

IENG/MANE490 Introduction to Manufacturing and Service Systems Design Project

Fall 2024-2025

Project Topic:

Establishing a photovoltaic (solar) panel (PV) manufacturing facility

Solar energy is a clean, renewable source of power. Unlike fossil fuels, which spew harmful emissions into the atmosphere when burned, solar panels quietly convert sunlight into electricity without any pollution. This reduction in emissions helps combat climate change and ensures a healthier planet for future generations. By harnessing the power of the sun, carbon footprint can be significantly reduced. A world where our energy needs are met without contributing to global warming is a beautiful vision.

Our current reliance on fossil fuels (like coal, oil, and natural gas) is unsustainable. These resources are finite and have detrimental effects on the environment. Solar energy provides an alternative, a way to break free from this dependence. As solar technology advances and becomes more affordable, we can shift away from fossil fuels. This transition is crucial for energy security and long-term sustainability.

The cost of solar panels has been steadily decreasing over the years. As a result, solar power is becoming more accessible to individuals, businesses, and communities worldwide. Imagine remote villages or regions where traditional energy sources are scarce. Solar energy can empower these areas by providing a reliable and affordable source of electricity. It is essentially limitless. The sun radiates an enormous amount of energy every second, and we only need to capture a tiny fraction of it to meet our global energy demands. Unlike fossil fuels, which will eventually run out, the sun will keep shining for billions of years. So, solar power is a sustainable solution for our energy needs. Solar energy isn't just about technology; it's about shaping a better future—one where we live harmoniously with our planet.

You are asked to design a facility that manufactures at least three types of a photovoltaic (solar) panel that may be used in the facilities such as homes, factories, hotels, hospitals and so forth. At each stage of the design, you should keep in mind to be in accordance with United Nations Sustainable Development Goals (UN SDGs) whenever relevant.

Project Requirements:

The final report must contain at least the following chapters and following contents of the chapters. All assumptions, limitations and constraints should be explicitly indicated at the beginning of each chapter.

1) Introduction:

This chapter should include at least the following; general information on the project, the planning horizon, Minimum Attractive Rate of Return (MARR), vision, mission statements and objectives of the company in general. Additionally, the options for financing the investment should be discussed. Note that, new investments are generally funded by credit (e.g. a bank loan, investors, etc.).

2) Rules and Regulations in TRNC:

- State all relevant rules and regulations, constraints, procedures and incentives about establishing a new company, constructing a plant, manufacturing, trade, business, etc., in TRNC.
- A conclusion should be presented at the end of the chapter about political feasibility of the considered investment in the TRNC.

3) Product Types:

List product types and/or their variants available in the market (generic types are enough). Provide brief descriptions, characteristics and functions of each.

4) Current Market:

At least the following information about the local market have to be provided:

- Demand level in the local market, past actual demand data for each above-mentioned product types and/or their variants.
- The pattern of the demand such as constant, trend, seasonal, etc.
- Selling price ranges for each product
- Names of the competitors, their product types and market shares

5) The Company in the Market:

The following, related with the considered company, have to be computed, discussed, decided and justified considering the information and data in Product Types and Current Market chapters:

- State the objectives, issues, threats, opportunities based on a SWOT analysis.
- At least three product types and/or variants that will be produced in the company should be decided and justified
- Develop marketing strategy of the company by considering market segmentation, target market, positioning, distribution channels; 4Ps (Product, Price, Place, Promotion) and loyalty programs
- Suggest a general market growth strategy for the company by considering market penetration, market development, product diversification, product differentiation, etc. Additionally explain the opportunities to export the product.
- Determine the best forecasting method that suits the pattern of the sales for each of product that you are going to produce. Make the forecast for each product over the planning horizon.
- Determine the market shares of the company for each of the products over the planning horizon year by year. Justify all based on your earlier work.
- Using your initial (year one) market share determine the total production quantities of all products that you plan to produce.
- Early financial feasibility check: Perform a pre-financial analysis to decide if the determined production quantities are feasible or not (consulting professional experts operating in similar industry may be helpful). Note that environmental and social impacts should also be considered to avoid serious problems which might arise

during implementation and operations. In case of infeasibility discuss what should be done to restore feasibility.

6) Engineering Standards:

Any manufacturing or service providing environment must satisfy a lot of technical standards. Standards are extremely important technical documents in engineering and related technical fields. A technical standard is an established and mandatory norm or requirement. It is usually a formal document that establishes uniform engineering or technical criteria, specifications, guidelines, characteristics, methods, processes and practices. Standards are the minimally accepted professional practice and/or quality that must be observed. By applying standards, organizations can help to ensure that their products and services are consistent, compatible, reliable, safe and effective. There are thousands of standards in use around the world. They cover everything from the simplest screw thread to the most complex information technology network.

The product, the working environment, packing, quality control, material handling, transportation, etc., must satisfy some relevant standards. These standards and their applications in the design project should be presented and discussed here. Any relevant rules and regulations should be included in Chapter 2.

7) Determination of the Manufacturing Processes:

a) What to be manufactured in the Company:

- Provide exploded assembly drawing/part photograph for the product and the component part drawings for the products that will be produced and indicate properties, characteristics, etc. for these products.
- Provide part lists of each product by indicating Make/Buy decisions based on realistic constraints and reasoning.

b) Required Manufacturing Operations:

All manufacturing operations that will be done in the company must be listed here considering the lists of the Make type parts presented in the previous section.

c) Process Design (initial step):

Develop an initial order of the required manufacturing operations and processes. Provide initial flow charts of all products that will be produced. Note that the design of the process and operations will be considered and finalized later in Facility Layout Chapter.

d) Technology:

Alternative technologies for each of the manufacturing operations listed in section b must be provided here. For each manufacturing operation, technologies should be evaluated and a selection should be made based on some realistic constraints and criteria.

e) Machinery and Equipment:

For every manufacturing operation find at least 3 alternative machines for each selected technology. Evaluate and select the machines using engineering methods based on your realistic constraints and criteria. Explain the reasons of

your final decisions (non-economic factors, etc.). Provide figures of the machines.

f) Standard Times:

Estimate time standard of each product (you can consult experts). To be noted that in real life operation analysis and design should be repeated every one or two months

g) Review, finalize, and justify all decisions taken earlier in this chapter based on economic and non-economic constraints. Present your finalized work and list all the changes made in this section separately.

8) Capacity Planning:

- Determine the production capacity of the company for each product by considering:
 - The demand forecasts, goals of the company, pattern of the demand, etc.
 - Applicable capacity adjustment options such as overtime, additional shift, hiring/firing, etc., in order to handle the demand.
 - Possible methods to smooth the production level such as keeping inventory, backlogging and outsourcing, etc.
 - Strategies to meet the demand such as chase, level, etc.

Note: Capacity planning should not contradict with your inventory policy; expansion plans, if any, should be considered in the Facility Layout chapter.

9) Material Handling:

- The material transportation from the suppliers to the facility, within the facility and from the facility to the customers should be considered. All needed vehicle and equipment types should be listed here. Comment on automation possibilities.
- At least 3 alternatives should be found for each different type of vehicles. Evaluate and select the material handling equipment and vehicles using engineering methods based on realistic constraints and criteria. Explain the reasons of your final decisions (non-economic factors, etc.).
- Number of vehicles that will be bought should be determined.
- All the decisions should be justified.

10) Quality Management:

It is very important for a company that its products are reliable and meet the product specifications. Thus, the production processes must be under continuous control. Develop a quality management system based on selected quality characteristics and quality control methods. Which characteristic(s) of the products will be measured?

11) Organization of the Company:

This chapter describes the structure of the company including administrative and production units. Discuss the functions of every unit in the organization chart. Describe the interrelationships between the units.

12) Personnel and Workforce:

- Provide the job descriptions and job specifications of all positions.
- Describe the workforce recruitment policy and selection process for each position.
- Determine the total number of employees that will be required for every unit of the company.
- Include Disabled Recruitment Regulations in TRNC.
- Salary administration: Discuss advantages and disadvantages of some applicable compensation methods and decide the wage payment system of the organization.

13) Financial Analysis:

The chapter analyses the two sides of the financial balance of the company. One side contains all types of cost, including energy, credit costs etc. In case the project is financed based on credit (bank loan, investors etc.), consider the interest rates and payment details. The other side is the income which involves selling price, number of products sold etc. The balance of the two sides indicates the annual profitability level of the company. Prepare annual income statements (profit and loss), provide the cash flows and calculate the Net Present Value (NPV) over the planning horizon. Conduct a financial feasibility study, including NPV, break-even analysis, payback period, etc. In case of financial infeasibility, discuss the ways to make it feasible in the Discussion and Conclusion chapter.

14) Discussion and Conclusion:

This chapter presents evaluations of the study including;

- Comments on the contribution of the considered investment to the industry and society in the TRNC,
- Limitations and assumptions,
- Brief review about the technological, environmental, legal, or political feasibility of the considered investment,
- Detailed discussions on all possible ways to achieve a profitable investment in case the investment is not economically viable.

REFERENCES

APPENDIX