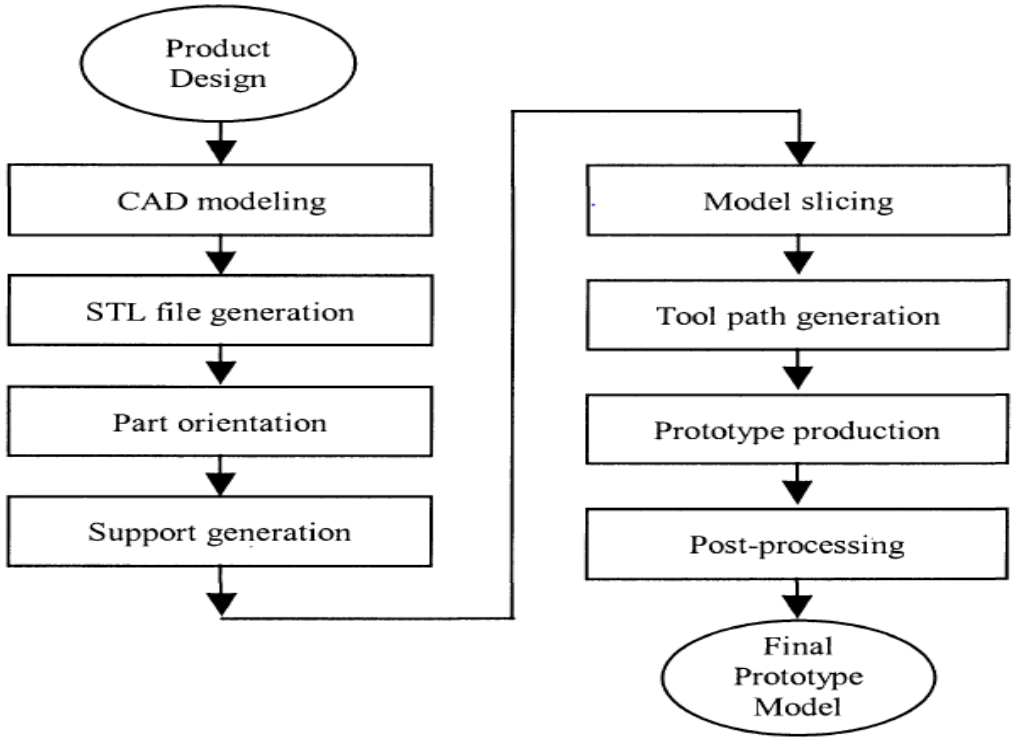
DATA PROCESSING FOR AM TECHNOLOGY

- Data processing includes the following steps from CAD modeling to Prototype Production.



DATA PROCESSING FOR AM TECHNOLOGY

CAD modeling:

- The first step in RP is to prepare a CAD model of the object to be fabricated using layer based manufacturing processes.
- For most of the available RP technologies, a solid model with **complete geometric information** is required.

STL interfacing:

- STL is a file format for approximately defining an object using triangular facets.

- When a CAD model is available, the entire part geometry is converted into STL format based on a tolerance for accuracy control.

Part orientation:

- Before processing for prototyping, a RP engineer needs to figure out the specific orientation in which the prototype model will be produced.
- Part accuracy, the amount of supporting material required and ease of post-processing are important factors influencing **part orientation determination.**

Support generation:

- To define support structures for supporting down-facing areas during part build-up.
- Support generation can be done on the basis of a STL model or the original CAD model.

Model slicing and tool path generation:

- In contrast to material removal manufacturing technologies, rapid prototyping technologies refer to a class of layer-based material increase manufacturing processes.

Model production on a RP machine:

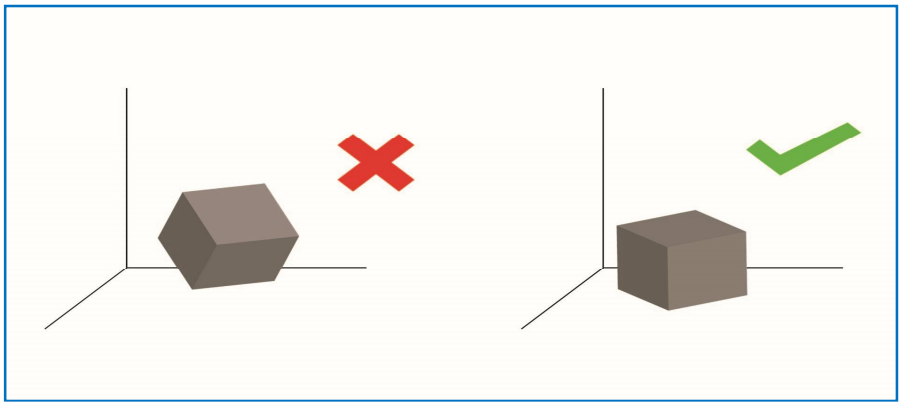
- The produced tool path is sent to a RP machine for building up the prototype model, including support, layer by layer.

Post-processing:

- Depending on the RP process involved, a post processing step might be needed for post-curing in the case of
  - **stereolithography**, for curing
  - furnace sintering in the case of **SLS**,
  - for removing the support structures
  - surface polishing in the cases of most other RP processes.

PART ORIENTATION

- Part orientation and support generation are two closely related issues in layered manufacturing.
- By selecting an optimal part orientation for model prototyping, it is possible to **shorten build time and minimize** the overall prototyping cost. Part orientation has a significant effect on the final part quality.



PART ORIENTATION

There are different models for part orientation determination, they are

1. A generic cost model
2. Part orientation for surface quality improvement
3. Part orientation with minimum support
4. Part orientation with multiple objective optimization

PART ORIENTATION

1. A generic cost model:

- The consolidated generic cost model is defined as, where the cost components are:

$$C_{tot} = C_{pre} + C_{build} + C_{mat} + C_{post}$$

C_{pre} direct cost related to pre-processing;

C_{build} machine utilization cost for building the prototype model;

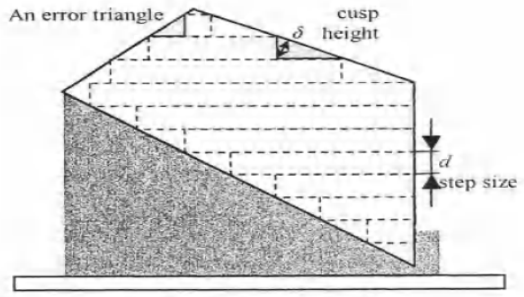
C_{mat} material cost including part modeling material and support material, if different; and

C_{post} post-processing cost.

PART ORIENTATION

2. Part orientation for surface quality improvement

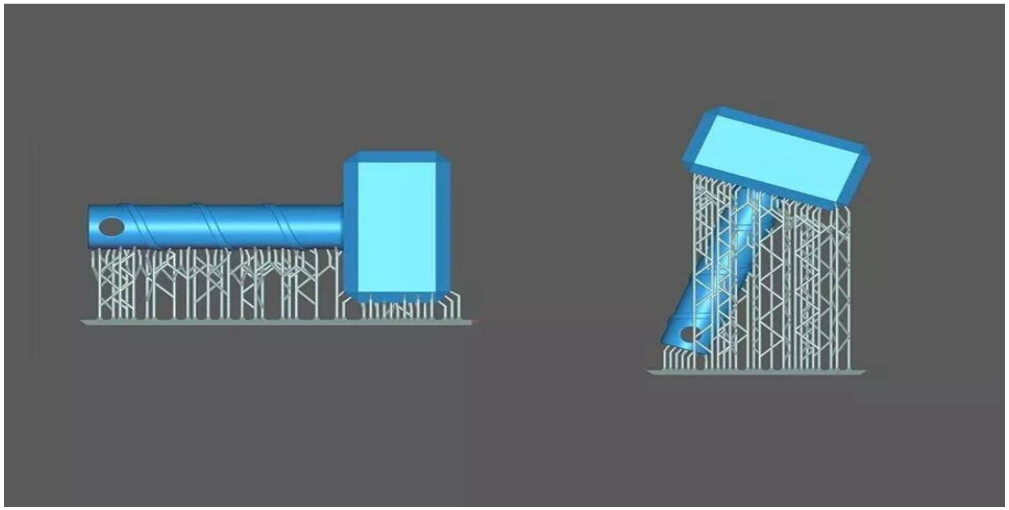
- While minimizing the **overall cost**, the surface quality of the final prototype model must also be observed.
- If a **small layer thickness** is used, one would obtain a fine part surface, but the overall **building time will be longer** and hence the surface quality is improved at a cost.



PART ORIENTATION

3. Part orientation with minimum support

- Part orientation will affect the volume of material required for model support and hence extend building time for some RP processes.



PART ORIENTATION

4. Part orientation with multiple objective optimization:

- There are many factors that need to be considered when searching for an optimal part orientation.
  - maximize the area of the base surface
  - minimize the number of sloped surfaces
  - minimize the total area of overhanging surfaces
  - Maximize the number of perpendicular surfaces
  - maximize the number of holes with their axes in the slicing direction

PART ORIENTATION