

## Cover Page

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## 1. Introductory Features

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*What is the full title of the firm? When was it founded and where is it located? (Give the full address).*

The firm in question is a steel processing facility, operating under the name *Sultan Steel SARL*, was founded in 1995 and is located in *Sultan Hangar, Bchamoun Industrial Park, Bchamoun, Lebanon*.

Sultan Steel is one of the firms in Lebanon that have survived the ongoing economic crisis that has started in early 2019, coupled with the COVID-19 economic decline, although not unaffected. The organization has suffered a severe decline in project opportunities and potential customers, due to the overall decrease in the local buying power.

The company boasts over 1200 completed projects under its belt, with upwards of 300 project ideas generated.

It shall be noted that the firm is a steel *processing* facility rather than doubling as a steel *manufacturing* facility, mainly because steel manufacturing is not profitable in Lebanon. Steel manufacturing requires a lot of energy, which is too expensive in Lebanon as opposed to other neighboring middle eastern countries (Middle East Steel, n.d.) due to the high energy price rates. This makes importing steel cheaper than manufacturing it locally, despite the 5% import tax.

*The main shareholders and their shares. Is the firm a joint venture, a franchise, a part of a holding company or a part of a multinational group?*

The firm is a part of a holding company, named *Al-Saltana Al-Qabida [Sultanate Holding]*. The shareholders are:

- Sultanate Holding
- MetaTrade
- Mac Energy
- NEXOIL
- 360Engineering

The exact shares are not to be shared, but Sultanate Holding holds the biggest share, since it is the parent company of Sultan Steel.

*Specify the sector and typical products the firm manufactures, and its shares in the domestic market and (if any) international markets.*

*Who are regarded as the customers of your practice organization (consider the end users, retailers, other manufacturers, employees, etc.)? Identify the stakeholders, i.e. the groups considered by the organization to have any sort of interest in the organization's activities (such as certifying agencies, labor unions, professional societies, government, local community, potential customers, competitors and employees).*

*Note: Questions 1.3 and 1.4 have been merged*

### **Available Products:**

The firm has a wide range of products available. These include:

- Pre-engineered buildings
- Modular porta-cabins
- Camps
- Modified containers
- Overhead and gantry cranes
- Architectural facades
- Silos and tanks
- Steel rebars

They also provide sheet metal processing and custom-made parts.

During the duration of the internship, the firm took ahold of a pre-engineered building project.

### **Market Shares:**

Since Sultan Steel specializes in special projects, it is difficult to get the respective market share of special projects. Add to that the unavailability of the information from the

Ministry of Economy & Trade in Lebanon, it is not possible to get the market shares of Sultan Steel in the local market.

Sultan Steel's target audience are mostly locals, so the impact they have internationally is negligible. Meaning, the international market shares of Sultan Steel are not available either.

**Customers:**

The customers and end users include both other companies and "regular customers". For example, individuals order steel rebars at varying dimensions, mostly to use them in construction of houses, whereas other steel processing facilities order the standard 12-meter steel rebars and process them later.

In addition, both companies and individuals order custom-made parts albeit in different magnitudes. Another example is the pre-engineered buildings, where a lot of traders are requesting huge steel hangars, to take advantage of the Lebanese lira exchange rate fluctuation. When the exchange rate gets higher, traders buy a lot of products, whether that be clothes, pharmaceutical drugs, low-grade electronics, and other non-perishable items, and sell these when the exchange rate worsens.

**Stakeholders:**

According to Minning (2021), stakeholders are grouped into three different categories: internal or external, primary or secondary, and direct or indirect.

Obviously the most immediate stakeholders are the owners (Sultanate holding and the rest of the shareholders). They are internal, primary, and direct stakeholders. Employees fall within the same categorization.

Customers are the most important stakeholders according to Minning, since a business cannot exist without the customers, and pleasing customers should be in a company's biggest interest. Customers are external, primary, and direct stakeholders. The customers of Sultan Steel comprise mainly of individuals seeking a specific project. When it comes to trading steel rebars, however, a good chunk of the customers are various companies who also operate in steel manufacturing and overlap with the competitors. *For the list of competitors click [here](#).*

Labor unions are external, secondary, indirect stakeholders. Unfortunately, in the context of the firm, not many employees have a labor union dedicated to their profession. The most prominent labor union is the Order of Engineers and Architects.

The government collects taxes from the firm. It is thus a stakeholder in that respect. It is an external, secondary, and indirect stakeholder.

Suppliers are external, secondary, indirect stakeholders. Suppliers of Sultan Steel include, but are not limited to:

- Alp Çelik (Turkish)
- Kamaridis GlobalWire Group (Greek)
- Steel Global (Turkish)
- ATAKAŞ (Turkish)
- Kaya Metal (Turkish)
- Vilmeks (Turkish)
- Tosyalı Algeria (Algerian, held by a Turkish Company)
- Biltema (Swedish)
- Proctor & Gamble (American)

Note that the prevalence of Turkish companies is due to both countries suffering a hyperinflation in each of their currencies, decreasing the Lebanese companies' buying power of anything priced in dollars. A further discussion is held in [Appendix A](#).

ISO analyzes the risk factor and makes sure that the procedures held in this otherwise dangerous job domain comply with OHS standards. It is an external, secondary, and direct stakeholders.

Sultan Steel has established very close relations with IMWS, whom also work in steel processing. Their facilities are close to one another and each company helps the other with processing and labor when needed. They are separate companies, but when they trade with each other, they offer each other a special price. They regard themselves as sister companies. IMWS is an external, primary, and indirect stakeholder.

According to Wroblewski (2019), competitors are also stakeholders – as opposed to Minning who does not share consider them as such. According to Minning’s categorization, competitors are external, secondary, and indirect stakeholders. Competitors of Sultan Steel include but are not limited to:

- Assi Steel
- Zeeni Steel
- DEMCO Steel
- J&P Steel
- Parissis Steel Engineering & Contracting
- Baroud Steel

*Provide a list of functions ~~performed~~ **that could be performed** by ~~the~~ industrial engineers in the practice organization.*

*Note: Modification in question 1.5*

Sultan Steel does not currently employ any industrial engineer; however, there is a lot of space in which an industrial engineer can operate in:

- Optimizing the facility layout
- Creating a time standard
- Designing the custom parts and the work elements needed
- Optimizing distances and minimizing the costs of transportation
- Determining the cost of each work element operation
- Project and project flow management
- Quality control
- Safety and ergonomics
- Inventory planning and control

As of now, these functions are either performed by non-industrial engineers, like quality control and inventory control, but others are not performed at all, like creating a time standard.

Since there are no industrial engineers currently employed, it is possible that the firm may achieve a higher efficiency level and lower cost had they employed one. After all, every company has some inefficiencies that could be toned down to reduce costs and wastage.

In the past, two months before this report was written, there used to be an industrial engineer who used to work at Sultan Steel in the quality control sector. Further details about their work were difficult to come across.

## 2. Analysis of the Macro Aspects

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*Identify major items of input of the production system you have observed. Specify where and how they are supplied (e.g., sources, means of transportation, volume and frequency of deliveries, usage rates etc.).*

The most incoming physical item is steel sheets, incoming at multiple points in one day. They are usually delivered in flat-bed trucks, both small and large. They are usually delivered in bulks of 10-20 for smaller orders (small in either magnitude, size, or both) and in the hundreds for larger orders. Effectively, the frequency and volume depends on current customer orders, or, for example, if a big order of a large number of steel beams is due, which needs many smaller parts, then the number of steel sheets coming in depends on the amount needed. Ultimately, the exact number of incoming sheets can vary highly.

Another incoming physical item is steel rebars. Sultan Steel does not manufacture them, but rather imports them and sells them locally. They are transported using flat-bed trucks and pickup trucks. The firm imports many types, differing by thickness and girth. They are usually sold to Sultan Steel at a length of 12m. The firm then sells them to customers depending on the given specifications. Usually, customers ask for steel rebars at certain lengths, different from the standard 12m. Other steel companies, or those who have cutting machines, prefer to buy steel rebars in the standard length and then cut it to the desired length themselves. *Details on frequency and amount are provided [here](#).*

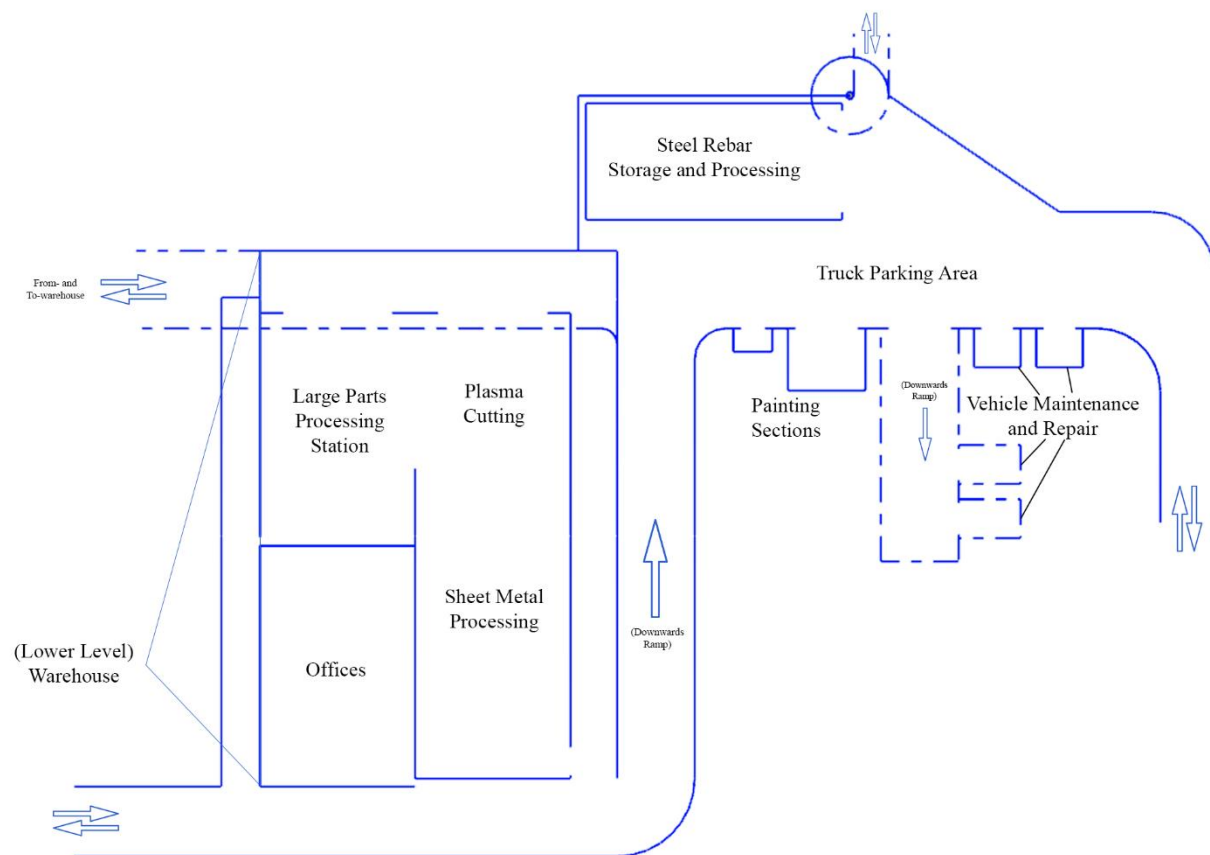
Another major input item is sheer physical labor; Sultan Steel currently employs 150 total workers, 50 of which are physical workers. Since the production is highly variable and each part is different than the one before it and the one after it, the manual part of production is higher than



that of companies that adopted a line of production system. In addition, much higher precision and skill is required in order to keep the quality high and consistent.

A critical input is energy, especially considering the fuel and diesel crisis in Lebanon. Currently, a company called Mac Energy, separate from the government and the ministry of energy, has contracted with Sultan Steel to supply them with constant energy.

*Identify the major facilities of the manufacturing firm you observed during your summer practice on a rough (free hand) sketch. Show a few items that flow among them (e.g., painted parts, sheet metal, vehicles to repair, spare parts, steam, fabric, design information, cardboard boxes, etc.).*

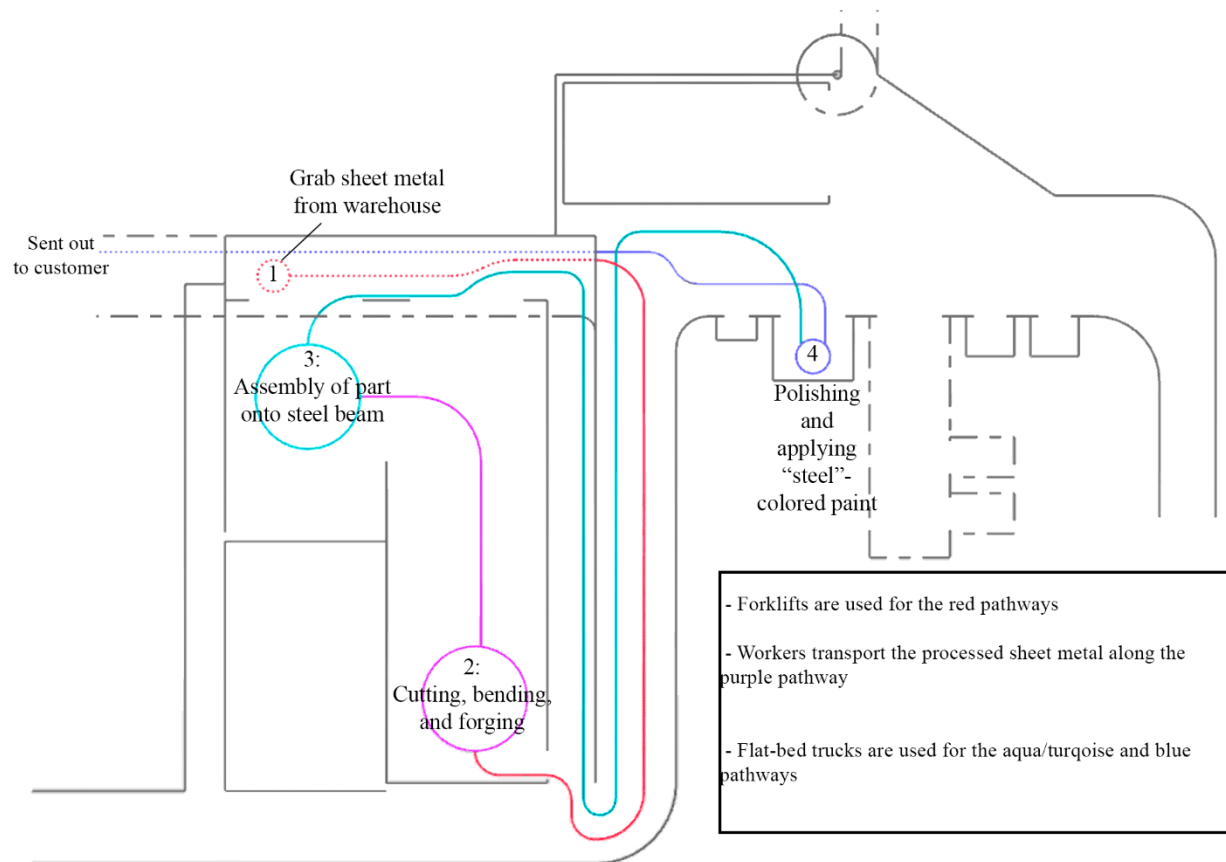


*Figure 1: Sketch of Facility with Department Descriptions*

As observed in figure 1, the facility has 4 total entrances and exits, excluding the entrances and exits in each department. The two western gates connect to the main road in

Bchamoun, and the other two connect to branched roads. Note that the northern gate close to the steel rebar storage and processing is a circular helix roadway.

Each department is a building in its own, and the roads that connect them are asphalt roads, just like any other road, allowing forklifts and trucks to travel and transport items between each department. The building housing the sheet metal processing and large parts processing areas is regarded as the main processing area. The facility is multi-layered, and the warehouse is one level under the offices and main processing area.



*Figure 2: Pathways taken by sheet metals to be produced into steel beams.*

Figure 2 offers a simplification of a manufacturing process. Sheet metals are first picked up from the warehouse in the lower levels using forklifts and are then carried into the main processing area. They are then processed according to the requirements needed, which includes some combination of cutting, bending, forging. They are then carried to the large parts processing site, usually by workers or by the overhead crane if the need arises. After being

installed into the steel beam at the large parts processing site, the whole assembly is then carried by a flat-bed truck to the painting section of the facility, and then sent out to customer after all the required parts are completed.

*Note: the dotted pathways indicates that it occurs at the lower floor level.*

*Specify the most prevailing factor for selecting the current location of the facility with regard to the factors listed above or the like. Support your ideas. (You may use a sketch, a table, a graph or a map, if necessary).*

The most prevailing factor is the fact that the location is part of an industrial site, and the part that the firm lies in is dedicated to multiple steel organizations. In addition, the land in which the facility was built on was owned by Sultanate Holding years before the facility was built.

### **3. Management Information System**

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*Specify the decision makers (individual or group, their positions within the organizational structure) and the related subject of decision-making with regard to one decision-making activity in each of these decision levels.*

The shareholders are highest decision makers, but their decisions are most general. Their decisions are related to whether to open a new facility, increase or decrease number of workers, or take steps to increase profit and/or decrease costs.

The highest decision maker within the company itself is the GM, general manager, who takes many major decisions, including accepting a project or not, adding new machines, applying a new standard, etc.

Next come the department heads, who manage the employees in each of their departments. Namely, financial department, drawing department, engineering department, and sales office, for example, all have managers that run the workers under them. They report to the GM. Their task is to make sure the job gets done in a certain timeframe and that it gets done perfectly without any problems, and their decisions are restricted to their department. For example, the financial department manager applies a new standard to work on in their financial

documents. Another example is that the workers return to the foreman in case they found a difficulty performing a task with the given parts.

Finally, come the workers, who take decisions on a personal level and on a day-to-day basis. The workers decide how they want to approach a task that they have been given. They report to their managers, i.e., the department heads.

*Identify the computer systems (computer networks, stand-alone PC's, workstations, main frames etc. -their types and approximate capacities) in use and their spread (functions or departments with extensive or low computer support in their operations) in your practice organization.*

The white-collar workers are all provided with a computer to work on, and the communication between each PC is based on emails and such. Some workers also use both a laptop and the provided computer for multi-tasking purposes.

Most of the machines (cutting, die forge, rollers, plasma machines, etc.) are equipped with a computer program to control the output accordingly, making them CNC machines. Some other machines are not controlled with CNC features and rely on completely manual input, like the piercing desk machine.

In general, 90% of the work of a white-collar worker is done through the PC. For example, the engineers and detailers study hangar projects through programs like AutoCAD. Accountants do their work on their PC's. Sales workers manage their sales on their computers. And so on.

#### 4. An Overview of the Production System

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*Provide a schematic representation of the ~~material flow~~ **production flow** of a particular product in your practice organization. Note that your diagram should include the complete flow from raw materials inventory through finished goods inventory with every point of conversion (workstations, stock points) being indicated.*

*Note: modification in question 4.1*

Since the most requested products at Sultan Steel are pre-engineered buildings and hangars, the production system for them will be presented (figure 3):

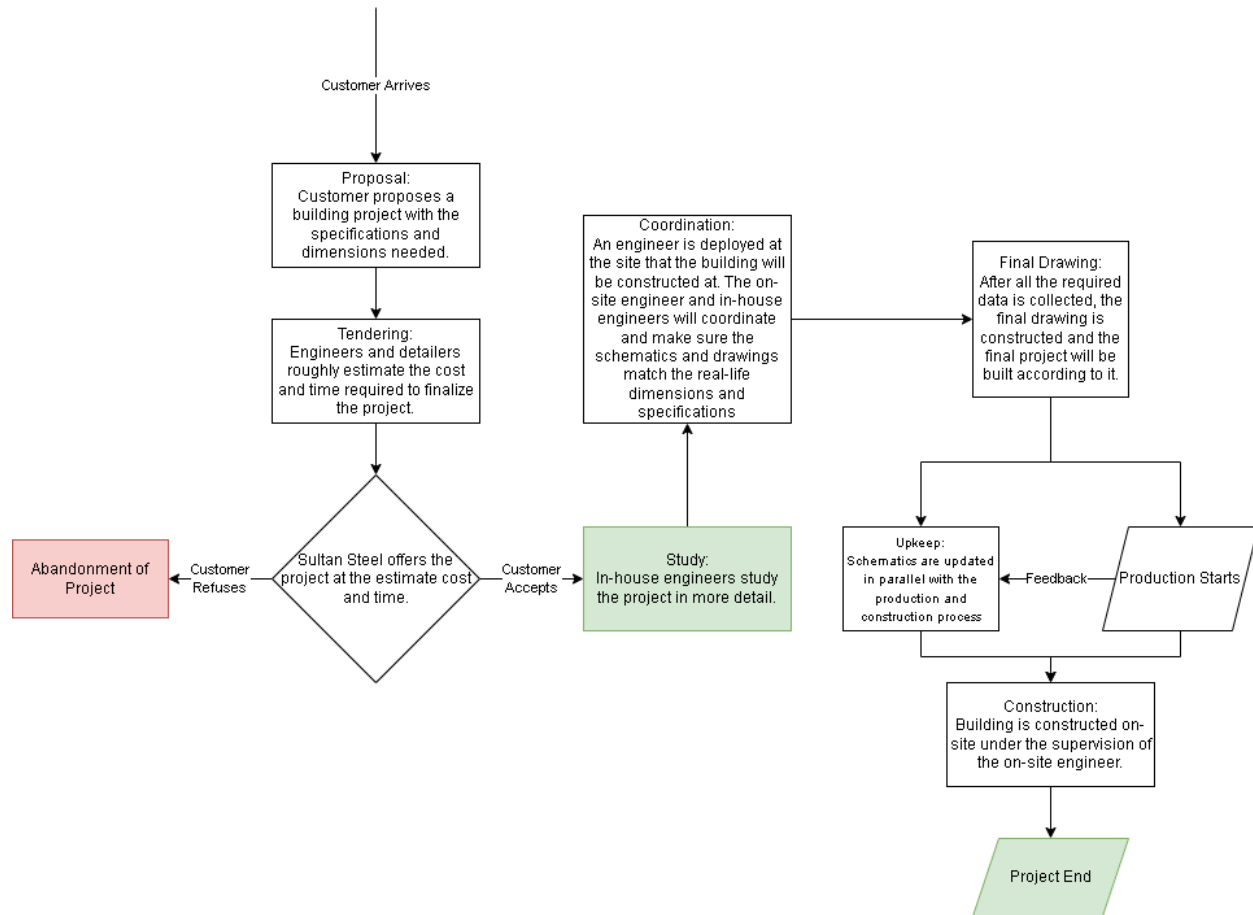


Figure 3: Process map of building a pre-engineered structure.

The most-time consuming part of is the production itself, despite it only being one “step” in the process map. Similarly, each step in this process map is comprised of many smaller steps. A takeaway is that the process is *mostly* linear, so a delay in one stage is a delay in the entire project.

The feedback that goes into upkeep is a complicated process and defers from one project to another. For example, the feedback may be that a certain part cannot be produced by the available machines, so the engineers have to formulate a way to get past that obstacle without compromising the structural integrity of the project.

Producing a hangar is an extremely complicated process, so an (simplified) operation chart is provided (figure 4):

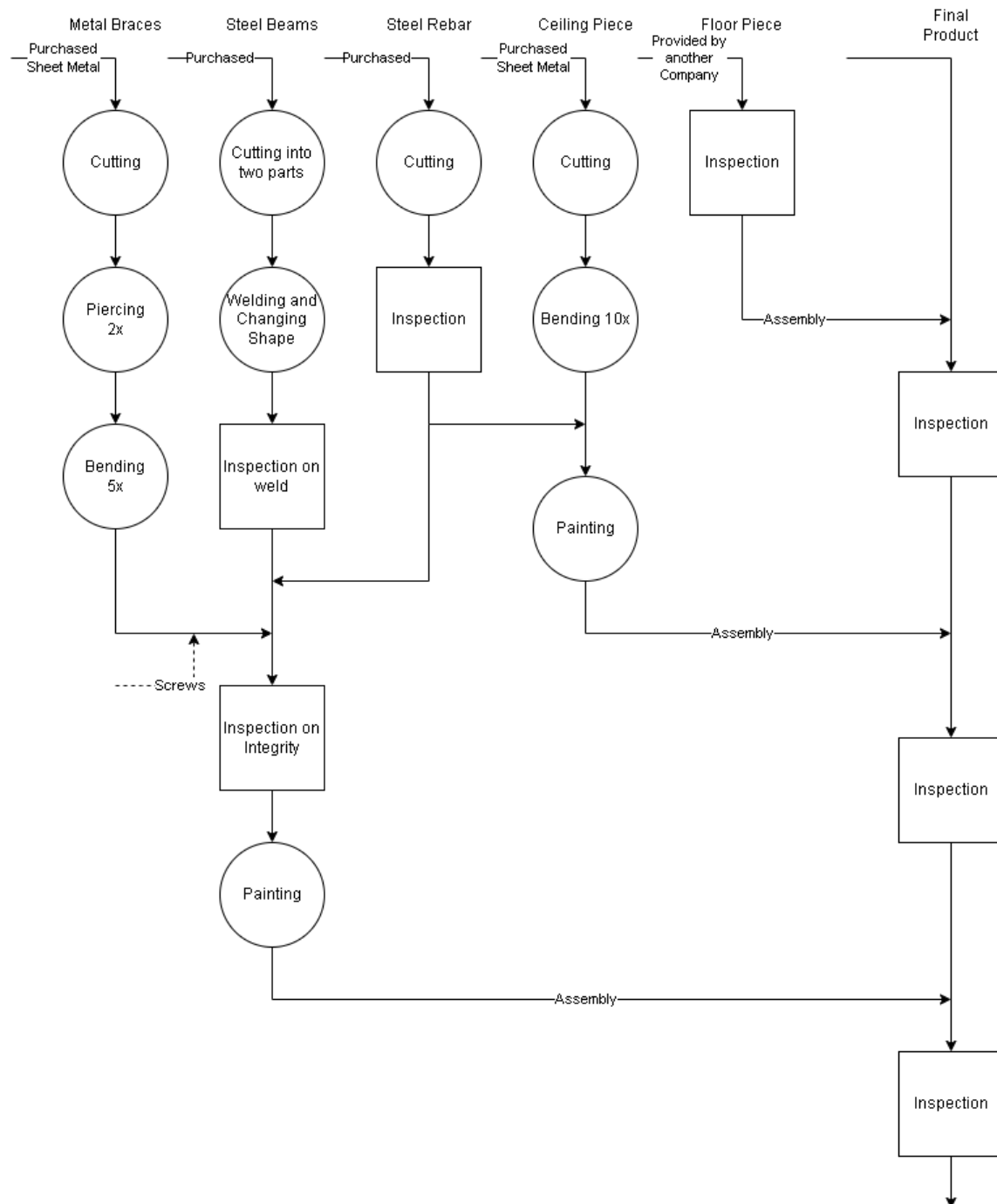


Figure 4: Operation chart of the production process of a pre-engineered hangar.

The project is extremely complicated to be placed into one chart, so it is overly simplified. So, only the most important three components are shown: the steel beams, floor pieces, and ceiling pieces. The wall pieces are produced in a similar but not same way as the ceiling pieces.

Note that assembly occurs on site, and that the floor pieces are not made of steel, but ceramic or tiles – same as other buildings. Pure steel buildings can become very dangerous and hot in the summers, but it is up to the customer to contract with another company to insulate the hangar from these unfavorable conditions.

To break down the production process even further, the production analysis flow process chart for the metal braces will be provided (table 1):

Type: <b>Product</b> / Material / Man	<b>Metal Braces</b>
Page: NaN of NaN	Present Method <input checked="" type="checkbox"/> Proposed Method <input type="checkbox"/>
Date: <b>February 10, 2023</b>	
Location: <b>Sultan Steel</b>	By: <b>Youssef Nsouli</b>

Process Description	Event Symbol	Time (min)	Dist (m.)
3m Sheet Metal arrives	○ → ▼ ▢ □	-	
Grab Sheet metal	● → ▼ ▢ □	2.4	2
Worker sets up cutting machine	● → ▼ ▢ □	0.1	
Cutting into 32cm long sheets	● → ▼ ▢ □	3.1	
Collect sheets	● → ▼ ▢ □	0.6	
Transport to piercing desk machine	○ → ▼ ▢ □	0.4	6
Pierce sheets once	● → ▼ ▢ □	7.3	
Store after piercing	○ → ▼ ▢ □	-	
Transport to die forge machine	○ → ▼ ▢ □	0.3	3.5
Bend each sheet twice	● → ▼ ▢ □	3.4	
Store after bending	○ → ▼ ▢ □	-	
Bend twice again	● → ▼ ▢ □	3.4	
Store after bending	○ → ▼ ▢ □	-	
Transport to large parts processing area	○ → ▼ ▢ □	2	~20
Bore a hole for each brace	● → ▼ ▢ □	~30	
Inspect holes	○ → ▼ ▢ ■	<0.1	
Grab screw	○ → ▼ ▢ □	0.1	
Grab metal brace	○ → ▼ ▢ □	0.14	
Screw in each metal brace	● → ▼ ▢ □	~10	

Table 1: Production analysis flow chart of metal braces from sheet metals until fixated onto the steel beam.

Explain the type of operations in your practice organization with regards to any one of the followings: production volume or product variety. Describe your reasons in detail.

Sultan Steel provides a large variety of products, ranging from pre-engineered buildings to silos and tanks to simple sheet metal processing. Each of these products requires a combination of different sets of parts, labor, dimensions, and steel specifications.

For example, the most prominent products at Sultan Steel are pre-engineered buildings. Sultan Steel does not use ready-to-use blueprints, because each customer that walks in asks for a different specification of these buildings. For example, once a customer asked for a 30m×40m hangar, and the next asked for a 29m×40m hangar with different interior considerations. Each requires a full-on study to make sure the hangar does not collapse under the stresses it may get subjected to.

Tanks and silos on the other hand, require a structure that complies with UL-142 regulations. This is especially important since the regulated production increases customer confidence in the product and elevates some of the “stress” and effort required to design a safe tank that can store flammable fluids. Such regulations require the firm to deviate from the same formula they use for their other products and stick with globally regulated standards.

Architecture façades also have a large range of variety in and of itself; each building requires a different façade that each requires a different set of operations, dimensions, etc.

The most versatile and varying product they offer is sheet metal processing, where each customer can walk in and order custom-made parts or souvenirs and the like.

All in all, the production system can be best described as a **project shop** process specialty with the capability of adopting a **batch shop** process when needed.

*Discuss the type or combinations of the types of layout you have observed in your practice organization. Support your points using rough sketches.*

Sultan Steel employs a combination of project/fixed-position layout and process layout. Each portion of the facility is divided into separate buildings: offices, main processing facility, warehouses, vehicle maintenance area, and painting area.

The main processing area has an area specifically for cutting, forging, and piercing, which could be considered a cell if there were more than one. There is also a section for all bending and rolling machines, and a section for plasma cutting.



In addition, the northern-western area of the facility is where the fixed-position layout is adopted; the bigger products are held there and are operated on using hand-held tools (due to the larger sizes making machines obsolete) and the smaller parts are added onto it. All in all, the main processing area adopts a process layout as a whole.

The parts are then moved to the painting area (if needed) where a fixed-position layout is also adopted. The large parts that are being painted are usually lifted by a small crane to increase maneuverability and make the paint job easier. After that, the parts are delivered to the customer.

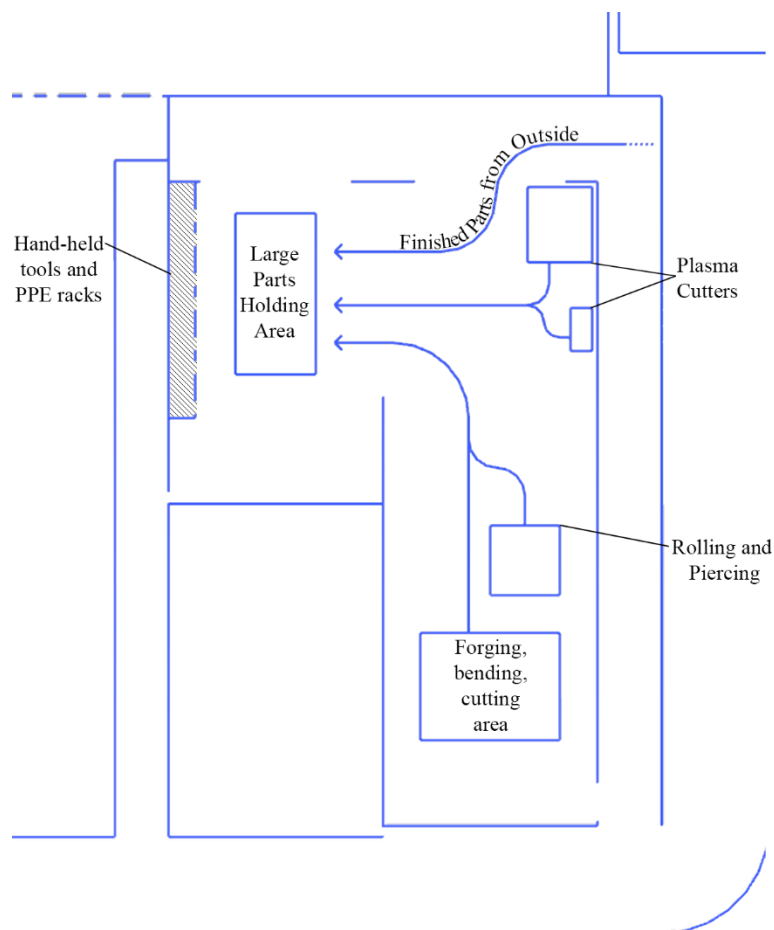
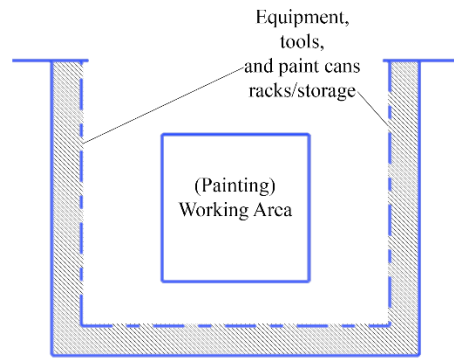
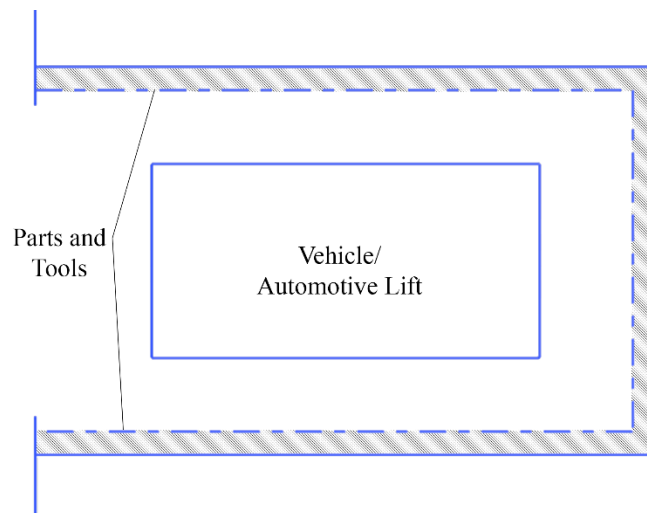


Figure 5: Flow of parts demonstrating the combination fixed-position layout and process layout.



*Figure 6: Fixed-position layout in a paint job area.*

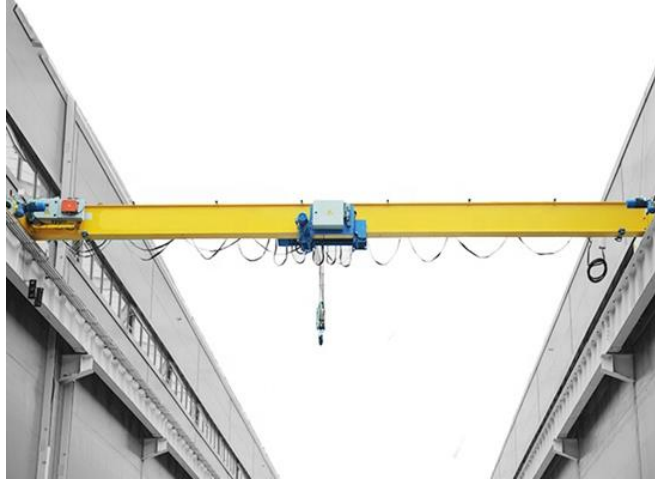
Within the vehicle maintenance area is a fixed-position layout, due to the nature of the job. The automotive lifts are used to lift the car up the ground and make it easier for the mechanic to work on the car from below (figure 7):



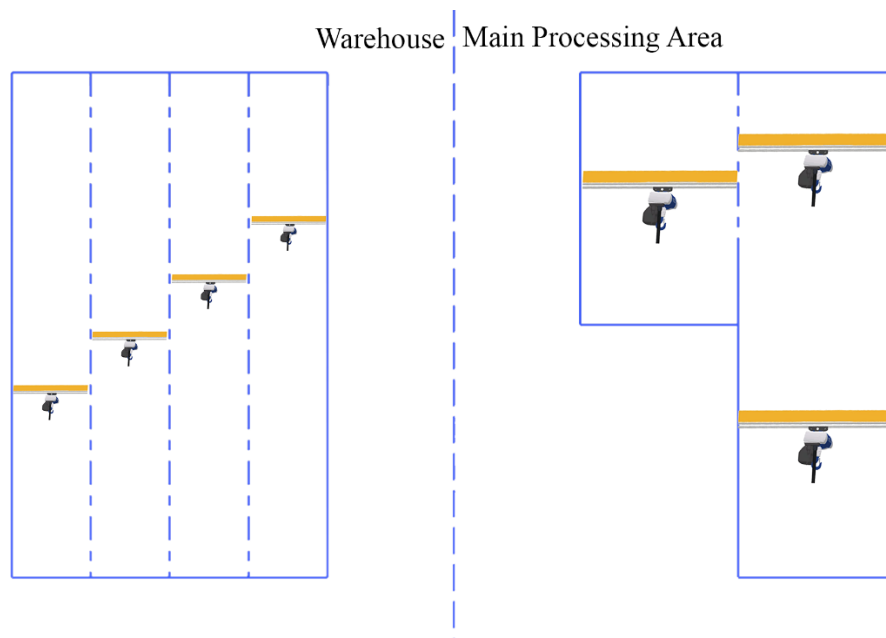
*Figure 7: Fixed-position layout in the vehicle-maintenance area*

*Identify some of the materials handling equipment in the plant and state where and for what purposes they are used. On a rough free-hand drawing, identify a path followed by any one of the materials handling equipment.*

The most common materials handling equipment within each part of the facility are the monorail overhead cranes. The hook of the crane can move freely in all three dimensions within the designated rails, as seen in picture 1 and figure 8:



*Picture 1: Monorail overhead crane.*



*Figure 8: Monorail overhead cranes used in the warehouse and main processing area.*

Not all the overhead cranes are the same, some of them have different speeds and can handle a different maximum load. The hook can be changed in order to accommodate for the different parts that it may need to hold. For example, if a single large sheet needs to be transported, a magnet is used and the sheet attaches to the magnet. Each crane has a different remote-control apparatus that the workers can use. Much care is taken when transporting items, since an item falling can result in machines being destroyed, injuries, or even death of workers.

A commonly used interdepartmental materials handling vehicles are forklifts. They are meant to carry a large number of small parts or a fewer number of medium-sized parts. On the other hand, for large parts, flat-bed trucks are used for interdepartmental transportation and are also used for long range transportation for incoming and outgoing parts and materials.

*Compute / Describe an appropriate productivity measure for your practice organization.*

Sultan Steel measures its productivity through the number of major projects done each year. Most of their revenue is generated from these projects and they have dedicated most of their workers to these projects. To them, a completed project is a satisfied customer, and the more projects they conduct, the more satisfied customers they get, and the more revenue they generate. Overall, in recent years, Sultan Steel has completed around three major projects every year.

*Are unit-manufacturing costs calculated in your practice organization? If yes, explain how they are calculated and provide an example. If no, describe how expenses will be accounted for under different cost items for any one of the products.*

Unit-manufacturing costs have been calculated, but not according to the company's expenses, but according to the competition; Sultan Steel has definitely calculated the cost of each work element and work operation, but they chose instead to price these operations to be in tandem and competitive against their competitors.

The way they have been calculated is that, for example, one bending operation is priced at 33 US cents. Each part is calculated as the cost of the raw material summed with the number of work operations needed to achieve the required shape. The “analytical price” in the provided example includes the cost of the electricity going into the operation and the wage of the worker, the percentage of their shift going to this specific operation, and the factory overhead. After that, they compare the cost of this bending operation to the firm and compare it with market value. Finally, Sultan Steel has decided to use a competitive price rather than the analytical price.

The exact details of the electricity price, factory overhead, and shift allocation is hidden from interns, but that is the basic calculation principle. Sultan Steel found that the analytical price is similar to the competitive price and decided to use the latter.

*Note: All prices in Sultan Steel are in US Dollars, which is the currency also used in most major transactions in Lebanon.*

*Carry out comparative ratio analysis using the balance sheets and income statements for the last two years and evaluate the financial standing of the organization. (Calculate all the necessary ratios for such analysis) or itemize titles for the balance sheet/income statement for the organization.*

I have not been given access to this information and these documents.

## **5. Production Planning and Control System**

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*State subjects of typical decisions on the types and quantities related to some specific products of your practice organization. Who make(s) these decisions? How are the decisions recorded and transferred to others in the organization? What is the basis for these decisions?*

Typical decisions in production planning include reduction of waste, which is mostly done by the detailers. The detailers will try to eliminate as much waste as possible by trying to add every scrap piece of metal into the project – whilst following the customer's requests, of course. An example of that is that Sultan Steel brings in a 6m piece of sheet metal but only a 5.7m of it is needed; the cutting process will leave a 30cm piece of sheet metal as scrap. The detailer will try to incorporate that piece of scrap metal somewhere into the project. If they fail to do that, that scrapped piece will be added to the waste pile and sold at \$350/ton. In both cases, the decision is passed onto the foreman in the facility who will propagate the decision to the workers.

Another typical decision is related to the trading part of the firm. Steel rebars will be used as an example, since it is the most traded item in Sultan Steel. A certain amount of steel rebars are needed to be present at all times, because when the firm sells these rebars, they are sent out the same day; there is no time to wait for a new shipment that has upwards of a month of lead time. So, the salesmen at the sales office anticipate the demand ahead of time, depending on historical data and the current economic situations, and more, and raise their order to the

warehouse keepers. The historical data indicates that the demand for steel rebars decreases in the cold seasons, possibly due to construction sites slowing down in these months, for example.

*What resources are controlled as scarce through careful planning in your practice organization? Name a few. How are their uses planned? How are the plans monitored?*

Scarce resources include energy and workers:

- **Energy:** Energy has been a scarce resource throughout 90% of Lebanon for the past 25 years at least, and the 2019 economic crisis has worsened it. The challenge lies in maintaining the amperage consumption under a certain limit. The company supplying the energy, Mac Energy, cannot supply the same power as an entire national power plant can. If power gets cut off whilst a worker is performing a work element, then the sudden stopping of the machine may cause severe injuries. As such, a lot of money is poured into this respect, to provide appropriate energy for consumption and make sure power doesn't get cut off.
- **Workers:** Workers are one of the most expensive assets of the company. So, it is important to manage the number of workers working. For example, due to the decline in the last couple of years, many workers have been laid off and continue to be laid off. Each worker that shows signs of severe slacking is, basically, hindering the firm from advancing. Each worker and employee is monitored to make sure that they are working at an acceptable pace.

*State four different items kept in stocks in your practice organization. What requirements do they serve, or what causes them? Use a graph to plot the inventory on hand (i.e. in the storage or use areas within the facilities of the company) versus time for at least one of these items. Do you observe any pattern? How can you explain that pattern (or none)? Supply your sources of data used in the plot.*

*Note: Question split into two parts.*

Four of the items always found in stock are steel sheets, steel rebars, steel tubing sections, and steel beams.

Steel sheets serve as safety stock, where in most cases, the inventory at the start of the day is the same or almost as the inventory at the end of the day, as seen in figure 9:



Figure 9: Variation of number of steel sheets across a certain day.

The steel rebars and tubing sections serve as a combination of safety stock and cycling stock, where a rough continuous review  $(s, Q)$  model is used for each, where steel rebars are imported overseas and tubing sections are manufactured in-house.

The time between orders of steel rebars is typically between 3-5 months. The  $Q$  for steel rebars is 4000 tons, and the  $s$  does not have a specific value (hence not a complete  $(s, Q)$  model) but is around 1500-2000 tons.

Steel beams are used in Sultan Steel's most important product, pre-engineered buildings, and they serve as cycling stock. When a project gets green-lighted, the firm orders the needed number of standard steel beams and stores them until they get processed and modified to the needed shape and specifications. This is displayed in figure 10:

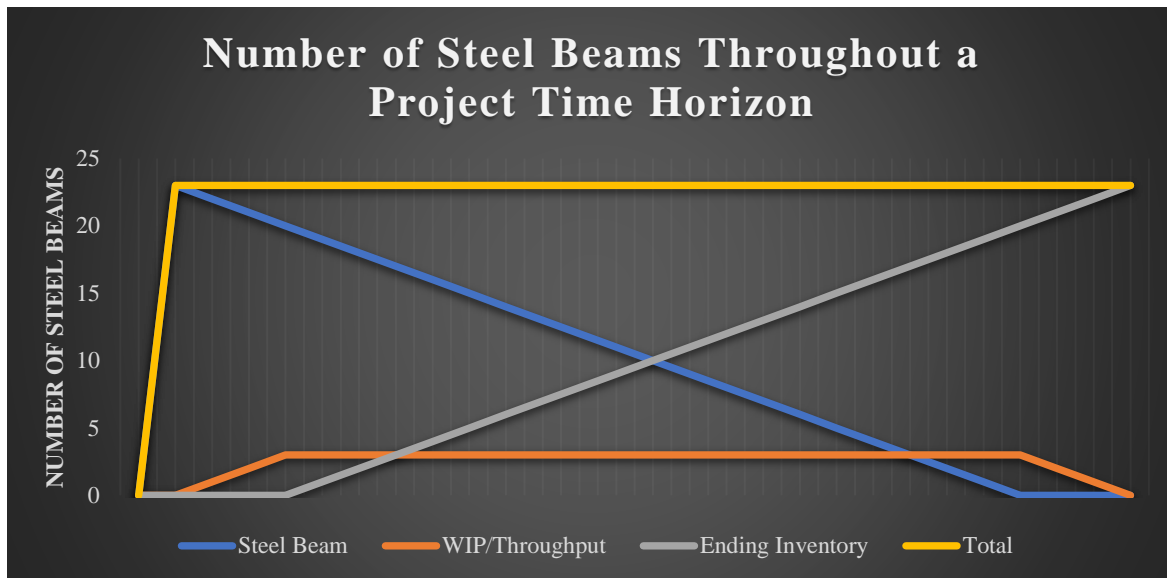


Figure 10: Number of steel beams in the main processing area throughout the time horizon of a pre-engineered-hangar project.

Note: “Total beams” is related to on-hand inventory position, and it shows where the replenishment point is.

What difficulties do you observe with regard to managing inventories?

Inventories face the firm with a problem of predicting demand and forecasting it. One of the workers explained that through experience, the forecasting becomes easier. For example, the demand for steel decreases in the winter, where external working conditions become less favorable.

Another thing is that counting inventory is difficult, especially with steel. Steel rebars are infamously hard to count, and they are usually bought in tons, not numbers. It is difficult to keep track of the mass of steel rebars coming in and out over a certain time horizon. Steel sheets are also too thin to count individually, forcing the workers to spend a considerable time counting the sheet metal before processing/transporting it.

## 6. Quality Planning and Control System

Choose a product and explain how the organization defines quality of it. How are customer requirements translated into product or service specifications (or



*characteristics)? Provide examples. Also describe the quality control activities that take place throughout the life cycle of that product.*

Sultan Steel defines quality in precision and accuracy of the dimensions of their products to meet the customer requirements. In the case of this firm, they deal with customers on a one-to-one basis, unlike production line facilities that have thousands or millions of customers whom have little interaction with the producer besides their product. The workers have continuous call sessions and email threads with the customer to make sure the project is perfect in the eyes of the customer.

For pre-engineered building or hangars, each extra centimeter may cause an instability in the structural integrity and cause it to collapse. To achieve that, the workers are taught to make workpieces precise along their dimensions and accurate to customer requirements. If any defect or inaccuracy is detected, the foreman or a professional is consulted.

Sultan Steel also mostly utilizes cold-working of steel and other metals over hot-working, which makes the steel stronger and harder to deform. Cold-formed steel is 20% stronger than hot-rolled steel (Ye et al., 2018). In addition, cold-formed steel is more sustainable and recyclable, more suitable for housing and low- and mid-rise buildings, and lighter making it easier to transport (Gordon, 2021).

To also make sure that the building translates well into the building site, an on-site engineer and the in-house engineer coordinate and modify the structural drawings accordingly. This coordination corrects for any external factors that have not been considered by the in-house engineer, for example: terrain, ground type, actual land dimensions, location, easiness of transportation of parts to the construction site, neighboring buildings, and other factors. For example, if the ground were dirt, then the foundation would be different than if the ground were sand.

As well as coordination between the two engineers, a feedback loop occurs between production and the in-house engineers and detailers. If the foreman informs the detailers that a part is not possible with the current machine setup, then they study whether it is more optimal to modify the structural drawings and sketches or buy the part as is from other steel firms (this is also where Sultan Steel may ask IMWS for a specific part).

## 7. Observation of a Professional at Work

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*Identify the most appealing position to you at the firm. Observe a professional who has this position and narrate your observations. You may want to mention his/her tasks/responsibilities, how he/she lives a typical workday, %breakup of activities, who he/she manages, who he/she reports to, and which background and skills he/she needs, and so on.*

An interesting position I found was the position of a foreman who also doubled as a sales analyst and salesman. Their tasks include:

- Communication with customers and feedback with them
- Communication between workers and other employees in the facility
- Managing the workers in their workshops
- Making sure the work and processes comply with ISO safety standards
- Inventory control, partially
- External logistics

Said person dedicates about 50% of their time in communication, whether it is with customers or with other employees. The other 50% is divided almost equally between the rest of the other tasks.

They usually spend most of their time in their office in a “hut” near the production area with a camera monitor feed to monitor the workers. Every now and then, they will go to the individual workers and observe the work in more detail. They are also responsible for other minor safety issues, like disallowing non-workers from entering, forcing workers to wear the proper PPE. In addition, while in their office, they call customers or have customers visit them (the hut is outside the work areas).

They manage the workers of course, warehouse keepers, truck and forklift drivers, and the other salesmen. They report to the General Manager of the company.

They have a degree in marketing, but have a considerable amount of experience with ISO, since they interned at multiple companies worldwide, including in companies like Germany and Holland. Because of their intense exposure to mechanical systems, they also have some on-

hands experience with drawing schematics. Although they themselves do not draw them, detailers and engineers may consult him to solve a certain problem they may have encountered.

## 8. Analysis of a Decision-Making Problem

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*Identify a decision-making problem in your organization. Formulate the defined problem pointing to the following issues:*

- *Who is the decision maker (owner of the problem)?*
- *What is the goal or the objective (direction of and satisfactory amount of improvement) of the decision maker?*
- *What are the alternative courses of action (to achieve the objectives)?*
- *What are the limitations, restrictions, and requirements of the system?*

A significant decision-making problem was encountered when a construction company requested an architectural façade for their upcoming building. The requested façade required a lot of steel pipes to be produced and was a significant portion of project.

The project was evaluated at \$4M and 1200 tons of steel pipe were required, aside other parts, of course. The problem lies in the steel pipes, because the firm did not have the required machines to do that. Since it is a façade project, the outcome had to be aesthetically pleasing, durable, and strong. The dimensions needed varied from one pipe to the other. Two main alternatives were considered: contract another company or buy a suitable machine.

Decision maker: In-house engineer

Goal: Reduce cost as much as possible

Alternatives:

1. Buy a CNC Steel Pipe Machine at a steep cost of \$500,000
2. Contract with another company to manufacture the required number of steel pipes

Restrictions:

- Budget (1 & 2)

- Facility area concerns (1)
- Training workers to work the machine (1)
- Introducing new safety standards (1)
- Less room for error (2)

### Limitations:

- Keeping a constant communication line with both the customer and the contracted company simultaneously (2)
- Variable, possibly lower cost (1)
- Fixed, possible higher cost (2)

### Requirements:

- 1200 tons of steel pipe, produced in the required dimensions and specifications
- Durability, longevity, compatibility, use of correct materials.
- Has to be aesthetically pleasing

After considering the possible defect rates in both alternatives, the cost of the machine and the needed raw material vs the cost of contracting another company, the fact that the machine can be used in future projects, and other factors, it was decided that buying the CNC machine was the better alternative.

The firm finally manufactured the needed amount of steel pipes and completed the project successfully.

## 9. Conclusion

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*If you had another four weeks of time in the same firm, what would you be occupied with and why?*

*Note: Question split into multiple parts*

I would perhaps be occupied with having an in depth look at the process of the major project currently being undergone at the firm. As I said, the process is extremely complicated and I believe that having a closer look into it would be very beneficial, especially since it

concerns time and planning management which touches an industrial engineer's professional field.

*What do you expect to learn in your future training as an industrial engineer that will help improve your understanding of production systems? How can you further develop your capability of handling problems of these systems?*

I expect to learn more about decision-making, quality control, and more on handling inventories. Also, management and project managing can prove to be very helpful in many situations and companies.

As far as decision-making and project management goes, it is one of the most required jobs in each company; each company has an ongoing project, one at least, and it needs someone to manage these projects. Usually, companies hire people with a business administration degree to manage these projects. However, I have heard many concerns from engineers were in most settings, there are projects run by engineers with multiple certificates and degrees related to the engineering field specifically, yet their project manager is not an engineer, usually a business administration graduate. This causes to be a gap between what the teams apply and are familiar with (in terms of technical knowledge and acknowledging system limitations and restrictions, etc.) and what the manager is familiar with. If the project manager is also an engineer, an industrial engineer, this gap can shrink and lessen.

Inventory planning and management is, clearly, a very complex process and is very dynamic and has a lot of variables. So far, learning about controlling inventory systems has been helpful, but I would like to see more about how industrial engineers control inventories in the physical sense – its layout and processes, worker assignment, ways to count inventory, minimizing cost and time of storage/collection, and other aspects.

*Drawing on your experience of this practice, discuss the differences between industrial engineering and other engineering disciplines with respect to their responsibilities and ways of approaching their duties in the production environment.*

It seems that industrial engineers work on the “macro” aspect of a system. In other words, industrial engineers will design a system that has multiple, smaller components and figure out the optimal interaction between these components, where these components may also be systems

that also comprise of subsystems, and so on, but industrial engineers will not design the most basic component. For example, industrial engineers will design a factory that has multiple machines or a factory with multiple parts and departments that contains multiple cellular machine groups that comprises of multiple machines, but they will not design the machines themselves.

*If industrial engineers are employed by the firm, what are the areas they work in? If no industrial engineer is employed, what activities (if any) do you think are suitable for IEs in your practice organization?*

As I previously stated, industrial engineers are not employed currently by the firm, but there has been one that has been hired before the start of this internship and they have been working in quality control.

As of now, I believe the firm could use an industrial engineer in inventory management and project management, since those two aspects seem to hinder the firm.

*Discuss top management's impression and attitudes towards industrial engineering functions and activities.*

As I have previously stated, the top management does not seem to be familiar with what an industrial engineer can offer to a company. However, when considering just the activities that industrial engineers can handle, I can say the top management would consider these activities as necessary and vital.

*You are required to fill out the online questionnaire on the website [www.ie.metu.edu.tr/~sp](http://www.ie.metu.edu.tr/~sp). The questionnaire should be filled out until the submission date of your summer practice report. Otherwise, your report will be considered as incomplete.*

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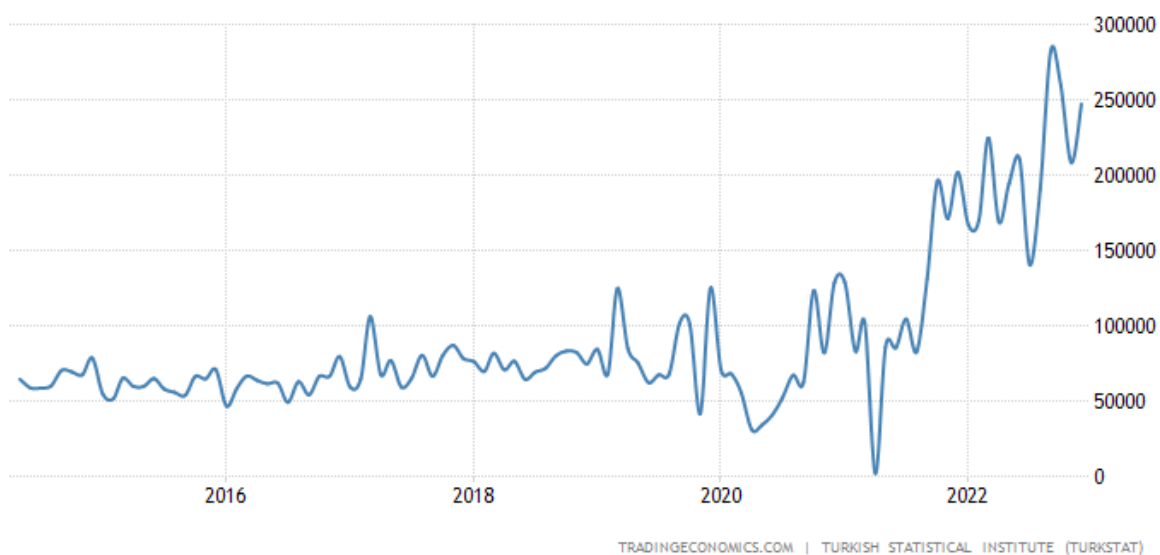
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## Appendix A

*...both countries suffering a hyperinflation in each of their currencies, decreasing the Lebanese companies' buying power of anything priced in dollars.*

The same phenomenon is observed in the Algerian company, where the country's currency has a low exchange rate against the US Dollar. It is also noteworthy that Turkish products are not only prevalent in Sultan Steel only, but more than 70% of products entering Lebanon – food, juice, pharmaceutical drugs, house appliances, electronics, etc. – are being imported directly from Turkish companies.

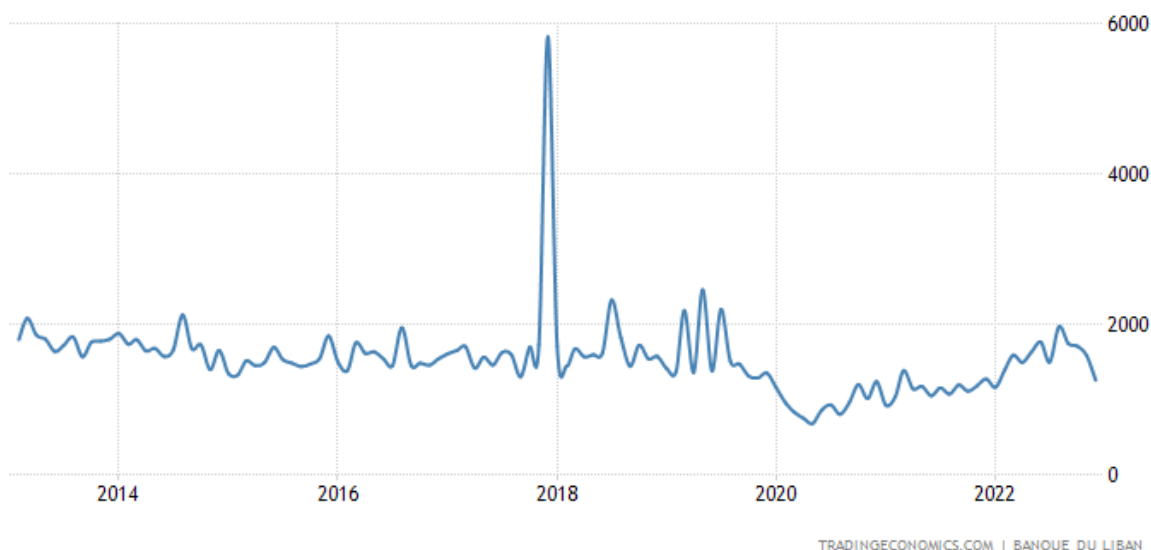
The shift to Turkish products can be accurately pinpointed on the following chart prepared by Trading Economics according to the data from Turkish Statistical Institute [TÜİK] (2023). The year 2019 marked the start of the Lebanese currency's hyperinflation, that continues to this day.



*Figure A1: Total value of exported products from Türkiye to Lebanon, in million dollars over an eight-year horizon.*

This is not due to the general increase in the number of imports to Lebanon. Figure A2 actually shows that the number of imports have roughly been the same over the same timeframe with a slight decline (Banque du Liban, 2023):





*Figure A2: Total value of imported products entering Lebanon, in million dollars over a 10-year horizon.*

Figure A2 may offer an explanation as to how the dip in imports to Lebanon between 2020 and 2021 may be related to the general dip in the value of imports from Türkiye to Lebanon.

A question arises: why did Lebanese traders and companies alike shift to Turkish products, as opposed to their Greek, Chinese, or Pakistani counterparts, for example? The answer lies in the short lead times between Türkiye and Lebanon, the Visa-free access of the Lebanese populace to Turkish grounds, and a mild similarity in culture making Turkish products attractive to Lebanese people and especially to the Muslims, whom comprise 67.8% of the population as of last year (Centra Intelligence Agency, 2023).

Returning to the example, Greek products appeal mostly to the Lebanese Christians (especially when it comes to clothes, food, etc.), whom although form a sizeable portion of the population (32.4%), are less than the total number of Muslims. Chinese products have a large exporting industry that offers a wide variety range, and can appeal to most cultures, but the long lead times and costly transportation are not as appealing. Pakistani products do not appeal to the Lebanese population due to wide cultural differences. In other words, Turkish products seem to have the perfect mix of characteristics to make them appealing to the Lebanese populace.