

## Using Teradata University Network (TUN), a Free Internet Resource for Teaching and Learning

**Robert Winter, Anke Gericke and Tobias Bucher**

Institute of Information Management, University of St. Gallen, Switzerland // robert.winter@unisg.ch // anke.gericke@unisg.ch // tobias.bucher@unisg.ch // Tel.: +41 71 224 2190 // Fax: +41 71 224 2189

### ABSTRACT

Business intelligence and information logistics have become an important part of teaching curricula in recent years due to the increased demand for adequately trained graduates. Since these fields are characterized by a high amount of software and methodology innovations, teaching materials and teaching aids require constant updating. Teradata has teamed up with lecturers and researchers to build and run a portal to support teaching business intelligence and information logistics. This article describes how faculty can use the Teradata University Network (TUN) to prepare and run courses by reusing teaching materials and running state-of-the-art commercial software provided in an application service provider model. It furthermore describes experiences with an actual course on management information systems taught by the authors. Students' feedback on the course design is presented and conclusions are drawn on two similar courses. Our action research results show that students' adoption of and feedback about such courses has been very encouraging.

### Keywords

Business intelligence, Information logistics, Data warehousing, Teaching resources, Teaching platform

### Introduction

Business intelligence comprises of a broad range of business-oriented topics (e.g. customer relationship management, business performance management) as well as technical topics (e.g. data warehousing, data mining, large databases). Due to its significance for business success, the demand for software in these fields as well as for the underlying information logistics infrastructure has increased during the last years and the strong demand will continue (Wixom & Watson, 2001). The increasing importance of business intelligence is supported by the forecasted growth rate of the business intelligence market as well as a recent Gartner survey which reports that “business intelligence jumped from the No. 10 slot to the second-highest priority on CIOs' agendas” (Graham, 2005). The increasing demand for business intelligence solutions is also linked to a demand for qualified personnel who are able to use business intelligence solutions and develop or manage the underlying information logistics infrastructure. For that reason it is necessary that academics include these topics in their curricula and impart this knowledge to their students. However it is not sufficient that students master the theoretical fundamentals: From a company's point of view, it is much more important that their future employees can handle real-world problems—instead of small textbook examples—and master state-of-the-art commercial tools—instead of research prototypes. That is why courses in the field of business intelligence should not only comprise of theoretical contributions and fundamental concepts, but should also enable students to use and understand current software tools.

The Teradata University Network (TUN) initiative addresses this issue. It was developed in cooperation with Teradata by a group of scholars in 2001. The Teradata University Network is a portal which can be used free of charge by lecturers and students in the fields of data warehousing, business intelligence/management information systems (MIS), and database. Academia is supported not only by providing a teaching material exchange, but in particular by providing easy and free access to centrally operated and state-of-the-art commercial software tools in these fields. The access to these tools is implemented as an application service provider model (Watson & Hoffer, 2003; Winter, 2004).

TUN comprises a total user group of almost 1,800 registered faculty members from 890 universities and colleges in 72 countries. Approximately 69% of the registered faculty members are located in North America, South America, Central America and the Caribbean, 13% are located in Europe, the Middle East and Africa, and 13% are located in the Asia Pacific Region. Within the last twelve months, the Teradata University Network was actively used (e.g. by viewing pages and/or contributing content) by almost 700 faculty members (all figures as of 2007-11-30).

In the next section, we position the Teradata University Network within the range of existing online resources for learning/teaching support in the field. An overview of goals and content of the Teradata University Network is presented. The section “TUN Access and Content Integration” provides information regarding access to and integration of new material into TUN. Different forms of using the Teradata University Network in academic teaching will be explained. The section “Application Case” illustrates how we used TUN to prepare and run courses in two master programs. We also report on students’ feedback and other lessons learned in that section. Finally, we identify the limitations of the Teradata University Network. A short summary is presented and suggestions for extensions are made in the final section “Conclusion and Outlook”.

## Related Work

TUN is a web-based platform that provides access to teaching materials and software tools to lecturers and students. However, the Teradata University Network is not an e-learning platform and can also not be compared to the so called “academy” or “university” programs from software vendors. The following is a comparison of the differences between e-learning platforms/software vendor programs and TUN. Afterwards, the Teradata University Network will be compared to similar platforms.

E-learning platforms make learning content available over the internet. They allow students to help support their learning process e.g. by presenting the contents already studied, presenting test results, providing communications tools, etc. (Baumgartner et al., 2005). Contrary to an e-learning platform, the Teradata University Network does not support the learning process directly. Lecturers can rather use TUN material to prepare in-class courses as well as e-learning/distance learning courses.

Next to e-learning platforms, various offers from software vendors exist under numerous labels (e.g. Oracle University—<http://education.oracle.com>, Microsoft IT Academy Program—<http://www.microsoft.com/education/msitacademy/>, Red Hat Academy—<https://www.redhat.com/training/academy/>) which provide documents and software tools to students and/or lecturers. Most of these services, however, are not free of charge and comprise of materials only from a single software vendor. In addition, software tools are usually not provided in an application service provider model so that lecturers and/or students have to install and manage such tools. In contrast, the Teradata University Network not only provides tools from several vendors that are partially integrated (e.g. by using the same data set), but also provides such tools in an application service provider model and free of charge.

Like the Teradata University Network, there are other portals that neither provide e-learning support nor represent a specific sales/support channel for software vendors. The Edna Portal (<http://www.edna.edu.au>), the Gateway to Educational Material (<http://www.thegateway.org>), and the platform “Multimedia Educational Resource for Learning and Online Teaching” (<http://www.merlot.org>) solely provide links to teaching material. In contrast, platforms such as EducaNext (<http://www.educanext.org>), Universal Brokerage Platform (<http://nm.wu-wien.ac.at/universal/>), and Ariadne (<http://www.ariadne-eu.de>, based on the Universal Brokerage Platform) store their teaching materials in a database—like TUN does. However, unlike the Teradata University Network, these platforms do not concentrate on a specific subject. They neither try to establish a common understanding in a certain field nor offer a common, keyword based access. Such platforms do not provide any software in an application service provider model. The Gateway to Educational Material offers links to software tools as well, but only freeware tools are included and these have to be installed on the lecturer’s/student’s computer.

## Goals and Content of TUN

TUN (<http://teradatauniversitynetwork.com>) has been created to:

- be a prime resource for knowledge about data warehousing, decision support systems, business intelligence, and databases,
- build an international community whose members share their ideas, experiences, and resources with others,
- serve as a bridge between academia and the world of practice.

Plans to create TUN were first announced in late 2001. In early 2002, the design was completed and testing began. After adding content, the Teradata University Network was promoted at different conferences and on web sites in summer 2002. The formal roll out in fall 2002 was followed by adding the Teradata database software, a dimensional modeling tool (research prototype), and MicroStrategy software through a web-based application service provider arrangement in 2003. In 2004 and again in November 2005, TUN moved to a new platform. By these migrations, the platform's layout was optimized, and content was made accessible by multiple indexing.

The teaching material provided by the Teradata University Network and the available software will now be explained, followed by a description of further TUN resources. TUN structures its content in two different ways: On the one hand, different teaching materials (e.g. articles, research reports, assignments, etc.) can be accessed according to subject matter (course type). That means a user can select material that focuses on data warehousing, business intelligence, or database. On the other hand, teaching material can be accessed according to the content type, which means that all available articles, research reports or assignments are presented to the user irrespective of the subject area.

The following teaching materials are available in the Teradata University Network (structured according to the content type as of 2007-06-06; *Figure 1* shows the structure according to both content type and course type):

- more than 80 articles,
- 18 assignments—including teaching notes,
- one book chapter,
- eight case studies,
- one link to a course web site,
- eight descriptions of the integration of different types of material (“integrated material”),
- eight podcasts,
- six PowerPoint presentations—including speaker’s notes,
- one software project,
- nine research reports,
- 14 course syllabi—most at graduate level,
- seven tutorials,
- 26 web seminars.

Under the category “integrated material” descriptions are given to explain the use of different kinds of material in an integrated form for course preparation. To give an example, descriptions of teaching materials from data warehousing, business intelligence, and database can be integrated to support a “customer relationship management” teaching module.

Besides the valuable range of materials for course preparation, the most important feature of the Teradata University Network is that data warehousing software, business intelligence software, and database software as well as other tools are made accessible through an application service provider model. Colleges and universities do not have to select, obtain, install, and maintain any software. Instead, all included tools can be used free of charge, using just browsers and internet access. Not only is the software made available, but the Teradata database is already loaded with various data sets, including those from popular textbooks. A substantial tutorial basis can be accessed with both the Teradata database and the Application Modules of MicroStrategy. As of 2007-06-14, the following software tools and data sets have been available on TUN:

- Teradata database: Access to data sets from leading textbooks, including e.g.
  - the “Mountain View Community Hospital” case from the Jeffrey Hoffer et al. textbook “Modern Database Management” (Hoffer et al., 2004),
  - the database used in chapters 7 and 8 of “Modern Database Management” (Hoffer et al., 2004), and
  - the database used in Richard T. Watson’s textbook “Data Management: Databases and Organizations” (Watson, 2003).
- Hyperion: TUN members are provided with free access to a business intelligence tool (Hyperion System 9 BI+) and a financial modeling tool (Hyperion System 9 Strategic Finance). The software is hosted by a different application service provider (CRESH.NET) and a separate registration is required to gain access to the Hyperion software.

- MicroStrategy 8: Since the beginning of 2007, the Teradata University Network has provided access to MicroStrategy 8. As of 2007-06-14, versions 7 and 8 ran in parallel but version 7 was taken out of service in fall 2007. The following modules are provided by MicroStrategy 8:
  - Customer analysis: e.g. customer segments analysis, analysis of the value proposition and the loyalty of customers, identification of cross selling possibilities, etc.,
  - Financial reporting analysis: analysis of receivables and payables, drawing the balance and profit and loss account, execution of future prospects, etc.,
  - Sales force analysis: analysis of product, distribution, and sales figures,
  - Sales and distribution analysis: analyzing the various factors that drive the sales and distribution process.
- University of Arkansas Resources: Access to large-scale, real-world datasets:
  - Sam's Club Database: A sales database provided by Wal-Mart Stores, Inc. containing six tables with more than 55 million rows.
  - Dillard's Department Stores Database: A sales database provided by Dillard's Inc. containing five tables and more than 128 million rows of retail sales.
  - Frozen Foods, Inc. Database: The data contains customer transactions for more than 13 thousand products shipped to 92 different sales districts in the United States. The database consists of six dimension tables that are linked to a fact table.
- Downloadable: Other easy-to-use, downloadable software e.g. a dimensional modeling tool and expert system software. In contrast to the main software offer, these software tools are research prototypes or evaluation copies with a restricted usage period.
- Demonstration: Various software demonstrations (e.g. for data quality management and data integration as well as a shell for expert systems).

TUN also comprises various resources from the commercial software training field. These resources however have not been peer reviewed:

- access to Teradata certification,
- over 100 white papers,
- over 150 web-based courses (1-2 hours each),
- Teradata user group,
- Teradata discussion forum,
- Tech Center: access to technical papers.

Besides the teaching materials and software tools listed above (see as well Figure 1), the mission of the portal is explained and the members of the TUN Advisory Board are presented. There is also an easy-to-use content submission form for new content or related web pages, and the latest newsletters as well as some quick start guides are provided. In order to gain fast access to the content of TUN, search functionality for document metadata was implemented in November 2005.

A separate portal for students, Teradata Student Network (<http://www.TeradataStudentNetwork.com>), provides access to a subset of the materials mentioned. Students are granted access to software tools, book chapters, articles, research reports, cases, projects, tutorials, podcasts and assignments—but not to syllabi, teaching notes and assignment solutions. Students can also use the web seminars and the tech center. By the end of November 2007, about 4,800 students from 395 universities and colleges in 62 countries have been registered for Teradata Student Network resources (all figures as of 2007-11-30).

## **TUN Access and Content Integration**

To gain access to the Teradata University Network, faculty must first register at the TUN web site. In addition to providing personal information such as name and university, applicants must provide a web page link that proves their teaching faculty status. This procedure is necessary because the material provided by TUN is—on the basis of fair use rules—only available to faculty members. Once their application has been authenticated (usually within 24 hours), faculty have access to the Teradata University Network. A separate registration is necessary for Teradata's SQL Assistant software which is coordinated with the Teradata University Network authorization. Registered TUN users can make the Teradata Student Network available to their students. A registration procedure for the Teradata

Student Network has been implemented in order to control database access (data sets are available for read-write access) and to collect usage metadata.

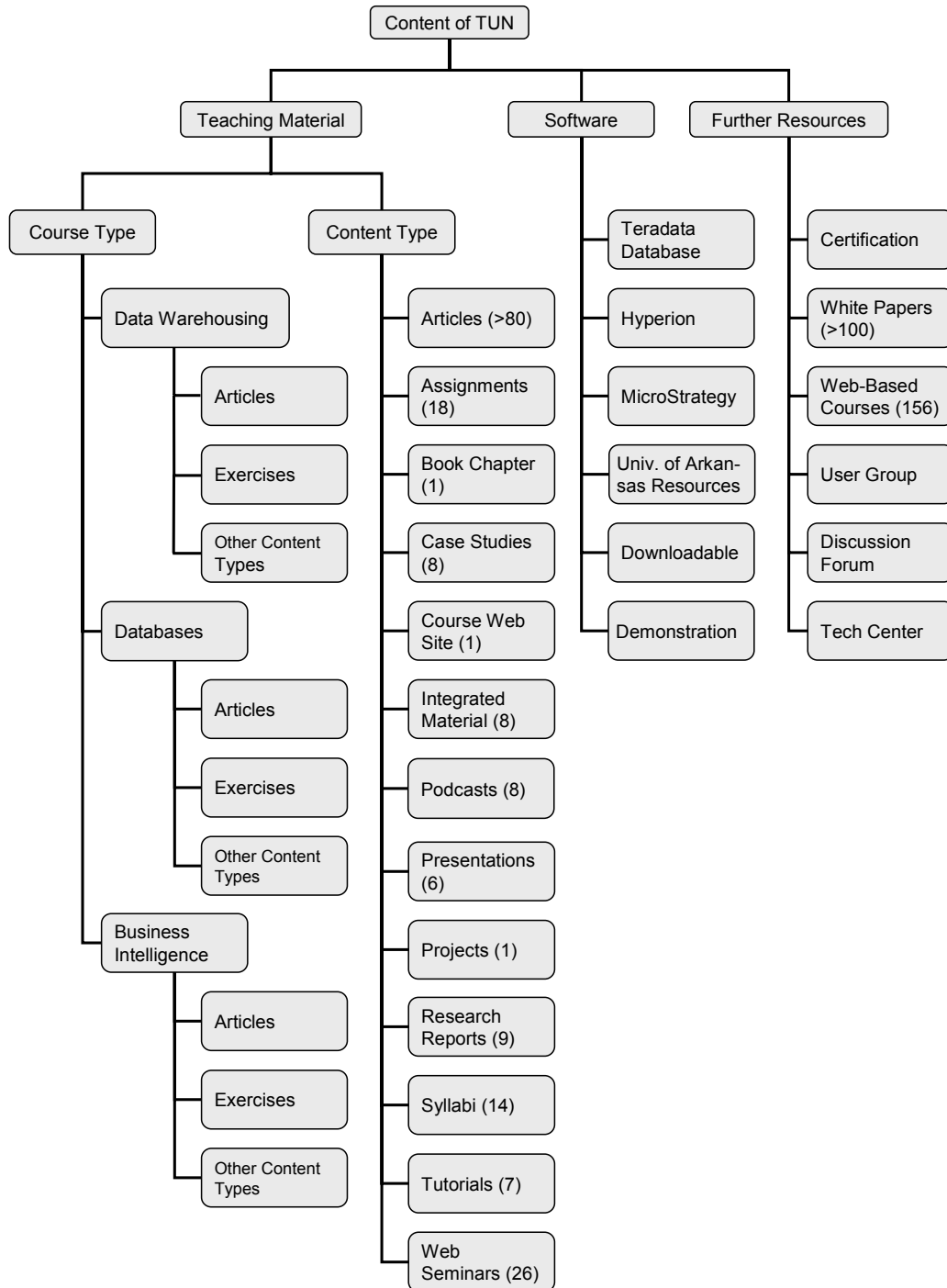


Figure 1. TUN content structure (all figures as of 2007-06-06)

What differentiates Teradata's initiative from other software vendors' resources for education is that leading academics are primarily responsible for the TUN vision, the evolution of TUN, and peer reviewing of submitted material. The Senior and Associate Directors work together with Teradata and other Advisory Board members as a management team in order to ensure that the Teradata University Network meets the needs of the IS academic

community. Project teams, led by board members, work closely with Teradata staff to make decisions, test prototypes, obtain beta testers, and make design decisions.

All content is reviewed by Senior and Associate Directors of the Board, i.e. by fellow faculty. As the value of the Teradata University Network increases with any further material, faculty are invited to submit material to the Director of the Board. There is an easy-to-use content submission form that collects the submitted metadata and allows the submitting faculty member to attach the content or provide a link for assessment. If appropriate, the reviewed content is released to the Teradata University Network and/or the Teradata Student Network.

## **Using TUN Resources to Support Teaching**

By using TUN resources, diverse instruction forms in the fields of data warehousing, business intelligence and database can be supported. This applies both to classroom courses as well as to self instruction (i.e. independent study) settings or hybrid forms thereof.

As a starting point for the planning of a new and/or adaptation of an existing course, different curricula are available in the Teradata University Network. Based on these materials, the lecture as well as the associated exercises, assignments, and even exams can be prepared. The numerous articles, book chapters, and research as well as practice reports available in TUN are particularly suitable. Furthermore, some PowerPoint slides as well as web seminars that can be used for self-instruction are provided in the Teradata University Network, allowing for the immediate adoption in the respective course. For preparing exercises, it is possible to revert to the case studies available in TUN. These can be worked on by the students individually or in groups. In most cases, the Teradata University Network provides the course instructors with teaching notes, questions, and sample solutions.

It is helpful to students to use the MicroStrategy BI Application Modules in connection with some exercises provided in TUN. In doing so, students gain hands-on knowledge and develop a thorough understanding of the lecture materials. In order to become familiar with the MicroStrategy tools, it is advisable for both instructors and students to complete the Micro Strategy tutorial and to do some lessons in the eTrainer. Within the tutorial, the user has the opportunity of giving reporting functions and navigation as well as the other features of the tool an unlimited and unrestricted trial (Wixom, 2004). The eTrainer is a web-based training environment that allows users to learn about handling the Micro Strategy tool and checking their acquired knowledge. Topics covered include basic tool navigation, looking for a report, changing a report (both in form and content), storing and deleting a report, as well as exporting and printing documents (MicroStrategy, n.d.).

To accomplish database exercises, the SQL (Structured Query Language) Assistant tool can be used. This enables users to work on the Teradata database with adequate data sets in order to interactively learn how to develop SQL queries. Besides accessing pre-defined data sets that are taken from popular database text books, it is also possible to upload individual data sets into the Teradata database. For the tailored use of the SQL Assistant tool, course instructors have the opportunity to create and administrate dedicated course environments. Password protection allows differentiation between databases used for in-lecture demonstrations and exercises, databases needed for assignments, and databases restricted to examinations. Consequently, Teradata University Network and Teradata Student Network users are granted both reading and writing access on the databases assigned to them.

It is worth noting that some of the aforementioned resources (e.g. PowerPoint presentations, case studies, and exercises) contain teaching notes which further simplify the development of a data warehousing or business intelligence course. If this assistance should prove insufficient and/or students have questions relating to Teradata University Network resources, course instructors may contact the Teradata customer service. Within the scope of TUN support service level agreements, inquiries are generally answered within a timeframe of 24 hours.

## **Application Case**

An application example for basing a distance learning course on Teradata University Network materials is the Management Information Systems (MIS) course that we teach every other semester as a core course in the Master of

Business Informatics program at the Virtual Global University (VGU, n.d.). We show which TUN resources were initially used in the conceptualization of the course, and which Teradata University Network/Teradata Student Network resources are available to students who attend the course. We also draw conclusions and present some lessons learned based on our experience as course instructors as well as on the students' feedback. Finally, we briefly report findings from two comparable courses on data warehousing and business intelligence that we teach once every academic year at the University of St. Gallen, Switzerland as an elective in the "Master of Arts in Information, Media and Technology Management" program (Fleisch & Gebauer, 2004).

## Course Outline and Objectives

The MIS course is intended to enable graduate students to understand the various types of information systems (IS) in commercial organizations as well as public administration. In contrast to the broad interpretation of MIS that is commonly followed at US universities (e.g. incorporating hardware and software foundations, MIS development, societal impacts, cultural issues and more), a narrow interpretation of MIS is followed in this course: MIS is defined as the various types of information systems used by commercial organizations and public administration in order to support management processes. As a consequence, the MIS course presents two different views for classifying MIS (business view, sessions 3 and 4; systems architecture view, sessions 5 and 6), as well as examples for every information systems sub-type. Additionally, analytical information systems are covered in more detail (sessions 7 and 8). As a conceptual foundation, information integration is presented as one of the primary goals of organizational information management. Students are provided with an overview of the changing scope and role of MIS from stand-alone systems to integrated components of information management and systems architecture (sessions 1 and 2). To round off and conclude the course, the most important management issues for information systems are presented, and future developments in the MIS field are outlined (sessions 9 and 10).

Since the sessions of the MIS course are conceptualized as self-instruction lessons, the main component of the course is a set of hypertext documents comprising the lecture notes and links to video presentations. These video presentations combine a video stream showing the instructor lecturing, with the associated PowerPoint slides of the presentation comprising the lecture material. The video presentations were produced by means of the PowerPoint add-on Microsoft Producer for Microsoft PowerPoint (Shelly et al., 2005). The lecture notes and video presentations are accompanied by links to assignments (either case studies or tool exercises), and recommended readings.

The topics and materials covered in the course and the associated assignments are exhibited in *Table 1*. The Teradata University Network resources that have been used for preparing the course are presented in the subsequent section.

*Table 1.* Topics of lectures and assignments

Session(s)	Topics covered in lecture(s)	Materials covered in assignment(s)
1	Introduction: definitions and foundations <ul style="list-style-type: none"> <li>– Data vs. information vs. knowledge</li> <li>– Information systems</li> <li>– Management information systems</li> <li>– Information management</li> <li>– Information integration</li> </ul>	Case study: "The benefits of data warehousing at Whirlpool" (Haley et al., 1999)
2	Changing scope of IS and different views on IS <ul style="list-style-type: none"> <li>– Information integration: directions, dimensions, techniques</li> <li>– Changing role and scope of IS</li> <li>– Different approaches to IS understanding <ul style="list-style-type: none"> <li>• Business view of IS</li> <li>• Systems architecture view of IS</li> <li>• Technical view of IS</li> <li>• Functional view of IS</li> </ul> </li> </ul>	Case study: "Data warehouse governance at Blue Cross and Blue Shield of North Carolina" (Watson et al., 2002)  Case study: "Implementing SAP R/3 at the University of Nebraska" (Sieber et al., 1996)
3 and 4	The business view on information systems <ul style="list-style-type: none"> <li>– Derivation of IS types from a business</li> </ul>	Case study: "Brittany Ferries makes plain sailing of using the Internet to deliver financial

	<p>viewpoint</p> <ul style="list-style-type: none"> <li>- Most important IS types <ul style="list-style-type: none"> <li>• Transaction processing systems</li> <li>• Office automation systems</li> <li>• Management information systems</li> </ul> </li> <li>- Other IS types <ul style="list-style-type: none"> <li>• Knowledge and information management systems</li> <li>• Decision support systems</li> <li>• Creativity support systems</li> <li>• Executive information systems</li> <li>• Inter-organizational systems</li> </ul> </li> </ul>	<p>statements to agents and resolve queries online” (AXS-one, 2005)</p> <p>Tool exercise: “AdVent Technology – Using the MicroStrategy Sales Analytic Module” (Bonney, 2003)</p> <p>Case study: “WISDOM provides competitive advantage at Owens &amp; Minor” (Stoller et al., n.d.)</p>
5 and 6	<p>The systems architecture view on information systems</p> <ul style="list-style-type: none"> <li>- Systems architecture model <ul style="list-style-type: none"> <li>• Model dimensions and resulting integration dimensions</li> <li>• Application types</li> <li>• Interface system types and reference model</li> </ul> </li> <li>- IS types and interface types from a systems architecture viewpoint <ul style="list-style-type: none"> <li>• Vertical applications</li> <li>• Information-centered applications</li> <li>• Analytical applications</li> <li>• Data warehouse systems</li> <li>• Horizontal applications</li> <li>• Enterprise application integration systems</li> <li>• Inter-company integration systems</li> </ul> </li> </ul>	<p>Case study: “Data warehousing supports corporate strategy at First American Corporation” (Cooper et al., 2000)</p> <p>Case study: “Continental Airlines Takes Off with Real-time Business Intelligence” (Anderson-Lehman et al., 2004)</p> <p>Case study: “Harrah’s high payoff from customer information” (TDWI, 2000)</p>
7 and 8	<p>Analytical applications</p> <ul style="list-style-type: none"> <li>- Reporting systems</li> <li>- Managed query environments</li> <li>- Decision support systems <ul style="list-style-type: none"> <li>• Decision support systems using artificial intelligence techniques</li> <li>• Data mining systems</li> <li>• Group decision support systems</li> </ul> </li> <li>- Executive information systems</li> <li>- On-line analytical processing and data marts</li> <li>- Support of process portals and packaged applications</li> </ul>	<p>Case study: “Production planning and control in textile industry” (Karacapilidis &amp; Pappis, 1996)</p> <p>Tool exercise: “On-line analytical processing”, using a PowerPlay web front end to explore data of the NASA workforce (NASA, n.d.)</p> <p>Case study: “CRM case study – Optimizing relationships at National Australia Bank, Inc.” (Khirallah, 2001)</p>
9	<p>Management of integrated information logistics</p> <ul style="list-style-type: none"> <li>- Three views on information management</li> <li>- Information systems management <ul style="list-style-type: none"> <li>• IS strategy and justification</li> <li>• IS architecture and portfolio planning</li> <li>• IS project management and support</li> </ul> </li> <li>- Data warehousing management <ul style="list-style-type: none"> <li>• Data warehousing strategy and justification</li> <li>• Data warehousing processes and tools</li> <li>• Data warehousing organization</li> </ul> </li> </ul>	<p>Case study: “3M moves to a customer focus using a global data warehouse” (Goodhue &amp; Wixom, 2001)</p>

10	<p>Trends in data warehousing and information logistics</p> <ul style="list-style-type: none"> <li>- What has been achieved so far...</li> <li>- Some current trends <ul style="list-style-type: none"> <li>• Inter-company information systems</li> <li>• Consideration of privacy legislation and concerns</li> <li>• Convergence of data warehousing and knowledge management</li> <li>• Using the web to create information</li> <li>• "Commodization" of data warehousing</li> </ul> </li> </ul>	Case study: "Analyzing the footsteps of your customers" (Theusinger & Huber, n.d.)
----	---	--

### Usage of Teradata University Network Resources

Various case studies and assignments have been adopted as they stand from Teradata University Network/Teradata Student Network (see *Table 1*). The pre-defined questions suggested by the case study and assignment authors were mainly adopted, and in some instances supported and/or substituted by individually designed questions. These referred to the case study itself and/or to the material covered in the respective lecture(s). The extensive teaching notes provided in TUN support the instructors in preparing elaborate reference solutions for the assignments. This information can be used both for grading as well as for giving the students well-founded feedback on their individual solutions.

In particular, the following case studies were taken from Teradata University Network/Teradata Student Network resources:

- "The benefits of data warehousing at Whirlpool" (Haley et al., 1999): The Whirlpool case illustrates a taxonomy of benefits that can be realized through data warehousing. Topics covered include: Data mart, data warehouse architecture, decision support systems and business intelligence, enterprise data warehouse, extraction-transformation-loading, on-line analytical processing, organizational issues, and return-on-investment.
- "Data warehouse governance at Blue Cross and Blue Shield of North Carolina" (Watson et al., 2002): This case study describes the award winning data warehouse governance practices at Blue Cross and Blue Shield of North Carolina. It also describes the warehouse, training and support, and the benefits realized. Topics covered include: Data governance, data models and modeling, data quality, data warehouse justification, extraction-transformation-loading, information requirements justification, and training and support.
- "Data warehousing supports corporate strategy at First American Corporation" (Cooper et al., 2000): This case describes the implementation of a customer relationship management strategy at First American Corporation. Topics covered include: customer relationship management, data mining, data quality, data warehouse justification, decision support systems/business intelligence, development methodologies, enterprise data warehouse, extraction-transformation-loading, metadata, on-line analytical processing, organizational issues, and project management.
- "Continental Airlines takes off with real-time business intelligence" (Anderson-Lehman et al., 2004): This case describes the development of real-time business intelligence at Continental Airlines. Powered by an active data warehouse, Continental has changed the way it does business. The case describes the conditions at Continental that led to this change, the real-time applications and technology that are used, the benefits realized, and the lessons that have been learned. Topics covered include: customer relationship management, data warehouse success/failure, decision support systems/business intelligence, enterprise data warehouse, extraction-transformation-loading, organizational issues, return-on-investment, and business impact.
- "Harrah's high payoff from customer information" (TDWI, 2000): This case study describes Harrah's customer relationship management business strategy, the technological and organizational changes that were required, the application of closed loop marketing, the resulting business benefits, and the lessons learned. Topics covered include: customer relationship management, data governance, data warehouse architecture, data warehouse success/failure, database performance, enterprise data warehouse, extraction-transformation-loading, operational data store, organizational issues, and return-on-investment.

- “3M moves to a customer focus using a global data warehouse” (Goodhue & Wixom, 2001): This case study describes the development of a data warehouse at 3M. It emphasizes the justification process, the technical infrastructure, and benefits. It is especially interesting because the savings from the consolidation of multiple decision support data marts exceeded the cost of the warehouse. Topics covered include: customer relationship management, data governance, data warehouse architecture, data warehouse justification, enterprise data warehouse, extraction-transformation-loading, hardware/software requirements, information requirements determination, organizational issues, and return-on-investment.

In addition to the aforementioned case studies, the Teradata University Network/Teradata Student Network tool exercise “AdVent Technology – Using the MicroStrategy Sales Analytic Module” (Bonney, 2003) is used in the MIS course. The exercise requires students to use the MicroStrategy 7 Sales Analytic Module (see Figure 2) to answer a total of three questions by submitting a screenshot or print-out of the produced reports. Students can access the MicroStrategy business intelligence front end by means of a standard web browser via Teradata Student Network. As already mentioned, it is advisable to require students to complete the MicroStrategy tutorial before working on the actual assignment.

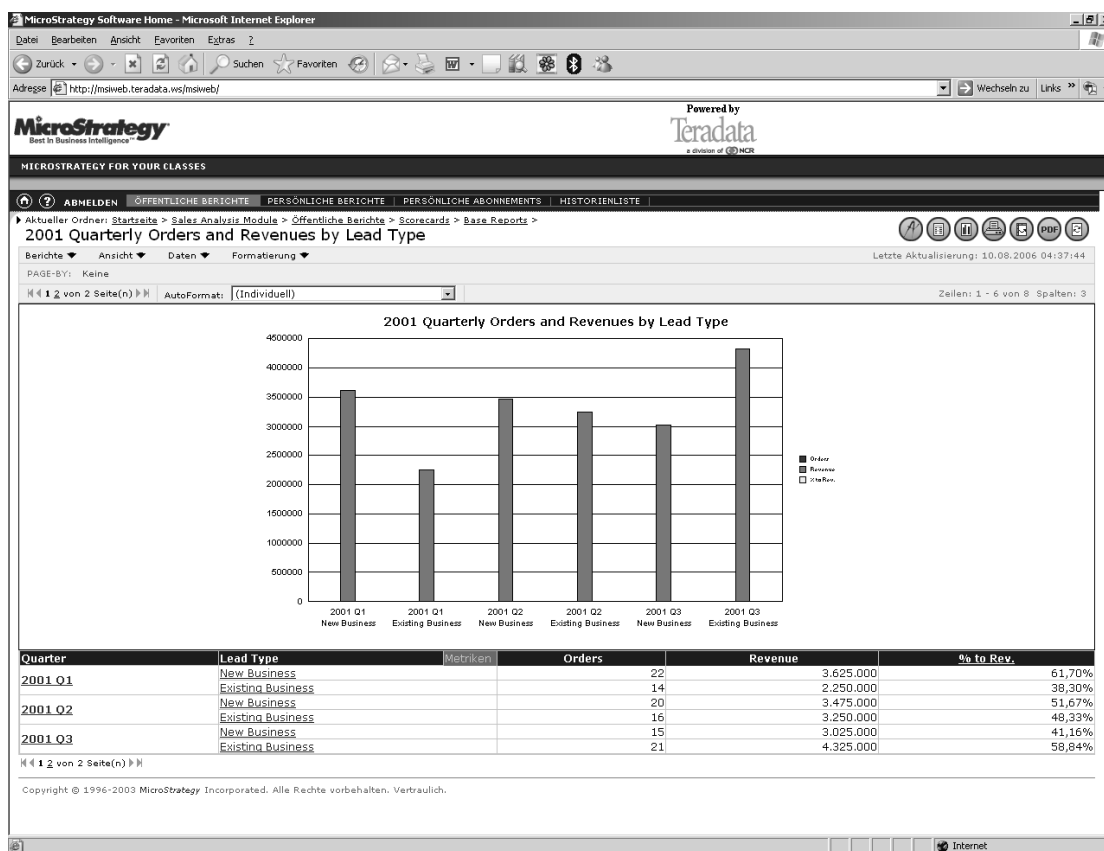


Figure 2. MicroStrategy Sales Analytic Module—Sample screenshot

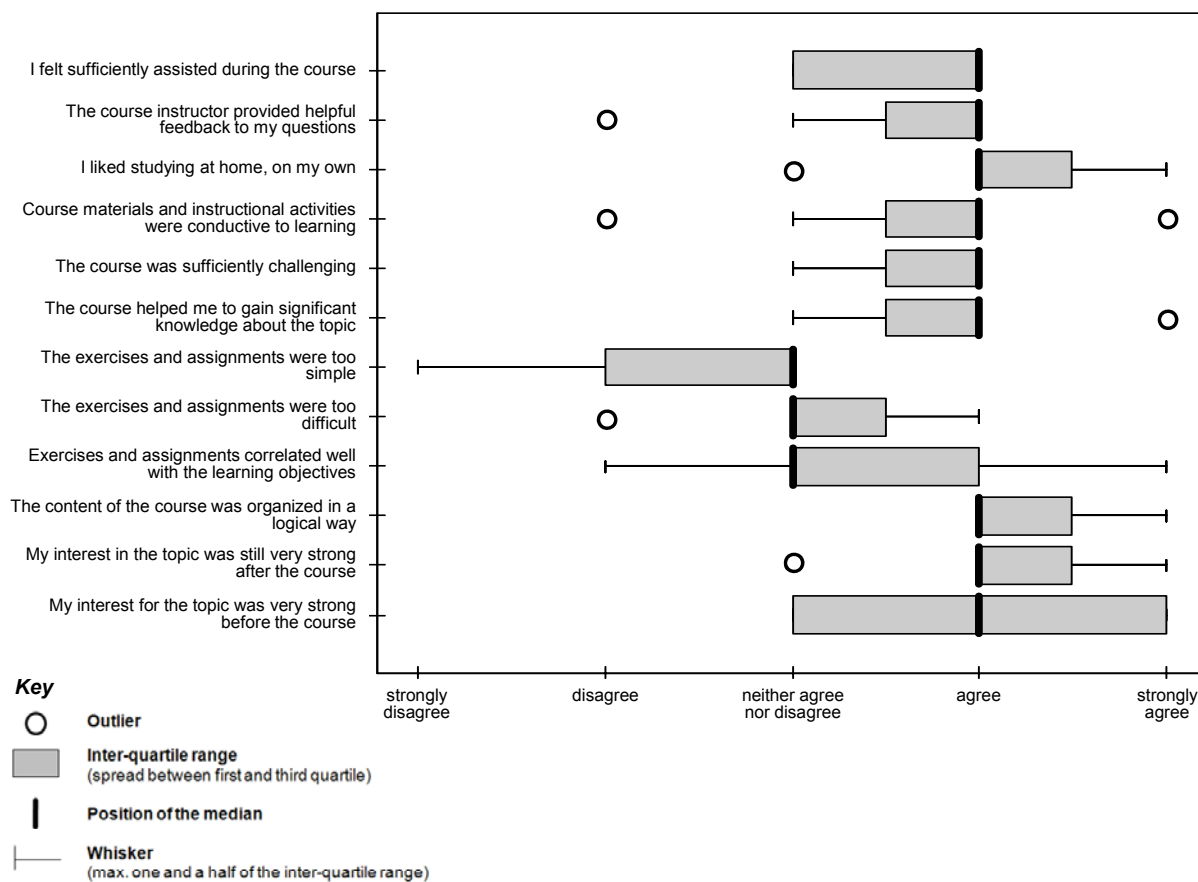
## Students' Feedback

At the end of the MIS course, students have the opportunity to provide the instructors with detailed feedback on the course contents and design by means of a standardized questionnaire. The questions cover statistical data, technical aspects (accessibility and quality of course materials, electronic communication with the instructors), evaluation of the course contents, and overall feedback and general comments.

Students' feedback on the MIS course has been very positive. All students who submitted the feedback questionnaire from the course taught in 2005/2006 characterized the overall course design as "good". Almost 60% of those reported "very good" or even "excellent" course design.

The box-whisker plot illustrated in *Figure 3* is a graphic representation of a set of descriptive statistics on the students' feedback on the 2005/2006 MIS course. The students were asked to indicate their level of agreement with twelve pre-specified statements (vertical axis of *Figure 3*) on a five-tiered Likert scale (horizontal axis of *Figure 3*). The underlying research question can be formulated as follows: "How do the students perceive the contents and design of the MIS course?"

Our initial hypotheses are that the self-instruction format as well as the electronic course materials, case studies, and tool exercises foster a positive learning environment and contribute to the overall learning success. The data from the students' feedback was analyzed with respect to these hypotheses. The length of the boxes in the box-whisker plot is determined by the respective inter-quartile range. The inter-quartile range is a measure for the statistical spread between the first and the third quartile, this covers 50% of the data. The position of the median within the inter-quartile range is depicted by the bold vertical lines within the boxes, indicating the skewness of the underlying distributions. The horizontal lines on the left and/or right sides of the boxes are referred to as whiskers. The length of the whiskers is restricted to one and a half of the respective inter-quartile range at the most, and in either case determined by an actual value of the data. Values outside of this range are separately marked by circles and referred to as outliers. If there are no values beyond the whiskers, their length is determined by the minimal and/or maximal value represented in the underlying data set.



*Figure 3.* Students' feedback on the MIS course

From the information depicted in the box-whisker plot, we conclude that the mainly electronic communication and interaction between students and instructors does not constitute any substantial barrier to learning. On the contrary, the majority of students felt sufficiently assisted and supported during the course, and liked the self-instruction format. It provided them with the opportunity to study on their own without any restrictions with respect to timing and/or study location. Students also perceived the electronic course materials and instructional activities as conducive to learning, and valued the logical organization of the contents. Regarding the level of difficulty, the majority of students characterized the course as “sufficiently challenging” and referred to the exercises and assignments as neither too simple nor too difficult. Our initial hypotheses about the positive effects of the self-instruction format as well as of the teaching materials therefore hold true.

However, the correlation between exercises and assignments on one side and learning objectives on the other side meets with slight criticism (cf. statement “exercises and assignments correlated well with the learning objectives”). Some students also commented on the partial lack of correspondence between assignments’ contents and the topics covered in the lectures. Clear needs for improvement exist: Either the lecture materials must be prepared in order to match the assignments, or the assignments have to be re-examined so they correspond with the lecture materials. However, since the Teradata University Network provides instructors with detailed teaching notes for the exercises and case studies, the instructors’ effort that is necessary for the adaptation and/or matching of these components is considered to be rather small.

Beside these points, overall feedback on the MIS course has been very encouraging. The majority of students agreed that the course helped them to gain significant knowledge about MIS, and reported that their interest in the topic remained equally strong or increased during the course.

### **Lessons Learned from Comparable Courses**

As already mentioned, we are also involved in the teaching of two comparable courses at the University of St. Gallen, namely one self-instruction course on business intelligence, and an in-classroom course on management information systems.

The business intelligence course covers the following topics: data warehousing architecture, data population (extraction-transformation-loading), data organization, database systems, Structured Query Language (SQL), multi-dimensional modeling, on-line analytical processing, data mining, performance management, customer relationship management, and other analytical applications. Similar to the MIS course previously described, the business intelligence course’s lecture material is made available to the students via a dedicated course web site. Students of the business intelligence course are also required to complete individual assignments and tool exercises that are based on and/or adopted from the Teradata University Network/Teradata Student Network.

In addition to the exercises outlined above, students have to complete exercises on multi-dimensional modeling and SQL. Teradata University Network/Teradata Student Network offers a wide range of corresponding assignments (e.g. Garfield, 2003 and 2004). The SQL queries on the Teradata database have to be performed by means of the Teradata SQL Assistant tool (see Figure 4). An introductory guide to SQL using this tool is provided in Teradata University Network/Teradata Student Network (Hoffer, 2005).

The students’ feedback on the assignments and especially on the tool exercises has been very positive. Students value the high quality of the case studies and see a huge advantage in gaining hands-on knowledge of the lecture materials by working with tools and tool demos provided in the Teradata Student Network.

The same is true for the course on management information systems held at the University of St. Gallen. This course covers basically the same material as the aforementioned MIS course, but is taught in-classroom. The students need to both attend the lectures and complete a total of eight exercises—seven tool exercises using (1) the Teradata SQL Assistant, (2) a multi-dimensional information modeling tool, (3) the MicroStrategy reporting modules, (4) an online business intelligence tool, (5) an open source data mining tool, (6) Microsoft Excel for decision support exercises, and (7) an executive information system adoption simulation tool as well as an integrative case study.

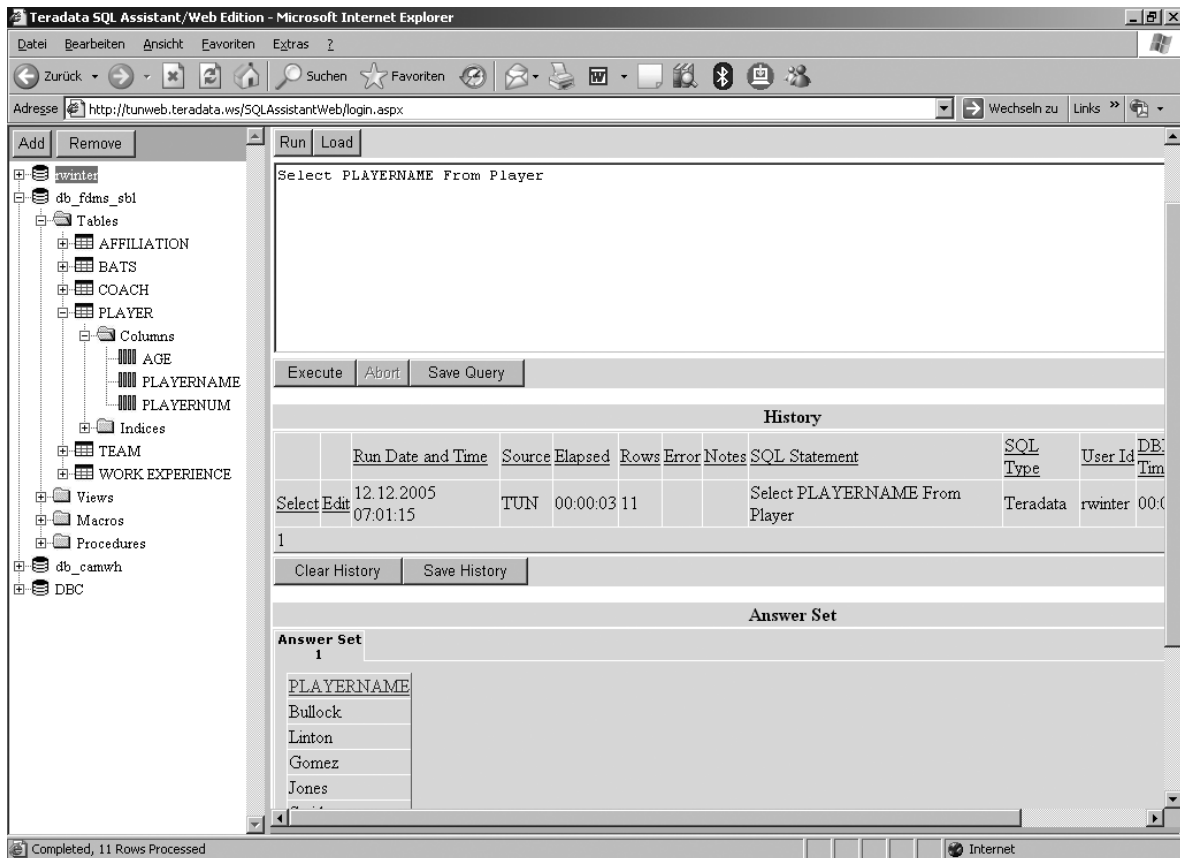


Figure 4. Teradata SQL Assistant tool—Sample screenshot

Teradata University Network/Teradata Student Network unfortunately does not contain a data extraction, transformation and loading tool nor a dedicated data mining tool. Since these two tool types are important for management information systems/business intelligence courses, an extension in this direction is advised.

## Limitations of the Teradata University Network

The advantages of the Teradata University Network can be seen in the easy exchange of teaching materials and in the free-of-charge access to state-of-the-art commercial software tools, but the limitations of this platform have to be taken into consideration as well.

Firstly, it has to be recognized that TUN will remain interesting for academia only if the available material is up-to-date. Secondly, it must be noted that the provided material is still fairly limited. These two facts indicate that it is necessary for lecturers and companies to remain willing to make their teaching materials and software tools available free of charge to others by using TUN.

The cost of the development and maintenance of the Teradata University Network and the Teradata Student Network are covered by software vendors. These companies aim at a marketing impact on future executives and lecturers. As a consequence, the choice of software tools provided on TUN is a result of Teradata's business and partnership strategy. So the amount of tools is limited to one tool for each field of application. However, a limited number of tools facilitates the integration of data sets and supports integrative application examples. In our courses, the SQL assignment, the information modeling assignment, and the reporting assignment operate on the same physical data set. Students therefore have the opportunity to learn about different analysis and visualization techniques without changes in meaning and context of the data and the depicted information.

Finally, a fourth limitation can be identified. The perspectives adopted within the Teradata University Network and the Teradata Student Network may be insufficiently diversified to suit many potential users. That is why validated findings about the actual use and the needs of the users are necessary; these would allow a focused evolution of the platform. Besides figures about registered Teradata University Network users and aggregated Teradata Student Network usage statistics, additional information regarding usage is currently collected in the Teradata Student Network. This data and the corresponding findings will be made available in the future.

## Conclusion and Outlook

The Teradata University Network is an innovative and effective support instrument for educators in the field of data warehousing, business intelligence, and database and the application of such information systems for management support. By supporting the development and execution of state-of-the-art, in-class as well as distance learning courses in these fields, the Teradata University Network helps to prepare students in a realistic, yet theory-grounded way. A substantial amount of teaching material (assignments, presentations, case studies, syllabi, etc.) is made available by an integrated platform with easy, free-of-charge access to state-of-the-art commercial software.

Useful extensions of TUN can be seen in the allocation of further teaching materials and software tools. The addition of a data mining tool, customer relationship management software, and an extraction-transformation-loading tool are planned. However, the integration of these tools as well as their evolution into a web-based application service provider model may take some time. After the planned additions, the Teradata University Network will provide a complete range of the most important types of data warehousing/business intelligence tools—but limited to one tool for each type.

Thanks to an increased internationalization of curricula and teaching aids, significant demand for non English-language materials has not been requested as yet. The multiple indexing of the content as well as the search functions make the Teradata University Network easier to reuse, entire courses as well as components. In order to support the integration of teaching materials into a broad range of courses and programs, the creation of even smaller content components and additional, searchable content metadata has been planned.

## References

- Anderson-Lehman, R., Watson, H. J., Wixom, B. H., & Hoffer, J. A. (2004). *Continental Airlines Takes Off with Real-time Business Intelligence*, retrieved June 19, 2008 from <http://kazman.shidler.hawaii.edu/ContinentalCase.pdf>.
- AXS-one (2005). *Case Study - Brittany Ferries. Brittany Ferries Makes Plain Sailing of Using the Internet to Deliver Financial Statements to Agents and Resolve Queries Online*, retrieved June 19, 2008 from <http://www.axsone.com/pdf/BrittneyFerries032602.pdf>.
- Baumgartner, P., Häfele, H., & Maier-Häfele, K. (2005). *Evaluation von Lernplattformen: Verfahren, Ergebnisse und Empfehlungen (Version 1.3)*, retrieved June 19, 2008 from [http://www.campussource.de/opensource/docs/evaluation\\_lernplattf\\_at.pdf](http://www.campussource.de/opensource/docs/evaluation_lernplattf_at.pdf).
- Bonney, L. (2003). *AdVent Technology: Using the MircoStrategy Sales Analytic Module*, retrieved June 19, 2008 from <http://www.teradata.com/t/page/135425/index.html>.
- Cooper, B. L., Watson, H. J., Wixom, B. H., & Goodhue, D. L. (2000). Data Warehousing Supports Corporate Strategy at First American Corporation. *MIS Quarterly*, 24 (4), 547-567.
- Fleisch, E., & Gebauer, H. (2004). *Das HSG Master-Programm für Business Innovation*, retrieved June 19, 2008 from [http://www.logistik.unisg.ch/org/logm/web.nsf/SysWebRessources/Information+IMT+Master+/\\$FILE/vorstellung\\_IMT\\_Master\\_Uni\\_St\\_Gallen.pdf](http://www.logistik.unisg.ch/org/logm/web.nsf/SysWebRessources/Information+IMT+Master+/$FILE/vorstellung_IMT_Master_Uni_St_Gallen.pdf).
- Garfield, M. (2003). *Six Data Modeling Exercises*, retrieved June 19, 2008 from <http://www.teradata.com/t/page/135748/index.html> (available after having logged in to TUN).

- Garfield, M. (2004). *Three Normalization Problems*, retrieved June 19, 2008 from <http://www.teradata.com/t/page/135762/index.html> (available after having logged in to TUN).
- Goodhue, D. L., & Wixom, B. H. (2001). *3M Moves to a Customer Focus Using a Global Data Warehouse*, retrieved June 19, 2008 from <http://www.teradata.com/t/page/135421/index.html> (available after having logged in to TUN).
- Graham, C. (2005). *Gartner Clients Consider Business Intelligence to Be a Major Priority*, retrieved June 19, 2008 from [http://www.gartner.com/DisplayDocument?ref=g\\_search&id=486797](http://www.gartner.com/DisplayDocument?ref=g_search&id=486797).
- Haley, B. J., Watson, H. J., & Goodhue, D. L. (1999). *The Benefits of Data Warehousing at Whirlpool*, retrieved June 19, 2008 from <http://www.igi-pub.com/downloads/teaching/IT5536.pdf>.
- Hoffer, J. A. (2005). *SQL Lab Manual*, retrieved June 19, 2008 from <http://www.teradata.com/t/page/135752/index.html> (available after having logged in to TUN).
- Hoffer, J. A., Prescott, M. B., & McFadden, F. R. (2004). *Modern Database Management* (7<sup>th</sup> Ed.), Upper Saddle River: Prentice Hall.
- Karacapilidis, N. I., & Pappis, C. P. (1996). Production Planning and Control in Textile Industry: A Case Study. *Computers in Industry*, 30 (2), 127-144.
- Khirallah, K. (2001). *CRM Case Study: Optimizing Relationships at National Australia Bank, Ltd.*, retrieved June 19, 2008 from [http://www.teradatalibrary.com/pdf/towergroup\\_020701b.pdf](http://www.teradatalibrary.com/pdf/towergroup_020701b.pdf).
- MicroStrategy (n. d.). *Overview of the MicroStrategy Site*, retrieved June 19, 2008 from [http://msi8web.teradata.ws/msidocs/MSTR8\\_TUN\\_Overview.pdf](http://msi8web.teradata.ws/msidocs/MSTR8_TUN_Overview.pdf).
- NASA (n. d.). *Exploring the NASA Workforce*, retrieved June 19, 2008 from <http://wicon.nssc.nasa.gov/index.htm>.
- Shelly, G. B., Cashman, T. J., & Sebok, S. L. (2005). *Microsoft Producer 2003: Essential Concepts and Techniques* (Vol. 1), Boston: Course Technology.
- Sieber, T., Siau, K., Nah, F., & Sieber, M. (1996). *Implementing SAP R/3 at the University of Nebraska*, retrieved June 19, 2008 from <http://homepages.strath.ac.uk/~cias19/teaching/40318/nebraskaU.pdf>.
- Stoller, D., Wixom, B. H., & Watson, H. J. (n. d.). *WISDOM Provides Competitive Advantage at Owens & Minor*, retrieved June 19, 2008 from <http://terry.uga.edu/~hwatson/owens&minor.doc>.
- TDWI (2000). *Harrah's High Payoff from Customer Information*, retrieved June 19, 2008 from <http://www.terry.uga.edu/~hwatson/Harrahs.doc>.
- Theusinger, C., & Huber, K.-P. (n. d.). *Analyzing the Footsteps of Your Customers*, retrieved June 19, 2008 from [http://ai.stanford.edu/~ronnyk/WBKDD2000/WBKDD2000\\_ARCHIVE/ii\\_2.pdf](http://ai.stanford.edu/~ronnyk/WBKDD2000/WBKDD2000_ARCHIVE/ii_2.pdf).
- VGU (n. d.). *Management Information Systems*, retrieved June 19, 2008 from <http://www.vg-u.de/cours1.asp>.
- Watson, H. J., Fuller, C., & Ariyachandra, T. (2002). *Data Warehouse Governance at Blue Cross and Blue Shield of North Carolina*, retrieved June 19, 2008 from <http://kazman.shidler.hawaii.edu/BCBSCase.pdf>.
- Watson, H. J., & Hoffer, J. A. (2003). Teradata University Network: A New Resource for Teaching Large Databases and Their Applications. *Communications of the AIS*, 12, 131-144.
- Watson, R. T. (2003). *Data Management: Databases and Organizations* (Vol. 4), New York: Wiley.
- Winter, R. (2004). Teradata University Network. In Leino, T., Saarinen, T., & Klein, S. (Eds.), *Proceedings of the 12<sup>th</sup> European Conference on Information Systems*, Turku, Finland, 1-4 (CD-ROM).
- Wixom, B. H. (2004). Business Intelligence Software for the Classroom - MicroStrategy Resources on the Teradata University Network. *Communications of the AIS*, 14, 234-246.
- Wixom, B. H., & Watson, H. J. (2001). An Empirical Investigation of the Factors Affecting Data Warehousing Success. *MIS Quarterly*, 25 (1), 17-41.