**MGT/ME/CS 3743 – Fall 2012**

**Analysis of Emerging Technologies**

Monday / Wednesday 4:35 to 5:55

Scheller College of Business Room 203

**Instructor:** Dr. Eric Overby

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# Course Motivation

Emerging technologies can change the business and societal environment rapidly and dramatically. Knowing how to analyze emerging technologies and to forecast their implications for individuals, businesses, markets, and society is a critical skill in a broad range of contexts, including:

* Managers considering the use of use an emerging technology within their organizations,
* Analysts predicting the impact of an emerging technology on an industry,
* Inventors or entrepreneurs developing a new technology,
* Policy-makers charged with helping society benefit from emerging technologies.

This course introduces students to methods for analyzing and making decisions about emerging technologies. This includes tools, principles, and theories for evaluating which technologies will emerge and why. Given this understanding, we can develop useful technology forecasts and leverage those forecasts for business advantage.

This course counts as an elective for the Management of Technology (“MOT”) certificate.

**Course Structure**

Most course sessions are two-pronged.

1. First, we will discuss an emerging technology, such as renewable energy, contactless payments, the “smart” grid, electric cars, DNA mapping, implantable ID chips, etc. We will consider the implications of the technology for business and society. In this way, the course is a survey of emerging technologies.
2. Second, and perhaps more importantly, we will use each technology as a “case” to explore a deeper principle related to the emergence of new technologies. This will give us a framework for making predictions about which technologies will emerge and which will not, including what we can do about it and how we can profit from it as managers. We will discuss methods of scanning the horizon for emerging technologies (i.e., methods for forecasting and invention) and the principles that govern whether a new technology is adopted or not (e.g., technology adoption theory, standards, network effects, design modularity, legal / normative forces, stakeholder impact, etc.)

An additional theme we will investigate is the information produced by emerging technologies and the managerial opportunities (e.g., personalization, insight) and threats (e.g., privacy, identity) associated with that information.

# Course Objectives

After this course, students should be able to:

* Discuss the prospects of emerging technologies such as those listed above.
* Apply tools and techniques to scan the horizon for emerging technologies relevant to business and society.
* Analyze how emerging technologies will affect individuals, firms, markets, policy, and society in the future.
* Predict which emerging technologies will be successful and why.
* Describe the system in which technologies emerge, including catalysts and inhibitors.
* Evaluate the opportunities and challenges associated with the information produced by emerging technologies.
* (I’d like to say that you’ll also be able to predict the future, but that’s a bit of a reach…)

**Grading**

* Emerging Technology Briefing (group) – 11%
* Presentation of Emerging Technology Briefing (group) – 3%
* Course Project (group) – 16%
* Presentation of Course Project (group) – 3%
* Mid-Term Exam (individual) – 23%
* Final Exam (individual) – 24%
* Homework Assignments (individual) – 10%
* Class Participation (individual) – 10%

*\* Group Composition:* Groups should consist of xx people. Please determine your group membership by **August 27**, as we will begin group activities relatively early in the semester.

Near the end of the semester, each group member will be asked to evaluate the degree to which each other group member contributed to the group’s efforts. Individual group members’ scores for the group assignments will be adjusted accordingly.

Emerging Technology Briefing: Each group will prepare a 3 to 4 page (single-spaced) briefing document on an emerging technology of their choice. Sources I recommend for potential topics include Technology Review, the Technology section of the New York Times, and Wired. The briefing document should contain the following sections:

1. Explanation of the emerging technology. Explain the technology on which you are focusing, including a brief history of the technology and its current status. Focus on the technology as opposed to a specific product. For example, your briefing should be about contactless payments (the technology), not Google Wallet (a specific product). In some cases, there may be only one product that currently reflects the technology, but that may not always be the case. So, focus on the technology. Recommended length: 0.5 to 1 page.
2. Predictions. Include *specific* predictions for what will happen with this technology *in the future* over the near-term (0-4 years), medium-term (5-10 years), and long-term (10+ years). This section should be structured as follows.
   * Develop a “cone of uncertainty” to depict the time horizon of each prediction and your level of certainty. We will discuss the “cone of uncertainty” in detail in one of our first sessions. Include a graphic depicting the cone of uncertainty, and then elaborate on the 3-4 most interesting predictions, including at least one prediction for the near-term, medium-term, and long-term. Include justification for each prediction (i.e., why will the prediction occur in the expected time frame, what factors affect your level of certainty, etc.)

Recommended length: 1 to 2 pages.

1. Implications for stakeholders: Consider the key stakeholders that are impacted by this technology, which will include both existing players and new entrants (i.e., entrepreneurs). Assume that your predictions turn out to be right, and describe the implications for the stakeholders. This section should be structured as follows:
   * List 3-4 stakeholders and discuss the implications for each of them. Discuss the following: How will the stakeholder be affected? How is it threatened by the emerging technology, and what should it do to capitalize on it?

Recommended length: 1 page.

A 1-2 sentence statement of the emerging technology that you will analyze is due on **September 10**. The briefing document is due on **October 10**. Some groups will need to complete their analysis earlier based on the timing of their presentations of the emerging technology briefings (see below.)

The briefing document will be evaluated on the coverage of the elements above, adherence to the structure described above, and overall clarity. The following provides examples of how points (out of 11) will be awarded.

* *8-11 points*: The briefing document clearly describes the emerging technology. Predictions are clearly described, and the time frames for the predictions are well thought out and justified. The relevant stakeholders are identified, and there is a well-argued discussion of how they will be affected and the actions they should take. The presentation is well structured and
* *4-7 points*: The briefing document describes the technology and discusses some implications for stakeholders. The presentation makes some predictions, but the predictions are general and/or are not well-motivated. The briefing document does not follow the structure described above.
* *0-3 points****:*** The briefing document describes a technology, but does not include predictions or implications for stakeholders.

Students often make the following mistakes in the course project:

1. They don’t follow the structure defined above. For example, they mention every prediction they developed, rather than focusing on their 3-4 most interesting predictions and going into depth on those. Or, they allocate too much space to Section 1 and leave little room for the predictions and stakeholder analysis sections.
2. They choose a topic that is too broad. As a result, the briefing document is too wide-ranging and does not offer interesting insights in any particular area.

Presentation of the Emerging Technology Briefing: Each group will present the analysis contained within their emerging technology briefing to the class. The presentation should last approximately 20-25 minutes. The structure of the presentation should mirror the structure of the briefing document. The prepared portion of the presentation should last about 20 minutes, with the remaining time devoted to questions and answers. Audio/video materials (e.g., YouTube clips) are often good complements to a presentation. However, these should consume no more than 3-4 minutes. Each group will sign-up for a presentation slot using T-Square.

Course Project: This is a group project. You are to **pretend that the year is 2022** and that you are looking back on the preceding 30 years (i.e., 1992-2022.) The project is to write a brief history (12 – 15 double-spaced pages) of a business or societal process. By “process,” I mean a set of steps to achieve some objective. For example, you might study the process of assembling a professional soccer team, the process of going to the doctor for a routine physical examination, etc. You are to present this as a narrative of how the process evolved over time, providing specific examples of developments not only in the 1992-2012 period but also in the 2012-2022 period. You are to present this as a retrospective; given that you are pretending it is 2022, you will “know” everything that happened from 2012-2022. Given space limitations, do not choose a process that is overly broad. For example, instead of studying the process of shopping, study the process of shopping for a specific good (e.g., a car, groceries, clothes.)

The report should consist of 4 sections:

1. The first section will present the process on which your group has chosen to focus. This section should describe why it is a process, i.e., what steps are involved and what is the process’s objective? E.g., if your process is shopping for groceries, the steps involved are: a) determining what items you need, b) determining which store to purchase the items from, c) getting the items from the store to your house, d) paying for the items, etc. The objective is to acquire groceries.

Recommended length: 2 pages.

1. The second section will review how the process evolved between 1992 and 2012. Be specific here; describe the key developments that changed how the process was conducted during this period (this will require some research). Also, which steps within the process (outlined in section 1) changed, and which did not?

Recommended length: 3-4 pages.

1. The third section of the report will discuss how the process evolved between 2012 and 2022. State the logical reasoning behind your analysis, including principles we cover in the course (as appropriate.) For example, did legal and normative forces create changes in the process, were new standards and/or platforms developed, etc. Use your analysis from 1992 to 2012 to identify the trends that continued into this period. Be specific in this section: describe how and why the process evolved, not merely that it evolved. Include specific “historical” occurrences from this period and describe why these things happened. For example, instead of stating that “5% of cars were self-driving by 2020”, state that “5% of cars were self-driving by 2020, with the majority of these in Nevada, where legal precedent was set as early as 2010, and in New York, which converted 50% of the NYC taxi fleet to self-driving cars in 2019 (after negotiations with the New York Taxi Workers Alliance broke down.)” In other words, don’t simply state the outcome; think deeply about how that outcome came to be (including issues and stumbling blocks that delayed the outcome) and describe that in your report. Sub-divide this section into smaller time spans (i.e., developments from 2012-2015, from 2015-2018, etc.) to improve the specificity of your description and what developments occurred when (and why).

Recommended length: 4 pages.

1. The fourth section of the report will discuss how businesses reacted to the changes in the 2012-2022 period. Which companies flourished and why? What start-ups were founded, and which incumbents were harmed? Be specific here. The report is retrospective, so you will “know” which companies did well and which did not.

Recommended length: 3 pages.

The report must contain each of these sections, although the third and fourth sections may be combined if that helps with the readability and flow of the document. **Think about how the report flows and use headings to signify different sections.**

A one paragraph statement of the process that you will analyze is due on **October 31**. The project is due on **November 28**.

The course projects will be evaluated on the coverage of the elements above and overall clarity. The following provides examples of how points (out of 16) will be awarded.

* *13-16 points*: The project clearly identifies the process and includes a discussion of both the 1992-2012 and 2012-2022 periods. The analysis for the 2012-2022 period is interesting, well-grounded, and specific, and the associated business reactions are clearly articulated and specific. The report is well-structured and flows logically.
* *6-12 points*: The project is missing or highly deficient in one of the four areas listed above. For example, the 1992-2012 period is not clearly discussed, the analysis for 2012-2022 is reasonable but mundane, overly general, and underdeveloped, and the business reactions in the 2012-2022 period are not clearly specified. Organization of the paper and presentation could be improved; the paper reads as though a different team member wrote each section and there was little to no effort to integrate the final paper into a coherent whole.
* *0-5 points*: The project fails to follow the outline provided above, e.g., it is missing entire sections, doesn’t describe a process, etc.

Students often make the following mistakes in the course project:

1. They don’t analyze a process.
2. They choose a process that is too broad. I have yet to see a course project that was too narrowly defined.
3. Related, the discussion in the report is too broad and not sufficiently deep. E.g., students include a lot of ideas but do not clearly discuss any of them.
4. They do not coordinate with each other on the project. The result is a poorly integrated collection of ideas that lacks coherence.

Mid-Term Exam: The mid-term exam will cover the material up to the date the mid-term is administered.

Final Exam: The final exam will primarily cover material subsequent to the mid-term, although because the course material is cumulative, some of the materials from the pre-mid-term portion of the course will be incorporated into the final exam.

Homework Assignments: Throughout the semester, we will have homework assignments. These assignments will have one or both of the following components:

* “Hands-on” exercises to familiarize you with some of the technologies we will explore.
* Questions that prompt you to comment on the issues raised by the readings. These are similar to case summaries, although much shorter (typically 1 page) and highly structured. The purpose of these assignments is to guide you as you read the assigned articles so that you are prepared for class discussion.

Homework assignments are due at the beginning of the class session for which they are assigned.

Class Participation: Class participation augments the overall learning experience, and you will be evaluated on your participation. We will rely heavily on class discussion based on assigned readings as the primary vehicle for learning. It is your responsibility to prepare for every class session, read the assigned articles, and participate in the discussions. Some tips for effective class participation are:

* Do the comments help other students learn?
* Are comments relevant to the discussion and linked to the comments of others?
* Do the comments go beyond repetition of the facts found within the readings? Is there a willingness to test new ideas? Are the comments creative and illustrate that the student has thought beyond the immediate application of the ideas?
* Do the comments link together different ideas, whether from other parts of the course, other courses, personal experience, etc.?

We will focus on experiential learning in this course. In order to maximize your learning and achieve a good class participation grade, you should:

1. Attend class. I will distribute a sign-in sheet for each session. If you wish to receive credit for attendance, you must sign the sign-in sheet.
2. Prepare for class by completing the assigned reading.
3. Engage with each other and participate in the discussion.

The following illustrates how class participation grades will be assigned (out of 10 points.)

* *9-10 points*: The student attends class regularly and is well-prepared for each session. The student is a consistent contributor to class discussions, and his/her comments go beyond recitation of facts. The student expresses well thought-out opinions about substantive issues.
* *6-8 points*: The student frequently participates, but there are times when the student’s comments indicate that s/he has not thought deeply about the assigned readings and associated issues.
* *5-7 points*: The student attends class, but does not participate in the discussion.
* *3-5 points*: The student participates when in class, but is frequently absent.
* *0-3 points*: The student is frequently absent and participation when in class is sporadic.

## **Class Policies**

Reading: All readings MUST be completed prior to the session for which they are assigned.

Attendance: If you will not be able to attend a class, please let me know in advance. Due to the nature of the class, attendance is very important. A poor attendance record will negatively affect your class participation grade.

Exams: No make-up exams will be given. If you have to miss an exam because of unavoidable circumstances, let me know in advance and we will work something out.

Academic honesty: We will abide by the Georgia Tech Honor Code. The complete text of the Honor Code is available at www.honor.gatech.edu.

Changes to the syllabus: The material within the syllabus is subject to minor changes due to circumstances throughout the semester. In particular, the availability of the guest speakers may cause the schedule to change somewhat. All changes will be announced and distributed in a timely fashion.

Use of electronic devices: All electronic devices (e.g., laptop, tablet, smartphone, etc.) are prohibited during class time unless being used in a class-based activity.

**Class Schedule**

| **Date** | **Topic** | Assignment / Reading / Case |
| --- | --- | --- |
| Introduction | | |
| Aug. 20 | Course introduction | Read the syllabus (required reading!) |
| Aug. 22 | Examples of emerging technologies  *Featured Technologies:* Handheld computing, wireless power, solar power, artificial intelligence | Read (these are all very short):   * What Your Phone Might Do for You Two Years From Now (Tedeschi, *New York Times*, Nov. 5, 2009.) * Facebook’s Timeline (Greenwald, *Technology Review*, May/June 2012.) * Automatic Recharging, From a Distance (Eisenberg, *New York Times*, March 10, 2012.) * Ultra-Efficient Solar (Wang, *Technology Review*, May/June 2012.) * Text and Voice Translation in Real Time (Simonite, *Technology Review*, May/June 2011.) |
| Forecasting and Invention | | |
| Aug. 27 | Forecasting Part 1: Techniques for *predicting* the future of technology: extrapolating from the past, Delphi method, etc.  *Featured Technology:* Robots | Read:   * Six Rules for Effective Forecasting (Saffo, *Harvard Business Review*, July 2007, pp. 122-131) * The Wisdom of (Expert) Crowds (Duboff, *Harvard Business Review*, September 2007, p. 28)   Review:   * Forecasting Methodology Tree (from www.forecastingprinciples.com)   Complete:   * Group membership affiliation |
| Aug. 29 | Forecasting Part 2  *Featured Technology:* Prediction Markets | Read:   * Prediction Markets at Google (Coles, Lakhani, McAfee, Harvard teaching case, Case number: 607088)   *Available for purchase at http://hbr.org.*  Complete:   * Homework Assignment |
| Sep. 3 | Labor Day – No Class |  |
| Sep. 5 | Forecasting Part 3  *Featured Technology:* Alternate reality games | Read:   * Making Alternate Reality the New Business Reality (McGonigal, *Harvard Business Review*, Feb. 2008, p. 25.)   Complete:   * Homework Assignment |
| Sep. 10 | Invention: Techniques for *creating* the future of technology. | Read:   * Twitter Unveils the Twindex, a New Political Index (Bilton, *New York Times*, August 1, 2012.) * TRIZ Overview (Norrie, True North Innovation, pp. 1-3.) * Introduction to TRIZ (Shulyak, Excerpted from *40 Principles – TRIZ Keys to Technical Innovation*, pp. 1-5, stop at “Standards.”)   Review / Skim:   * 40 Inventive Principles with Examples (*TRIZ Journal*)   Complete:   * Homework Assignment   Due:   * 1-2 sentence statement of the emerging technology that you will analyze for your emerging technology briefing. |
| Sep. 12 | Guest Speaker – Rob Stoker, Boeing |  |
| Sep. 17 | Technology Adoption and Diffusion of Innovations  *Featured Technology:* Synthetic dirt, electric bicycles, and olfactory interface technology. | Read:   * The Best Thing Since Sliced Bread (Stires, *Fortune*, Oct. 29, 2001. * Dodging Horse Racing Injuries with Artificial 'Dirt' (Adams, NPR, Oct. 6, 2006). Read story at http://www.npr.org/templates/story/story.php?storyId=6209658 and listen to podcast. * The Commuter Bike Redesigned and Electrified (Pogue, *New York Times*, Feb. 3, 2011). * Now on the Small Screen: The Scent of a Kitchen (Grimes, *New York Times*, Sep. 13, 2000).   Complete:   * Homework Assignment |
| Underlying Principles of Emerging Technologies | | |
| Sep. 19 | Technology platforms and network effects  *Featured Technology:* Operating systems for mobile devices | Read:   * The Power of the Platform at Apple (Lohr, *New York Times*, Jan. 29, 2011). * Why AT&T and Verizon Are Rooting for Windows Phones (Chen, *New York Times*, April 24, 2012.) * The Shape of the Battle for Hardware, Software and Cloud (Hardy, *New York Times*, July 6, 2012.)   Complete:   * Homework Assignment |
| Sep. 24 | Technology platforms: Reach and Holdup  *Featured Technology:* Digital media | Read:   * What’s Your Google Strategy (Hagiu and Yoffie, *Harvard Business Review*, April 2009 pp. 74-81.) * Verizon Deal May Expose iPhone Flaws (Nocera, *New York Times*, Jan. 14, 2011).   Complete:   * Homework Assignment |
| Sep. 26 | Standards  *Featured Technology:* Cloud computing, HTML5 | Read:   * What Every CEO Needs to Know About the Cloud (McAfee, *Harvard Business Review*, Nov. 2011). * The Standards Question (Naone, *Technology Review*, July/August 2009). * Standards (Varian, *The Economics of Information Technology*, pp. 35-39.) |
| Oct. 1 | Guest Speaker – Monique Shivanandan, Capital One |  |
| Oct. 3 | Mid-Term Exam |  |
| Oct. 8 | Modularity, flexibility, other design principles  *Featured Technology:* “Smart” homes | Read:   * Managing in the Modular Age: Architecture, Networks, and Organizations (Garud, Kumaraswamy, and Langlois, pp. 1-12.) * The Dangers of Modularity (Fleming and Sorenson, *Harvard Business Review*, September 2001, pp. 20-21.) |
| Oct. 10 | Sustainability  *Featured Technology:* Carbon Capture | Read:   * Earth: The Sequel The Race to Reinvent Energy and Stop Global Warming (Krupp and Horn, pp. 3-13.) * Utility Shelves Ambitious Plan to Limit Carbon (Wald and Broder, *New York Times*, July 13, 2011.) * A Coal-Fired Plant That Is Eager for U.S. Rules (Wald, *New York Times*, Jan. 5, 2012.)   Due:   * Emerging Technology Briefing |
| Oct. 15 |  | Fall Break |
| Oct. 17 | Sustainability  *Featured Technology:* “Clean energy”: solar, geothermal, fusion | Read:   * Six Sources of Limitless Energy? (Morse, *Harvard Business Review*, Sept. 2009, pp. 66-67.) * A Skeptic Looks at Alternative Energy (Smil, *IEEE Spectrum*, July 2012.) * There’s Still Hope for the Planet (Leonhardt, *New York Times*, July 21, 2012.) * Fuel to Burn: Now What? (Mouawad, *New York Times*, April 10, 2012.)   Complete:   * Homework Assignment |
| Oct. 22 | Infrastructure  *Featured Technology:* Electric Cars, Hydrogen Cars | Watch:   * Documentary – Who Killed the Electric Car – Available on iTunes and YouTube (in parts)   Read:   * G.M., in a First, Will Sell a Car Designed for Electric Power This Fall (Fisher, *New York Times*, Jan. 5, 1996.)   Complete:   * Homework Assignment |
| Oct. 24 | Infrastructure  *Featured Technology:* Charging / Refueling infrastructure | Read:   * A New High-Tech Assault on Midtown Traffic Jams (Haughney, *New York Times*, July 18, 2011.) * Across Europe, Irking Drivers Is Urban Policy (Rosenthal, *New York Times*, June 26, 2011.) |
| Oct. 29 | Infrastructure  *Featured Technology:* “Smart” grid | Read:   * The Grid Is Getting Smarter, but It's a Long Way from Smart (Orcutt, *Technology Review*, April 2012) * Power Control (Cass, *Technology Review*, Dec. 2010). Be sure to explore the interactive graphic. |
| Oct. 31 | Stakeholder Impact  *Featured Technology:* Contactless Payments | Read:   * Battle of Electronic Wallets (Talbot, *Technology Review*, March 2012.) * Many Competing Paths on the Road to the Phone Wallet (Brustein, *New York Times*, May 6, 2012). * Swiping is the Easy Part (Bernard and Miller, *New* *York Times*, March 23, 2011).   Complete:   * Homework Assignment   Due:   * A one paragraph statement of the process that you will analyze for your course project |
| Nov. 5 | Stakeholder Impact  *Featured Technology:* Contactless Payments | Read:   * The Death of Cash (Helft, *Fortune*, July 9, 2012.) |
| Nov. 7 | Legal and regulatory considerations  *Featured Technology:* Network management and network neutrality | Read:   * Introduction (Lessig, *Free Culture*, pp. 1-7.) * Should the Airwaves Be Neutral? (Woolley, *Technology Review*, Nov./Dec. 2010.) * Keeping the Internet Neutral (Porter, *New York Times*, May 8, 2012.)   Watch:   * The Case Against Network Neutrality (http://www.youtube.com/watch?v=0KSkfRv9pQg)   Complete:   * Homework Assignment |
| Nov. 12 | Ethical and Normative considerations  *Featured Technology:* Implantable ID chips. | Read:   * Hands On: How Radio-Frequency Identification and I Got Personal (*IEEE Spectrum*, March 2007, pp. 18-23.)   Complete:   * Homework Assignment |
| Nov. 14 | Guest Speaker – James Washburn, Siemens |  |
| Information Implications of Emerging Technologies | | |
| Nov. 19 | Personal Profiling  *Featured Technology:* Personalized Medicine | Read:   * The Patient of the Future (Cohen, *Technology Review*, March/April 2012.) * Technological Healing (Begley, *Technology Review*, January/February 2012.) * U.S. Tries Open-Source Model for Health Data Systems (Lohr, *New York Times*, Feb. 2, 2011.) * Better Loving Through Chemistry (Singer, *New York Times*, Feb. 6, 2010.) |
| Nov. 21 | Group Project Discussion |  |
| Nov. 26 | Future of the Internet and Search  *Featured Technology:* Information Search and Retrieval | Read:   * The Future of the Internet and How to Stop It (Zittrain, pp. ix-x (Preface) and pp. 1-5 (Introduction). Available at: http://futureoftheinternet.org/download   Complete:   * Homework Assignment |
| Nov. 28 | Course Project Presentations | Due:   * Course project. |
| Dec. 3 | Course Project Presentations |  |
| Dec. 5 | Course Project Presentations and Course wrap-up |  |