

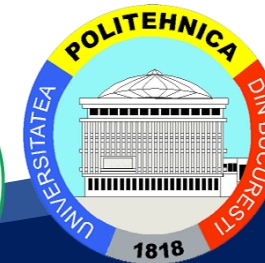


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Course 11: Collaborative Manufacturing Systems

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Wasawat Nakkiew, Pisut Koomsap



Curriculum Development
of Master's Degree Program in
Industrial Engineering for Thailand Sustainable Smart Industry

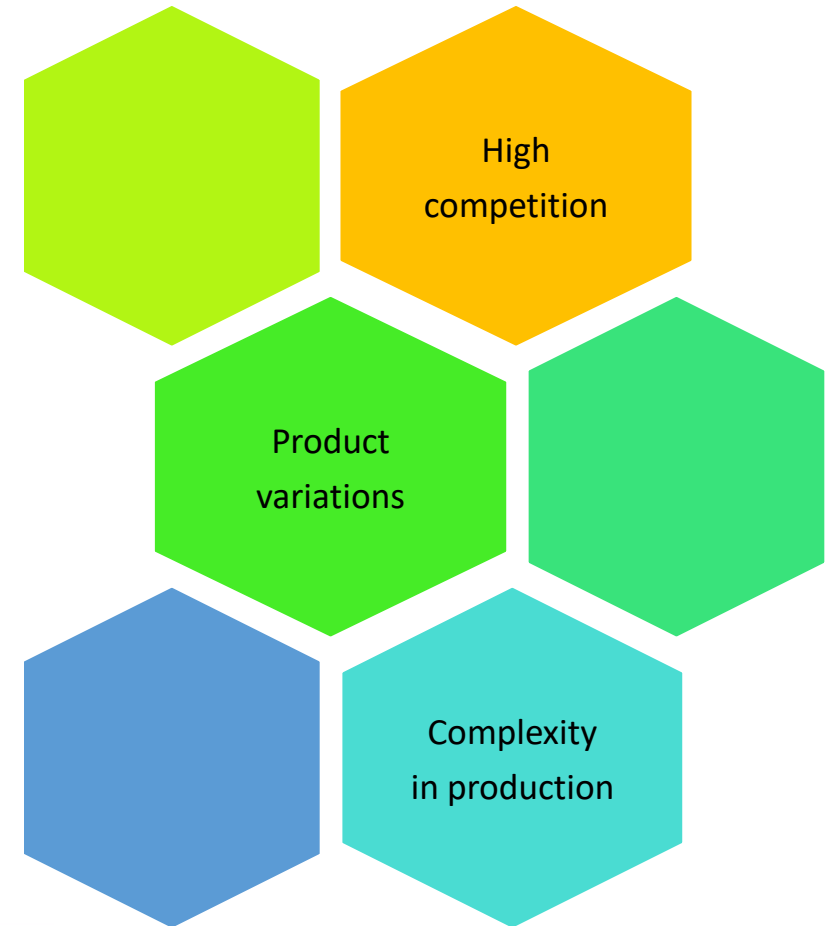
Competing through manufacturing

Solutions for improve manufacturing efficiency

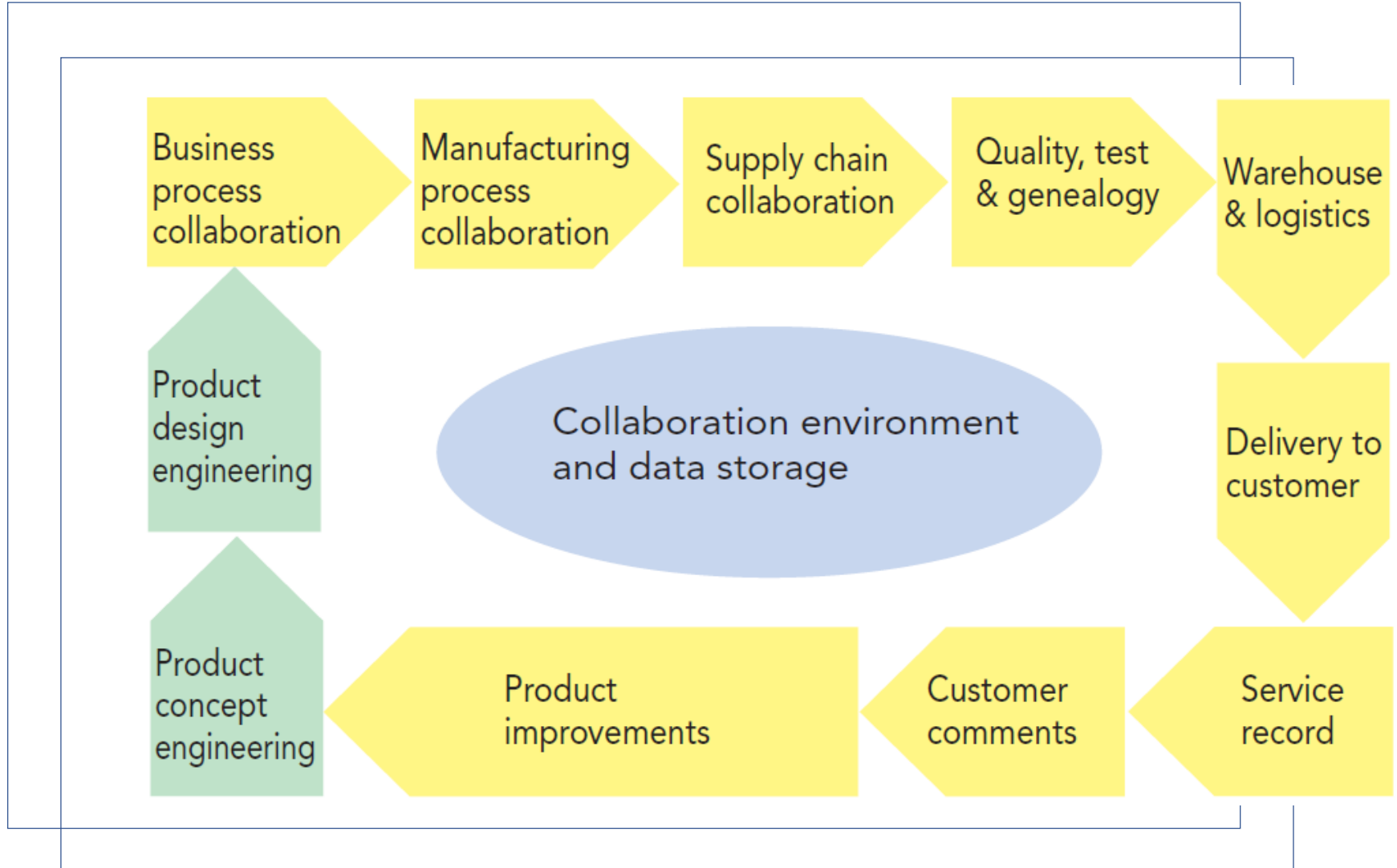
- ✓ Reduce waste material
- ✓ Conduct preventive maintenance
- ✓ Standardize work
- ✓ Quantify everything
- ✓ Apply new technologies
- ✓ Strengthen supply chain management

Key is Collaborative
manufacturing

Why?

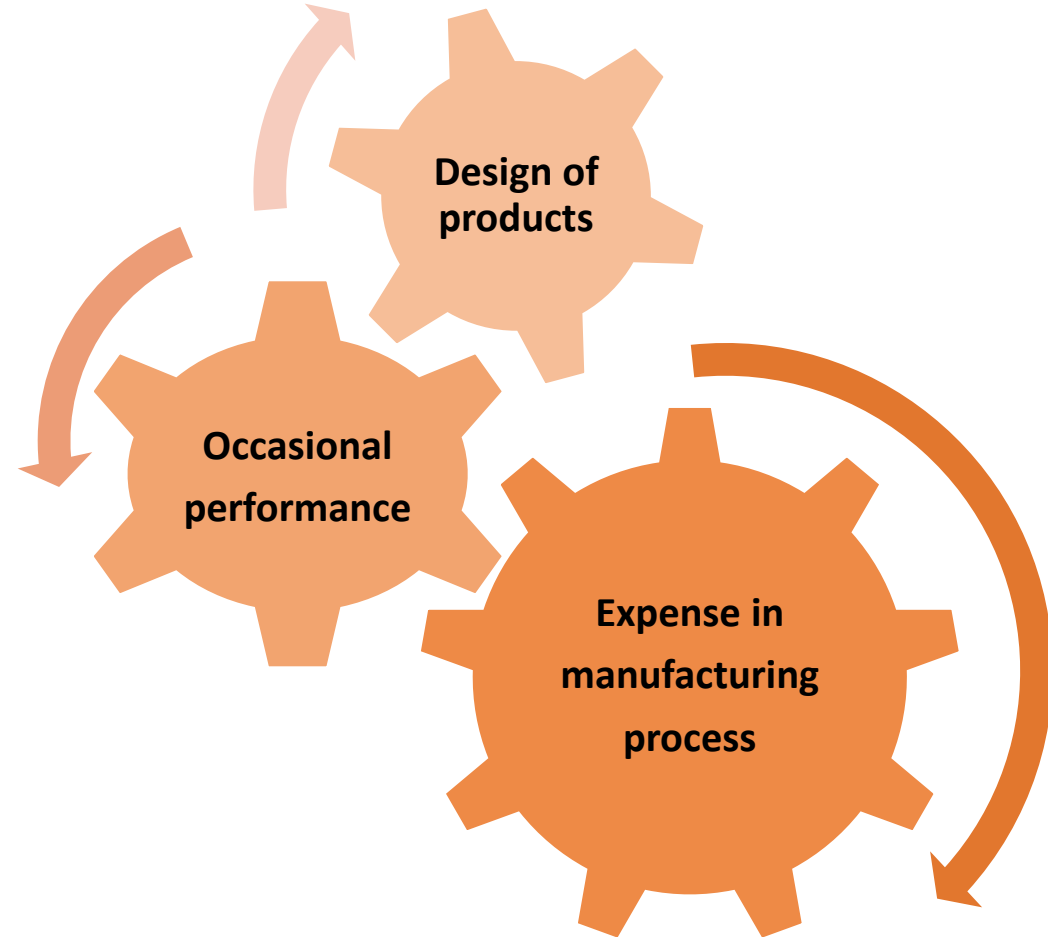


Collaboration



Collaborative Manufacturing System

Sharing information between business processes across internal or external partners in the value chain network



Collaborative manufacturing

With collaborative manufacturing,
all parties in the
business relationship contribute to the
betterment of the whole



By ACR.

Collaborative
Manufacturing
Systems



Course Objective



Collaboration among partners to form a value network has become necessary as up-to-date information is so critical in a competitive market. **Sharing of information** among a network of physical units on the shop floor and connecting internal manufacturing processes and business processes with external business processes allow a company to offer a core competence with flexible, responsive operations meeting the expectations of customers and the value network partners.

This course aims to build students' competence in **collaboration in manufacturing** from the board picture of collaborative manufacturing management down to **collaboration on a shop floor**. The students will learn from concepts, applications, and hands-on experience



Course Learning Outcomes (CLOs)

The students on the completion of this course would be able to

CLO1: Recognize a potential collaborative manufacturing in a factory (understand)

CLO2: Identify a value network for collaborative manufacturing for a business (apply)

CLO3: Apply collaborative manufacturing management in practice (apply)

CLO4: Manipulate collaborative robots for collaborative tasks (apply)

CLO5: Manage manufacturing collaboration on a shop floor (apply)



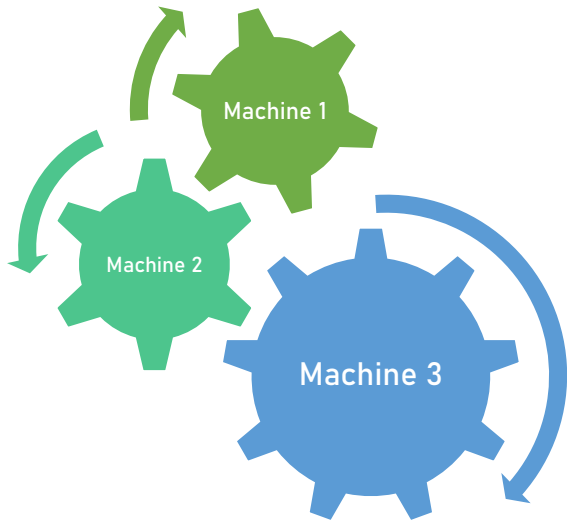
I Collaborative Manufacturing Management

- Evolution of Manufacturing Systems
- Collaborative Manufacturing Management Model
- Collaborative Manufacturing Management Fundamentals and Infrastructure
- Ontology for Collaborative Manufacturing

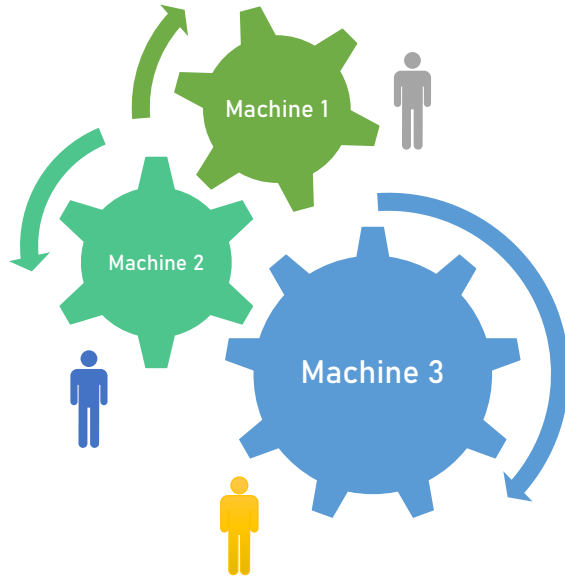


II Machines Collaboration on a Shop Floor

- Distributed Manufacturing
- Distributed Arrival Time Control for Real-Time Scheduling
- Collaborative Material Handling System
- Collaborative Manufacturing Processes

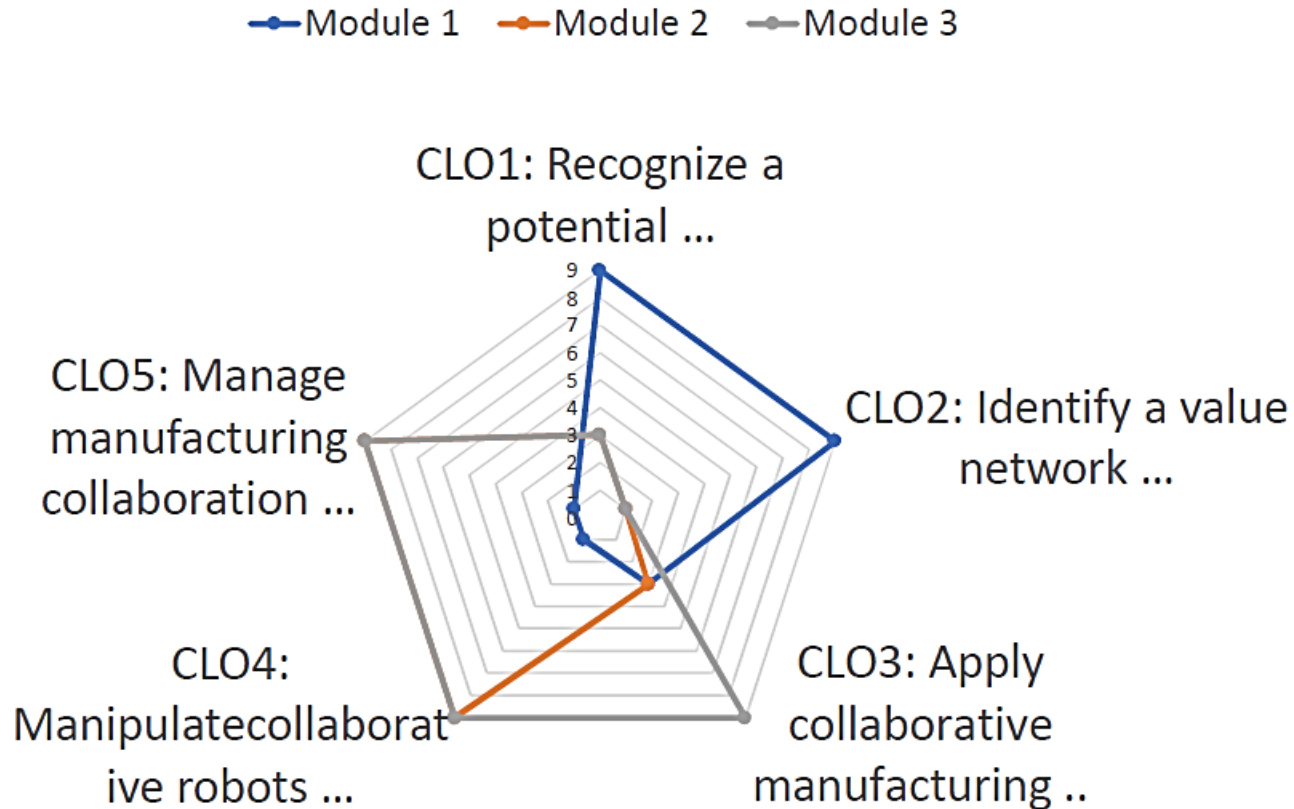


III Man-Machine Collaboration on a Shop Floor



- Evolution of Man-Machine Collaboration
- Industrial human augmentation systems
- Flexible Human-Robot Collaboration
- Cyber-Human System

Modules' Contribution to Course Learning Outcomes



Module I: Collaborative Manufacturing Management

Module II: Machines Collaboration on a Shop Floor

Module III: Man-Machine Collaboration on a Shop Floor

Module's contribution to Laboratories:

Module I: Collaborative Manufacturing Management

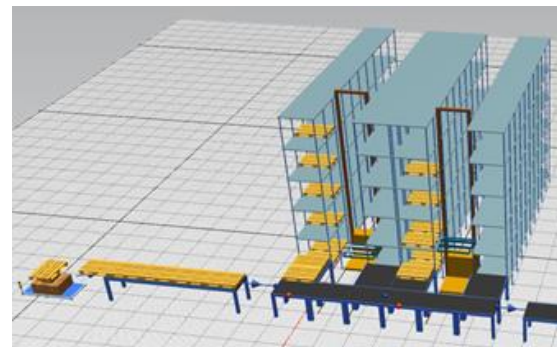
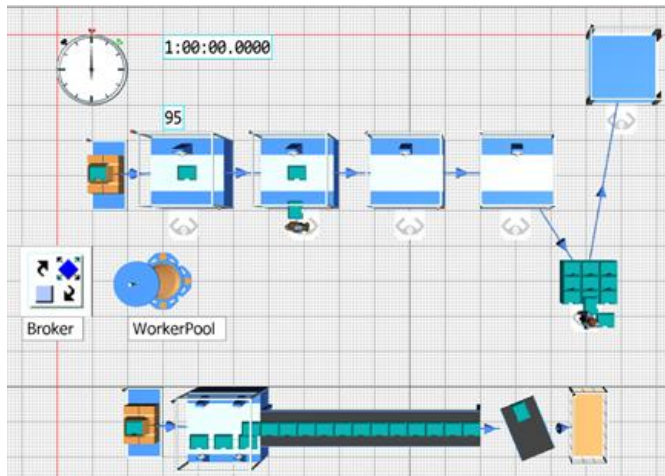
- laboratory on plant simulation

Module II: Machines Collaboration on a Shop Floor

- laboratory on collaborative machines, robots
- laboratory on collaborative material handling system

Module III: Man-Machine Collaboration on a Shop Floor

- laboratory on collaborative robots

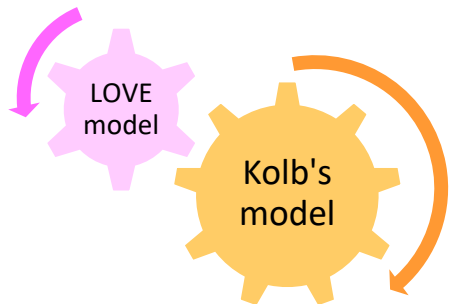


Learning Experience Embedded Course Outline- Collaborative Manufacturing System

Module	Subtopic	Sequence of learning stages (Learning experience)			
		AC	AE	CE	RO
I. Collaborative Manufacturing Management	1. Evolution of Manufacturing Systems	1(LO)		12(LE)	13(L)
	2. Collaborative Manufacturing Management Model	2 (LO)	3(E)	12(LE)	13(L)
	3. Collaborative Manufacturing Management Fundamentals and Infrastructure	7(LO)	4(LE)	5(LO)	6(L)
	4. Ontology for Collaborative Manufacturing	10(O)	11(LE)	8(VL)	9(L)

Entry stage

Fulfil during the group project



Note

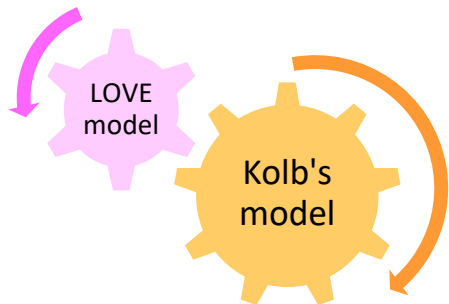
- **Kolb's model** → AC: abstract conceptualization, AE: active experiment, CE: concrete experience and RO: reflective observation.
- **Love model** → L: Learning, O: Observing, V: Visiting and E: Experimenting

Learning Experience Embedded Course Outline- Collaborative Manufacturing System

Module	Subtopic	Sequence of learning stages (Learning experience)			
		AC	AE	CE	RO
II. Machines Collaboration on a Shop Floor	1. Distributed Manufacturing	17(LO)	18(O)	15(LO)	16(L)
	2. Distributed Arrival Time Control for Real-Time Scheduling	22(LO)	19(LE)	20(LO)	21(L)
	3. Collaborative Material Handling System	23(LO)	24 (LE)	25(LE)	26(L)
	4. Collaborative Manufacturing Processes	27(LO)	28 (LE)	29(LO)	30(L)

Entry stage

Fulfil during the group project



Note

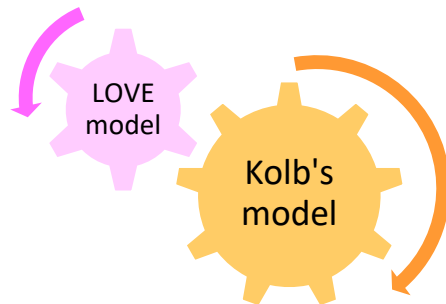
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Learning Experience Embedded Course Outline- Collaborative Manufacturing System

Module	Subtopic	Sequence of learning stages (Learning experience)			
		AC	AE	CE	RO
III. Man-Machine Collaboration on a Shop Floor	1. Evolution of Man-Machine Collaboration	31(LO)	32 (LE)	39 (LO)	40 (L)
	2. Industrial human augmentation systems	33(LO)	34 (LE)	39 (LO)	40 (L)
	3. Flexible Human-Robot Collaboration	35(LO)	36 (LE)	39 (LO)	40 (L)
	4. Cyber-Human System	37(LO)	38 (LE)	39 (LO)	40 (L)

Entry stage

Fulfil during the group project



Note

- **Kolb's model** → AC: abstract conceptualization, AE: active experiment, CE: concrete experience and RO: reflective observation.
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Assessments

	CLO1	CLO2	CLO3	CLO4	CLO5
Formative Assessment Method					
Class discussion and participation (5%)	9	9	3	3	3
Peer assessment in class activities (5%)	3	3	9	9	9
Practical exercises (20%)		3	9	9	9
Assignments (10%)		9	9	3	3
Summative Assessment Method					
Presentation (10%)		3	3	9	9
Group project (50%)		3	9	9	9

9: Strong; 3: Moderate, 1: weak





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Thank You

Together We Will Make Our Education Stronger



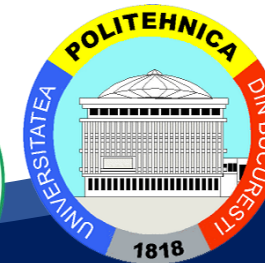
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