COURSE DESCRIPTION:
CTL.SC2X SUPPLY CHAIN DESIGN
FALL SEMESTER 2015

DETAILS:

Key Dates:

- **30 September 2015** - Course opens at 1500 hours UTC (11:00 AM EDT)
  (each week's material will be released on subsequent Wednesdays at 1500 hours UTC)
- **4 November 2015** - Course enrollment closes – last day to register for course
- **18 November 2015** -Verified Status closes – last day to convert from Honor to Verified Certificate. Also, last day to be ID Verified.
- **9 December 2015** - Final Exam opens
- **23 December 2015** - Final Exam is due and class closes.
- **5 January 2016** - Certificates are made available.

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COURSE DESCRIPTION:

CTL.SC2x Supply Chain Design covers all aspects involved in the design of supply chains for companies and organizations anywhere in the world. This course is the second of three courses in the MITx X-Series on Supply Chain Management. We will be building off of the core models that we introduced in CTL.SC1x, Supply Chain and Logistics Fundamentals, and setting the stage for how supply chains fit into the larger picture in CTL.SC3x, Supply Chain Strategy. However, this course is completely stand-alone so you are welcome to join us even if you have not already completed CTL.SC1x.

The course is divided into four main topic areas: Physical flow design, Supply chain finance, Information flow design, and Organization/Process design.

In the design of physical flows, we start with very simple formulations (the Transportation & Transshipment Problems) and keep adding complexity (service constraints, facility location, etc.) in order to highlight the inherent trade-offs between costs and service. Using Mixed Integer Linear Programs (MILPs), you will learn how to run scenarios and to conduct sensitivity analysis. We will touch upon more advanced topics in network design, to include robust optimization, flexible design, multi-commodity flows, and multiple time period models. Finally, we will address practical concerns where you will discover that the math is the easiest part of Network Design! There are many challenges involved in running a successful network design project, to include collecting the right data, engaging the right people, making the right (realistic) assumptions, and ensuring that you are running the model and not the other way around!

The second topic area concerns Supply Chain Finance. The overall objective of this area is for you to learn how to translate supply chain concepts and actions into the language of the Chief Financial Officer (CFO) of a company. We begin with a brief introduction to basic financial tools used by CFOs: Income statements, Balance sheets, and Cash flows. You will learn how to apply Activity Based Costing to understand how costs are reflected in individual products and processes. We will introduce the concept of Working Capital and discuss how the Cash-to-Cash cycle works. Finally, we will show how to conduct Discounted Cash Flow Analysis to help understand the long-term value and benefits of any investment.

In the design of the information flow section we cover how firms communicate with suppliers, internal resources, and customers. Starting with sourcing, you will learn basic (and some advanced) procurement techniques and strategies to include Supply Chain Risk contracts, Reverse Auctions, and Optimization Based Auctions. We continue the design of the information flow of a supply chain by diving into the production process. You will learn how to set up and solve the Fixed Horizon Problem - the core model that is used in most production planning systems. We will also introduce the concept of a Bill of materials and Material Requirements Planning (MRP) and Distribution Resource Planning (DRP) systems. Finally, we discuss how to collaborate and communicate with your downstream customers. We will also explain how the Sales & Operations Planning or S&OP process works. This is the main method that firms use to keep their production and operations teams in synch with their sales and marketing teams.

In the last section, we will introduce the concepts of business process redesign as well as performance metric design. These two tools often go together since a mis-match in the performance metrics often causes poor process results. Finally, we will discuss organizational design within the supply chain organization focusing mainly on the centralize/decentralize decision.

COURSE ORGANIZATION

CTL.SC2x is divided into eleven weeks. The first ten weeks feature lessons and problems while the 11th week is a final exam that covers all of the material taught in the course. Prior to the 1st week, we will release some information on course logistics and background material that should help you be prepared for the course.

Weeks 1 through 10 are the course content-based weeks. Each of these weeks is comprised of a number of sub-sections to include:

Welcome to the Week Video – a short (<2 minutes) video welcome from me providing an overview of what will be covered in the coming week.

Interactive Lessons – each week will have 2 lessons. Each lesson consists of a bundle of short videos interspersed with Quick Questions and discussions. Each video is between 2 – 12 minutes in length with the total duration of videos in a complete lesson ranges from 40 minutes to just over an hour. They are designed to be able to be watched in one sitting – but do not need to be. The Quick Questions within each lesson are not graded, but are designed to help reinforce the concepts introduced in the videos. For each lesson, you are able to download PDFs of a complete set of slides (both annotated and unannotated) as well as a Key Concepts document that contains summaries of the lessons, primary equations, and other pertinent information.

Practice Problems – these are problems that you can use to test your skills on the concepts covered in the lessons. They are all worth solving, but the practice problems that we feel are especially important are marked with an asterisk. These problems are NOT graded (which is why they are called *practice* problems). They are solely designed to help you learn the concepts. Verified certificate students will have access to additional practice problems that they can use to further hone their skills.

Graded Assignment – this is the only graded component each week. The assignment will usually consist of two to three problems that may include a data set. Graded assignments are due two weeks after being assigned. THERE ARE NO EXTENSIONS GRANTED TO THESE DEADLINES - THEY ARE HARDWIRED INTO THE SYSTEM. Graded assignments are worth 60% of your total grade.

Verified Student Supplemental Material – Verified Certificate students will also have access to supplemental videos and documents and additional practice problems. These materials are intended to round out the supply chain education of the student - but are not covered in the Graded Assignments or Final Exam. As the name implies, they are supplemental.

The 11th and final week consists of a Final Exam – the final exam will be a series of questions that cover all of the material presented in the course. The final exam will be released on 9 December 2015 and is due two weeks later on 23 December 2015. Again, **THERE ARE NO EXTENSIONS GRANTED TO THIS DEADLINE**. The final is worth 40% of your total grade.

DISCUSSION FORUM:

There is a discussion forum on the website that is designed to be used by students of CTL.SC2x. You may use this as a forum to discuss course concepts, problem-solving approaches, interesting references, New England sports teams, and any other topics related to the course or the course material. You may also use it to ask questions for the teaching assistants. However, **please do not post any questions on or solutions to any of the graded assignments**. They will be removed and the student who posted will be contacted and dealt with individually. Please observe appropriate online etiquette as outlined in the Forum Guidelines posted in the Course Handouts section of the course Info tab. The course staff, to include the awesome Community TAs, moderates the forum and will try to respond to all queries within 24 hours.

The proper avenue for getting clarification on a Graded Assignment is to email the SCx_graded_help list scx_graded_help@mit.edu. The instructor and the TAs man this private email list. We will respond privately to your query within 24 hours.

GRADING:

The grading in this course consists of Graded Assignments each week and a Final Exam. There are 10 total graded assignments; one each for weeks 1 through 10. Each Graded Assignment might consist of multiple parts and questions, of course. While the number of questions asked within each week varies slightly, each week's Graded Assignment counts as 6% of your total grade. You will not be able to drop any of the weekly graded assignments. The Final Exam is worth 40% of the total grade. You must score at least 60 percent to pass this course and earn a certificate.

CERTIFICATION:

Online students who achieve a passing grade in CTL.SC1x earn a certificate of mastery. These certificates indicate that you have successfully completed the course, but will not include a specific grade. Certificates are issued by edX under the name of MITx. For this course in Fall of 2015, there are two certificate options: Honor and Verified.

The Honor Certificate is free. As an Honor Certificate student, you will have access to all lesson videos and slides, quick questions, Key Concept documents, and most of the practice problems.

The Verified Certificate costs $100 to administer and requires you to show some sort of identification during the semester. Verified Certificate students have access to additional practice problems, supplemental materials, and occasional live discussions. It is also important to remember that in order to earn the MITx Supply Chain XSeries Certificate - you must successfully pass and receive a Verified Certificate in each of the three courses (CTL.SC1x, CTL.SC2x, and CTL.SC3x).

The Graded Assignments and the Final Exam are identical for all students regardless of their certification status. If you are just interested in learning the material - then the Honor Certificate is probably fine. But, if you wish to use this for further studies or certificates, I urge you to consider the Verified Certificate option. Dates for converting are posted at the top of this document.

See the edX FAQ for more details on certificates (https://www.edx.org/student-faq).

PREREQUISITES:

This is an advanced modeling course so we presume you have a basic understanding of high school level math (especially algebra). We will be utilizing some more advanced (college level) methods involving statistics, probability, and optimization, but we will spend time explaining the principles involved. However, CTL.SC2x is not designed to be an introductory methodology course, so if you feel that you need to brush up on some specific topics (before or during the course) I highly recommend using the Khan Academy (http://www.khanacademy.org/). It is free and is very useful. I periodically use it to refresh myself on topics and techniques I have not used for a while.

We also assume you are proficient with (or at least vaguely comfortable) using spreadsheets. You will need to use spreadsheets to solve many of the practice and graded problems. We have taken great pains to make sure that all functions and features we demonstrate in the video lectures and require for the problems can be accomplished in either Microsoft Excel or LibreOffice. Excel is the world's most commonly used spreadsheet but is not free, while LibreOffice's Calc module is a very comprehensive spreadsheet and has the benefit of being opensource (i.e., free). Week 0 contains some practice problems for you to brush up on your spreadsheet (Excel or LibreOffice) skills.

REFERENCE MATERIAL:

There is no single textbook for this course. However, there are many excellent texts and reference books that you might want to consider looking up or adding to your personal library if this topic is of interest. One sad note about books on supply chain management is that they rarely use similar notation for the same concepts! This is a long-standing frustration for anyone working in this space. We will be consistent within our class, but chances are if you consult any text on Supply Chain Management the specific notation will differ slightly.

Here is a list of reference texts that I find very helpful. These are not the only books out there; they are just the ones I typically find myself referring back to. If there are later editions – use those!

Watson, Michael, Sara Lewis, Peter Cacioppi, and Jay Jayaraman, Supply Chain Network Design, 1st Edition, FT Press, 2013.

Chopra, Sunil and Peter Meindl, Supply Chain Management, Strategy, Planning, and Operation, 5th edition, Pearson Prentice Hall, 2012.

Silver, Ed, David Pyke, and Rein Peterson, Inventory Management and Production Planning and Scheduling, 3rd Edition, John Wiley & Sons, 1998.

Ballou, Ronald, Business Logistics: Supply Chain Management, 3rd edition, Pearson Prentice Hall, 2003.

Cachon, Gerard and Christian Terwiesch, Matching Supply with Demand: An Introduction to Operations Management, 3rd edition, McGraw-Hill, 2011.

Daganzo, Carlos, Logistics Systems Analysis, 4th edition, Springer-Verlag, 2004.

Additionally, in each lesson's Key Concept document that summarizes the relevant material we will list specific references that might be helpful. I hope that these materials will be useful to your learning experience!