

## **Annexe A: New/Revised Course Content in OBTL+ Format**

### **Course Overview**

The sections shown on this interface are based on the templates [UG OBTL+](#) or [PG OBTL+](#)

If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to [Data Transformation Status](#) for more information.

Expected Implementation in Academic Year	AY2024/AY2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Rohit Bhatnagar
Course Author Email	arbhatnagar@ntu.edu.sg
Course Title	Lean Operations and Analytics
Course Code	BC3411
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

## Course Requisites (if applicable)

Pre-requisites	AB1202
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

## Course Aims

The main objectives of this course are i) to appreciate the key principles/approaches of lean operations including waste elimination, increased speed and response, improved quality, and reduced cost & ii) to gain an understanding of the methodologies, tools, and techniques necessary for analyzing, implementing, managing, and continuously improving operations in both manufacturing and service industries. Topics covered in the course include Toyota Production System, Lean Principles, Value Stream Mapping, Pull Systems, Six Sigma, Lean thinking in manufacturing and service operations, and use of tools like optimization, queuing, simulation, and statistical analyses for modelling and analyzing real life systems. The course will use a mix of lectures, case studies, and problem-solving exercises, to introduce the students to the latest tools, techniques, issues, and strategies in lean operations management. A special focus of the course will be on the operations and technology function in both manufacturing and service sectors. This segment will provide rich opportunities for students to be exposed to challenges in manufacturing and service operations and gain insights through projects.

## Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Describe fundamental issues in lean operations such as reducing waste, inventory and variation and improving responsiveness and quality in the firm's operations
ILO 2	Explain the key trade-offs necessary for designing, managing, and improving lean operations
ILO 3	Compute key performance measures related to the trade-offs
ILO 4	Relate key performance measures with analysis and comparison of alternate systems to strategic goals of companies

## Course Content

The course content will have as its backdrop the fundamental concepts and techniques necessary for designing, managing, and improving operations and processes in both manufacturing and service industries by using appropriate lean methodologies. The course adopts a “process management” viewpoint while addressing a variety of strategic and tactical issues. The main topics covered include: 1. Introduction to Lean Operations. Operations Strategy. Real World Applications. Case Study. 2. Process View of Operations and Fundamentals of Process Analysis. 3. Reducing Waste and Improving Quality. Toyota Production System. 4. Reducing Inventory in Operations. Traditional versus Lean Inventory Systems. 5. Improving Responsiveness by reducing lead times. Pull versus Push Systems. Dice Game. 6. Measuring and Reducing Variation in Operations. Lean Six Sigma 7. Global Examples in Lean Excellence. 8. Introduction to Simulation Modelling. Arena Simulation. 9. Simulation Modelling using Arena. Advanced Concepts in Simulation. Statistical Analyses for Steady State Simulation Results. 10. Lean Supply Chains

## Reading and References (if applicable)

Most of the assigned reading materials and class notes will be provided online on NTULearn (<http://ntulearn.ntu.edu.sg>). Required All students will be required to purchase access to Littlefield Simulation Game and the cases used in the course. There is no prescribed textbook for the course, and we will use several readings and reference materials, which will be incorporated in the class notes. These references include: 1. An Introduction to Lean Work Design: Fundamentals of Lean Operations Volume I, Lawrence D. Fredendall and Mathias Thurer, 2016, Business Expert Press. (FT1) 2. An Introduction to Lean Work Design: Standard Practices and Tools of Lean, Volume II, Lawrence D. Fredendall and Mathias Thurer, 2016, Business Expert Press. (FT2) 3. Lean Production for Competitive Advantage –A comprehensive guide to Lean Methodologies and Management Practices, John Nicholas, 2011, Productivity Press, NY. (N) 4. Staying Lean –Thriving Not Just Surviving, Peter Hines, Pauline Foulds, Gary Griffiths, Richard Harrison, 2011, CRC Press, Taylor, and Francis Group. (HFGH) 5. Improving Business Performance with Lean, James R Bradley, 2012, Business Expert Press, NY. (B) 6. Building Lean Supply Chains with the Theory of Constraints, Mandhyam M. Srinivasan, 2012, McGraw-Hill, NY. (MMS) 7. Simulation with Arena, W. David Kelton, Randall P. Sadowski, Nancy B. Zupick, 2015, Sixth Edition, McGraw-Hill. (KSZ) 8. Operations Management, 2nd Edition by Gerard Cachon and Christian Terwiesch, 2020, McGraw-Hill, ISBN: 978-1-260-54761-0 (CT) 9. Operations Management, Eleventh Edition, Lee J Krajewski, Manoj K Malhotra, Larry P Ritzman, 2016, Pearson. (KMR)

## Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Lean Strategy: 1. Introduction to Lean Operations. 2. Operations Strategy and Role of Lean Thinking	1	Lecture Notes. FT1, FT2, CT, KMR		
2	Real World Implementation Issues in: 1. Operations Strategy 2. Case Analysis: Fabritek 3. Film: Aravind Eye Hospital	1,2,3	Lecture Notes Case Study Analysis		
3	Process View of Organizations: 1. Fundamentals of Process Analysis 2. Product & Process Design 3. Process Analysis Exercises and Mini Cases	1,2,3	Lecture Notes Exercises		
4	Process View of Organizations (continued): 1. CASE: NATIONAL CRANBERRY COOPERATIVE 2. Exercises and Mini Cases 3. Process of Ongoing Improvement	1,2	Lecture Notes CT, KMR		

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
5	Introduction to Simulation Modeling: 1. Arena Simulation 2. Exercises	3	Lecture Notes KSZ Exercises		
6	Reducing Waste and Improving Quality, Toyota Production System – Prototype for Lean Operatio Toyota's Seven Wastes. Kaizen. Exercises/Mini Cases	1,2,3	Lecture Notes, CT, KMR		
7	Global Examples in Lean Excellence/Reducing Inventory in Operations: 1. CASE: TOYOTA MOTOR COMPANY ; Introduction to Inventory Management ; Traditional versus Lean Inventory Systems, 4. Value Stream Mapping	1,2,3	Lecture Notes MMS Toyota Production System Case Study Analysis		
8	Improving Responsiveness in Operations: 1. Pull versus Push Systems ; Dice Game	1,2,4	Lecture Notes Exercises		

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Reducing Variation in Operations: 1. Lean Six Sigma 2. Understanding & Measuring Process Variation 3. Measuring Process Capability 4. Statistical Process Control Procedures ; Quiz	1,2,3	Lecture Notes N, HFGH, B, CT		
10	Advanced Concepts in Simulation Modeling: 1. Simulating Complex Examples in Arena. Statistical Analyses for Steady State Results ; Electronic Beer Game ; Littlefield Simulation Game Briefing	2,3	Lecture Notes KSZ Exercises		
11	E-Learning: Simulation Based Exercises	1,2,3	Lecture Notes KSZ		
12	Lean Supply Chains: 1. Aligning Supply Chain Incentives ; Negotiation Game	2,3,4	Lecture Notes MMS Exercises		

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
13	Term Project Presentations ; Wrap Up	1,2,3 ,4			Presentation s

## Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Seminars	The seminar sessions will have considerable opportunities for interaction and discussion on the conceptual questions raised in the class. This will allow you to think critically and share your ideas with the class. Deep thinking, reviewing materials and clarifying your doubts/questions will provide you a sound platform to do well in the course assessments.
In-Class activities	Case studies, exercises, games, and Littlefield Simulation will be discussed in class and after allowing you some time for group discussion, I will call upon individuals to share their analysis. We will also discuss the real-life implications of this analysis.
Term Project	The term project is integrative in nature and will encompass all intended learning outcomes (ILO1, ILO2, ILO3 and ILO4). There will be ample opportunities for you to have continuous interaction with me to monitor your progress. I will also provide feedback to enable you to improve the quality of your analysis.

# Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Quiz)	ILO1, ILO2, ILO3	Acquisition of knowledge	20	Individual	Holistic	Multistructural
2	Continuous Assessment (CA): Others(Cases, Games, Littlefield Simulation)	ILO1, ILO2, ILO4	Critical Thinking	20	Team	Holistic	Multistructural
3	Continuous Assessment (CA): Project(Term Project (written report and in-class presentation))	ILO1, ILO2 ILO3, ILO4	Problem Solving & Decision Making Oral communica tion Teamwork and Interpersonal Skills	40	Team	Holistic	Multistructural
4	Continuous Assessment (CA): Class Participation(Class Participation)	ILO1, ILO2, ILO3	Oral Communication	20	Individual	Holistic	Multistructural

Description of Assessment Components (if applicable)

# A mandatory peer evaluation will be done for the Group Project at the end of the course. The peer evaluation forms are given in the Appendix/Outline. The adjustment of project work marks for unequal contributions among members is also described.

Formative Feedback

You will get feedback on your submissions. The feedback will be both verbal and written. Feedback is central to the group project. You will be provided feedback on your project proposal to help you identify the strengths and weaknesses of your proposal. During the term, you will be given periodic verbal feedback on your content and analysis so that you are able to continuously improve the quality of your work

# NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Collaboration	Intermediate
Communication	Intermediate
Decision Making	Advanced
Problem Solving	Advanced
Critical Thinking	Advanced

# Course Policy

## Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## Policy (General)

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments, and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

## Policy (Absenteeism)

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

## Policy (Others, if applicable)

Good academic work depends on honesty and ethical behavior. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU HonorCode, a set of values shared by the whole university community. Truth, Trust, and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion, and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

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