



GLOBAL INFORMATION SYSTEMS: STRATEGIC, TECHNICAL & ORGANIZATIONAL PERSPECTIVES

MARCH 2008 – PROFESSOR STUART MADNICK

As an example:

“Airbus’ A380 double-decker jet is two years behind schedule, sending billions of dollars in potential profits down the drain. ... But the reason sounds too simple to be true: Airbus factories in Germany and France were using incompatible design software, so the wiring produced in Hamburg didn't fit properly into the plane on the assembly line in Toulouse.”

Although this might sound like a technology problem, its causes are deeply entangled with strategy and organizational policy issues.

That is the focus of: **“GLOBAL INFORMATION SYSTEMS:
STRATEGIC, TECHNICAL, AND ORGANIZATIONAL PERSPECTIVES”**

As another example, one of the case studies that we consider throughout the course is based upon the experiences of an MIT Sloan graduate who rose to Chief of Staff for Foreign Exchange for one of the world's largest banks.

He had recommended to the Board the development of a new Global Foreign Exchange Trading system. It was supposed to take 1.5 years and cost \$25M. It is now 2.5 years and \$35M later and it is not done. Some consultants brought in to evaluate it say it is close to completion, others say it is a hopeless cause.

What do you do? Some issues to consider are:

- What was the strategic purpose of the system? Are the assumptions still valid? Are there other ways to accomplish the necessary goals?
- Were the technical choices made appropriate and correct? What are the alternatives?
- What are the reasons for the different reactions throughout the organization to the proposed system? (ranging from rave reviews to all-out attempts to kill it.)

Note: No prior experience with Information Technology is required.

OCTOBER 23, 2006

GLOBAL BUSINESS

BusinessWeek online

Wayward Airbus

Cross-border clashes have led to costly production errors. Job One for a new CEO will be to unify the jetmaker

Airbus' A380 double-decker jet is two years behind schedule, sending billions of dollars in potential profits down the drain. But the reason sounds too simple to be true: Airbus factories in Germany and France were using incompatible design software, so the wiring produced in Hamburg didn't fit properly into the plane on the assembly line in Toulouse.

It's one of the costliest blunders in the history of commercial aviation, and it has plunged Airbus

Motivation:

- It is estimated that 50% of IT dollars are spent on Enterprise Information Integration (EII).
- Lack of IT interoperability is estimated to cost \$15B in capital facilities industry alone.
- NRC report on the 9/11 event noted the serious lack of effective interoperation of intelligence databases.
- *BW*: Airbus' A380 double-decker jet is two years and billions behind schedule due to incompatible design software

Learn the fundamental theories and essential skills for tackling these and many other related problems. By exploring the critical issues of global and internet-based information systems from multiple perspectives, this course is especially relevant to those who wish to effectively exploit information technology in their organizations.

Course Structure:

The course is divided into four parts.

Part 1: Strategic Connectivity (*Applications & Cases*)

We start with the strategic benefits and implications of intra- and inter-organizational systems in an increasingly global environment, the need for integration of information through frameworks such as competitive forces and interlinked value chains.

Part 2: Physical Connectivity (*Communications & Network Technology*)

This part focuses on critical communications and network technologies, such as hardware, (e.g., RFID), software/protocols (e.g., TCP/IP), and architectures (e.g. Wide Area Networks - Internet) needed to interconnect systems.

Part 3: Logical Connectivity (*Database/XML/Web Services / Semantic Web*)

This part focuses on new technologies to aid logical connectivity, especially to address the syntactic and semantic mapping requirements. For example, I get "profit" data from two divisions who do their accounting differently - how do I reconcile these differences to make effective comparisons? This part of the course presents recent developments, mostly from the fields of Heterogeneous Distributed Database Management Systems, web data extraction, Web Services, and the Semantic Web.

Part 4: Organizational Connectivity (*Organizational and Policy Factors*)

The final part focuses on the organizational implications and management policy challenges of making effective use of systems that span normal organizational boundaries. Theories of loosely coupled organizations, development of standards, and motivating strategic alliances will be explored.

SYLLABUS SUMMARY

	<u>Day</u>	<u>Date</u>	<u>Topic</u>	<u>Assignment Due</u>
1	Sat	March 1	<u>INTRODUCTION</u>	
			<u>I. STRATEGIC CONNECTIVITY</u>	
2	Sat	March 1	Exploiting Web Aggregation	
3	Sat	March 1	Information Technology Strategy (Interlinked Value Chains)	
4	Sun	March 2	Strategic Case Study (Johnson & Johnson and FXX Cases)	HW1: J&J
5	Sun	March 2	Business and Industry Transformation (McKesson Case)	
			<u>II. PHYSICAL CONNECTIVITY</u>	
6	Sun	March 2	Wide Area Networks (Packet Network, Internet2, IP-v6)	
	Mon	March 3	-- NO CLASSES --	
7	Tues	March 4	Emerging Technologies III (RFID & its IT infrastructure)	
			<u>III. LOGICAL CONNECTIVITY</u>	
8	Tues	March 4	Introduction to Database Management Systems	
9	Wed	March 5	Distributed Homogeneous Databases	HW2
10	Wed	March 5	Distributed Heterogeneous Databases	
11	Thur	March 6	View Integration Among Databases (ER Diagrams)	
12	Thur	March 6	Web as a Database (COIN Project)	
13	Fri	March 7	Semantic Integration (COIN Project)	HW3
14	Fri	March 7	Component Architectures (CORBA) and Web Services	
			<u>IV. ORGANIZATIONAL CONNECTIVITY</u>	
15	Sat	March 8	Loosely-Coupled Organizations (ERP)	HW4
16	Sat	March 8	Markets and Hierarchies: Organizational Coupling	
17	Sat	March 8	Development of Standards	
18	Sun	March 9	Motivating Strategic Alliances & Organizational Transformation	
			<u>V. FINALE</u>	
19	Sun	March 9	Course Summary and Review	
20	Sun	March 9	FINAL EXAM	

ASSIGNMENTS AND EXAMS

Assignments:

- There are 2 kinds of assignments in this class: (1) assigned readings and (2) 4 written homework assignments (HW).
- Each assignment is due in class on the date indicated on the syllabus. These due dates are firm. If you anticipate a problem, see the instructor beforehand!
- Since partial credit is given, it is much better for you to turn in a partially complete assignment than to turn in nothing at all. Points will be subtracted for late homework. These assignments are important because: (1) they help to reinforce the concepts presented in class, (2) they prepare you for the examinations, and (3) they constitute a significant portion of your final grade.

Exams:

- In addition, there is a final exam as indicated on the syllabus.

Academic Integrity:

- All assignments, except if indicated otherwise, are to be done individually.

GRADES POLICY

Grades will be assigned based on the following guidelines:

- Class participation: 20%
- Homework: 40%
- Final Exam: 40%

Reading List

(as of 12-15-2007 – subject to change)

INTRODUCTION

1 Introduction

1. Carol Hildebrand, "Putting Two and Two Together," Darwin Magazine, January 2002.
(<http://www.manyworlds.com/default.aspx?from=/exploreCO.aspx&coid=CO190215503007> – just the summary page)
(Discusses the challenges and benefits of information systems integration. Integration may cost 50% of IT budget. Uses Dell as an example.)
2. "Why Your Integration Efforts End Up Looking Like This..." CIO Magazine, November 15, 2001. (<http://www.cio.com/archive/111501/efforts.html>)
(This article argues that getting different vendors to truly integrate complex software is impossible. Highlighting major problems faced by Oracle customers who were promised true integration and found that they never got it, not even a more limited form.)

I. STRATEGIC CONNECTIVITY

2 Exploiting Web Aggregation

1. Stuart Madnick & Michael Siegel, "Seize the Opportunity: Exploiting Web Aggregation", MISQ Executive, 1(1), March 2002, pp. 35-46.
(This paper examines the development of aggregators, entities that collect information from a wide range of sources, with or without prior arrangements, and add value through post-aggregation services. Two key types of aggregators are comparison and relationship aggregators. It also suggests different business models as possible aggregator entry points into an industry and describes their impact on the value chain.)
2. Hongwei Zhu and Stuart Madnick, "Reutilization and Legal Protection of Non-Copyrightable Database Contents", (with Hongwei Zhu), Proceedings of the IASTED International Conference on Law and Technology (LawTech 2006), Cambridge, Mass., October 9–11, 2006, [SWP #4622-06, CISL 2006-07] (<http://ssrn.com/abstract=926609>)
(This paper discusses the legal issues related to data re-use, including the European Union's Database Directive.)

3 Information Technology, Corporate Strategy, and Competitive Advantage

1. Michael E. Porter, "Strategy and the Internet," Harvard Business Review, March 2001, pp. 63-78.
(Uses the five forces model and value chain model, but in the context of the Internet. He argues that the Internet does not change the "old rules". He dispels many Internet myths, which have become more obvious in recent years, and illustrates that the "old rules" are also the "new rules." He also suggests six principles for Strategic Positioning: (1) right goal, (2) value proposition, (3) distinctive value chain, (4) trade-offs, (5) fit, and (6) continuity of direction.)

[SUGGESTED OPTIONAL READING] Michael Porter & Victor Millar, "How Information Gives You Competitive Advantage," Harvard Business Review, July-Aug 1985, pp. 149-160.

(This is a classic paper. Presents a summary of the key ideas from Porter's widely-cited books Competitive Strategy and Competitive Advantage. It identifies five forces that determine industry profitability: (1) the entry of new competitors, (2) the threat of substitutes, (3) the power of buyers, (4) the power of suppliers, and (5) rivalry among the existing competitors. It also proposes three generic strategies for success: (1) cost leadership, (2) differentiation, and (3) focus.

Another important concept is the value chain. The five major components of the value chain are: (1) inbound logistics, (2) operations, (3) outbound logistics, (4) marketing & sales, and (5)

service. There are three infrastructure activities that support the value chain: (1) human resource management, (2) technology development, and (3) procurement.

The value chain provides a systematic way to examine all the activities of a firm. Linkages, or "connectivity", between value chains is an important way to exploit strategic advantages. Furthermore, this article identifies three ways that technology affects competition: (1) it alters industry structure, (2) it supports cost and differentiation strategies, and (3) it spawns new businesses.)

4 Strategic Case Study (Johnson & Johnson Case)

1. Jeanne Ross, "Johnson & Johnson: Building an Infrastructure to Support Global Operations," MIT CISR Working Paper 283, Sept 1995, pp. 1-10. (
2. Stuart Madnick, "Next Generation Global Foreign Exchange System (FXX)," Jan 1998, pp. 1-2 [special excerpt prepared for this class.]
(Both of these cases, one full-length, one a mini-case, illustrate situations where integrating existing information to support global operations was necessary.)

5 Inter- and Intra-Organizational Systems (McKesson Case)

1. James E. Short, and N. Venkatraman, "Beyond Business Process Redesign: Redefining Baxter's Business Network," Sloan Management Review; Fall 1992; 34, 1.
2. N. Venkatraman, "IT-Enabled Business Transformation," Sloan Management Review, Winter 1994, pp. 73-87.
3. Michael R. Vitale, "American Hospital Supply Corp.: The ASAP System (A)," Harvard Business School, Case 9-186-005.

II. PHYSICAL CONNECTIVITY

6 Wide Area Networks

1. Cisco Systems, "Chapter 3: Introduction to WAN Protocols," Internetworking Technology Handbook, 2005, pp. 1-8.
(http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/introwan.pdf)
(Introduction to WANs – such as circuit switched networks and packet networks and the evolution of Internet2.)
Michael Calore, "Internet2 and You," Wired Digital Inc, 2006, pp. 1-3.
<http://www.webmonkey.com/webmonkey/03/08/index4a.html?tw=backend>

7 Emerging Technologies: RFID

1. The Association of the Automatic Identification and Data Capture Industry, "Radio Frequency Identification RFID: A Basic Primer," August 23, 2001, pp. 3-13.
(This paper gives an overview of RFID technologies and some of the key applications.)
2. S. Tu, S. Madnick, and L. Wu, "Improving UccNet-Compliant B2B Supply Chain Applications Using a Context Interchange Framework", Proceedings on International Workshop on Business and Information, Taipei, Taiwan, March 26-27, 2004, pp. 4-14.
(http://papers.ssrn.com/sol3/papers.cfm?abstract_id=529702)
(Discusses UCC-Net which in its new form, now called EPCGlobal, serves as part of the RFID information infrastructure. Some of the shortcomings of UCC-Net are identified. This provides a good transition to the issues addressed in the Logical Connectivity part of the course.)

III. LOGICAL CONNECTIVITY

8 Introduction to Database Management Systems

1. Microsoft, "The Desktop Database Backgrounder", 1995.
(Provides a good background on basic database management systems concept and types of databases, such as hierarchical, network, and relational.)

9 Distributed Homogeneous Databases

1. Jason Durbin , “Distributed Database Concepts,” Oracle8i Distributed Database Systems, Oracle Documentation Library, 1999, 37pp.
(http://www.mid.main.vsu.ru/docs/oracle/server.816/a76960/ds_conce.htm#12157)
(Discusses distributed database systems, including several types of “transparency” and “autonomy”.)
2. M. Tamer Ozsu and Patrick Valduriez, “Distributed and Parallel Database Systems”, ACM Computing Surveys, Vol. 28, No. 1, March 1996, pp. 125-128,
(<http://delivery.acm.org/10.1145/240000/234368/p125-ozsu.pdf?key1=234368&key2=4132675401&coll=GUIDE&dl=GUIDE&CFID=7991613&CFTOKEN=29762043>)
(Discusses some of the key requirements of distributed database systems, especially concurrency control and replication.)

10 Distributed Heterogeneous Databases

1. Gomer Thomas, Glenn Thompson, Chin-wan Chung, Edward Barkmeyer, Fred Carter, Majorie Templeton, Stephen Fox, and Berl Hartman, “Heterogeneous Distributed Database Systems for Production Use”, ACM Computing Surveys, Vol. 22, No. 3, September 1990, pp. 237-265. (<http://delivery.acm.org/10.1145/100000/96607/p237-thomas.pdf?key1=96607&key2=8832675401&coll=portal&dl=ACM&CFID=7991581&CFTOKEN=46053762>)
(This paper presents the basic concepts of heterogeneous databases and describes several early experimental systems, such as Dataplex and Multibase.)

11 View Integration Among Databases

1. Vicki L. Sauter, “Entity-Relationship Diagrams (ERD),” University of Missouri - St. Louis, August 13, 2000. (http://www.umsl.edu/~sauter/analysis/er/er_intro.html)
(Provides an introduction to ER diagrams.)
 2. C. Batini, M. Lenzerin, and S. B. Navathe, "A Comparative Analysis of Methodologies for Database Schema Integration", ACM Computing Surveys, 18(4), 12/1986, pp. 323-364. (<http://delivery.acm.org/10.1145/30000/27634/p323-batini.pdf?key1=27634&key2=2052675401&coll=portal&dl=ACM&CFID=7991581&CFTOKEN=46053762>)
(A "schema" is a representation of all the data to be managed by an organization. In the context of distributed database systems and inter-organizational systems, it may be necessary to use data that spans two or more organizations. This paper addresses the issue of integrating the individual database schemas. It discusses various causes of schema differences and various approaches to solving these problems.)
- [OPTIONAL READING: David George, "Understanding Schema and Semantic Heterogeneity in the Context of Database Schema Integration", Journal of the Department of Computing, UCLAN, Issue Number 4, May 2005."
(This paper provides some motivation for the causes of heterogeneous systems and describes the process of integration – similar to the Batini et al paper.)

12 Web as a Database

1. “An XML Primer,” Tellme Networks, Inc. (<https://studio.tellme.com/general/xmlprimer-p.html>)
(Provides an introduction to XML and gives a brief comparison between HTML and XML.)
2. A. Firat, S. Madnick, and M. Siegel, “The Caméléon Web Wrapper Engine”, Proceedings of the VLDB2000 Workshop on Technologies for E-Services, September 14-15, 2000, pp. 1-14.
(Describes the web wrapping technology for enabling semi-structured web sites to be accessed as if they were SQL relational databases.)
3. S. Madnick, “The Misguided Silver Bullet: What XML will and will NOT do to help Information Integration,” Proceedings of the Third International Conference on Information Integration and Web-Based Applications and Services, September 2001, pp. 1-10.
(Describes both the capabilities of XML, that improve upon HTML, and its limitations, especially with addressing semantic problems – more about this in next session.)

13 Semantic Integration

1. Stuart Madnick, "Metadata Jones and the Tower of Babel: The Challenge of Large-Scale Semantic Heterogeneity", Proceedings of the 1999 IEEE Meta-Data Conference, April 6-7, 1999, pp. 1-13.
(Describes the problem of semantic heterogeneity – where the same “word” may have multiple interpretations. For example, does “price” include tax or not, is it in Dollars or Pounds, etc.)
2. Tim Berners-Lee, James Hendler, and Ora Lassila, “The Semantic Web,” Scientific American, May 2001, pp. 1-7. (http://www.sciam.com/print_version.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21)
(This is the seminal paper when Tim Berner-Lee first introduced the notion of the “semantic web.”)
3. Aykut Firat, Stuart Madnick, Benjamin Grosf, “Contextual Alignment of Ontologies in the eCoin Semantic Interoperability Framework,” Journal of Information Technology Management, 2006.
(Describes the approach to context mediation developed at MIT and the use of ontologies)

14 Component Architectures & Web Services

1. Steven J. Vaughan-Nichols, “Web Services: Beyond the Hype,” Computer, 2/2002, 18-21.
(This paper presents a brief overview of “web services.”)
2. Mark Hansen, Stuart Madnick, and Michael Siegel, “Process Aggregation using Web Services,” Proceedings of the Workshop on Web Services, e-Business, and the Semantic Web: Foundations, Models, Architecture, Engineering and Applications, (WseBT’02, Toronto, Canada), May 2002, published in LNCS, Springer-Verlag, New York, pp. 12-27.
(<http://link.springer.de/link/service/series/0558/papers/2512/25120012.pdf>)
(This paper shows how web services can be used to accomplish process integration, as well as the challenges that must be overcome.)

IV. ORGANIZATIONAL CONNECTIVITY

15 Loosely-Coupled Organizations

1. Army Enterprise Solutions Competency Center, “ERP Overview”, April 20, 2006.
(Presents a brief overview and history of ERP systems.)
2. Jeanne Ross, “The ERP Revolution: Surviving Versus Thriving”, MIT CISR Working Paper, November 1998, pp. 1-10.
(Describes motivations for ERPs: Infrastructure (common platform), Capability (process improve, data visibility), and Performance (cost reduction, decision making, customer responsiveness). Major difficulties and success factors: (1) metrics, (2) on-going resources, (3) management reporting, and (4) addressing resistance. Major point is that standardized processes and data is key to flexibility.)
3. Karl Weick, "Educational Organizations as Loosely Coupled Systems," Administrative Science Quarterly, Volume 21, March 1976, pp. 1-19.
(This is a classic paper that presents the notion of "loosely coupled" organizations, using educational organizations as examples. It argues that although certain actions or events may seem "irrational," it is often because we do not fully understand what is going on. He also presents seven advantages of loose coupling.)

16 Markets and Hierarchies: Organizational Coupling

1. Bryan D. Jones , “Bounded Rationality”, Annual Review of Political Science, Vol. 2: 297-321, June 1999)
(<http://polisci.annualreviews.org/cgi/content/full/2/1/297>)
(Presents key issues of bounded rationality, uncertainty, complexity, and opportunism. These ideas were first introduced by Herb Simon.)
2. Oliver Williamson, “The Economics of Organization: The Transaction Cost Approach,” The American Journal of Sociology, Vol. 87, No. 3. (Nov., 1981), pp. 548-577.
(This is a classic paper that introduces transaction cost economics. Discusses reasons for vertical integration and multi-divisions. Asset specificity discussed.)

17 Development of Standards

1. Dale Goodhue, Michael Wybo, and Laurie Kirsch, "The Impact of Data Integration on the Costs and Benefits of Information Systems", MIS Quarterly, 9/1992, pp. 293-311.
2. Dale Goodhue, Michael Wybo, and Laurie Kirsch, "Strategic Data Planning: Lessons From the Field", MIS Quarterly, March 1992, pp. 11-34.
3. Joan Bader, Chris Hayward, Stuart Madnick, Jonathan Razo, Michael Siegel, "An Analysis of Data Standardization across a Capital Markets / Financial Services Firm," MIT Sloan Working Paper, 8/16/1999, pp. 1-16.

18 Motivating Strategic Alliances & Organizational Transformation

1. John Kotter, "Leading Change: Why Transformation Efforts Fail", Harvard Business Review, March-April 1995, pp. 59-67.
2. Charley Osborn, Stuart Madnick and Y. Richard Wang, "Motivating Strategic Alliances for Composite Information Systems: The Case of a Major Regional Hospital", Journal of Management Information Science, Vol. 6, No. 3, Winter 1989/90, pp. 99-117 [also appeared in Proceedings of the 1989 Hawaii International Conference on System Sciences (HICSS), January 1989 -- Nominated for Best Paper at HICSS.]
(http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=49180)
(*This paper explores the nature of strategic goals underlying composite information systems, also referred to as inter-organizational systems, and ways to increase the likelihood of success through three techniques: (1) bi-directional benefits, (2) co-operative pay-out, and (3) asymmetric control.*)

V. FINALE

19 Course Summary and Review

20 FINAL EXAM