Name: _____ Group:_____

THE CASE STUDY

SIMULATION SITUATION

A revolutionary breakthrough in medicine and technology!

The creation of the powered exoskeleton, an orthopedic robot, could well revolutionize the daily lives of people with impaired mobility. This extraordinary robot has the ability to replace or support defective muscles of the human body by transmitting or transforming motion. It can be used to good advantage in many situations, for instance, to boost the strength of elderly or disabled subjects or to aid in rehabilitating the injured. The robot could also be used in the industrial sector for easy handling and transport of extra heavy loads. Although still in its infancy, the powered exoskeleton is a highly promising invention that bears watching with keen interest.

Exo inc. is intent on claiming a lion's share of the exoskeleton market and is pulling out all the stops to succeed. Certain sources report that the company president has asked a firm of consulting engineers to develop new products.

MEMO
Robotech Consultants

TO: All consulting engineers
DATE: February 9, 2022
SUBJECT: Awarding of Exo inc. contract

We are proudly to announce the recent awarding of a major contract: Exo inc. has retained our services to draft plans for an exoskeleton that can:

- lift the user (in order to get into bed, take a bath, and so on)
- enable the user to pick up objects
- enable the user to bend over
- enable the user to raise his or her legs

Entrusted with this mandate, we are forming a working group of four consulting engineers who will analyze everyday objects (and their systems) in order to understand how they function and find inspiration for producing design plans for the exoskeleton. If you are interested in this project, kindly let me know as soon as possible.

Thank you for your collaboration.

Robert Smith
Robert Smith
General Manager

In this situation, you are to play the role of a Robotech consulting engineer who signs on for the exoskeleton project. Your job will require you to:

- Choose one of these four objects: can opener, corkscrew, correction roller or pipe wrench.
- Analyze your object by drawing:
  - a design plan
  - a technical diagram
- Produce a design solution for a specific exoskeleton function.

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Name: _____ Group: _____

CREATING THE CONTEXT

I ask myself questions

1. What is an orthosis?

2. What is a prosthesis?

3. What is a exoskeleton?

4. For whom are you designing the exoskeleton?

5. What questions will guide your technological analysis?

I must

6. Reformulate the goal of the case study in your own words.

Name: _____ Group: _____

CREATING THE CONTEXT *(continued)*

I think

7. What type of system do you think each of the following objects contains? Is it a motion transmission or transformation system? Justify your answers.

Can opener: _____

_____

_____

Corkscrew: _____

_____

_____

Correction roller: _____

_____

_____

Pipe wrench: _____

_____

_____

What I know and what I must find out

8. Use the table below to write down the information you have and the information you have to find.

What I know . . .	What I must find out . . .

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Name: _____ Group: _____

CREATING THE CONTEXT *(continued)*

I prepare my work

9. How will you find the information you need for your case study?

10. Identify the main steps of your study in chronological order.

Reflection

	Yes	No
Do I clearly understand what I have to do?	☐	☐

Name: _____ Group: _____

GATHERING INFORMATION

I do research

1. What are the basic mechanical functions?

_____

2. Name two types of guides.

_____

3. Name six types of links.

_____

_____

_____

4. What is a motion transmission system? Give a few examples.

_____

_____

_____

_____

_____

5. What is a motion transformation system? Give a few examples.

_____

_____

_____

_____

_____

6. What is a driver?

_____

_____

7. What is a driven?

_____

_____

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Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

I analyze my results

Examine your chosen object and answer the questions below.

1. What is the object?

_____

2. What is its global function?

_____

_____

3. Name a few physical, human or esthetic constraints that may have influenced the design of this object.

- _____
- _____
- _____
- _____

4. Produce the design plan for your object on the next page. Mark the following information on the plan:

- ☐ the name of each part
- ☐ the symbols for the motion transmission or transformation system
- ☐ the symbol for the force used
- ☐ the symbols for the types of motions produced
- ☐ the type of system involved
- ☐ the names of the driver and the driven

5. Produce the technical diagram for your object on page 8. Mark the following information on the diagram:

- ☐ the shapes of the parts
- ☐ the names of the parts
- ☐ the names of the links
- ☐ the symbols for the guides
- ☐ the materials to be used

Reflection

Do I clearly understand what are:	Yes	No
• typical functions?	☐	☐
• links of mechanical parts?	☐	☐
• function, components and use of motion transmission systems?	☐	☐
• function, components and use of motion transformation systems?	☐	☐
• speed change?	☐	☐

Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

Design plan

Type of system: _____ Driver: _____

_____ Driven: _____

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Name: _____ Group: _____

GATHERING INFORMATION *(continued)*

Technical diagram

Name: _____ Group: _____

COMPLETING THE CASE STUDY

I make suggestions

1. Working with your team, match the objects (and their systems) with the exoskeleton functions.

– Using the diagrams produced by the team members, name the system used by each object.
– Then use an arrow to connect each system with an exoskeleton function.

Object	Exoskeleton function
Can opener System: _____	Lifts the user.
Corkscrew System: _____	Enables the user to lift objects.
Pipe wrench System: _____	Enables the user to bend over.
Correction roller System: _____	Enables the user to raise his or her arms.

2. Working on your own, decide on your design solution for the exoskeleton function you chose.

– Explain briefly your design solution for your part of the exoskeleton.
Describe how your part of the exoskeleton performs the target function.

_____

_____

_____

_____

– Use the next page to produce a design plan illustrating how your system will perform the function of the part of the exoskeleton you have chosen.

– Explain what types of links and guides would be included in your part of the exoskeleton.

_____

_____

_____

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Name: _____ Group: _____

COMPLETING THE CASE STUDY *(continued)*

Design plan

Type of system: _____ Driver: _____

_____ Driven: _____

Reflection

	Yes	No
Have I considered various design solutions?	☐	☐

Name: _____ Group: _____

VALIDATING THE CASE STUDY

I justify my approach

1. Explain how your part of the exoskeleton performs the target function. Describe precisely how motion is transmitted or transformed in your system.

2. Name at least one advantage of your system.

3. Name at least one disadvantage of your system.

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Name: _____ Group: _____

MY EVALUATION

Use the evaluation grid on the next page for your self-evaluation. Enter A, B, C, D or E in the appropriate spaces in this table.

SSC2 Makes the most of his/her knowledge of science and technology				
Criteria*	**Observable indicators**	**Me**	**Teacher**	**Comments**
1	**Creating the context** Definition of the goal and formulation of questions for analyzing the technology		☐ With help	
2	**Gathering Information** Production of a design plan and a technical diagram for the chosen functional object		☐ With help	
3	**Completing the case study** Identification of a design solution and choice of appropriate types of links and guides		☐ With help	
4	**Validating the case study** Justification of the design solution		☐ With help	

*** Evaluation criteria**

1 Formulation of appropriate questions
2 Appropriate use of scientific and technological concepts, laws, models and theories
3 Relevant explanations, solutions or actions
4 Suitable justification of explanations, solutions or actions

Name: _____ Group: _____

EVALUATION GRID

SSC2 Makes the most of his/her knowledge of science and technology

Criteria*	Observable indicators	A	B	C	D	E
1	**CREATING THE CONTEXT** Definition of the goal and formulation of questions for analyzing the technology	The questions for analyzing the technology are relevant. The goal is very clearly defined.	The questions for analyzing the technology are relevant. The goal is clearly defined.	The questions for analyzing the technology are more or less relevant OR the goal is more or less clearly defined.	The questions for analyzing the technology are more or less relevant AND the goal is more or less clearly defined.	The work needs to be redone.
2	**GATHERING INFORMATION** Production of a design plan and a technical diagram for the chosen functional object	The design plan and the technical diagram for the chosen object are accurate and complete.	The design plan and the technical diagram for the chosen object are complete, but contain a few minor errors.	The design plan and the technical diagram for the chosen object are incomplete or contain several errors.	The design plan and the technical diagram for the chosen object are incomplete and contain several errors.	The work needs to be redone.
3	**COMPLETING THE CASE STUDY** Identification of a design solution and choice of appropriate types of links and guides	The design plan shows how the chosen solution works. The choice of link and guide types is appropriate.	The design plan shows how the chosen solution works, but there are several minor errors or omissions. The choice of link and guide types is appropriate.	The design plan shows more or less how the chosen solution works OR the choice of link and guide types is more or less appropriate.	The design plan shows more or less how the chosen solution works AND the choice of link and guide types is more or less appropriate.	The work needs to be redone.
4	**VALIDATING THE CASE STUDY** Justification of the design solution	The justification is very clearly stated and relevant. At least one advantage and one disadvantage are given and are relevant.	The justification is clearly stated and relevant. At least one advantage and one disadvantage are given.	The justification is more or less relevant Or the advantage and the disadvantage are more or less relevant.	The justification is more or less relevant AND the advantage and the disadvantage are more or less relevant.	The work needs to be redone.

*** Evaluation Criteria**

1 Formulation of appropriate questions
2 Appropriate use of scientific and technological concepts, laws, models and theories
3 Relevant explanations, solutions or actions
4 Suitable justification of explanations, solutions or actions