**2019 Course Syllabus**  
**T55 – 510: Understanding Emerging & Disruptive Technologies**  
**SPRING 2019**  
**Master of Engineering Management**  
**The Henry Edwin Sever Institute | School of Engineering & Applied Science**

**Washington University in St. Louis**

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**COURSE OVERVIEW**

T55-510: Understanding Emerging & Disruptive Technologies (3 units) (required for MEM)  
We live in an era of rapid technology innovation and disruption. Blockbuster was the darling of Wall Street in 2004 and filed for bankruptcy in 2010. Blockbuster CEO said in 2008: “Neither Redbox nor Netflix are even on the radar screen in terms of competition.” Microsoft laughed off the first i-phone and laughed off Google. IBM laughed off the first personal computer. These have indicated over time that there should be a true sense of urgency and warning to all business leaders. Numerous technologies are threatening disruption today in what we call the 4th Industrial revolution: Automation, Machine Learning, Block chain, LIFI, Internet of Things (IOT), Artificial Intelligence, 3D & 4D Printing, 3D Scanning, Computer vision, 5G wireless networks, Drones, Bio-manufacturing, Quantum Computing, Holograms, Nanotechnology, Piezoelectrics, Energy harvesting, Wearable tech, Generative design, Augmented Reality & Virtual Reality. In this course we will look at understanding what they are and how they might make or break countless companies in the coming years.

Prerequisite: graduate standing.

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**INSTRUCTOR OVERVIEW**

Name – Natacha Alpert  
Company / Title MIRAS3D  
Availability / Contact info – natacha.alpert@wustl.edu  
Background: Natacha Alpert has been in the footwear industry working creatively for the past 17 years with the iconic brands Nine West, Lumberjack Italy, Allen Edmonds, Vince, Via Spiga, Sols 3D printed insoles, Replica labs, DVF, Asics, Sam Edelman, Kenneth Cole, Timberland, Adidas and Reebok in the USA and Globally. Her main focus is bringing together product and innovation - building product collections in lifestyle brands with a vision to create iconic new categories and start-ups. By combining Innovation, 3D & 4D Printing, Wearable tech, Robotics, Computer Vision Technology, Material Innovation & Nanotechnology - her work for the past 17 years has been connecting brands to new and disruptive technologies.

Learning philosophies: Interactive learning environment that encourages creativity, curiosity and growth. Learning through real brand examples of start-ups, corporate product stories and experiential learning by applying real business applications to new and emerging disruptive technologies.

**LEARNING OBJECTIVES**

1. Understand the true impact of some of the most critical emerging and disruptive technologies in business.  
2. Discern the difference between sustainable and disruptive technologies and why the distinction is so important.  
3. Learn to clearly communicate what it is, its potential applications, and the impact it can have on the business.  
4. Gain insights as to why companies often fail to respond well and early enough to disruption.
COURSE SCHEDULE for Spring 2019 (Also in Canvas)

- **Week 1**: Intro – Go over learning objectives, Syllabus & industries the class is interested in. Cover the key differences between Sustainable and Disruptive technologies and how to implement. Review the future of Emerging and Disruptive technologies and key impactful technologies over the past 20 years to set the foundation for the class.

- **Week 2**: Artificial Intelligence and Machine Learning – We will look at how these key disruptive technologies for the 4th Industrial revolution link to so many of our future disruptive innovations. In this session we will look at how, what and why these technologies are so important plus exactly how they touch each innovation we will cover throughout the course.

- **Week 3**: An overview of IOT and review of the Bill Gates memo “The Internet Tidal Wave”. In this session we will look at a high level overview of IOT and in-depth review of Bill Gates memo by looking at his strategy, challenges and solutions he provided for the age of the Internet.

- **Week 4**: The effect of Automation and Robotics in the Supply chain of the Future. In this session we will look at the role of Automation and Robotics in what we are calling the 4th Industrial Revolution. We will look at pro’s and con’s and projections for the next 10 years and an in-depth look at how automation and the use of robotics will help create a new supply chain of the Future and promote true sustainability.

- **Week 5**: 3D & 4D Printing additive manufacturing for the future. In this session we will look at the History of 3D & 4D printing and its role in all industries. We will look at how additive manufacturing will help shape production in our current supply chain and also what this means for consumers of the future. We will cover 3D & 4D printing in all materials SLS, FDM, Metal, TPU, TPR and future material development.

- **Week 6**: Augmented Reality, Virtual Reality & Holograms. In this session we will look at multiple sensory modalities, including the visual, auditory, haptic somatosensory applications of AR & VR and the differences between them. We will discuss how the overlaid sensory information can be constructive i.e. additive to the natural environment. We will also take an in-depth look at hologram technology. Hologram technology has evolved over the years and it will be a disruptive technology for the future replacing phones, TV’s and existing hardware technology. We will look at the current and future evolution of hologram technology.

- **Week 7**: Nanotechnology: In this session we will look at Nanotechnology & the development of instrumentation and measurement solutions for manufacturing systems, medical diagnostics and imaging systems. We will look at how nanotech combines electromechanical systems, complex algorithms, and computation systems to create instruments and measurement solutions for problems and how that can apply to industry. **2nd Part of Class**: Innovation Roadmaps and Beyond presentation. In the 2nd part of class we will do a review of what we have learned in the first 6 weeks and how to create Innovation Product briefs and Innovation Roadmaps essential to the process useful for the Final Class Project due. We will then link back to the Bain and McKinsey reports that outline the path to 2030.

- **Week 8**: 3D Scanning, Computer vision & Drones: We will look at the future of sensory technology computer vision, acoustic and ultrasonic imaging, large-scale computation and simulation, optimization, metrology, autonomous systems and 3D scanning connected to machine learning. **INDUSTRY GUEST SPEAKER FOR 3D SCANNING**.

- **Week 9**: LIFI Technology & 5G. In this session we will look at the future of LIFI and how in the future, LED light will be our source of WIFI. LIFI is a wireless optical networking technology that uses light-emitting diodes (LEDs) for data transmission. LIFI is designed to use LED light bulbs similar to those currently in use in many energy-conscious homes and offices and will be part of engineering, architecture, IOT and how we interact with products.

- **Week 10**: Block chain: Block chain Disrupts More than Banks and is not be limited to currencies like Bitcoin disrupting the banking and mortgage systems. We will look at breakthroughs in this security management and industry experimentation in the fashion and music industries. In the
longer term we will look at how Block chain might even be the method of taking identity management from the dominant tech companies. GUEST SPEAKER ON BLOCKCHAIN.

- **Week 11**: Generative Design and Quantum Computing: The role of the designer and engineer in the Future. Generative design is a form finding process that can mimic nature’s evolutionary approach to design (Biomimicry) We will look at the engineer’s role and design goals and then explore innumerable possible permutations of a solution to find the best option. By using cloud computing, generative design can cycle through thousands—or even millions—of design choices, test configurations and we can learn from each iteration what works and what doesn’t. The process can enable designers and engineers to generate brand new options, beyond what a human alone could create, to arrive at the most effective designs for the future. GUEST SPEAKER ON QUANTUM COMPUTING

- **Week 12**: Bio-manufacturing, Piezoelectric’s and Energy Harvesting technologies: In this session we will look at the automated generation of biologically functional products with structural organization from living cells, bioactive molecules, biomaterials, cell aggregates such as micro-tissues, or hybrid cell-material constructs, through bio-printing or bio-assembly and subsequent tissue maturation processes. We will also look at how materials that are grown labs will be our materials of the future. We also will categorically review and compare the state of the art vibration based energy harvesting approaches. The goal is to evaluate the contemporary Energy harvesting is the process of obtaining electrical energy from the surrounding vibratory mechanical systems through an energy conversion method using smart structures, like, piezoelectric, electrostatic materials and the role of this technology in wearable technology.

- **Week 13**: Final Projects – Group Presentations
Each Team will present 2 of the new and emerging technologies we have covered in the course. Each team should create and imagine a use case for these. Each team will then present a 15 min Power Point Presentation. We will then go over final conclusions of the course and plans for the Future.

**CLASS MEETING**

- **Day(s), time Location / classroom**

**CLASS TEXTS / MATERIALS / TOOLS**

Required:

- **Book 1**: “The Innovators Dilemma” Clayton M Christensen- Chapters: Intro, 1, 2, 3, 7 &11
- **Book 2**: “Machines of Loving Grace: The Quest for Common Ground Between Humans and Robots” John Markoff - Chapters: Intro 1, 2, 3, 4, 6
- **Book 3**: “Smart people should build things “Andrew Yang – Chapters: 1, 2, 6 & 8
- **Book 4**: “Life 3.0: Being Human in the Age of Artificial Intelligence” Max Tegmark. Chapters 1, 2, 3, 7, 8
- **Book 5**: “The 5 dysfunctions of team “Patrick Lencini. Full Book

Required Industry Reports:

- McKinsey & Company: Jobs lost, Jobs Gained: Workforce transitions in a time of Automation
- Bain: Labor 2030: The Collision of Demographics, Automation and Inequality.

Required Case Studies:

- HBSP “Leading Change “John P Kotter
- Bill Gates Memo “The Internet Tidal Wave “
- MIT Sloan Management Review Good Days for Disruptors
- Big-Bang Disruption - Larry Downes, Paul F. Nunes
• Disruptions, Decisions, and Destinations: Enter the Age of 3-D Printing and Additive Manufacturing Jan H. Kietzmann; Leyland Pitt; Pierre R. Berthon

Required Articles:

• VR PDF Hospitals
• War Of AR/VR/MR/XR Words – Forbes article

Optional:

• Case Study: Digital Microscopy at Carl Zeiss: Managing Disruption Willy Shih
  Software: (good to know)
• Fusion 360 Autodesk
• Innovation software: https://ezassi.com/innovation-software/
• Rhino or Solid works
• Book: “The lean start-up “Eric Reis

GRADE COMPOSITION

<table>
<thead>
<tr>
<th>Major Coursework Components</th>
<th>Component Proportion</th>
<th>Coursework Sub-component</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation</td>
<td>10%</td>
<td>Class Participation. Weekly pop quizzes on weekly readings</td>
<td></td>
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<tr>
<td>Homework Assignments</td>
<td>35%</td>
<td>1st 750 Word Essay</td>
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<td></td>
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<td>2nd 750 Word Essay</td>
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<td></td>
<td>3rd Compare &amp; contrast the Bain and Mc Kinsey Report 15 Mins PowerPoint</td>
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<tr>
<td>Final Project</td>
<td>55%</td>
<td>Pick 2 of new and emerging technologies we have covered in the course and create and imagine a use case for these. Power point Presentation</td>
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COURSEWORK COMPONENTS DESCRIPTIONS

1st assignment – Write a 750 - word single space essay on the difference between sustainable and disruptive innovation. Compare and contrast based off the book and please provide 2 examples each of a sustainable and disruptive technology.

2nd Bill Gates Memo – Write a single space 750 - word essay of learnings from the memo – outline Bill Gates strategy, the challenges he faced and the guidance he provided.

3rd Compare and contrast the Bain and Mc Kinsey Reports and your predictions for the future - 15 Mins Presentation Powerpoint

Final Assignment: Pick 2 of new and emerging technologies we have covered in the course and create and imagine a use case for these.

GRADING POLICIES
1. <Penalties for late work>
2. <Policies on missed exams, & quizzes>
3. <Regrading policy (if applicable)>
4. <Extra credits opportunities (if any)>
5. <Attendance policy, indicate the number of classes that can be missed without penalty, as well as the penalties that accrue thereafter>
6. <Policy on Incomplete – SEAS policy>

Grading Scale:

<table>
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<th>Letter Grade</th>
<th>%</th>
<th>Points Toward GPA</th>
<th>Letter Grade</th>
<th>%</th>
<th>Points Toward GPA</th>
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<tbody>
<tr>
<td>A+</td>
<td>≥ 97%</td>
<td>4.0</td>
<td>C+</td>
<td>77% - 79%</td>
<td>2.3</td>
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<tr>
<td>A</td>
<td>93% - 97%</td>
<td>4.0</td>
<td>C</td>
<td>73% - 76%</td>
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<tr>
<td>A-</td>
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<td>3.7</td>
<td>C-</td>
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<td>B+</td>
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<td>3.3</td>
<td>D+</td>
<td>67% - 69%</td>
<td>1.3</td>
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<tr>
<td>B</td>
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<td>3.0</td>
<td>D</td>
<td>65% - 66%</td>
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<tr>
<td>B-</td>
<td>80% - 82%</td>
<td>2.7</td>
<td>F</td>
<td>&lt; 65%</td>
<td>0.0</td>
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</tbody>
</table>
I. **POLICIES TO BE INCLUDED AT THE INSTRUCTOR’S DISCRETION**

**Use of Laptop Computers and Electronic Devices in the Classroom**
Laptop & tablet computers, smart phones and other electronic devices can be helpful in taking notes, providing tools for course exercises and referencing course related materials. However, they can also be distracting when used for non-course related activities such as emailing & texting, posting on social media, reading news sites, shopping online, or looking at YouTube videos. Some students have even been observed working on class assignments for the same or other courses. As common sense suggests, and a March 2013 study by Faria Sana, Tina Weston and Nicholas J. Cepeda confirmed, students who are multitasking during class have less understanding and recall of what’s being discussed. The study also found that “participants who were in direct view of a multitasking peer scored lower on a test compared with those who were not.”

As mentioned earlier this course is part of a professional, graduate program. Consequently, it is expected that students conduct themselves in a professional manner. This includes being engaged in the class proceedings, by attentive listening, critical thinking, asking appropriate questions and participating in active discussion. Your attendance and participation in class is important for the class and is expected to be more than just physical attendance. Engaging in non-class related activities during class time is not acceptable and disrespectful of the lecturer and other students.

* Reference the Wall Street Journal article: I’m Banning Laptops from My Classroom, July 10, 2016 by Stuart Green
* Reference the WashU Teaching Center Article [https://teachingcenter.wustl.edu/resources/course-design/developing-course-policies-on-laptops-mobile-devices/](https://teachingcenter.wustl.edu/resources/course-design/developing-course-policies-on-laptops-mobile-devices/)

**Privacy and Security**
Recording of class sessions either audio or video is prohibited without permission from the instructor and the other class members.

**Collaboration:**
With the exception of your team projects, all assignments are to be completed on your own. You are encouraged to discuss ideas and techniques broadly with other class members, but all written or presentation work, whether in preliminary or final form, is to be generated by you working alone. If in doubt - ask.

**Language Sensitivity**
When in the classroom, all students should speak English at all times. While meeting with classmates on a classroom project, speak a language that every student present (in your group) understands, without exception.

**Professionalism:**
You are part of a professional, graduate program. Consequently, it is expected that students conduct themselves in a *professional* manner. This includes being on time for classes and meetings, being prepared, and participating in class discussions, group activities, projects, etc. The level of professionalism you exhibit throughout the course will impact your final grade. It directly affects the participation portion of the grade but is also taken into consideration in all other aspects of the course as it reflects the overall quality of professional performance.

**SEVER/UNIVERSITY POLICIES**
Ethics of Academic Integrity (SEAS)
All students in the School of Engineering & Applied Science are expected to conform to high standards of conduct. This statement on student academic integrity is intended to provide guidelines on academic behaviors which are not acceptable.

Engineering courses typically have many problem sets assigned as homework. You are not allowed to collaborate when solving homework problems, performing lab experiments, writing or documenting computer programs, or writing reports unless the instructor specifically states otherwise.

It is dishonest and a violation of academic integrity if:

1. You turn in work which is represented as yours when in fact you have significant outside help. When you turn in work with your name on it, you are in effect stating that the work is yours, and only yours.
2. You use the results of another person’s work (exam, homework, computer code, lab report) and represent it as your own, regardless of the circumstances.
3. You request special consideration from an instructor when the request is based upon false information or deception.
4. You submit the same academic work to two or more courses without the permission of each of the course instructors. This includes submitting the same work if the same course is retaken.
5. You willfully damage the efforts of other students.
6. You use prepared materials in writing an in-class exam except as approved by the instructor.
7. You write on or make erasures on any test material or class assignment being submitted for re-grading.
8. You collaborate with other students planning or engaged in any form of academic dishonesty.
9. You turn in work, which is represented as a cooperative effort, when in fact you did not contribute your fair share of the effort.
10. You do not use proper methods of documentation. For example, you should enclose borrowed information in quotation marks; acknowledge material that you have abstracted, paraphrased or summarized; cite the source of such material by listing the author, title of work, publication, and page reference.

II. WASHINGTON UNIVERSITY IN ST LOUIS SUPPLEMENTAL RESOURCES

1. Disability Resources: If you have a disability that requires an accommodation, please speak with instructor and consult the Disability Resource Center at Cornerstone (cornerstone.wustl.edu/). Cornerstone staff will determine appropriate accommodations and will work with your instructor to make sure these are available to you.

2. English writing support: For additional help on your writing, consult the expert staff of The Writing Center (writingcenter.wustl.edu) in Olin Library (first floor). It can be enormously helpful to ask someone outside a course to read your essays and to provide feedback on strength of argument, clarity, organization, etc. < The Engineering Communication Center http://engineering.wustl.edu/current-students/student-services/Pages/default.aspx offers students in the School of Engineering and Applied Sciences help with oral presentations, writing assignments,
and other communications projects, as well as job-search documents such as resumes and cover letters.

3. **English competence**: Students are encouraged to check their grammar and spelling before submitting their written works. Although, students are free to choose whatever the tools that best fit their need, some of the common tools for grammar & spelling checking, citation making in different writing styles can be found in the list below.
   b. [https://www.grammarly.com](https://www.grammarly.com) – Grammarly [Free & Paid Service]
   d. [http://www.citationsoftware.com](http://www.citationsoftware.com) – Citation Machine [Free & Paid Service]

4. **Bias reporting**: The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. See: [brss.wustl.edu](http://brss.wustl.edu)

5. **Mental health service**: Mental Health Services’ professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: [shs.wustl.edu/MentalHealth](http://shs.wustl.edu/MentalHealth)

6. **Sexual Harassment**: Sexual harassment is a form of discrimination that violates university policy and will not be tolerated. It is also illegal under state and federal law. Title IX of the Education Amendments of 1972 prohibits discrimination based on sex (including sexual harassment and sexual violence) in the university's educational programs and activities. Title IX also prohibits retaliation for asserting claims of sex discrimination. The university has designated the Title IX Coordinator identified below to coordinate its compliance with and response to inquiries concerning Title IX.

For more information or to report a violation under the Policy on Discrimination and Harassment, please contact:

**Discrimination and Harassment Response Coordinators**

- Apryle Cotton, Asst. Vice Chancellor for Human Resources
  - Section 504 Coordinator
  - Phone: 314-362-6774
  - Email: apryle.cotton@wustl.edu
- Leanne Stewart, Employee Relations Manager
  - Phone: 314-362-8278
  - Email: leannerstewart@wustl.edu

**Title IX Coordinator**

- Jessica Kennedy, Director of Title IX Office
  - Title IX Coordinator
  - Phone: 314-935-3118
  - Email: jwkennedy@wustl.edu

You may also submit inquiries or a complaint regarding civil rights to the United States Department of Education's Office of Civil Rights at 400 Maryland Avenue, SW, Washington, DC 20202-1100 or by visiting the [U.S. Department of Education website](http://www.ed.gov) or calling 800-421-3481.