget and Teradata hosts TUN, the faculty board is in charge of the content and structure of the portal, giving focus to the needs of educators and students.

Table 1 summarizes the content offered on TUN in mid-2008.

*Teradata DBMS/SQL software	*BI/OLAP software
*Data modeling software	*Demos
*Articles	*Case studies
*Multimillion line databases for student use	Lectures with Power Point Slides
*Tutorials	*Web Seminars
Syllabi	Lesson Plans
*Podcasts	*Projects

Table 1. Content Offered by the Teradata University Network (Mid-2008)

Note: Items marked with an * are also available to students on the Teradata Student Network

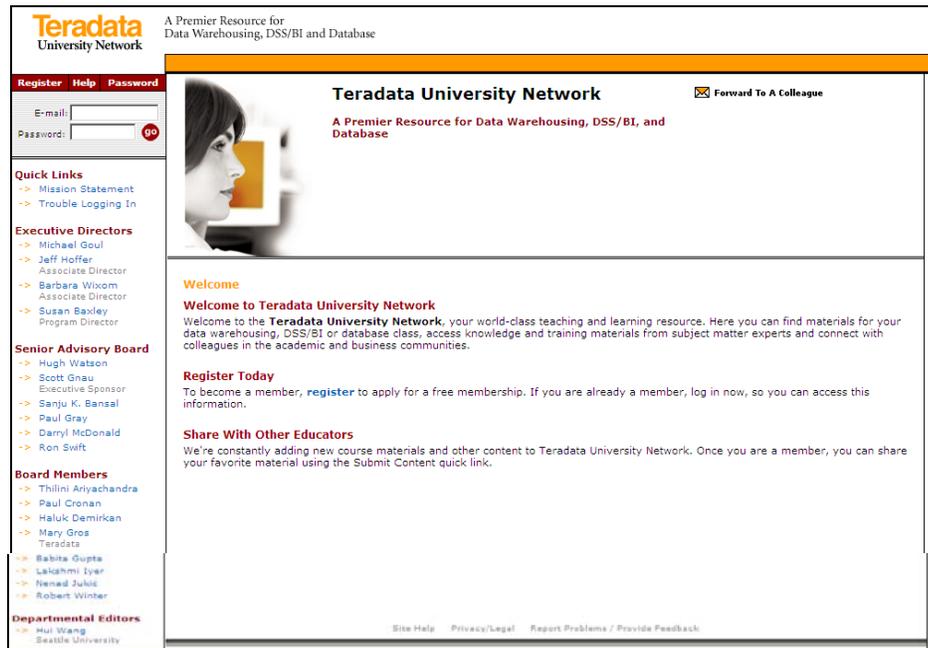
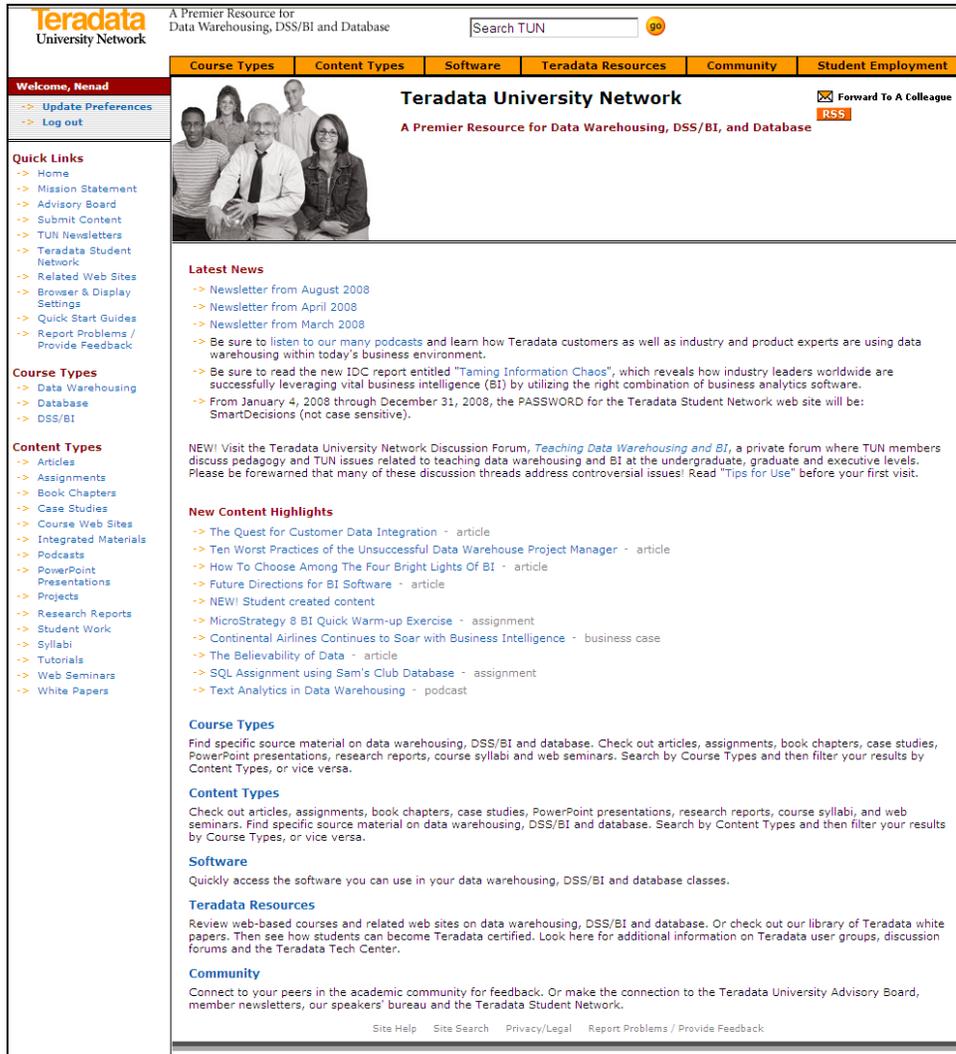


Figure 1. Teradata University Network Sign-in Screen (www.teradatauniversitynetwork.com).



This screen appears after a first-time user registers for TUN or an existing user logs into TUN.
Figure 2. TUN Home Screen

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The following subsections briefly describe the capabilities listed in Table 1 and explain how they can be used to assist and enhance the educational process.

3.1 Teradata Database, SQL, and Large Datasets

Teradata's RDBMS is available on TUN for use as Software as a Service¹. The DBMS is hosted and maintained by Teradata on a massively parallel processing (MPP) server located in Rancho Bernardo, CA. The server provides fast execution of SQL queries, even for large data sets. Faculty and students enter their SQL queries using Teradata SQL Web Assistant, Teradata's commercial web-based user interface. Not only is the Teradata Database a representative

¹ From Teradata's point of view, SaaS means that it does not need to spend huge sums to provide and maintain software, support and, in some cases hardware at schools worldwide.

of a relational database technology so that that it can be used to illustrate and teach RDBMS concepts, but it can also be used in conjunction with other RDBMSs, such as Oracle², to illustrate the differences among commercially available systems.

3.2 Data Sets

Although users are welcome to create and enter their own data sets, all accounts include access to collections of existing data sets stored by Teradata. These collections include:

1. The data sets associated with six of the most popular contemporary database management textbooks: (Hoffer, Prescott, & Topi, 2008) data sets for the three latest editions (Rob & Coronel, 2008) data sets for the two latest editions (Watson, 2005) data sets for the two latest editions (Pratt & Adamski, 2005) data sets for the 5th edition (Gillenson, 2004) data sets for the latest edition (Pratt, 2004) data sets for the 7th edition
2. Through a partnership with The University of Arkansas, four corporate datasets are provided (Sam's Club, Dillard's Department Stores, Frozen Foods Inc. and a synthetic set labeled Hallux Productions). Each of these data sets contains millions of rows of data.

As a result, faculty can assign student exercises and problems that involve querying and analysis of data in real-world scenarios. The use of such large data sets greatly enhances the students' academic experience, not to mention their résumés.

3.3 OLAP and Business Intelligence

The category of On-line analytic processing (OLAP) software tools, also often referred to as Business Intelligence (BI) tools, is represented on TUN by MicroStrategy 8 (www.microstrategy.com/software). MicroStrategy 8, a highly interactive software package, contains an accompanying collection of datasets, predefined reports, assignments, and tutorials. The MicroStrategy software enables faculty to teach their students about the fundamental OLAP functionalities (such as pivoting, drill-down, roll-up, slice-and-dice, scorecards, dashboards) used in Decision Support Systems and to undertake Business Intelligence analytics. The scripted demos and in-depth tutorials help students learn about the underlying concepts while at the same time offering meaningful hands-on experience in decision support and BI. These skills are particularly important in the years ahead where information technology professionals can be expected to be more deeply involved with the content of what is in their databases.

3.4 ER and Dimensional Modeling

ER modeling is one of the principal techniques for conceptual modeling of both operational databases and data warehouses. TUN provides two tools: FatFreeERD and FatFreeStar. FatFreeERD, an ER modeling tool that requires

no installation is available for download. Once downloaded, TUN and TSN members simply unzip, and then use the tool to create conceptual database models for class exercises and projects. The tool provides a no-cost alternative to commercially available case tools.

Dimensional modeling is both a principal technique for modeling data marts and one the most popular technique for modeling data warehouses. FatFreeStar is a dimensional modeling tool which, like FatFreeERD, once downloaded and unzipped, is ready for use. Neither tool requires licensing and can be used in an unrestricted fashion.

3.5 Demonstrations and Trial Copies

TUN offers access to classroom demonstrations and trial copies of expert system tools, ETL tools, data mining tools, data quality and integration tools. TUN's offering of a variety of modern data management and analysis software provides faculty with the opportunity to give their students knowledge and skills that can make them more competitive in today's job market. A properly designed and conducted class, which uses these resources to teach and illustrate underlying concepts, will position students as prospective employees that understand how to facilitate processes and solve problems. Through that understanding, they can easily switch from one platform to another.

3.6 Planners Lab and Tableau

Features and resources are continuously being added to TUN and TSN. Two of the latest additions, in 2008, are Planners Lab™, a modeling and visualization software package and Tableau, data visualization software for creating high-performance interfaces for data sets of any size.

Planners Lab is a tool for use in DSS, in financial modeling and analysis, in simulation, and, particularly important, in visualization. The software creates models that provide the same answers as Excel™ but in a much easier, more powerful and more intuitive way. Rather than requiring filling in cells, Planners Lab uses equations written in the user's ordinary language (e.g., Profit = Sales – Cost). These equations reflect what the user is thinking. The assumptions as well as data are explicit, readable, and understandable. Models can be easily modified on the fly to reflect what-if questions and statistical uncertainties. Visualization is state-of-the-art easy drag and drop for instantly seeing graphical results and cause-and-effect relationships. Planners Lab is built on a language used commercially in the 1980s the Interactive Financial Planning System (Gray, 1987) modified for today's classroom use. The Planners Lab supports easy query of SQL databases and Excel files.

Tableau software allows users to open data from a variety of sources (such as: Excel spreadsheets, Access files, text files, SQL Server, Oracle, DB2, MySQL, PostgreSQL, Firebird, SQL Server Analysis Services, Hyperion Essbase) and then, using an easy drag and drop interface, create interactive visual summaries of data. In addition to providing a quick and easy way for aggregating, slicing, and pivoting of data, this product offers many analysis and visualization features, including the state-of-the art interactive charting and graphing capabilities (numerous types of charts), integrated mapping (combining visual representations of data summaries with geographical maps), animation features

² Oracle requires separate Academic Licensing from Oracle Academic Alliance

(allowing observation of geographic and other trends over time), and dashboards. Tableau allows users to create different types of outputs including .pdf documents and interactive web pages.

3.7 Additional Teaching Materials

TUN provides access to teaching materials ranging from traditional database courses to courses dealing with data warehousing, decision support, business intelligence, data mining, data integration, data visualization, Customer Relationship Management, and business performance management (BPM). Tabs on the network's Home Page (Figure 2) organize the material in three ways:

1. *By content type.* For faculty who are interested in selecting individual items, the Content Types area on the TUN web-site organizes teaching materials into the following categories: Articles, PowerPoint Presentations, Assignments, Projects, Book Chapters, Case Studies, Syllabi, Course Web Sites, Tutorials, Integrated Materials, Web Seminars, Podcasts, and White Papers.
2. *By course type.* The Course Types tab bundles the contents according to three types of courses: Data Warehouse, Database, and DSS/BI. For example, if Database is selected, all of the TUN materials of use in a database course are listed together, in a structured and organized way. Different lists are shown when Data Warehousing or DSS/BI is selected.
3. *By "Integrated Materials".* This option provides descriptions and guidelines on how materials can be used together, organized by topics that are often covered in different courses. For example the Dimensional Modeling and OLAP entry suggests how to introduce these topics to the students, which articles to assign as readings, what assignments should be given, which tools to use, how and which demos to present, and more.

3.8 Summary

In summary, the collection of lectures, articles, case studies, and other teaching materials provided on TUN is a comprehensive resource that can be used on its own, or in conjunction with text books and other content, to give students a solid theoretical and practical foundation of concepts and methodologies.

4. THE TERADATA STUDENT NETWORK

The Teradata Student Network (TSN), the companion site to the Teradata University Network, is the version of TUN accessible to student members. Instructors that are TUN members are given a TSN password that they distribute to all their students. Once students receive the password, they can register and be members of TSN for the semester.

TSN is not a site that is separate from TUN, but it is simply a version of TUN geared for the use of student-members. As shown in Table 1 in Section 3, its structure and organization is equivalent to that of TUN, with certain items (e.g. solutions to exercises) omitted for obvious reasons (e.g. so the faculty, if they so decide, can use the exercises as a part of a test). Leaving certain content at the discretion of the

instructors is the main reason for creating TSN as a student version of TUN. However, if instructors who are TUN members want to make the TUN content which is not accessible on TSN available to their students, they are free to download it and distribute it to their students.

5. BENEFITS AND VALUE OF TUN

This section discusses the benefits and value of TUN to faculty and students. The following observations are based on our own experiences, those of other educators that use TUN to facilitate teaching of their IS classes, and those of students using the TSN resources. TUN and TSN serve a number of constituencies, including:

- novice faculty
- experienced faculty
- researchers
- students in formal classes
- students in self-learning mode

Novice IS faculty, just starting to teach traditional and/or emerging courses (such as database management, data warehousing, BI) can use the TUN resources as a starting point in creating and selecting their teaching materials. TUN offers sample syllabi and course outlines for a variety of courses, accompanied by suggestions on how to use the other available resources (such as software or homework assignments). These resources allow novice faculty to configure and deliver comprehensive state-of-the-art IS courses early in their teaching careers with minimal effort compared to working without these resources. The benefits result from time saved and from acquiring knowledge and from providing time to foster research efforts. As we discuss below, the TUN capabilities often inspire people to undertake research using the tools, data sets, and other resources provided.

Experienced IS Faculty. For faculty experienced primarily in teaching traditional IS topics, the Teradata University Network allows them to expand into teaching emerging topics. These faculty members reduce their cost in time and effort needed to identify, learn, prepare and configure materials and resources. Although it is much easier to retreat to the comfort of teaching already familiar topics from already familiar sources, the accessibility and richness of resources provided turn out to be powerful motivational tools for experienced faculty members venturing into teaching new topics and courses.

Teradata University Network resources also assist faculty who already teach a portfolio of traditional and emerging topics. Adding TUN resources can enrich existing, established courses. For example, if the Oracle Discoverer OLAP tool is used in teaching OLAP concepts, minimal effort and no software acquisition costs are incurred to add TUN's Microstrategy 8 as a second tool for expanding the students' OLAP experience. This approach serves two purposes:

1. It enables students to add another tool skill to their resume, and, perhaps more importantly,

2. It clearly illustrates to students that the essential functionalities of OLAP tools are universal, and by doing so it instills confidence in students that they can handle any OLAP tool in their future careers.

Research. The Teradata University Network can facilitate research projects. In Section 3, we described how the access to the large corporate data sets enhances teaching. The same data sets, coupled with the ability to use the power and speed of Teradata's parallel processing, open unique opportunities for faculty interested in conducting original research in such areas as data mining, query processing, and performance management. The Network's sizeable collection of reference materials, including case studies and articles, as well as the ability to connect with other researchers around the world, enriches TUN member research efforts

Students. One of the more self-evident benefits for students who are TSN members comes from their instructors using the TUN resources to expose them to the relevant knowledge, tools, methodologies, and concepts, in a variety of IS-related areas. However, there are additional student benefits beyond what their teachers expose them to. For example, TSN student members have the option to become certified in Teradata technology for a nominal fee (a very small fraction of a standard price for certification). Furthermore, TUN partnered with a number of Teradata customers (most of whom are Fortune 500 corporations) to create internships that are described and posted on the TUN and TSN sites. These additional benefits are available both to the TSN student members who are taking classes using TUN resources and the TSN student members who are in a self-study mode, exploring and taking advantage of TUN resources through directed studies or their own initiative.

Faculty Time Requirements. The previous paragraphs in this section illustrate the benefits and value of TUN to its members. What are the costs? As shown in the sidebar in Section 1, no monetary costs are associated with TUN. However, it is not a completely free lunch. To become proficient, faculty invest time and effort to learn:

- how to navigate the portal,
- the available features and functionalities, and
- how to use the software tools

so they can teach with TUN. Fortunately, most of this work is for initial set up. Much of it is the minimal and unavoidable cost of acquiring new knowledge and skills. To acquire the same amount of knowledge and skill with any other system would require more individual time and effort plus money for resources. Similarly, the ongoing cost is greater because other systems (discussed in the next section), which do not use the Software as a Service approach, require installation, licensing, ongoing maintenance, and computer storage space for the software and for faculty and student work.

6. CONCLUSION

Several other vendor-sponsored academic initiatives, containing database-related components, are available for use in classroom (notably Oracle Academy

(<http://academy.oracle.com>) and Microsoft Developer Network Academic Alliance (<http://msdn2.microsoft.com/en-us/academic>)). TUN differs from those initiatives in the following ways.

1. Unlike the other initiatives, there is no charge for TUN. The other initiatives, being in-house departments of commercial vendors, charge (either nominal or market-level) for software and services. Teradata sees TUN as a philanthropic effort and manages it through its Community Relations group.
2. TUN is steered and managed by the advisory board composed principally of university professors, together with several senior Teradata managers (See Figure 1 for a list of members).
3. Teradata Corporation covers its internal costs through an internal budget as well as hosting TUN. The faculty members of the advisory board are in charge of the content and structure of the portal. In addition to the direction provided by the faculty board, significant input from faculty members who use TUN to teach is reflected in the content, structure, and objectives of the TUN.
4. TUN is, in essence, a large volunteer effort by faculty supplemented by Teradata's corporate donations of services, software and hardware rather than a result of a corporation seeking to obtain some monetary return for its help. The serious involvement of the academic community enables TUN to focus on the needs of faculty and students.
5. From the point of view of all the vendors involved, university access helps grow the Business Intelligence Market by increasing both education and awareness.

Summarizing the benefits of TUN, Professor Jeff Hoffer, a TUN faculty board member, states:

"Notions of one-stop-shop for resources about BI, DSS, data warehousing, and database; convenient, ubiquitous (web portal) access to resources; high quality standards on posted resources; unbiased materials (not just what one vendor wants you to know about their products/services); and current, varied materials (so faculty have choices of white papers, webinars, cases, etc.) are some of the most important value propositions."

The above quotation captures the motivation behind the TUN initiative. In Watson & Wixom (2007) TUN is described as one of the two premier Business Intelligence resources available for academics and their students. TUN can be described as the ultimate free good, where the term free refers not only to the cost of acquiring the software and materials, but also to the cost of hosting and managing. An initiative, such as TUN, where cost, resources, and support personnel factors are eliminated from the equation, enables any ambitious faculty member with Internet access to provide a first-class learning experience to their students. The benefits and value of TUN goes beyond enabling teaching efforts; it also facilitates academic research and provides students with career building opportunities.

More information about TUN and TSN portals can be found in Watson & Hoffer (2003) and Jukic & Gray (2008). New features and capabilities are being added on regular basis and the most current information is always presented on the TUN (www.teradatauniversitynetwork.com) and TSN (www.teradatastudentnetwork.com) portals themselves.

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AUTHOR BIOGRAPHIES

Paul Gray is Professor Emeritus and Founding Chair of Information Systems and Technology at Claremont Graduate University. He was selected as Information Systems Educator of the Year 2000 at ISECON 2000. He specializes in decision support systems, business intelligence, knowledge management, and data warehousing. Although retired, Prof. Gray continues to teach, do research, consult, and curate the Paul Gray PC Museum at Claremont Graduate University. He is currently Visiting Professor at the University of California, Irvine



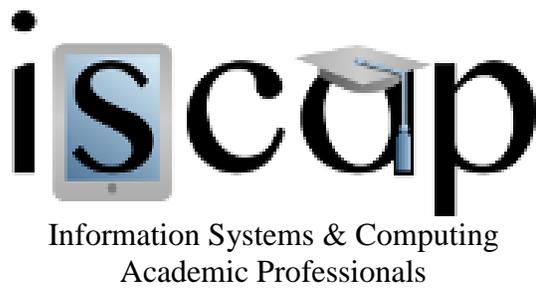
Nenad Jukic is an Associate Professor of Information Systems and the Director of Graduate Certificate Program in Data Warehousing and Business Intelligence at Loyola University Chicago School of Business Administration. He conducts active research in various information technology related areas, including data warehousing/business intelligence, database management, e-business, IT strategy, and data mining. In addition to his academic work, his engagements include providing expertise to a range of data management, data warehousing, and business intelligence projects for U.S. military and government agencies, as well as for corporations that vary from startups to Fortune 500 companies.



APPENDIX 1. JOINING TUN

TUN is available exclusively to university and college faculty. To become a member of TUN requires completing the "register" option form available on the TUN website (www.teradatauniversitynetwork.com) (Figure 1). The registration information provides TUN with contact information and allows TUN to authenticate the applicant is a faculty member. Once the membership is approved, TUN faculty members receive an e-mail welcoming them and the password to be used by their students. A password is required so that Teradata can verify that the requestor for service is a student entitled to use the system rather than an outsider seeking to use the system for free.

Students enrolled in a course taught by a member of TUN are eligible to access the Teradata Student Network (TSN). When students use the password for the first time to access the student website (www.teradatastudentnetwork.com) they complete a short registration process and are then ready to use this resource.



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