What's a Scenario? An Electronic and Electrical Engineering perspective.

A scenario is a realistic and authentic real world engineering challenge that is posed to the students. The students are put into small teams and are given a week to develop a solution to the challenge. We have found that around four students per group maximises the input per student, however groups from 3-20 have also been used depending on the scenario.

The development of the solution will involve the following steps (roughly in chronological order):

1. Defining the problem.
2. Understanding the customer requirements and putting these in to verifiable engineering specifications.
3. Brainstorming and developing a potential solution.
4. Testing this and optimising this solution through the use of calculations, computer models and simulations.
5. Optimising the system design and parameters.
6. Conducting experiments to obtain performance estimates and unknown parameters.
7. Prototyping parts of the solution and testing that these meet the specification and operating requirements.
8. Constructing the complete prototype.
9. Demonstrating the operation of the final system or aspects of it.
10. Communication of results to the customer and to the production team.

Each challenge is designed to draw on the knowledge and skills that the students have gained in the taught courses and laboratory sessions that precede it. The topic of the scenario should be sufficiently open so a range of solutions are possible but should be sufficiently constrained to ensure that students should be able to develop a solution that meets at least some of the design requirements. We have found that students particularly engage with scenarios where they produce a tangible output. Constraining can be achieved through: having quite a focused task (don't make the problem to broad), having tightly defined outcomes, restricting the range of components that are available and/or cost of components (setting a budget).

The rationale behind a week long scenario in which students only work on the scenario is to simply the time management for the students, here they only have one task to work on and a single deadline. This also more closely mimics an industrial design team that is working to a deadline on a single project. To further simplify the time management and team working we use a series of timetabled check points during the week where the students are required to present their progress to a facilitator. At these presentations the facilitator also provides feedback often in the form of have you thought about X? or considered requirement Y?

A typical Scenario timetable is as follows:

Monday 10:00 Brief introduction, present the problem as a customer and define the scenario deliverables. (30 minutes)

Students then work in a group on tasks 1-3 above.

Monday 15:00 Presentation of Design Brief (10 minutes per group). The students present there proposed design and explains how this will meet the customer requirements.

Tuesday Hardware signoff. Students present detailed designs, models and simulations as required to justify any hardware that they require.

Friday Scenario Assessment. Students typically present their results in the form of a short presentation 1 slide per person to a facilitator. They then demonstrate their system and the facilitator asks questions about the design. Students may also be asked to submit a report often in the form of a design specification which may include: A statement of purpose, system diagram, system specification, user guide, circuit diagrams and cad drawings to allow the system to be reproduced.

The students are required to have a team meeting each day during the scenario to ensure that each member of the team knows what the others are doing and to ensure that tasks are assigned to each member. The meeting chair and minute taking is rotated through each member of the team. Meeting agendas and minutes are submitted to ensure that this is done.

Examples of Scenarios

Electronic and Electrical Engineering

Electromagnetic weight lifting. Here the goal is to design an electromagnet coil that lifts the most weight. The system is constrained by the coil winding space and the batteries that are allowed to power it. The problem requires students to experimentally characterise the appropriate battery parameters and develop a mathematical model of the entire system in order to determine the optimum wire gauge and battery combination with which to construct the coil. Students then construct the coil and it is tested in a competition with the other teams the winning team is the team who lifts the weight that is closest to their predicted weight.

What's the number on the line? (AKA Phone tapping). Here the goal in to non-destructively determine the phone number that is being dialled on a phone cable that is strung around the lab. The students need to develop a sensing system to capture the analogue signal and then decode the number, which they will typically do using digital signal processing.

Engineering the perfect Espresso. Here the goal is to develop a system that is able to tell the baristas what the flow-rate is when making an espresso that will also survive the wet and steamy environment of a coffee shop. The system should also simplify the baristas workflow. This requires the interfacing of an appropriate sensor and programming of a microcontroller to calculate the flow-rate and display it to the barista along with the integration of multiple systems into a single device.

Where did they live? Students are given a set of data that has been extracted from the sensors on a commuters cell phone after a tube disaster at Kings Cross. Here the aim is to use this data to determine to address of the cell phones owner. The students first have to determine what the data is (accelerometer and compass readings) and then used this to work out where the person is likely to live.

Muscle activity Sensing. Students are asked to develop a sensor that is able to measure the activity of muscles and use this to control something like a robotic arm.

Biochemical Engineering

Growing Duckweed. Students are tasked with designing a bioreactor for a client to culture a Lemna strain producing a biopharmaceutical compound. Students are given a target product yield they need to achieve and have the opportunity to collect kinetic data on this strain in the lab to inform their design. Using CAD software they then develop a 3D model and, once this is fabricated, test the mixing efficiency, light cover, ease of use, sampling, cleaning etc and must demonstrate its capabilities and competitiveness from a cost and sustainability point of view.

Finally and most importantly scenarios must capture the imagination of students, excite students and allow them to put into practice the skills that they will require as a practicing engineer. To this end the assessment should not be onerous for them and us and the task should be constrained to the week.

Facilitation sessions

During the week

Assessment (within the week)

Four slide presentation. The group prepares a four slide presentation, each member of the team should be able to present any slide. Each team member is randomly chosen to present one slide and asked a question on that aspect of the system. The Student Presentations and feedback comments from the assessing academic are videoed. Students are then required to watch the videos and comment on the good and bad aspects of their performance in their reflective portfolios.

System Spec Sheet.

Templated summary of results. Single page report.

Group or individual marks

a) Flat group mark

b) Group + individual. A straightforward method of assessing the individual's contribution and understanding is to use the single slide presentation and question during the presentation.

d) Peer assessment to provide and individual component. A tool will be provided

60-80% Technical

20-40% Professional Skills

Students should receive their marks and feedback within a week.

Putting together groups

Splitting first year tutorial groups. Students have already met each other.

Assigning groups based on order of arrival.

Overt social engineering of groups has not found to result in better groups than random allocation. In fact it will often produce more extreme results.

Tips and Tricks

Team Icebreaker.