Set of products

1. These products are produced using a set of *resources* that perform a number of *processing steps* where after each step, except the last step,
2. the intermediate product is either directly used by the next processing step or stored in one of the available *storage tanks*.
3. The last processing step is typically the packaging step after which the finished product is shipped out, so that the storage of the finished product is not part of the scheduling model.
4. The products this particular plant produces are liquid and one needs to imagine that intermediate products are processed as a batch and only when a processing step is finished
5. abatch is transferred to either the next processing step or to a storage tank
6. no continuous flow of products through the plant
7. before the packaging step of a product A the material that is handled is an intermediate product, we do tend to refer to this intermediate product also as product A.

Demands

1. What the plant needs to produce is defined by the set of *demands*. Each demand defines a certain quantity of a certain product that needs to be delivered within a certain *time window* and before a certain *due date*.
2. Each demand is to be processed as one entity throughout the entire production process, i.e., a demand is not broken up in different production batches nor put together from parts of different production batches.
3. One can decide to not fulfil a demand, this against a *non-delivery cost* that is proportional to the quantity of the demand.
4. Note that if one decides to not fulfil a demand, it implies that one does not execute any processing step for that demand.

Processing time

1. All processing steps have a *processing time* that is defined by a constant part and a part that is proportional to the quantity of the demand.
2. Each of the steps may have different alternative resources that can execute the step
3. each such alternative may have a different processing time and *processing cost* to execute.

Set up time

1. Going from processing one product to another on a resource may require a *setup*. Such a setup takes time (*setup time*), has a cost (*setup cost*),
2. may require an additional *setup resource* during the setup time.
3. A setup step takes place directly before the processing step, i.e., the end of the setup coincides with the start of the processing step
4. All resources in the plant can only do one thing simultaneously, including the setup resources.
5. Setup resources themselves do not require setups.

Storage

1. Storage tanks have a specified maximal quantity they can hold
2. They furthermore can only hold one type of product simultaneously
3. switching from one product to another takes time as the tank needs to be cleaned.
4. This also holds if switching takes 0 time units, i.e., if no cleaning is required, as we do not want to mix two different products.
5. Switching a storage tank does not require a setup resource.

Intermediate product

1. Production of intermediate product into the tanks happens at the end of the preceding processing step, consumption happens at the start of the succeeding processing step
2. Both production and consumption of intermediate product are assumed to be instantaneous
3. So if the intermediate product from a preceding processing step is directly transferred to the resource of its succeeding processing step, the end time of the preceding step will be equal to the start of the succeeding step. In that case the product truly will not use any storage tank, implying that this batch of intermediate product has no influence at all on what the tanks hold at that point in time.
4. One can have a constraint that requires a certain *minimal delay* in the *precedence constraints* that can be defined between processing steps, this to allow the intermediate product settle for some time. If that is the case, the intermediate product has to be stored in a storage tank.