The final exam is based on lectures and the following reading material. Use this guide to help focus your study – exam questions will be drawn from the list of terms and questions on the succeeding pages.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Source</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1. Net present value calculations (note we’re interested in the internal rate of return, defined on web page)</td>
<td>handout on web page</td>
<td>Cash_Flow.pdf</td>
</tr>
<tr>
<td>T2. IT History</td>
<td>Reader, R. Nolan</td>
<td>pp. 3 – 33</td>
</tr>
<tr>
<td>T4. Competing with IT</td>
<td>Reader, O’Brien II</td>
<td>71 – 93</td>
</tr>
<tr>
<td>T5. Frito Lay Case</td>
<td>Reader</td>
<td>95 – 115</td>
</tr>
<tr>
<td>T6. Information Management</td>
<td>Textbook Ch. 2.3</td>
<td>38 – 50</td>
</tr>
<tr>
<td>T7. IT Applications</td>
<td>Textbook Ch. 3.1-3.3</td>
<td>59 – 82</td>
</tr>
<tr>
<td>T8. Cisco Case</td>
<td>Reader Cisco guest speaker Ken Moll (see web site)</td>
<td>117 – 135 CiscoSlides.pdf</td>
</tr>
<tr>
<td>T9. Electronic Commerce</td>
<td>Textbook Ch. 3.4-3.6</td>
<td>83 – 98</td>
</tr>
<tr>
<td>T10. Alibris Case</td>
<td>Reader</td>
<td>137 – 147</td>
</tr>
<tr>
<td>T11. IT Architecture</td>
<td>Textbook Ch. 4</td>
<td>107 – 132</td>
</tr>
<tr>
<td>T12. Client-Server Computing</td>
<td>Textbook Ch. 5</td>
<td>139 – 154</td>
</tr>
<tr>
<td>T13. Sun Case</td>
<td>Reader</td>
<td>149 – 168</td>
</tr>
<tr>
<td>T14. Modularity and Layering</td>
<td>Textbook Ch. 6</td>
<td>157 - 190</td>
</tr>
<tr>
<td>T15. Computer and Communication Industries</td>
<td>Textbook Ch. 7</td>
<td>198-226</td>
</tr>
<tr>
<td>T17. Database Management</td>
<td>Textbook Ch. 15.1, 15.2</td>
<td>415-425</td>
</tr>
<tr>
<td>T18. MySQL Case</td>
<td>Reader</td>
<td>179-216</td>
</tr>
<tr>
<td>T19. Networking</td>
<td>Textbook Ch. 18</td>
<td>493-512</td>
</tr>
<tr>
<td>T20. Economics and Policy</td>
<td>Textbook Ch. 8.1, 8.2, 8.3</td>
<td>231-240, 244-247, 254-263</td>
</tr>
<tr>
<td>T21. Applications and the Organization</td>
<td>Textbook Ch. 9 Project management guest speaker Mark Cianca</td>
<td>273-283 lecture notes for 6/1</td>
</tr>
<tr>
<td>T22. Akamai Case</td>
<td>Reader</td>
<td>213-235</td>
</tr>
</tbody>
</table>
T1. Net present value and the rate of return

- Know the definitions of net present value (NPV), internal rate of return (IRR or IROR) as we used them in class. When NPV=0, we call i the internal rate of return.
- Know the mathematical expression for the NPV for a series of cash payments, and be able to calculate it as a function of i or of d (d is the discount factor).
- Know how to solve the inverse problem of computing d given the NPV and the series of payments.

T2. IT History

- What distinguished the Data Processing Era?
- What distinguished the Micro Era from the Networking Era?
- Why did Data Processing Era managers feel threatened in the Micro Era?

T3, T4. O’Brien Chapters from Reader

- Porter’s competitive model (5 forces). Why is it useful?
- Porter’s strategy model (2 primary + 3 secondary strategies). Differentiation and cost leadership are primary strategies; innovation, growth, and alliances are the three secondary strategies. We classify companies by a primary strategy--secondary strategy pair. For example, many high tech startup companies may be characterized as following a differentiation-innovation strategy.
- Porter’s value chain model, business functions, and business processes (which may span multiple functions).
- Switching costs and lock-in effects
- Barriers to entry
- Business process streamlining (or business improvement) vs. Business Process Reengineering (BPR)
- (BPR is called business transformation in Messerschmitt 3.3.1)
- Knowledge management

List of four short cases from O’Brien that may be on the exam

<table>
<thead>
<tr>
<th>Organization</th>
<th>Page</th>
<th>Key point, lesson, or example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Royal Carribean</td>
<td>50</td>
<td>IT systems unproductive without leadership or business process co-design</td>
</tr>
<tr>
<td>2 Cisco Case</td>
<td>53</td>
<td>Virtual manufacturing/SCM exemplar; 70% gross margins</td>
</tr>
<tr>
<td>4 Hershey</td>
<td>69</td>
<td>Due to complexity, IT projects can fail if rushed or not planned properly</td>
</tr>
<tr>
<td>7 GE</td>
<td>87</td>
<td>Famous example of Total Quality Management (TQM)</td>
</tr>
</tbody>
</table>

T5. Frito-Lay Case

- What was the HHC?
- What were the main reasons why Frito-Lay deployed the HHC?
- What changes in marketing strategy did Frito-Lay believe the HHC data would help enable?

T6. Messerschmitt 2, Information Management

- Data, information, knowledge, wisdom
- Search, browse, navigate
- Push vs. pull
- Index, metadata, hyperlink, recommender

T7. Messerschmitt 3.1, 3.2, 3.3, IT Applications

- Departmental applications
- Enterprise applications
- Commerce applications
- Customer Relationship Management (CRM)
• Transaction Processing Systems (TPS) – see also lecture slides
• Online Transaction Processing (OLTP)
• Workflow
• Human resource management (HRM)
• Operations
• Business processes
• Business transformation
• Enterprise Resource Planning (ERP)
• Decision support

T8. Cisco ERP Case Study: Ken Moll’s talk on Cisco Systems (May 13th – Lecture 13)

• What are some of the actions that Cisco took that contributed to the successful deployment of ERP?
• What mistakes did Cisco make?
• What are the important lessons that another company that wants to deploy ERP could learn from Cisco’s experience?
• What are Cisco’s core products?
• According to Ken, Cisco’s new strategy is move into Market adjacencies like IP Telephony, Telepresence, WebEx Conferencing, Data Centers. Is this a diversification or vertical integration strategy?
• For the most part, how did Cisco move into these new ‘adjacent’ markets by buying COTS, building in-house, outsourcing, or by way of acquisitions?

T9. Messerschmitt 3.4-3.6, eCommerce

• Inter-enterprise commerce (B2B)
• Supply chain management (SCM)
• Mass customization
• Electronic data interchange (EDI)
• Consumer commerce (B2C)
• Inter-consumer commerce (C2C)
• Four typical steps in e-commerce transactions: (1) matching buyers and sellers; (2) negotiating terms and conditions; (3) consummation; (4) customer service. SEE CHART, PAGE 85—know these 4 steps

T10. Alibris Case

• How did Alibris plan to change Interloc’s revenue model?
• How did Alibris plan to avoid being disintermediated?
• Why did Alibris abandon Thunderstone software, and why did it choose to switch to Oracle?

T11. Messerschmitt 4.1, 4.2, IT Architecture

• Data vs. information
• Information represented as data
• Digital data needs structure and interpretation for its meaning to be recovered
• Regeneration, replication
• System architecture elements: decomposition, functionality, interaction.
• Why do we architect systems in this way?
• Emergence
• Hierarchy
• Software layering
• What is the benefit of architecting software with layers?
• Operating System (OS), middleware, file system, Database Management System (DBMS)
• Network functions
• Messages and packets
• Internet, extranet, intranet
• Ethernet, LAN

T12. Messerschmitt 5, Client-Server Computing

• Client-server architecture
• Peer-to-peer architecture
• Two-tier and three-tier architectures
• Shared data (server), application logic (server), presentation (client)
• Fat client vs. thin client
• books4u.com software architecture diagram

T13. Sun Case

• Name one or two key differences between the 3-tier architecture and Sun’s 4-tier architecture.
• What benefits are provided to Sun’s customers by the 4-tier architecture?
• Which is more expensive: Sun’s application server, or the ongoing maintenance of heterogeneous software applications on diverse platforms?
• What advantage did Microsoft have over Sun in dealing with line of business managers in customer firms? (See p. 158)

T14. Messerschmitt Ch 6 -- Modularity and Layering (157-190)

• Modularity, Granularity, Hierarchy
• Interfaces – actions, parameters, and returns
• The Layering Principle
• Layers of computing Infrastructure
  ++Applications, Components, Middleware, Operating System, Networks
• Data and Information in Layers
• Abstraction and Encapsulation
• Terms/Concepts from Lecture Slides:
  o decomposition
  o granularity
  o hierarchy
  o interface
  o data type
  o fragmentation
  o data integrity
  o horizontal structure
  o spanning layer
  o abstraction
  o encapsulation

T15. Messerschmitt Ch 7 -- Computer and Communications Industries (198-226)

• Infrastructure and Applications
• Bundled vs. Unbundled Applications/Services
• Decomposition and Assembly (also covered in Ch 10)
• Components and Custom Development
• Interoperability
• Outsourcing
• System Integration
• Products and Services
• Stovepipe (turn-key solution) and Integrated Infrastructure
• Vertical Integration and Diversification
• Computing/Communications Convergence
• Standardization
  1. Why are they needed?
  2. Why do companies participate?
  3. Reference Models and Interfaces
  4. De Facto and De Jure Standards
  5. Standards Bodies
  6. Open Standards


• Definitions and Examples for each: Algorithm, Protocol, Format, Policy
• From Lecture 13
  o What is another term for a “distributed algorithm?”
  o Interoperability requires an algorithm, protocol or policy?

**T17. Messerschmitt Ch 15 – Data Sharing (415-425)**
- DBMS: Structured Data Model, Persistence, Transaction support, Access Control, Encapsulation, Scalability
- RDBMS (Relational): Fields (Columns), Records (Rows)
- Markup Languages: XML, HTML (Presentation vs. Content)
- Transactions: (ACID) Atomicity, Consistency, Isolation, Durability—see sidebar, p. 429
- Lecture 13 Notes:
  o What does SQL stand for? Is it an open or proprietary standard?
  o What is an open standard?
  o Open Source vs. Proprietary Software
    ▪ Development Methodologies
    ▪ Licensing
  o Why do companies participate in OSS?

**T18. MySQL Case**
- What is a RDBMS?
- What recent developments have occurred for this company since this case study was written in 2004?
- How does MySQL make money? Can't I download and use MySQL for free?
- What is a General Public License (GPL), and what are the 4 freedoms?
- Why were MySQL's customers willing to pay for the product, when they could get the product for free under a GPL?
- What are the different segments of the database market?
- In which segment is MySQL strongest?
- Name 3-4 of the most important suppliers of database management systems.
- What competitive advantages over the major DBMS suppliers does MySQL have in the Web Site data segment of the market?
- Why would large enterprises prefer to manage their mission-critical, enterprise-wide data with database software from one of the traditional major DBMS providers, rather than using MySQL's product (which is much cheaper)?

**T19. Messerschmitt Ch 18 – Functions of a Network (493-512)**
- Statistical Multiplexing vs. Time Domain Multiplexing (TDM)
- Circuit-Switched (PSTN) vs. Packet-Switched Network (OSI Model—7 Layers, in practice we only care about 5 layers)
  o Application Layer – DNS, HTTP, FTP
  o Presentation Layer – ignore
  o Session Layer – ignore
  o Transport Layer – TCP, UDP, ICMP (‘ping’)
  o Network Layer – IP Addressing, ip packets, ip headers, routers
  o Data Link Layer – Ethernet, frames, MAC Addresses, Collision Domains, switches, hubs
  o Physical Layer – Ethernet cables, wireless, serial cables, etc.
- Network Congestion
- QoS: Quality of Service: VoIP, Audio, Video Streaming
- Lecture 15 Concepts:
  o More terms:
    ▪ Layering of Network Architecture
    ▪ Statistical multiplexing
    ▪ Physical Layer
    ▪ Link Layer
    ▪ Ethernet
    ▪ Hubs and Switches
    ▪ MAC Addresses
    ▪ Network Layer
    ▪ Routing Table
IP Addresses
Encapsulation of IP packets within an Ethernet Frame
Transport Protocols – TCP and UDP
ISP, NSP, Local Loop,
Telephone Company Local Office
Web Caching
  • Big picture analysis of the architecture of the Internet, using
    1-decomposition,
    2-Metcalfe’s Law
    3-hierarchy, and
    4-statistical multiplexing

T20. Messerschmitt Ch 8 – Economics and Policy (231-240, 244-247, 254-263)
  • Network Effects: Two types: Direct/Indirect, description and examples
  • Network Effects upon Standards
  • Lock-in:
    • What is Lock-in?
    • What affect does adoption of an ‘open standard’ have on Lock-in?
  • Switching cost
  • Economic Properties of Information: Creation, Replication, Distribution
  • Production/Fixed costs, Regeneration costs, Economies of Scale, Cost Recovery, Value Judgment
  • Intellectual Property
  • Winner-take-All Market
  • Price Discrimination
  • Versioning
  • Copyright, Patent, Trademark, Trade Secret
  • Lecture 16 Concept: Externality

T21. Messerschmitt Ch 9 – Applications and Organization (273-283)
  • Scalability
  • Commercial Off-the-Shelf (COTS), Make in-house, or Outsource?
  • Outsourcing: fixed price vs. time-and-materials pricing?
  • Application Lifecycle: Management, End-Users, Operators/Administrators, Maintenance, Suppliers and Customers

T22. Akamai Case
  • What product did Akamai produce?
  • Who where their customers?
  • How did Akamai’s product help their customers compete?
  • What is ‘web caching’?
  • What does the 'last mile' refer to?
  • Where are the bottlenecks in the Internet according to the case study?
  • What is a Content Distribution Network (CDN)?
  • What does it provide over ordinary web Caching?
  • Where did Akamai locate its servers?
  • What barriers to entry existed for a new entrant to build a CDN to compete with Akamai?
  • Did Akamai choose to market its products with a direct sales force or through distribution partners? What are the advantages of each choice?
  • Why did Akamai’s marketing strategy have to change, and when?

T23. Messerschmitt Ch 13 – Trustworthiness (369-380, 386-391)
  •Availability vs. Security
  • Authentication vs. Authorization
  • Security: Authentication, Message Integrity, Confidentiality, Non-repudiation, Access Control