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EXECUTIVE SIMULATION MEZQUITE: INC¹

Introduction

Founded by a well-renowned business dynasty, Mezquite Inc. is a small growing company created to sell and manufacture electrical household appliances based on new, open-source technology. The ELECTROCLEAN, the first product sold by the company, is the first appliance of its kind on the market and aims to develop a whole new category in the competitive home appliance landscape. As stated by a member of the third generation of the dynasty and the leading family member involved in launching the company: “*We want the ELECTROCLEAN to be an integral part of every household*”.

Two years after its launch, the owners have decided to change the company’s management to accelerate growth and spur global expansion. Recognizing your leadership skills and expertise, you have been recruited to join this new management team.

The company operates in a competitive market alongside similar firms that have also used the same technology to develop equivalent products. At the start of your tenure, all companies in this emerging industry segment are in the same competitive position: 1) They sell an identical Electroclean product with the same initial characteristics, 2) They have achieved comparable sales and market share in the regions where the product is available, and 3) They share similar production capabilities, financials, and company histories.

¹ Based on the case P 01 eC 01 “Mezquite LTD., A Managerial Business Simulation”, by Professor Miguel Estrada.

Case developed by Professor **Arturo Orozco Leyva**, of the Operations Management Department of the Instituto Panamericano de Alta Dirección de Empresa, and Professor **Albert Girbal Puig**, **Àlex Grasas**, and **Alejandro Lago** of the Production, Technology, and Operations Management Department from IESE Business School, for it to be used as a basis for discussion and not as an example of adequate or inadequate management in a specific situation.

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The Decision-Making Process: The Simulation Context

As the new management team, you are responsible for making strategic, tactical, and operational decisions over the coming years of the company—unless you are dismissed due to poor performance, mismanagement, or lack of trust from the Board of Directors.

Your decisions must span all key functional areas: Product design, marketing and sales, operations, logistics, finance, people, ESG,² etc. Importantly, these decisions must be aligned with a clear and adaptable company strategy.

Time in the simulation is organized into “Periods”, each representing four months and composed of 8 fortnights of 10 working days (also called Subperiods), totaling 80 working days per period. Each simulated year includes three periods, resulting in a full year of 240 working days (3×80). When you take over as management, you begin at Period 7, which corresponds to the start of Year 3 of operations.

At the start of each period, you must input all your company decisions into the simulation platform. These decisions fall into two categories:

1. **Period-wide decisions.** These remain fixed for the entire four-month period (e.g., product pricing, machinery purchases, long-term financing adjustments).
2. **Fortnight-specific decisions.** These allow for finer control (e.g., product shipments, credit line changes) and must also be planned before the simulation run.

Important: All decisions for the period—both strategic and operational—must be submitted together before the simulation run begins.

Once decisions are submitted, the simulation runs and generates detailed performance reports covering market results, operational efficiency and financial outcomes. These reports reflect both your company’s decisions and those of your competitors. You will use these outputs to evaluate your strategy, identify mistakes or missed opportunities, and plan your actions for the next period.

Details on the company’s current market situation, your functional responsibilities, and how to navigate the simulation platform are provided in the accompanying *Participant’s Guide*.

What follows provides details on the company’s market and financial situation, as well as the functional responsibilities and decisions your team will need to address. Specific instructions on how to access the simulation, input decisions, and analyze reports can be found in the accompanying *Participant’s Guide*.

Chapter I. Global Market Context

Section I. a) Regions, Segments, and Demand Forecasts

Market Regions. Mezquite operates in a global market divided into 5 distinct regions: Center, West, East, and South. Each region functions independently, with unique market demands and customer behaviors specific to that region.

² The term ESG (Environmental, Social and Governance) refers to a series of criteria used to assess a company’s performance and commitment in these areas. At Mezquite, certain decisions directly influence these criteria.

Customers Segments. Each region varies in population size and demographics. However, since Electroclean represents a new product category, information on customers segment preferences and behavior remains relatively scarce.

Your marketing department has decided to divide the market into two primary sociodemographic segments:

- *High-end:* This segment consists of individuals and families with medium-to-high incomes, representing a smaller share of the population in each market. While evidence is not conclusive, this group is expected to be less price-sensitive and place greater value on product performance, advanced functionalities, and design.
- *Low-end:* This segment includes individuals with mid-to-low incomes (those with very low incomes are not considered a target for the new appliance). It constitutes a larger portion of the population in most markets. While generally more price-sensitive, their attitudes toward the product are not yet fully understood. They are expected to prioritize performance and efficiency but may also show interest in additional functionalities due to the novelty of the appliance.

Population and aggregated demand. The product has been introduced in the Center, West and North regions over the past two years, achieving significant growth and market penetration. The East and South regions remain untapped markets.

The estimated average household population per company for each segment and region is provided in **Table I. 1**. The average demand per company (in units) observed during Periods 1 to 6 in the markets where Mezquite is present is available in **Table I. 2**.

The estimated average households per company for each segment identified in the different regions of the country is provided in **Table 1. 1**. For example, in the Center region, Mezquite estimated that there would be around 110,000 households, in average, per company in this region.

The simulation uses population and market demand data on a per-company basis, allowing it to scale dynamically with the number of companies. To determine the total population size and total demand for each market, the average values from the tables must be multiplied by the number of companies operating in that market.

Table I.1 Target Populations* Per Company by Region and Segment (in # of households)

Segment\Region	Center	West	North	East	South
High-end	35,200	24,000	19,600	10,000	9,600
Low-end	74,800	51,000	50,400	40,000	20,400

(*) Target populations assume that, over the long term, Electroclean could achieve a stable 22% to 25% penetration over the total households in the markets where it is being sold.

Table I.2 Average Demand per Company by Regions in Periods 1 to 6 (units)

Year	Period	Center	West	North
1	1	4,100	1,800	700
	2	3,600	1,900	1,200
	3	6,600	2,700	2,600
2	4	6,000	2,800	2,700
	5	5,100	2,900	2,700
	6	8,900	4,028	4,100

Historical sales data indicate some seasonality, with higher growth observed during the holiday season in the last period of each year (Periods 3 and 6).

Future growth forecasts, however, lack industry consensus. Existing markets are expected to see continued product penetration, though growth rates may slow or stagnate as penetration matures. The East and South markets are expected to follow a similar trajectory but with significant uncertainty. These markets could develop more rapidly due to the faster spread of information across regions.

Table I.3 shows the expected annual demand per region in year 3 (comprising Periods 7, 8, and 9) according to aggregated studies.

Table I.2 Average Demand per Company by Regions in Periods 1 to 6 (units)

Region	Expected Demand in Year 3
East	3,000 to 5,000
South	2,500 to 3,500

Total demand, however, is subject to multiple factors influenced by aggregated company decisions, including average market prices, total advertising expenditure, product appeal, and other variables. It is the responsibility of the Marketing and Sales department to account for these uncertainties when developing the company's forecasts.

Section I. b) Competitor's Position

Competitors. The number of companies competing in each region may vary across simulations (hence the need to use average demand per company).

At the beginning of Period 7, all competitors (including your company) offer the same entry-level product in the Center, West, and North regions. Consequently, all competitors initially hold equal market shares in these regions. For example, with five companies in the simulation, each would control 20% of the market in each of these regions at the beginning of Period 7.

In the East and South regions, where no product has yet been introduced, the competitive landscape is open. Market shares in these regions will depend on the sales generated by each company's decisions during the period. In the extreme scenario where only one company enters a new market, that company would capture 100% of the market share for that period.

The product and marketing decisions that your company makes in each region, compared to those of your competitors, will determine the potential demand you can meet in each region (and consequently, your potential sales and market share). Since each market operates independently, companies can adopt distinct strategies for different regions. For example, a company might lead the market in the Center region but hold minimal market share in the West or North regions.

As markets evolve and mature, market shares are unlikely to shift dramatically from one period to the next due to consumer inertia. This should be factored into your strategy when positioning your company in each market. Gaining significant market share in a region where competitors are already well-established may require sustained commercial effort over multiple periods.

However, abrupt changes in market share can occur due to competitors' risky strategies or operational failures. For instance:

- **Pricing Missteps:** Consumers have limits on their disposable income for appliances like Electroclean. Excessively high prices or abrupt price changes can lead to sudden sales drops and market share losses.
- **Operational Failures:** A company may be unable to fulfill the potential demand generated by its commercial strategies due to poor operational planning, production issues, or inaccurate forecasting. This results in lost sales and an actual reduced market share. In extreme cases, it could even lead to the company being effectively pushed out of the market.

Section I. c) Channels and Sales

The primary distribution channel for Mezquite products consists of regional distributors. These distributors are Mezquite's direct customers and are responsible for supplying products to various retailers through their proprietary networks of warehouses and transportation. Importantly, each distributor operates exclusively within its assigned region, meaning distributors in one region are entirely independent of those in other regions.

As the simulation progresses, additional sales channels may become available. These could include direct sales to large retail chains, partnerships with online merchants (e.g., Amazon), or developing your own e-commerce platform. However, the availability of these channels depends on the simulation's context and decisions made by the instructors. More details on the specific decisions needed to manage the distributor channel are given in **Section III. c) Channel Commercial Effort**.

The total demand generated by your company in a period is evenly divided over 4 months. This demand is allocated to the end of each month, corresponding to the even fortnights (fortnights 2, 4, 6, and 8). If you fail to meet the requested demand in any of the even fortnights, the unmet demand in this month is lost and is considered a lost sale.³ This process is independently verified in each of the five market regions. To minimize lost sales, it is essential to plan and distribute your production of Electrocleans to regional warehouses efficiently to meet demand on schedule.

Chapter II. Innovation

Mezquite currently commercializes a single product under a unique brand. Due to the early stage of innovation and budgetary restrictions, the product offered in the market has limited features. However, the Innovation department has been collaborating with marketing to define a range of possible improvement features aimed at making the product more appealing to different market segments.

As part of the innovation strategy, the company must decide which improvements are more relevant, considering that these enhancements have an impact on key customer preferences, such as

³ A lost sale does not increase demand at the competition in the period in question, but it does jeopardize one's own demand in the following periods.

design/aesthetics, performance, and convenience. Different segments prioritize these dimensions differently, and these preferences may evolve over time.

The Innovation department has evaluated the proposed features and estimated the upfront development investment required to integrate each feature into a new Electroclean design. They have also estimated the extra variable cost per unit produced for each improvement, accounting for increased labor and additional components. Notably, the improved features are incorporated into the product during a just-in-sale postponement process at the company warehouses, right before the product is shipped to distributors. This approach reduces production and logistics complexity by maintaining only the basic product configuration in inventory. The improvements are applied at the final stage, eliminating the need to produce, manage, and track different product variants throughout the simulation. This strategy streamlines operations while offering flexibility in meeting customer demands.

Table II. 1 provides a preliminary list of product features, along with their estimated upfront development costs and extra variable production costs. The costs are additive, meaning that the total investment and variable costs for incorporating multiple features are the sum of the individual costs of those features.

The development costs are paid upfront at the beginning of the four-month period when the decision to introduce the feature is made. The company accounting policy is to record these development costs as intangible assets in the balance sheet and amortize them over the course of 3 periods.

The extra variable costs are incurred (and paid) at the time of sales (i.e., in the even fortnights). These costs are calculated as the units sold multiplied by the extra unit cost. In the accounting records, they are reflected in the P&L as an extra variable production cost item line (refer to **Section VI** for more details).

Once an improvement is chosen, the feature becomes active at the beginning of the current period and remains active in the subsequent periods without incurring additional development costs, though variable costs continue to apply as sales occur.

Chapter III. Marketing

The Marketing and Sales teams are tasked with setting product prices, allocating advertising budgets across various media, managing commercial efforts in the sales channels, and defining payment terms for each region. Below, details and impact of each of these decisions are reviewed.

Section III. a) Price

Companies can set different final customer prices for each product and market region where they wish to operate. Prices are set once at the beginning of the four-month period and remain fixed throughout the period. (i.e., they cannot be adjusted fortnightly). If you intentionally decide not to enter a market region or wish to exit a market in a period (regardless of the market share), you must set a sale price of zero for that region. Note that this will cause all marketing decisions to have no effect; for example, if you advertise in a market but set the price to zero, the advertising will have no impact on customer awareness.

When determining your pricing policy, consider the varying price sensitivities of customer segments. The high-income segment is less price-sensitive than the low-income segment. While there is no regulated maximum price, excessively high prices can be perceived as unreasonable by the market.

In such cases, distributors may suspend their orders entirely, leading to a potential loss of market presence.

Table II.1 Product Improvements

ID	NAME AND DESCRIPTION	Innovation Cost	Product Cost
# 1	STAINLESS MATERIAL This makes the appliance attractive and durable.	\$15,000	\$ 0.15/unit sold
# 2	RECYCLABLE MATERIALS The appliance is produced with environmentally friendly materials that can be recycled at the end of their lifecycle.	\$30,000	\$ 0.15/unit sold
# 3	ENERGY EFFICIENCY The appliance becomes more efficient and uses less electric power for its operation.	\$30,000	\$ 0.15/unit sold
# 4	LIGHTER AND MORE COMPACT The external design of the appliance is modified so it may be installed in an easier way.	\$30,000	\$ 0.30/unit sold
# 5	IMPACT RESISTANCE The frame material is replaced so it becomes more resistant to impacts.	\$30,000	\$ 0.30/unit sold
# 6	NOISE REDUCTION The Electroclean becomes less noisy.	\$45,000	\$ 0.30/unit sold
# 7	IMPROVED BATTERY CAPACITY The Electroclean's battery life allows for a longer performance on a single charge.	\$45,000	\$ 0.45/unit sold
# 8	SELF-CLEANING The system can automatically cleanse its container, requiring the user to only change the water in a dedicated container.	\$45,000	\$ 0.45/unit sold
# 9	SPEED SETTINGS By substituting the electronic device used by the appliance to supply energy to the motor, the Electroclean may operate at three different speeds, which allows increasing its applications.	\$30,000	\$ 0.45/unit sold
# 10	DIGITAL CONTROLS A new digital-type unit in the controls of the appliance, with luminous display, makes it more attractive and sophisticated.	\$45,000	\$ 0.45/unit sold
# 11	VOICE-CONTROLLED SYSTEMS The integration with voice-controlled systems, like Siri or Alexa, allows users to control the appliance by giving voice commands for a handsfree experience.	\$45,000	\$ 0.75/unit sold
# 12	AUTOMATION AND PROGRAMABILITY It automatically starts and ends the programmed functions.	\$45,000	\$ 0.75/unit sold
# 13	MULTIFUNCTIONAL ACCESSORIES With some design modifications, the Electroclean can be connected to a series of accessories already existing in the market, which increases its possible uses.	\$115,000	\$ 1.00/unit sold
# 14	MAPPING TECHNOLOGY Using advanced mapping technology, the Electroclean navigates and cleans in an efficient manner, covering all spaces and avoiding obstacles.	\$115,000	\$ 1.00/unit sold

During the 6th four-month period (the most recent period of Mezquite's operations) the price set for each Electroclean was \$68 in the Center and West market regions. In the North market, however, the

price was set at \$91. This price difference is due to Mezquite's production plants being located in the Center and West regions, while in the North, additional transportation costs are incurred to distribute products. Despite the higher price, the North population has shown moderate acceptance. Pricing for the South and East markets remains largely unknown. However, populations in these regions are likely to have rational limits, based on their budgets and alternative options, regarding what they perceive as a reasonable price.

Section III. b) Advertising

Advertising for the Electroclean is conducted through traditional media outlets: radio and television. The Marketing department is responsible for developing an advertising media plan based on available channels. A subcontracted advertising agency will handle the design, production, and media placement according to your plan. Instructors may choose to open the possibility of using other advertising channels during the simulation, in which case additional instructions will be provided.

The key elements to define for each period include:

Ad intensity in each media (e.g., number of ads). For traditional media like TV and radio, this intensity is defined by the number of spots to be broadcasted in each media for each region during a period. TV has global coverage across all regions so your advertising decisions will have an impact on the five market regions simultaneously. Hence, you only have to decide the total number of spots. The impact of these spots is the same in all regions and it is independent of how many regions Mezquite is present in. On the other hand, radio spots have a local reach and impact in each region and, hence, must be contracted region by region. Each spot has a unit cost which includes the basic production and broadcasting rights (see **Table III.1** for a summary of media description and costs).

Message focus. You need to strike a balance between two types of advertising focus:

- A generic focus, which emphasizes your brand while linking it to the overall benefits of the Electroclean as a product category, and
- A feature focus, which highlights the particular advantages and features that differentiate your company's product from those of competitors.

You can define this balance using percentages. For example, a 50% generic / 50% feature mix in TV advertising would give equal emphasis to general product benefits and your company's specific differentiators. A 25% generic / 75% feature focus would lean more heavily on your product's unique attributes. However, each orientation must have at least 10%, meaning the only acceptable extremes are 90/10 or 10/90 — a 100% focus on either side is not allowed.

Generic focus is most effective in the early stages of market development, when customers are still unfamiliar with the product category. It helps to create awareness and associate the Electroclean concept with your brand name. Overloading customers with technical details at this stage may reduce ad effectiveness and make your brand less memorable. Moreover, a generic message creates an early demand for an Electroclean as it informs customers about the need and benefits. Aggregated advertisement by all companies generates the need to purchase an Electroclean and shall generally increase the overall demand for the product.

On the other hand, the feature focus is better suited for customers who are already familiar with Electroclean and are considering a purchase. In this case, highlighting your product's distinct features can help steer buyers toward your brand instead of a competitor's. Feature focus becomes more relevant as the market matures and product penetration increases (i.e., later periods). It is also

necessary when, as a company, you invest in product innovation substantially as you may need to make your customers aware of your product's new features.

Media Strategy. When allocating the budget across media, companies need to consider the reach and impact of different media on the various segments of each market: TV advertising is used to address more affluent customer segments, while Radio should reach low-income segments with greater impact.

It is important to consider the strong competition for consumers' attention: the more competitors advertise, the harder it will be for your commercials to stand out and secure prime-time slots. Conversely, excessive overall advertising can lead to information saturation, resulting in diminishing returns as advertising efforts are significantly increased.

To address this, we recommend maintaining a well-balanced communication strategy while closely monitoring the actions of competitors. This approach will help you avoid both overexposure and insufficient advertising efforts.

Your total advertising expenses will include the combined cost of all your TV and Radio spots in a period. This total expense will be evenly distributed across eight fortnights and paid fortnightly throughout the period.

Table III.1. Media Types, Characteristics, and Costs

Media	Reach	Decision	Focus	Cost	Observations
TV	National	# of spots	Min 10% brand / 90% generic Max 90% brand / 10% generic	\$3,000 /spot	Higher reach in high-income segments
Radio	Regional	# of spots per region	Min 10% brand / 90% generic Max 90% brand / 10% generic	\$300/spot	Higher reach in low-income segments

Section III. c) Channel Commercial Effort

As described earlier, Electrocleans are primarily sold through distributors. The company must determine the level of commercial effort to allocate to developing and maintaining distributor relationships through a dedicated sales force. Sales representatives are responsible for regularly visiting local distributors to promote sales, discuss product placement, and encourage them to push Electrocleans to retailers.

The size of your sales force, relative to that of your competitors, determines your distributor coverage in each region and the extent to which distributors prioritize your product over competitors'. A larger sales force can lead to higher sales by increasing influence at the distributor level. While a strong sales force is especially important during the early stages of market penetration, the need for constant supervision tends to decrease as distributors become loyal and your product gains market presence. Loyal distributors may maintain relatively strong sales volumes even with a smaller sales force. However, the effectiveness of your sales team will always depend on the actions of competitors in the region.

Sales representatives are full-time employees. The company incurs a one-time hiring cost per new salesperson at the beginning of the period, covering recruitment and training expenses. Salespeople receive a fixed salary, paid fortnightly, and do not earn commissions. This salary cost is evenly

distributed across the eight fortnights of the period in which they are hired. Layoffs do not incur additional expenses. **Table III. 2** summarizes the specific cost parameters of your workforce.

Lost sales (potential demand generated but unmet) can frustrate the sales team. When this occurs, some sales representatives may resign, typically at the rate of one salesperson per region per month of lost sales. This resignation may happen even if the lost sales are only a small fraction of the total demand.

Table III.2. Distributors' Sales Force Effort Main Parameters

Channel	Current commercial effort (period 6)	Set-up cost (hiring cost)	Recurrent cost per period (salary)
Distributors	Sales force 44 salespeople	\$1,000	\$750

Section III. d) Payment Terms

You may offer up to four different payment plans to distributors, with each plan involving additional discounts in exchange for faster payment. Within a region, all distributors are subject to the same payment terms, meaning you can select only one payment plan per region and period. Discounts tied to payment terms do not influence competitive market allocation. Offering higher discounts will not result in distributors or retail chains increasing their capacity to sell larger volumes. Payment plans are therefore a purely financial decision.

Table III. 3 shows the discounts and payment periods.

Table III.3 Discounts and Payment Terms

Payment Type	Payment term (fortnight)	Discount
A	0	13.0%
B	2	7.5%
C	4	2.5%
D	8	0.0%

From an accounting perspective, Electroclean units delivered to distributors are recorded as net sales revenues in your P&L at the distributor price (which is the final customer selling price minus the distributor margin). Discounts related to payment terms are then deducted to determine net sales revenue in the P&L. Notably, sales occur and are recorded only in even fortnights (at the end of the month).

Accounts receivable arise when sales are recorded but payment is deferred based on the agreed payment terms. In the simulation, sales are recorded only in even fortnights, while payment collections depend on the type of payment terms agreed with the distributor. For example, if a distributor with payment terms of type C receives a sales order in the 2nd fortnight, your company will log that as receivable in the balance sheet and will only collect the cash payment after four fortnights, i.e., at the beginning of the 6th fortnight.

Chapter IV. Production and Procurement

The company must decide its production footprint, which involves determining (a) which of the regions has a production facility and (b) dimensioning the adequate size of the factory in terms of real estate (“plant modules”), equipment (“machines”), and workforce, according to a given production structure.

Section IV. a) Manufacturing Process

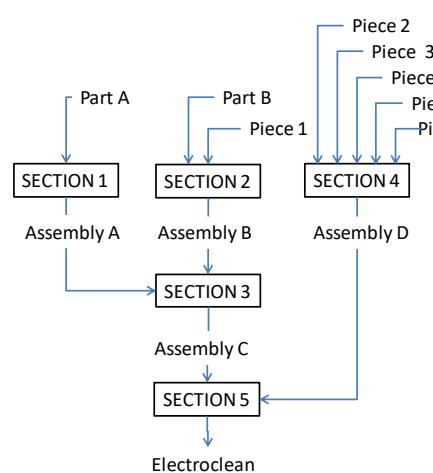
The production process is shown in **Figure IV. 1**. As seen from the figure:

- The process is divided into five stages (or “sections”).
- Eight different “Raw Materials” are necessary to manufacture the Electroclean: Parts A and B, and pieces 1 to 6 (the distinction between parts and pieces is detailed in Section IV. c). The quantities needed for one finished product are specified in **Figure IV. 1**.
- Sections 1 to 4 produce intermediate assemblies A, B, C, and D (“Work-in-Progress”) while Section 5 assembles the final product (“Finished Goods”).
- Production time for each one of the five sections is one fortnight. For instance, parts A entering section 1 at the beginning of the fortnight are transformed into assemblies A at the end of that same fortnight and will be available in section 3 at the beginning of the next fortnight. Note that assemblies manufactured in the last fortnight of the previous period will arrive as input for production in the first fortnight in the new period in the next section.
- Finished products (Electrocleans) in Section 5 are available to be shipped or sold in the same fortnight they are produced.

To set your production schedule for a plant, you must define the regular production level for each section on a fortnightly basis, that is, the number of units to be produced in each section during regular working hours of every fortnight. Additionally, you may choose to enable Saturday overtime during selected fortnights, which allows you to produce up to 20% more than the planned quantity for that fortnight.

Your ability to reach the scheduled production levels will depend on both the section’s capacity and the productivity of your workforce. Each section’s theoretical capacity is determined by the amount of equipment and labor allocated to it. However, actual production may vary, as nominal capacity can increase or decrease depending on employee satisfaction and its impact on productivity (see **Section IV. c** on labor decisions).

Figure IV. 1 Production Processes



Material	Batch size	Consumption per Electroclean
Part A	30 unit	1.00 unit
Part B	12 unit	0.20 units
Piece 1	1 unit	0.01 units
Piece 2	100 units	8.00 units
Piece 3	30 units	0.30 units
Piece 4	60 units	0.60 units
Piece 5	100 units	2.00 units
Piece 6	150 units	0.75 units

Section IV. b) Equipment ("Machines")

The production process requires four types of machines (types 1, 2, 3, and 4) and labor for both operating the machines and performing additional manual tasks. Each section of the production process has specific machine and labor requirements:

- Section 1: Requires type 1 machines, each of which must be operated by one worker.
- Section 2: Requires type 2 machines, each of which must be operated by one worker.
- Section 3: Involves a two-step process that uses type 3 and type 4 machines sequentially on the same product. Therefore, the total production capacity of Section 3 is determined by the lower capacity between the installed type 3 and type 4 machines.
 - Type 3 machines are available in two versions: 3-alpha (less automated) and 3-beta (more automated). Both perform the same operations but differ in speed and the number of workers required. Importantly, neither version can function unless a sufficient number of workers is assigned.
 - Type 4 machines are operated by one worker.
- Section 4: Requires type 4 machines, with one worker per machine. Type 4 machines are versatile and can be used in Sections 3, 4, and 5. However, their capacity varies depending on the section, as they operate on different work-in-progress elements in each section.
- Section 5: Also requires type 4 machines, each operated by one worker. Additionally, complementary manual assembly tasks are performed by crews of three workers, who do not operate machinery. The actual production capacity of Section 5 is limited by the lower of the following two constraints:
 - The capacity of the type 4 machines installed in the section
 - The capacity of the assembly crews. For example, 15 workers (i.e., 5 crews) with a productivity rate of 50 Electrocleans per crew can produce up to 250 Electrocleans per fortnight.

Machines occupy physical space and sufficient factory space must be available to accommodate them. Each machine type requires a specific number of "spaces" within a factory module (see more details in **Section IV. e)** "Facilities"). To ensure enough capacity for your equipment, you will need to purchase additional plant modules as necessary. **Table IV. 1** shows the prices, capacities, space requirements, and number of employees needed per machine. It also includes the initial availability of each machine type in the Center and West regions.

Purchase of machines. Machines are readily available and can begin operating immediately upon purchase, starting from the first fortnight of the four-month period, even when purchased for newly established plants. Payments for new machines are always charged at the beginning of the corresponding four-month period. Each machine has a defined operational lifetime, after which it ceases to function and must be replaced. Machine purchases are recorded as new fixed assets in the company's books and depreciated on a straight-line basis over the machine's useful life.

Resale of machines. Machines can be resold at 65% of their netbook value, calculated as 65% of the purchase price minus accumulated depreciation. For example, a type 1 machine purchased for \$10,600 at the start operations in Mezquite could be sold at \$1,378 at the beginning of Period 9. This is based on a 35% discount, considering that after 8 periods of depreciation, the resale value is 65% (\$10,600 - \$8,480).

Transfer of machines. Machines can be transferred between plants in different regions as needed and will be operational at the beginning of the period. The transport cost for each transfer depends on the origin and destination, as detailed in **Table IV. 2**. Machines are transported by airplane, and the transfer takes one fortnight.

Table VI.1 Production Equipment Characteristics and Current Equipment Available

	Machine 1	Machine 2	Machine 3		Machine 4	Crews (3 people)
			ALFA	BETA		
PRICE	\$ 10,600	\$ 7,000	\$ 88,500	\$ 155,400	\$ 2,500	--
REQUIRED OPERATORS	1	1	30	6	1	3
OCCUPATION SPACES	1	1	5	6	1	0
LIFESPAN (PERIODS)	10	10	20	20	8	--
POWER (kW)	10	9	15	16	6	--
FORTNIGHT CAPACITY	SECTION 1 SECTION 2 SECTION 3 SECTION 4 SECTION 5	200 ASM-A 70 ASM-B 450 ASM-C 150 ASM-D*	600 ASM-C	400 ASM-C*	130 ELECT*	50 ELECT
NUMBER OF MACHINES CURRENTLY IN:						
CENTER REGION	SECTION 1	7				
	SECCIÓN 2	22				
	SECTION 3		3	0	4	
	SECTION 4				10	
	SECTION 5				11	
WEST REGION	SECTION 1	3				
	SECTION 2	9				
	SECTION 3		1	0	2	
	SECTION 4				3	
	SECTION 5				3	

* Note: A type 4 machine assigned to a particular section cannot be used in another section simultaneously. As a result, the capacities of these machines are specific to the section to which they are allocated (ASM = Assembly; ELECT = Electrocleans).

Table IV. 2 Transport Cost of Machines Across Regions (in \$)

	M1	M2	M3a	M3b	M4
Center-West West-Center	960	840	1,440	1,800	360
Center- North North-Center	1,320	1,155	1,980	2,475	495
Center-East East-Center	2,460	2,152.50	3,690	4,612.50	922.50
Center-South South-Center	1,200	1,050	1,800	2,250	450
West-North North-West	1,260	1,102.50	1,890	2,362.50	472.50
West-East East-West	1,440	1,260	2,160	2,700	540
West-South South-West	1,740	1,522.50	2,610	3,262.50	652.50
North-East East-North	1,740	1,522.50	2,610	3,262.50	652.50
North- South South-North	2,160	1,890	3,240	4,050	810
East-South South-East	3,480	3,045	5,220	6,525	1,305

Energy consumption. All machines involved in the production of Electrocleans consume electricity. To calculate energy consumption, we assume that each machine has a nominal power rating (“power term”). Based on this, the actual consumption (“consumption term”) is calculated by multiplying the power by the number of hours worked—that is, the total kilowatt-hours (kWh) consumed.

For example, a type 1 machine has a nominal power of 10 kW. If it operates at 100% capacity during a fortnight (i.e., 80 hours: 10 days × 8 working hours per day), it will consume 800 kWh in that fortnight, or 6,400 kWh per period. If a machine operates for less than 100% of the time, its energy consumption decreases proportionally. **Table IV. 3** provides the installed nominal power for each machine type.

Table IV.3. Electrical Power per Machine and Electricity Costs

	Machine 1	Machine 2	Machine 3			Machine 4		
			ALPHA	BETA	Section 3	Section 4	Section 5	
Nominal Power (kW)	10	9	15	16	6	6	6	
Cost for power installed	\$30 each kW installed/year (\$10 each kW installed/period) ⁴							
Consumption term	\$0.06 / kWh							

⁴ Installed kW is the sum of the power (in kW) of all the machines available at a given time.

Electricity is supplied by the local utility company which charges for both the Power term (“kW of power installed”) and the consumption of electricity (“Consumption term”):

- **Power term:** This is a fixed charge for the period, payable regardless of the actual energy consumed. It ensures the availability of the required electrical power in kW. The cost per kW is detailed in **Table IV. 3**. For instance, if the total installed power for all machines in Period 7 is 637 kW, the power term cost would be \$6,370.
- **Consumption term:** This is the variable charge based on actual energy consumption (in kWh). The cost per kWh is also shown in **Table IV. 3**. For instance, at a rate of \$0.06/kWh, and with 637 kW of installed power, if machines operate at 100% capacity, they would consume 50,960 kWh per fortnight, or 407,680 kWh per period, resulting in a total energy cost of \$24,460.80.

The total electricity cost appears in the P&L, while payments are recorded in the subperiod cashflow report. Additionally, the current electricity supplier uses a non-renewable energy mix, meaning that electricity consumption results in CO₂ emissions, a factor to be considered in your ESG performance (see **Chapter VII. Environmental sustainability**).

Several measures can be implemented to reduce both the external cost of electricity and the company’s CO₂ footprint, particularly by installing photovoltaic (PV) panels or sourcing electricity from green suppliers. If any of these measures are adopted, the corresponding savings (e.g., from PV panels) or additional costs (e.g., from green energy providers) will be reflected accordingly in your P&L statement and in the cashflow report.

Section IV. c) Raw Materials (“Parts and pieces”) and Work-In-Progress (“Assemblies”)

The total cost of electricity is shown in the income statement (CR) and payments in the cash flow report by sub-period. It should also be noted that the current electricity supplier uses a generation mix that is not 100% of renewable origin, therefore, electricity consumption generates CO₂ emissions that must be considered (see ESG section).

Several measures can be taken to reduce the “external” cost of electricity and the CO₂ footprint, **in particular buying PV panels and supplying electricity from green sources.** *Should some of the mentioned measures be adopted, the associated savings (PV panels) or additional costs (green supplier) will be incorporated in your CR and payments, accordingly.*

The production of an Electroclean requires eight raw materials (see **Figure IV. 1**): Parts A and B, as well as Pieces 1 through 6. Additionally, production involves managing four intermediate assemblies: A, B, C, and D.

Procurement of pieces. Pieces (1-6) are commodity materials that must be purchased at the beginning of the period in a single order. Due to their nature, the ordering cost is negligible. Orders are delivered at the beginning of the first fortnight of the period in which they are placed. Suppliers deliver these pieces in batches, with batch sizes and prices detailed in **Table IV. 4**.

Procurement of parts. Parts A and B are specialized materials that can be ordered in partial deliveries. Orders may be placed in any given fortnight and are available for use within the same fortnight. Each order incurs an ordering cost to account for administrative expenses, separate from the cost of the materials themselves (see **Table IV. 4**). These costs are paid in the fortnight the order is placed.

Three suppliers offer different purchasing terms and conditions, as summarized in **Table IV. 4**. Supplier A requires immediate payment upon delivery and does not offer any special terms. Supplier B offers a 2-fortnight payment term and a volume discount: 16% off for orders of 150 or more batches of parts A, and 16% off for orders of 80 or more batches of parts B. However, there is a 20% probability that this supplier will fail to deliver an order. In such cases, the order is cancelled, and no payment will be made to the supplier. Supplier C offers an 8-fortnight payment term but no discounts.

Inventory Management. The inventories of parts A and B, and assemblies A, B, C, and D incur an inventory holding cost (including factory warehouse salaries, insurance, obsolescence, impairment, and storage space). These costs are paid fortnightly, based on the stock levels observed at the end of each fortnight. While inventories of pieces are maintained, their holding costs are negligible and therefore not accounted for.

Table IV.4 Materials and Assembly Key Parameters

Material	Batch size	Batch price (i.e., cost to Mezquite)			Ordering cost (per order)	Inventory holding cost per unity
Parts		Supplier A Immediate fortnight payment (100% delivery)	Supplier B 2-fortnight delay payment (20% off no delivery)	Supplier C 8-fortnight delay payment (100% delivery)		
Part A	30 units	\$125	\$100 (-16% if Q>150 batches)	\$140	\$2,300	\$ 0.30
Part B	12 units	\$330	\$264 (-16% if Q>80 batches)	\$370	\$6,000	\$ 4.50
Pieces		Single supplier (Beginning-of-period payment)				
Pieces 1	1 unit	\$60			-	-
Pieces 2	100 units	\$7			-	-
Pieces 3	30 units	\$36			-	-
Pieces 4	60 units	\$24			-	-
Pieces 5	100 units	\$30			-	-
Pieces 6	150 units	\$28			-	-
Assemblies						
Assembly A	1	N/A			\$ 0.20	
Assembly B	1	N/A			\$ 0.40	
Assembly C	1	N/A			\$ 0.60	
Assembly D	1	N/A			\$ 0.20	

The inventory levels of raw materials and assemblies that you have on-hand to start operations in Period 7 are shown in Table IV. 5.

Table IV.5 Raw Material Inventories at the Beginning of Period 7

Material	Units in the Center	Units in the West
Part A	3,496	1,016
Part B	765	293
Piece 1	94	36
Piece 2	3,844	1,424
Piece 3	3,125	1,208
Piece 4	6,131	2,356
Piece 5	16,736	6,456
Piece 6	4,439	1,596
Assembly A	7,432	3,622

Section IV. d) Facilities (“Plant Modules”)

Facilities encompass all the land area required at the manufacturing sites for production, material flow, and storage, as well as proportional space for offices and other support functions. Note that storage of finished goods is managed separately in external warehousing facilities (see **Chapter V. Logistics**).

To streamline real estate planning and decision-making, the term “plant module” is used to represent facility space requirements. A plant module combines the various area components mentioned above. Each plant module contains 18 available spaces, with different machines occupying a specific number of spaces, as detailed in **Table IV. 6**.

Table IV. 6 Space Occupancy Per Machine

Machine 1	Machine 2	Machine 3		Machine 4
		ALPHA	BETA	
Spaces	1	1	5	6

Purchase and dimensioning of modules. You must ensure that you have enough modules and spaces to accommodate all available machines. If the number of modules is insufficient, the system will automatically lease the additional modules required for the period at a very high cost. This is an emergency measure to avoid production stoppages. The shortage of modules must be resolved in the next period to prevent further leasing.

Module purchases or leases are paid at the beginning of the period. Purchased plant modules represent a real estate investment added to your fixed assets; they do not generate depreciation in the balance sheet.

You may also open new plants in the North, East, and South regions. However, to protect employment and preserve the nation’s current revenues, the government has enacted a law restricting the relocation of facilities. As a result, you must maintain at least one plant module in any region where you have begun operations.

Module purchase prices, leasing costs, occupancy capacity (in spaces and modules), and the current number of modules owned by the company are detailed in **Table IV. 7**.

Table IV. 7 Facilities (“Plant Module”) main price and occupancy parameters

Modules	
Purchase Price	\$50,000
Resale price	\$50,000
Leasing cost (in case of emergency)	\$75,000
Administrative cost (per module and period)	\$10,000
Occupancy capacity	18 spaces
Modules in Center	4
Modules in West	2

Resale of modules. Plant modules can be resold at their purchase value.

General and administrative expenses. The company will also incur general and administrative expenses (e.g., administrative staff, services, property tax). These G&A expenses are assumed to be directly related to the number of plant modules; that is, proportional to the company’s production size. The administrative cost per module and four-month period is shown in **Table IV. 7** and is evenly distributed across the 8 fortnights of the period.

Chapter V. Logistics

Products are never shipped directly from manufacturing facilities to customers. Instead, all manufacturing output is first stored in the regional warehouse located within the same region. From these warehouses, the company distributes products to distributors and other sales channels (if any). To ensure product availability, the company must maintain adequate warehouse capacity in each region where it plans to sell its products and coordinate inter-warehouse shipments when necessary.

Section V. a) Warehousing

Warehouse capacity is rented from logistics operators under fixed-period agreements, as the company does not own its warehousing facilities. Capacity is negotiated based on the number of modules, each with a fixed rental cost per period and a fixed storage capacity for finished products. **Table V. 1** shows the values for these parameters as well as the available capacity at the end of Period 6.

Capacity Planning. The required warehousing capacity must be defined at the beginning of each period for every region and remains fixed for the entire period. If the planned capacity is insufficient to store stock at the end of any fortnight, the excess stock will be deemed non-storable, considered damaged, and discarded. This lost stock will be recorded as a direct inventory loss, deducted from the balance sheet, and recognized in the P&L as an additional direct cost of goods sold (valued at zero price), resulting in a loss.

Inventory Prioritization. Inventory priorities are assigned each fortnight based on company policies and scheduled shipments:

1. First, shipments arriving from other regions during the fortnight and local finished production from the previous fortnight are added to the warehouse inventory.
2. Next, shipments scheduled to other regions are prioritized from the available stock. If there is no stock left to fulfill these shipments, they remain unfulfilled.
3. Finally, any remaining inventory is allocated to fulfill local sales within the region.

Impact of Lost Sales. If inventory is insufficient to meet local sales demand, sales will be lost in that region. Lost sales within a period due to insufficient inventory cannot be reallocated to another team in the same period. The simulator penalizes lost sales by reducing demand for the affected region in the following period.

Table V. 1. Warehouse Cost and Capacity. Number of Modules Rented in Period 6

Storage Unit	Rental cost per period	Storage capacity (Electroclean units)
Module	\$800	100

Region	Capacity rented (modules)
Center	48
West	25
North	20
East	-
South	-

Section V. b) Transportation

Deliveries between regional warehouses are managed through independent freight transportation services, as Mezquite does not operate its own fleet. The company can choose from among three modes of transportation: truck, train, and airplane. For each shipment, decisions must be made regarding the origin and destination, the quantity to be shipped, the fortnight of dispatch, and the selected transportation mode.

Due to the product's bulkiness, high value, and fragility, transportation is both time-consuming and costly. Transport fees, delivery times, and reliability vary significantly by mode. **Table V. 2** provides a qualitative comparison of transportation modes to help evaluate their respective advantages and disadvantages.

Table V. 2 Freight Transportation Options

	Airplane	Truck	Train
Average speed	Fast	Slow	Slow
Compliance with delivery	Reliable	Not very reliable	Highly uncertain
Fees	Very expensive	Expensive	Cheap
Discounts per volume	Not offered	Between 6%-19%	Between 11%-27%

Transport costs. They include door-to-door freight charges, insurance, and any applicable import/export duties between regions. Volume-based discounts may apply (see **Table V. 3** for cost details by mode, origin-destination, and shipment volume). Freight service payments are made in the fortnight the shipment is dispatched.

Shipment Transit Times. Transit times depend on the transportation mode selected and may vary. **Table V. 4** outlines the expected transit time distributions for each mode and origin-destination pair, expressed as probabilities of full shipment arrival in a given fortnight. For example: East-to-South shipments by truck have a 50% probability of arriving in full within 5 fortnights and a 50% probability of arriving within 6 fortnights. Airplane shipments are always 100% reliable and take exactly one fortnight.

Note: Shipments scheduled to arrive after the period ends will appear in reports with the status “In Transit” until delivered in the subsequent period.

Table V. 3 Freight Transportation Costs. Unit Fees (\$ per Electroclean transported)

Regions		Airplane			Truck			Train		
		Shipment size			Shipment size					
		Small	Medium	Large	Small	Medium	Large			
Center-West	\$19.20	\$18.00	\$16.80	\$15.60	\$13.20	\$12.00	\$10.80			
West-Center										
Center- North	\$26.40	\$20.16	\$18.96	\$18.48	\$19.69	\$18.24	\$14.40			
North-Center										
Center-East	\$49.20	\$47.52	\$43.52	\$40.80	\$46.32	\$42.00	\$39.60			
East-Center										
Center-South	\$24.00	\$18.00	\$16.80	\$16.32	\$16.80	\$15.60	\$12.72			
South-Center										
West-North	\$25.20	\$22.08	\$21.60	\$18.00	\$20.40	\$18.00	\$16.80			
North-West										
West-East	\$28.80	\$28.32	\$27.60	\$26.64	\$27.60	\$26.40	\$24.48			
East-West										
West-South	\$34.80	\$33.60	\$32.40	\$31.20	\$32.40	\$28.80	\$24.00			
South-West										
North-East	\$34.80	\$33.60	\$31.20	\$28.80	\$32.40	\$28.80	\$24.00			
East-North										
North- South	\$43.20	\$38.40	\$37.20	\$36.00	\$38.40	\$36.00	\$28.80			
South-North										
East-South	\$69.60	\$64.80	\$58.80	\$57.60	\$63.60	\$57.60	\$56.40			
South-East										

Small shipment: from 1 to 999 units.

Medium shipment: from 1,000 to 1,999 units.

Large shipment: from 2,000 units or more.

Table V. 4 Truck and Train Transit Times and Reliability

Regions	Mean	Transit Times (# of fortnights)							
		1	2	3	4	5	6	7	8
Center-West	Truck	50%	50%						
	Train	20%	30%	50%					
Center- North	Truck		100%						
	Train		50%	50%					
Center-East	Truck		50%	50%					
	Train		25%	50%	25%				
Center-South	Truck		100%						
	Train		50%	50%					
West-North	Truck		100%						
	Train		50%	50%					
West-East	Truck		50%	50%					
	Train		25%	50%	25%				
West-South	Truck			50%	50%				
	Train			50%	50%				
North-East	Truck		50%	50%					
	Train		50%	50%					
North- South	Truck				100%				
	Train				50%	50%			
East-South	Truck					50%	50%		
	Train					10%	30%	40%	20%

Chapter VI. People

Section VI. a) Factory Workers

Managers must decide on the appropriate number of workers required in each section of every plant at the beginning of each period. Details on the number of workers needed per machine and section (including manual labor crews in Section 5) are provided in **Chapter IV**. Workforce allocation will remain constant throughout the period.

Workers can be reassigned between sections within the same plant but cannot be transferred between facilities. Current agreements prohibit inter-plant employee transfers; therefore, relocating a worker to another plant requires terminating their employment at the original facility and rehiring them at the new location.

Hiring and layoffs. The number of new hires or layoffs is calculated as the difference between the workforce from the previous period and the proposed workforce for the current period, determined

separately for each plant. When the workforce increases, hiring takes place at the beginning of the period, and the company incurs a one-time cost per hire to cover contracting and training expenses. When the workforce decreases, layoffs occur at the beginning of the period, and severance payments are made for each worker laid off.

Regular Salaries. In addition to hiring and layoff costs, workers receive fortnightly salaries, which the company must set for each region at the start of each period. Salaries remain fixed throughout the period and must (i) be higher than the government-mandated minimum wage, and (ii) remain competitive to avoid internal tensions, particularly if other companies in the region offer higher wages.

Overtime costs. Managers may schedule overtime during specific fortnights, allowing for a 20% increase in production (equivalent to adding Saturday as a workday). Workers earn an additional \$12 per fortnight of overtime, paid in the same fortnight it is worked.

Indirect Production Expenses. In addition to direct labor costs, indirect production expenses are incurred to support operations. These include salaries for foremen, quality control staff, maintenance teams, and other support roles. Such expenses are calculated as 50% of the total factory workers' salaries (including overtime) and are allocated evenly throughout the fortnights.

Table VI. 1 summarizes the main prevailing hiring, layoff, and salary conditions, and shows the current number of workers allocated to each section.

Table VI. 1 Workforce Data Prevailing at the End of Period 6

	Center Region	West Region
Hiring cost	\$240	
Layoff cost	\$220	
Salaries	\$27.3/fortnight	\$27.3/fortnight
Minimum salaries	\$26/fortnight	\$26/fortnight
Overtime	\$12/fortnight	\$12/fortnight
Indirect expenses	50% of salaries (incl. overtime)	50% of salaries (incl. overtime)

Numbers of workers allocated	Center Region	West Region
For machines 1	7	3
For machines 2	22	9
For machines 3 alpha	90	30
For machines 4 in section 3	4	2
For machines 4 in section 4	10	3
For machines 4 in section 5	11	3
For crews in section 5	75	21
Total	219	71

Section IV. b) Social Benefits

The People Department is responsible for implementing improved working conditions and labor benefits to enhance employee satisfaction, reduce absenteeism, and boost productivity. Improving labor conditions and workforce motivation is a priority mandated by the company's owners,

particularly in light of the recent unionization of a significant majority of the workforce. Low morale and inconsistent labor practices could lead to strikes, further emphasizing the importance of this initiative.

Salaries. They are a key factor influencing employee satisfaction or dissatisfaction. Significant disparities in wages or benefits among competing companies can result in higher absenteeism and lower productivity. Currently, all companies offer fortnightly wages slightly above the country's minimum salary, which is generally insufficient to inspire long-term loyalty or motivation.

Additional Benefits. Beyond salaries, the company can introduce various benefits to improve employee satisfaction, such as health insurance, extended personal days, training programs, improved workplace safety, and other perks that may yield productivity gains. **Table VI. 2** outlines the full range of available benefits. By strategically combining wages with these additional benefits, the company can enhance workforce motivation.

Employee satisfaction is measured at the end of each period. Higher satisfaction levels are expected to correlate directly with increased productivity, driven by reduced absenteeism and improved day-to-day engagement.

Table VI. 2 Social Benefits

Benefit Name	Description	Impact
Personal days	Number of justified personal days off granted to employees during the period.	Additional workers may be hired automatically by the simulator to compensate for reduced working hours. Extra hiring and salary costs are reflected in the Social Costs tab.
Budget for additional training	Budget for worker training programs aimed at increasing capabilities, expressed as a percentage of the total wage bill.	Extra costs are included in the Social Benefits Costs line in the P&L and paid every fortnight.
Health and Safety budget	Budget for workplace safety improvements, expressed as a percentage of the total wage bill.	Extra costs are included in the Social Benefits Costs line in the P&L and paid every fortnight.
Union representatives	Full-time union representatives managing workplace coordination.	Additional workers may be hired automatically by the simulator. Hiring and salary costs are reflected in the Social Costs tab.
Reduction of working hours	Reduction in working hours per period, enhancing work-life balance.	Additional workers may be hired automatically by the simulator to compensate for reduced hours. Extra hiring and salary costs are reflected in the Social Costs tab.
Profit sharing	Percentage of net profit from the previous period shared with employees.	Extra costs are included in the Social Benefits line in the P&L and paid every fortnight.
Health Insurance	Company-provided medical insurance (expressed as a percentage of the total wage bill).	Extra costs are included in the Social Benefits line in the P&L and paid every fortnight.

Chapter VII. Environmental Sustainability (ESG)

Sustainability has become a critical focus area for modern businesses. As a management team, you are responsible for addressing not only the environmental impact of your company's operations but also the welfare of your employees. This extends the scope of responsibility towards a comprehensive ESG⁵ (Environmental, Social, and Governance) approach.

Your company's environmental footprint will be measured by total CO₂ emissions, based on a full analysis of your operations and any abatement measures implemented. Your ESG policy must be reviewed and approved, as any other strategic decision, by the Board of Directors. Public disclosure of your company's environmental friendliness by activist organizations could significantly influence market and regulatory perceptions. In addition, the Board expects an **annual 15% reduction** in your carbon footprint. Failure to meet this target was one of the key reasons the previous management committee was asked to step down.

The following sections provide a concise overview of the main sources of CO₂ emissions you must account for, as well as the actions your company can take to reduce their impact.

Section VII. a) Sources of CO₂ Emissions

The complete list of elements contributing to CO₂ emissions is outlined below. **Table VII. 1** specifies the CO₂ emissions per unit for each source. Total emissions are calculated by multiplying the operational volumes by these per-unit emission factors.

The complete list of elements that generate CO₂ emissions is described below. The simulation will provide you with detailed reports with an estimation of your actual emissions as well as the impact of your abatement decisions. You are not expected to calculate exactly the emissions for each CO₂ source, but rather to understand how they are generated and make appropriate decisions to reduce them.⁶

Raw Materials (Parts). Parts A and B purchased contribute to CO₂ emissions from both their manufacturing (by suppliers) and their transportation to our facilities. These emissions must be included in the final product's carbon footprint. Emissions vary by supplier due to differences in manufacturing technology (more or less polluting) and origin (affecting transport-related emissions). In our case, emissions are recorded at the moment of purchase, not at assembly or sale. **Table VII. 1** shows the estimated emissions per part purchased.

Manufacturing. During production, machines consume electricity, and the company must account for the CO₂ emissions generated from producing this electricity. The attributable emissions depend on total energy consumption and the quality of the electricity mix used. Currently, the mix is not very “green,” producing 0.4 kg CO₂ per kWh consumed. If machines operate below full capacity, energy use—and thus emissions—are calculated proportionally to utilization.

Product Improvements. Certain product improvements require additional components or postponement activities that can increase or reduce the product's carbon footprint compared to the standard version. Some features will raise CO₂ emissions per unit, others will lower them. Since postponement occurs at the moment of sale, these emission changes are recorded then.

⁵ We focus specifically on the "ES" components, with the Government ("G") aspect deferred to future editions. For simplicity, the ESG designation is maintained.

⁶ Note that emissions reported may not completely match your own calculations.

Note: these emissions are separate from customer perceptions of the product's environmental friendliness.

Construction of Factories. Building new plant modules generates substantial CO₂ emissions due to the materials used and energy consumed. Emissions are calculated per module at the time of construction. In line with good accounting practices, these emissions are distributed evenly over 12 periods to reflect the lifecycle of the asset.

Transportation of Electrocleans. All transportation of finished products will also incur CO₂ emissions. Emissions generated by a shipment are a function of the distance and weight/volume transported, and the mode of transportation used, airplane being the most polluting mode (e.g., 800 gr CO₂/ton/km), followed by truck (e.g., 250 gr CO₂/ton/km), and then train (e.g., 85 gr CO₂/ton/km). To help your analysis, the parameter table below already provides details for each origin-destination and mode, the estimated kg CO₂ per Electroclean shipped (assuming a given distance for each origin-destination and Electroclean weight). These emissions are recognized at the moment of departure of the shipment.

Transportation of machines. When machines are transferred between factories, they are transported by air at the start of the period. Emissions are calculated proportionally to an Electroclean's emissions using a "machine correction factor," provided in **Table VII. 1.**

Disposal of Products (due to lack of warehouse capacity). Any Electroclean discarded due to insufficient warehouse capacity must be transported to a recycling center for disassembly and material recovery. These activities also generate CO₂ emissions.

Table VII. CO₂ Emissions Parameters

Emissions from raw materials procurement kg CO ₂ /part			
	Supplier A	Supplier B	Supplier C
Part A	3.67	6.18	3.58
Part B	5.46	8.33	5.33

Emissions from manufacturing (power consumption emissions) kg CO ₂ /unit ⁽¹⁾			
	Emissions at capacity (kg CO ₂ / fortnight)	Capacity (units/fortnight)	kg CO ₂ /unit
Machine 1	320	200	1.60
Machine 2	288	70	4.11
Machine 3 Alfa	480	450	1.07
Machine 3 Beta	512	600	0.85
Machine 4 (S3)	192	400	0.48
Machine 4 (S4)	192	150	1.28
Machine 4 (S5)	192	130	1.48

⁽¹⁾ We calculate the kWh consumed by each machine operating at its nominal kW power for 80 hours per fortnight to determine total fortnightly consumption. CO₂ emissions are then calculated using an emission factor of 0.4 kg CO₂ per kWh, based on the company's current electricity purchasing mix.

Emissions from new module construction ⁽²⁾	
Plant module built (kg CO ₂ /module)	405,000

⁽²⁾ These emissions are evenly distributed over the 12 periods following the module's purchase and construction, reflecting a reasonable average lifespan of the asset.

Emissions from processing Throwing away Electrocleans	
Electroclean thrown away	12 kg CO ₂ /unit per recycling 1.2 kg CO ₂ /unit for transport

Emissions from improvements		
ID	NAME AND DESCRIPTION	Emissions kg CO ₂
# 1	STAINLESS MATERIAL	-0.025
# 2	RECYCLABLE MATERIALS	0.023
# 3	ENERGY EFFICIENCY	-0.025
# 4	LIGHTER AND MORE COMPACT	0.045
# 5	IMPACT-RESISTANCE	-0.05
# 6	NOISE REDUCTION	0.045
# 7	IMPROVED BATTERY CAPACITY	-0.075
# 8	SELF-CLEANING	0.068
# 9	SPEED SETTINGS	0.068
# 10	DIGITAL CONTROLS	-0.075
# 11	VOICE ASSISTANCE INTEGRATION	0.107
# 12	AUTOMATION AND PROGRAMMABILITY	0.107
# 13	MULTIFUNCTIONAL ACCESSORIES	0.143
# 14	MAPPING TECHNOLOGY	0.143

Emissions from Transport – Electroclean Finished product ⁽³⁾ Kg CO ₂ /electroclean							
	Airplane	Truck			Train		
		Shipment Size			Shipment size		
		Small	Medium	Large	Small	Medium	Large
Center-West	16.00	5.00	4.67	4.33	1.30	1.18	1.06
Center-North	22.00	5.60	5.27	5.13	1.94	1.80	1.42
Center-East	41.00	13.20	12.09	11.33	4.56	4.14	3.90
Center-South	20.00	5.00	4.67	4.53	1.65	1.54	1.25
West-North	21.00	6.13	6.00	5.00	2.01	1.77	1.65
West-East	24.00	7.87	7.67	7.40	2.72	2.60	2.41
West-South	29.00	9.33	9.00	8.67	3.19	2.84	2.36
North-East	29.00	9.33	8.67	8.00	3.19	2.84	2.36
North-South	36.00	10.67	10.33	10.00	3.78	3.55	2.84
East-South	58.00	18.00	16.33	16.00	6.26	5.67	5.55

⁽³⁾ Assumptions for transport emissions: airplane-800 g CO₂/ton/km; truck-250 g CO₂/ton/km; train-65 g CO₂/ton/km.

Emissions from Transport – Machines Correction factor (% of emissions wrt Electroclean)	
Machine 1	x50
Machine 2	x43.75
Machine 3 Alpha	x75
Machine 3 Beta	x93.75
Machine 4	x18.75

Section VII. b) Actions to Reduce/Offset CO₂ Emissions

Management has four different options to reduce or offset CO₂ emissions and improve the company's environmental performance. **Table VII. 2** summarizes the cost and expected impact of each option.

Solar Panels. Solar panels generate clean electricity with zero emissions. This is an investment paid at the beginning of the period, added to ESG fixed assets, and depreciated over the panels' lifetime (see cost and lifespan in **Table VII. 2**). In emissions accounting, the amount of green energy produced offsets an equivalent amount of CO₂ emissions from “non-green” electricity used by machines, resulting in a negative adjustment to reported emissions.

Purchase Green Energy. The company can buy a percentage of its electricity needs from an eco-friendly provider. This increases electricity costs but generates zero emissions for the amount purchased. The green energy purchased offsets an equivalent amount of CO₂ emissions from “non-green” electricity consumed by machines.

Tree Planting. Tree planting campaigns can be used to compensate for CO₂ emissions, thereby reducing net CO₂ emissions. The cost of planting is paid at the beginning of the period, and trees incur a maintenance cost every fortnight. **Table VII. 2** provides the CO₂ absorption ratio per tree, along with planting and maintenance costs.

Purchase CO₂ Credits. The company can purchase carbon credits, each offsetting 1 ton of CO₂. Prices vary depending on the purchase horizon (1, 2, or 3 periods) and the period in which the credits are acquired.

Table VII. 2 CO₂ Abatement Actions

Option	One time investment/cost (beginning of the period payment)	Recurrent cost (subperiod payment)	Impact of CO ₂ emissions
Solar panels	\$420 per panel (Lifetime 25 years)	5% annual maintenance (\$7 per period per panel)	Energy production per period-panel: 266 kWh Emissions “reduced” per period-panel: 106.4 kg CO ₂
Green energy	N/A	20% over cost (Reg. supplier price: \$0.06/kWh)	Zero emissions per green kWh (Emissions reduced by 0.4 kg CO ₂ /kWh)
Trees	\$6.25 per tree	\$50/year for 80 trees (\$16.67 per period)	1 ton CO ₂ per 80 trees per year (333 kg CO ₂ per period)
CO₂ Credits	None	Variable cost distributed evenly across fortnights	1 ton of CO ₂ for each credit

Section VII. c) Environmental Reporting (Emissions Report)

The simulator provides a complete summary report of your emissions by category and the corresponding emissions offsets achieved through abatement measures. It also provides three key summary metrics:

Emissions Intensity per Period. measured as the total kg CO₂ per unit produced. Your Board requires this figure to be reduced by at least 15% by the end of each year. For example, if your Period 6 intensity is 29.93 kg CO₂/unit, emissions should decline progressively in Periods 7, 8, and 9 so that, by Period 9, intensity is below 25.4 kg CO₂/unit, and below 21.6 kg CO₂/unit by Period 12.

ENV KPI (%). The Environmental KPI is a performance score from 0% to 100% assessing your emissions reduction achievements, as reported by an independent environmental audit firm (100% corresponds to an A+ rating). The evaluation compares your emissions trajectory with that of market competitors and against standardized industry targets. The exact algorithm used (including minimum thresholds, industry percentiles, and weightings) is not disclosed by the auditor.

ESG KPI (%). This KPI is a weighted average of the company's environmental positioning (ENV-KPI) and its social positioning, represented by the Workforce Mood indicator/Productivity factor resulting from labor relations decisions. This KPI evaluates each company from an ESG perspective and compares its performance with that of other companies in the same environment. The ESG KPI ranges from 0 (worst) to 100 (best) and reflects the company's standing relative to the market average.

Chapter VIII. Finance

The company's Finance Department is responsible for: (a) monitoring financial performance, (b) overseeing expenditures and investments, and (c) ensuring both short-term and long-term liquidity (i.e., maintaining sufficient cash for operations and planned investments). In collaboration with the CEO, it is also responsible for defining a coherent balance between debt and equity. The company's financial situation at the end of Period 6 is presented in **Chapter IX**.

Section VIII. a) Financial Instruments

The company has access to various short-term and long-term financing options, which may evolve over time as market conditions and company performance change. Limits, interest rates, and other terms may be adjusted as the simulation progresses. **Table VIII. 1** provides a complete description of the available options, interest rates, and limits for this version of the case.

Short-Term Financing:

- **Short-term line of credit.** An unsecured facility provided by the company's local bank, available on a fortnight-by-fortnight basis up to a limit established at the beginning of each period. Interest rates and limits may change from one period to another as banks update their terms. **Table VIII. 1** details the prevailing conditions.

In any period, the maximum total amount available under the line of credit is capped at a given percentage of the company's net fixed assets, as measured at the beginning of the current period, considering the possible asset purchases and sales made that period. This limit may eventually be indexed to other parameters, depending on the terms set by the bank (see **Table VIII. 1** for the current limit). For example, with net fixed assets totaling \$697,625 at the end of Period 6, the credit line limit for Period 7 is \$230,216. Given that the starting

balance for Period 7 is \$113,000, the company can still draw up to an additional \$117,216 during Period 7. Interest on the outstanding balance is accrued fortnightly, based on the closing balance of each fortnight (see **Table VIII. 1** for exact rates and limits).

- **Short-term deposits.** Cash surpluses can be invested in short-term deposit accounts to earn interest income. Deposits can be adjusted fortnightly, allowing funds to be added or withdrawn as needed. Interest is calculated on the deposit balance at the end of each fortnight and credited to the company on a fortnightly basis. Applicable interest rates are shown in **Table VIII. 1**.
- **Other products.** Other short-term financing alternatives may become available during the simulation and will be discussed with the instructor or the participating bank.

Long-Term Financing:

- **Mortgages.** The bank offers mortgages to finance long-term investments such as plant modules, machinery, product improvements, solar panels or tree planting campaigns. As of the end of Period 6, the company already has active mortgages with a defined repayment schedule (see **Table VIII. 1** for details).

New mortgages must be negotiated and approved by the bank individually at the beginning of each period. The process for setting interest rates and repayment terms may vary and will be clarified at the start of the simulation. Interest is calculated on the total mortgage balance at the beginning of the period and is payable at the start of the following period. For example, if the mortgage balance is increased by \$100,000 to a total of \$600,000 at the beginning of a period, and the interest rate is 6%, the company will accrue interest expenses of \$36,000, payable at the beginning of the next period. Interest accrued in the prior period must also be paid at the beginning of the current period.

Emergency loan. The company must maintain a positive cash position (a) at the beginning of each period after accounting for all initial payments (i.e., in the initial cash flow) and (b) after each subsequent fortnight (i.e., in the subperiod cash flows; see **Section VIII. b**). If the cash position becomes negative at any of these points, the company will automatically receive an emergency loan to cover the shortfall, preventing a temporary default on payments.

The emergency loan is issued for the exact amount required to cover the deficit and carries a significantly high interest rate (e.g., 30% per four-month period). Emergency loans taken during the period accumulate and remain outstanding until the period ends, even if multiple loans are issued in different fortnights. Interest accrues for the remainder of the period, regardless of whether the company's cash position later improves. Repayment does not occur within the same period; instead, at the start of the next period, accrued interest is paid first, followed by repayment of the principal during the first fortnight.

The emergency loan is strictly a last-resort mechanism of the game and must not be used intentionally as a regular financing tool. Deliberate reliance on this facility is considered equivalent to a de facto bankruptcy if the amounts are substantial and is prohibited. Such misuse would reflect extremely poorly on the Chief Financial Officer and the management team.

Additional financing instruments may, over the course of the simulation, be requested by companies or made available by the bank or other stakeholders.

Table VIII. Financing Options

Finance Option	Interest per period (Period 7)	Limit (Period 7)	Current amount (End Period 6)	Observations about payments
Line of credit	10%	33% net assets ⁷ (\$230,216)	\$113,000	Changes per fortnight. Interest paid by fortnight.
Short term investments	4%	No limit	\$200,000	Changes per fortnight Interest paid by fortnight.
Mortgages	6%	\$800,000	\$500,000 Payment schedule \$240,000 (Begin 10 th) \$130,000 (Begin 12 th) \$130,000 (Begin 18 th)	Interest and principal paid at the beginning of the next period.
Emergency loan	30%			If it is too high, bankruptcy of the company will ensue.

Section VIII. b) Cashflows Management and Schedule

The company must manage a detailed schedule of receipts (cash inflows) and payments (cash outflows) to ensure sufficient liquidity is maintained at all times during the period. To achieve this, it is essential to distinguish between initial cash flows and subperiod (fortnight) cash flows.

Initial cash flow. These occur at the very beginning of the period, before any operations have commenced. They are typically associated with long-term decisions (e.g., plant and equipment purchases, product improvements, mortgages), operational decisions fixed for the duration of the period (e.g., hiring of sales force, warehouse rentals, payments for parts), or obligations carried over from previous periods (e.g., taxes, interest, and other payables).

Subperiod (fortnight) cash flow. These occur fortnightly during the operational phase of the period. They are linked either to decisions executed in specific fortnights (e.g., parts purchases, shipments, use of short-term lines of credit) or to recurring payments (e.g., salaries, energy costs).

To assist the Finance Department in maintaining visibility over payment schedules, a detailed list of receipts and payments is provided in **Table VIII. 2**.

⁷ Machines and modules only.

Table VIII. Receipts and Payments Schedules

<i>Concept</i>	<i>Schedule</i>
	Procurement
Payment to suppliers (pieces)	Initial
Payment to suppliers (parts)	In the ordering subperiod
Ordering Cost (parts)	In the ordering subperiod
	Production
Energy Costs	In each subperiod based on the production
Inventory Holding Cost	In each subperiod
Warehouse Rental Expenses	Initial
Equipment and Module Purchases/Sales	Initial
Machine Transfer & Installation	Initial
Modules "Emergency" Leasing	Initial
	Logistics
Freight	In the outbound shipment subperiod
	Innovation
Product Improvements upfront investment	Initial
Additional production costs from improvements	In sales subperiods (2, 4, 6 & 8) based on the number of goods sold
	Sales
Customers Payments	In sales subperiods (2, 4, 6 & 8) based on the number of goods sold
Sales and Administration Expenses	Distributed equally across 8 subperiods
	Labor
Hirings and Dismissal Expenses (including extra hirings by labor benefits)	Initial
Workers' Salaries	In each subperiod
Workers' Overtime	In each subperiod when the overtime was activated
Indirect Labor Expenses	In each subperiod
Profit sharing from the previous period	Initial
Labor benefits	Distributed equally across 8 subperiods
	ESG
Green investment (panels, trees, etc.)	Initial
Maintenance cost of solar panels & trees	In each subperiod
Green energy provider	In each subperiod
	Finance
Tax payments	Initial
Interest Paid on Mortgages	Initial
Interest Paid on Emergency Loan	Initial
Interest Collected on Short-Term Investment	In each subperiod
Interest Paid on Line of Credit	In each subperiod
Mortgage Increase/Repayment	Initial
New Shares Issued	Initial
Dividend Payments	Initial
Emergency Loan Repayments	Fortnight 1 of the following period
Short-Term Investment Deposits/Withdrawals	In each subperiod
Line of Credit Increase/Repayment	In each subperiod
Emergency Loan activation (automatic)	Initial and in each subperiod

Accounts payable and receivable. At the beginning of Period 7, the company holds certain accounts payable to suppliers arising from purchases made in previous periods under deferred payment terms, as shown in **Table VIII. 3**. Similarly, there are outstanding accounts receivable from customers, detailed in **Table VIII. 4**.

Table VIII. 3 Current Accounts Payable Schedule

Fortnight	2nd	3rd	5th	6th
Amount	\$17,468	\$61,630	\$11,620	\$53,250

Table VIII. 4 Current Accounts Receivable Schedule

Fortnight	2nd	4th	6th	8th
Amount	\$295,885.30			

Chapter IX. Company Situation and Reports (End of Second Year)

In the simulation platform, you will have access to detailed reports on the company's performance for Period 6, prior to your assumption of management responsibilities. You are encouraged to review these reports carefully to extract meaningful insights that will support sound decision-making in future periods.

The company's profit and loss statement for Period 6, as well as the aggregate results for the entire Year 2, are presented in **Table IX. 1**. The balance sheet at the start of Period 7 is provided in **Table IX. 2**.

Detailed instructions on how to access and navigate all available reports can be found in the *Participant's Guide*.

Table IX. 1 Company's Income Statement at the End of Period 6 and Full Year 2

Income statement		
	Period 6	Full Year 2
Net Sales	\$1,183,541	\$2,794,061
Cost of Goods Sold	(\$481,439)	(\$1,054,945)
Gross Income	\$702,101	\$1,739,116
Warehouse Rental Expenses	(\$74,400)	(\$180,800)
Freight Expenses	(\$64,839)	(\$173,168)
Installation Expenses (Machine movements)	\$0	\$0
Worker Hiring and Dismissal Expenses	(\$1,100)	(\$3,020)
Machine Rental	\$0.00	\$0
Social Expenses	\$0.00	\$0
Sales and Administration Expenses	(\$316,200)	(\$609,650)
Energy costs	(\$29,518)	(\$86,678)
CO ₂ Abatement Cost	\$0	\$0
Assets Disposal	\$0	\$0
EBITDA	\$216,043	\$685,801
Depreciation of Plant and Equipment	(\$60,312)	(\$180,939)
Product Improvements Amortization	\$0	\$0
Depreciation of ESG Assets	\$0	\$0

Operating Income	\$155,730	\$504,863
Interest on Lines of Credit	(\$26,037)	(\$85,051)
Interest on Mortgage	(\$30,000)	(\$73,200)
Interest on Emergency Loans	\$0	\$0
Interest on Investments	\$5,000	\$6,300
Financial Expenses	(\$51,037)	(\$151,951)
Extraordinary Income and Expenses	\$0	\$0
Net Profit Before Taxes	\$104,693	\$352,913
Taxes Payables (accrued in last period)	(\$52,346)	(\$176,457)
Net Profit	\$52,346	\$176,457
Dividends	\$0	\$0

Table IX. 2 Balance Sheet at the End of Period 6

ASSETS	
Current Assets	\$1,227,318
Cash	\$219,615
Short-term Investments	\$200,000
Accounts Receivables	\$295,885
Inventories:	\$511,817
- Raw Materials	\$70,149
- Work in Progress	\$308,876
- Finished Products	\$132,791
Fixed Assets	\$697,625
Plant and Equipment (gross)	\$1,059,500
ESG Assets (gross)	\$0
Intangible Assets (gross)	\$0
Accumulated Depreciation and Amortization	(\$361,875)
Total Assets	\$1,924,943
EQUITY & LIABILITIES	
Liabilities	\$839,314
Accounts Payables	\$143,968
Lines of Credit	\$113,000
Interests Payable	\$30,000
Emergency Loan	\$0
Mortgage Loans	\$500,000
Taxes Payables	\$52,346
Shareholders' Equity	\$1,085,628
Retained Earnings	\$183,281
Period Profit (Loss)	\$52,346
Issued Capital	\$850,000
Total Liabilities & Shareholders Equity	\$1,924,943