TEACHING SESSION PLAN

Module: Engineering in Business	**Level / Stage (6,7,8)** **7, 8** **Year: 1**

Title of session/ topic: Lean Manufacturing

Length of session: 2 Hours

Mark the type of session:

Lecture X **Tutorial ☐** **Lab ☐** **Studio ☐** **Workshop ☐**

Module Outcome (What module outcome(s) is the class/session aligned to)**:**

Outcome 8 – Lean manufacturing

Outcome 2 – design for manufacture

Outcome 3 – bill of materials

Class/Session Outcomes: Upon completion of this session, you should be able to: (Share with students e.g. Write on board /slide/ project image at beginning of lecture for students)

1. Evaluate different approaches to manufacturing
2. Explain what is meant by lean manufacturing
3. Design and construct an assembly line for a particular product
4. Identify and name product rules for assembly / manufacture
5. Time and group manufacturing tasks to balance an assembly line

Select & Prioritise Your Content:

For the session, decide what material is used in class and what material the students should study independently and/or online. To do this, think about the material and its relative importance and prioritise and list in the appropriate quadrant.

	In class / live (online) Support Learning	Independent Learning (student completes)
Priority (need to know)	First: Students allowed to build whichever way they want Second: Lean manufacturing techniques are introduced, tasks are timed and grouped to speed up delivery and improve quality	Resources available on line include video links to Toyota's "Kanban" manufacturing system. Online moodle quiz to be completed at end of lesson
Supplementary (nice to know)	Kanban system which will be covered next lesson	Review of times and product codes

Material in quadrants 1 and 3 typically become the focus during classes. Quadrants 2 and 4 represent material students could study themselves and use the VLE/Moodle and online learning objects to support this learning.

Think about how you might incorporate *Technology Enhanced Learning Tools and Blended Online/Digital Learning Objects,* that will develop students learning and engagement with the module.

Time	**Teacher Activity**	**Student Activity**	**Resource Used**
0-5 min	Explain to students what the lesson will entail – what the learning outcomes will be, what they will be able to do by the end of the session.	Listening	
5-15 min	Talk through theory on lean manufacturing and task at hand	Listening	
15-30 min	Students broken into groups. Assembly kits distributed, problem explained, team names taken, individual job assigned to teams, 1 customer per team is given instructions how to record time and quality	Discussing with peers relating to team name, individual tasks, organising parts from assembly kit	Kando Assembly kit (pictured below). Product information sheets
30-50 min	Task of assembly is carried out – teacher observes, helps out and instructs where necessary. Might be necessary to stop the clock and give students a chance to regroup. 2 mins per trolley	"customer" calls out order, building team has 2 minutes to construct the trolley based on the product sheet. Customer times them and checks quality of finished product	Kando Assembly kit Product information sheets Customer matrix to monitor time and quality

50-60 min	Discussion of success, quality etc. with students – write on whiteboard their %on time, % quality for each team	Calling out numbers to teacher, listening, reflecting, informing teacher where they could improve	Whiteboard
60-75 min	Present information on "product rules", new product codes, assembly lines, timing and line balancing to speed up manufacturing procedure	Listening, note taking	Powerpoint and projector
75-85 min	Aid teams to reorganise based on new information – this time with reduced "staff"	Reorganisation, reassignment of tasks	
85-95 min	Task of assembly is carried out – with new rules – teacher observes, helps out, instructs 1 min per trolley	As before – "customer" calls out product this time using new code. Team builds it (each only building a sub assembly this time)	Kando Assembly kit Product information sheets Customer matrix to monitor time and quality
95-105 min	Reflection on how quality and timing was improved using lean manufacturing techniques	Listening, note taking	
105-115 min		Doing online quiz	Online moodle quiz for lean manufacturing

Note digital student engagement tools required for this session/lesson:

Powerpoint presentation and (on screen) stopwatch displayed during class, projector and whiteboard used. Video demonstrating techniques for trolley assembly will be uploaded to moodle for students who struggle with the classroom environment (or recap / demo for absent students). Moodle is used to complete a quiz at the end of the lesson.

Teacher Reflection:

What worked well?

This lesson is very heavy on the psychomotor domain. Students have to learn during the lesson how to assemble trolleys using parts provided in a kit and a product sheet showing the completed trolleys. The trolleys are not difficult to assemble, but there are 12 different trolleys all quite similar so it is easy to mix up parts or make mistakes. The first pass at making the trolleys was very messy and timing and quality were both very poor. Although the completely student led approach was very chaotic, it is the point of the lesson. After this, techniques for getting the trolleys right (product rules, when part A is blue, part B is also blue etc.) are discussed (these are previously only known to the "customer"). In the first pass the whole group tries to work together. In the second pass, staff are reduced and the time allowed to complete the trolley is also reduced. The actual manufacturing roles of each student are chosen by them, so it is still a very student led approach. I like to incorporate constructivism into my lessons wherever possible, and here the students are learning on what they have just experienced and improving their skills and their techniques. There is very little theory covered – only that which relates directly to their task. This is compared to more complex manufacturing plants (cars, med devices etc.) and the importance of line balancing, stock taking and even manufacturing plant floor layout are very easily demonstrated using this kit. The kit itself is inexpensive but invaluable in demonstrating all of these lean manufacturing techniques at a very practical level to the students.

Another idea I incorporated was to encourage peer review and feedback – this is possible by getting each group to go around to the other groups before the assembly is started to see how they are tackling the problem – there is no "right" way to do the assembly – I'm always eager to encourage peer discussion during a lesson.

What did not work well?

More time should be taken for pre-task guidance and some students decided to start making parts of trolleys before they should be allowed, and were annoyed when they were asked to dismantle them.

Very common mistakes were not pointed out as the students were assembling and these were repeated throughout the first run of the exercise – again students were annoyed at this, but the point of the exercise is to do badly on the first run. Formative feedback is then given once the task is completed once. Methods to improve are suggested but sometimes students continued to repeat old mistakes on the second run with some students deciding to "go rogue" when constructing which was not helpful.

To what extent did you address different domains of learning?

The psychomotor domain is fully engaged during this lesson with basic movements, skilled movements and physical activities all being utilised. Toward the end of the lesson the students perform tasks like a highly skilled assembly line to produce trolleys. The point is not to become good at making trolleys, but to observe the success of lean manufacturing techniques. The increase in quality and parts delivered on time shows the power of lean manufacturing techniques practically

to the students. The students are “learning through doing” – almost completely student led. They see for themselves how techniques improve success.

What would I do differently next time?

More pre-task guidance could be used. Instead of talking them through what they will be doing, I would explain the point of the experiment more clearly to prevent students going ahead themselves or trying to race each other. There is also a tendency for these engineering students to start to build structures during breaks – these have to be disassembled before the next task can be done so I would assign 1 group member to be in charge of stock and disassembly.

Students at work with the Kando Assembly kit (kit, parts and product information sheets pictured):