

Upgraded Technology and Application In Die Casting

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Introduction

Today in competitive world, it is difficult to run with the speed of the market, without implementation of the new technologies in Industrial world. The whole world is coming closer due to the regular advancement in technology. It is not a matter today that one item is being made in western part of the world and other part in eastern part, but they are so similar that they appear as if both parts are made under one roof. Thanks to the technology, which has removed the differences in east and west. New technologies are being changed and upgraded very fast, so we must be aware of this latest technology in terms of its application and profitable use.

CAD/CAM/CAE for tool engineering is now become an essential part to keep pace with growing technology and demand for low cost, quality, precision & faster delivery. The followings are the few latest methods, which are being used today in die making industry:

- 1. Scanning of product to be die cast.**
- 2. CAD/CAM (Computer added design and manufacturing)**
- 3. CAPP (computer added process planning)**
- 4. CAI (computer added inspection)**
- 5. 2D drawing To 3D modeling**
- 6. 3D model to 2D drawing**
- 7. Black-box designing (conceptual base designing)**
- 8. Analysis & Simulation (stress, Strain, thermal analysis etc.)**
- 9. Analysis for Gate, runner, ejector pins and cooling line etc.**
- 10. NC data generation**
- 11. Rapid prototyping**
- 12. Concurrent engineering**

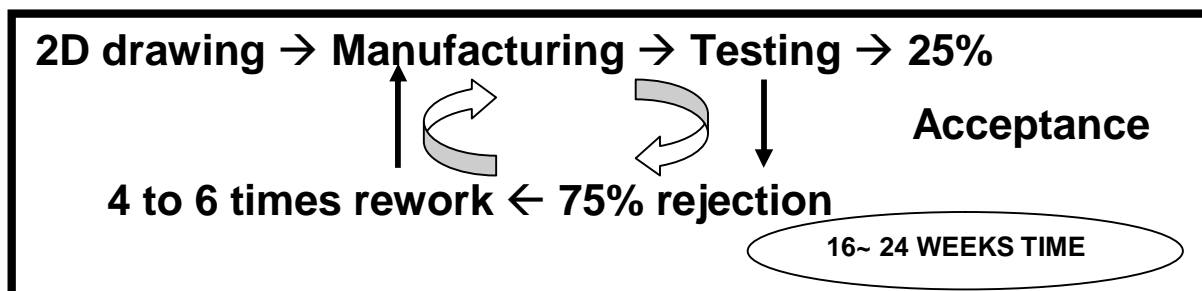
Pressure diecasting die design: Old approach

Following methods (one or more) were (still being followed) being adopted for designing and manufacturing of diecasting dies depending upon the complexity of the part and facilities available for tooling:

- **Create a pattern for copy milling** – mechanical stylus follows the surface contours and translates into shape directly on the die steel or electrode.
- **Rough milling** – with the help of marking & templates keeping 5~10 mm excess machining allowance using conventional machines.
- **Final Milling** – with the help of indexing table, rotary table and other traditional accessories.
- **Specific Machining** – with profile cutters for machining of different shapes.
- **E.D.M.** – using conventional electrodes for individual feature, shape and sharp corner.
- **Grinding** – conventional grinding to achieve final dimensions and shape.
- **Polishing** - manual operation to improve the surface finish of the die at final stage.

Above conventional method needs skilled manpower with lot of time for hit and trial to develop the dies. It is **impossible to achieve** following with conventional method due to the limited process capabilities:

- Repeated feature design and dimensions for multiple cavities
- Electrodes for various stages of EDM
- Uniform wall thickness
- Control on Part weight and Shot weight
- Complex surfaces
- Die repetition
- Faster development



Pressure diecasting die design – with upgraded method



Application of CAD/CAM technology in Diecasting

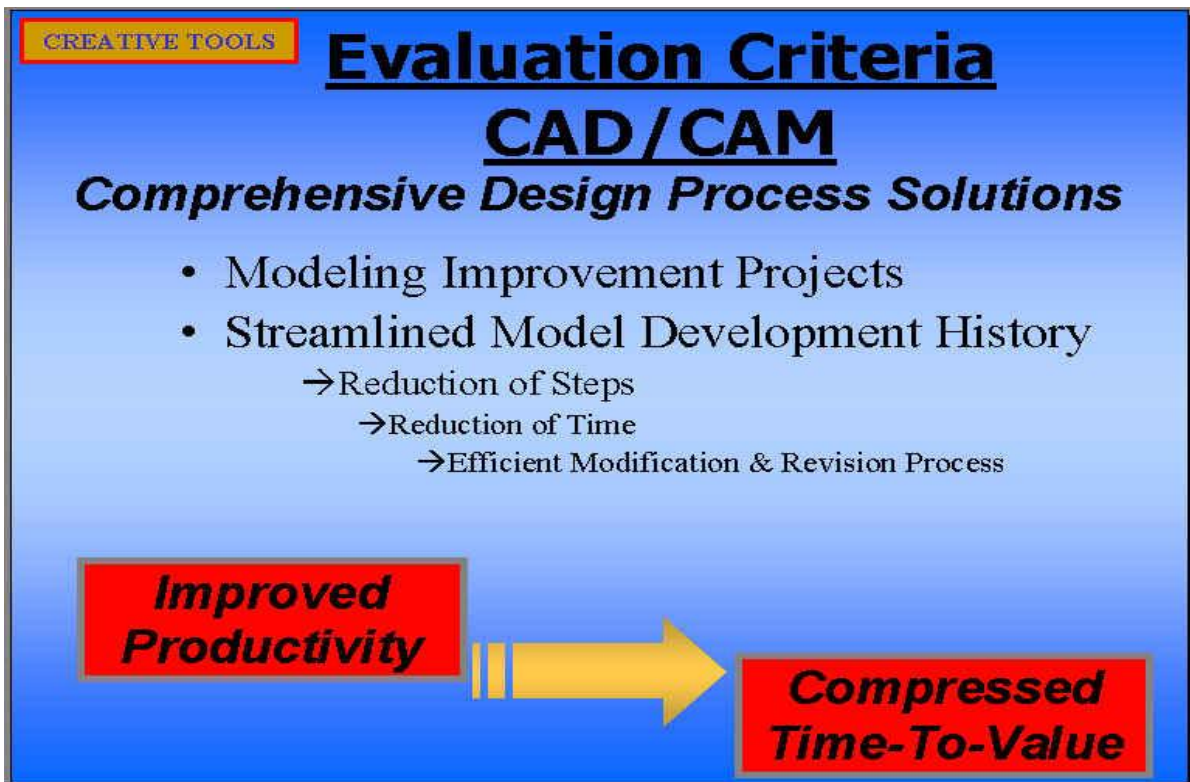
1. Scanning of product to be die cast

Reverse engineering is one of the important methods to register the shape of a product by scanning in die casting field. Hybrid products can be easily created out of many products by scanning, modeling and super-imposing on each other. Features can be selected from one part and can be married together to get hybrid product. Model can also be created out of damaged part by scanning, surfacing and modeling. This is the cheapest and fastest method of product development.

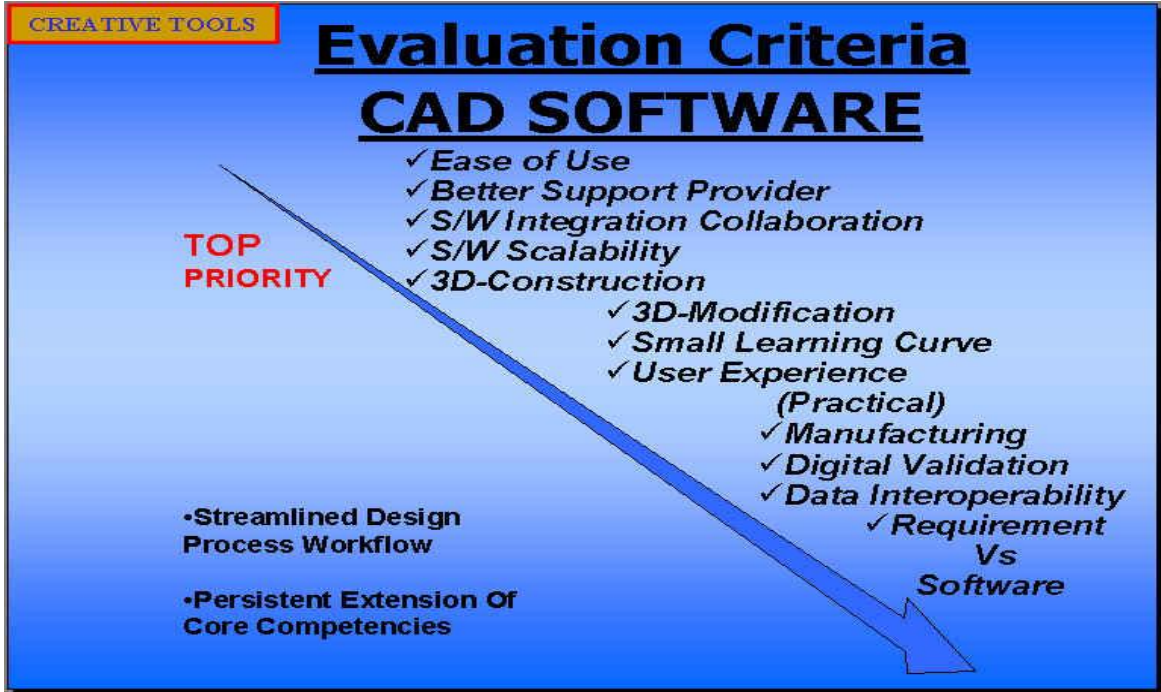
2. CAD/CAM (Computer added design and manufacturing)

CAD/CAM methodology means associated 3D modeling system to handle all the tool design, manufacturing and analysis related activities with ease of use.

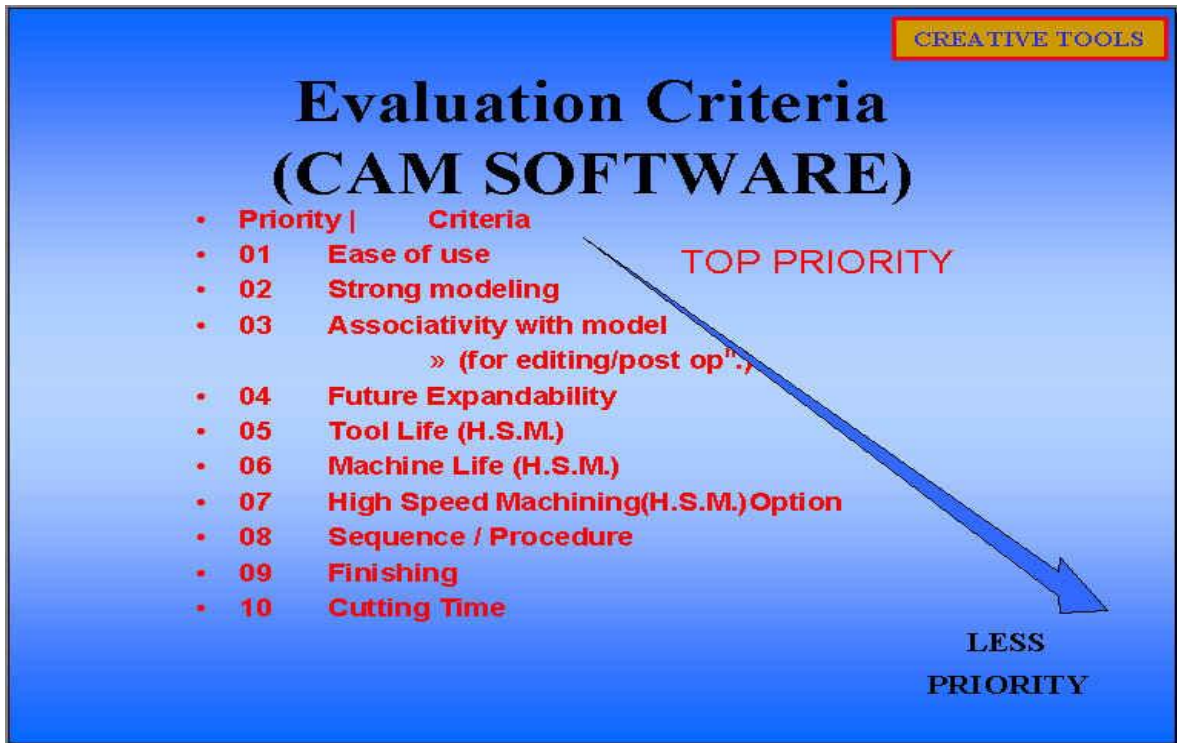
CAD/CAM software selection criteria is as below:



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3. CAPP (computer added process planning)

In case of dies, 3D model of core, cavity and other die parts are further processed for step-to-step working. All the features are divided in various steps to make easy working for the operator on CNC/ conventional machines. Operators need not to bother for many operations and their sequences. He has to perform only the operation no. allotted to him. This way the inspection at each stage is easier, also operator will not have a feeling of complicated machining. Complicated machining can be easily achieved by using CNC and conventional machines, so CAPP is an important aspect from cost, quality and time point of view of a die.

4. CAI (computer added inspection)

Computer added inspection (CAI) could be done with the help of scanned point cloud data. It can be used for Comparison between CAD model and scanned model of the product, produced by a die, can be done by superimposing to illustrate the warpage, shrinkage and dimensional behavior. This method can be used for inspection and data storage for large dies where manual work can also be registered as CAD data for future.

5. 2D drawing To 3D modeling

Normally 2D drawings are being provided by customers, so 3D model can be made with the help of 2D drawing supplied by the customer. Some time it is felt that few dimensions are not correct, in that case modeling can be continued with assumed dimensions. Model can be changes at any time after confirming the assumed dimensions. This is an important aspect of concurrent engineering. In fact in CAD/CAM creation of 3D model is only time consuming rest of the activities are just pressing the button technology.

6. 3D model to 2D drawing

For normal shop floor working 2D drawing plays an important role. Creation of 2D drawing out of 3D model is very easy with any no. of sections required to clarify the details of the product. Software is capable enough to give any desired dimensions with linear and geometrical tolerances.

7. **Black-box designing (conceptual base designing)**

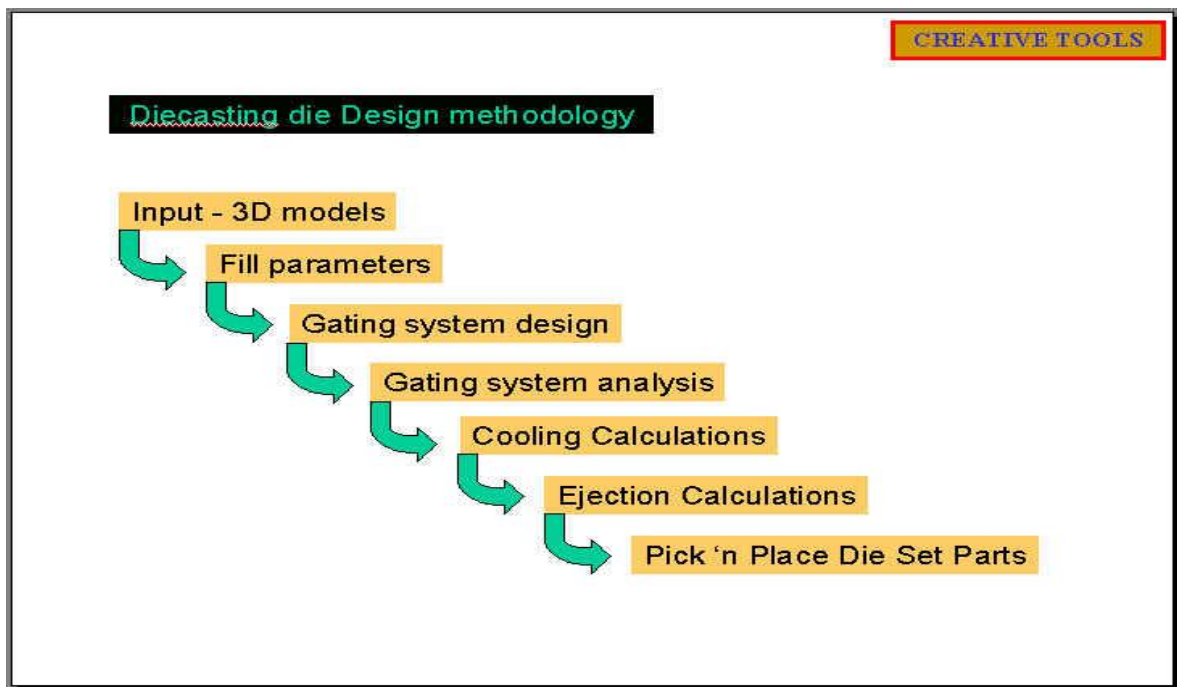
CAD/CAM technology is very important tool for creating the new shape and design of the product. Aesthetics of the product can be visualised from all aspects, which saves lot of development time of a product. Earlier, finalisation of new shape was very laborious job. Wooden patterns were being manufactured by pattern maker, which takes lot of time. Latest black-box designing (styling) method is described as below:

- Free hand sketching → Rendering → selection of styling part →**
- make 3D model of selected style →**
- (a) Make rapid prototype sample or**
- (b) CNC machining of wooden /acrylic prototype**

8. **Analysis & Simulation (stress, Strain, thermal analysis etc.)**

Simulation is a computational algorithm, which has been developed to reduce the time involved for the designing. Finite element analysis has been carried out for calculation of different working conditions to optimise the material and design at the initial stage.

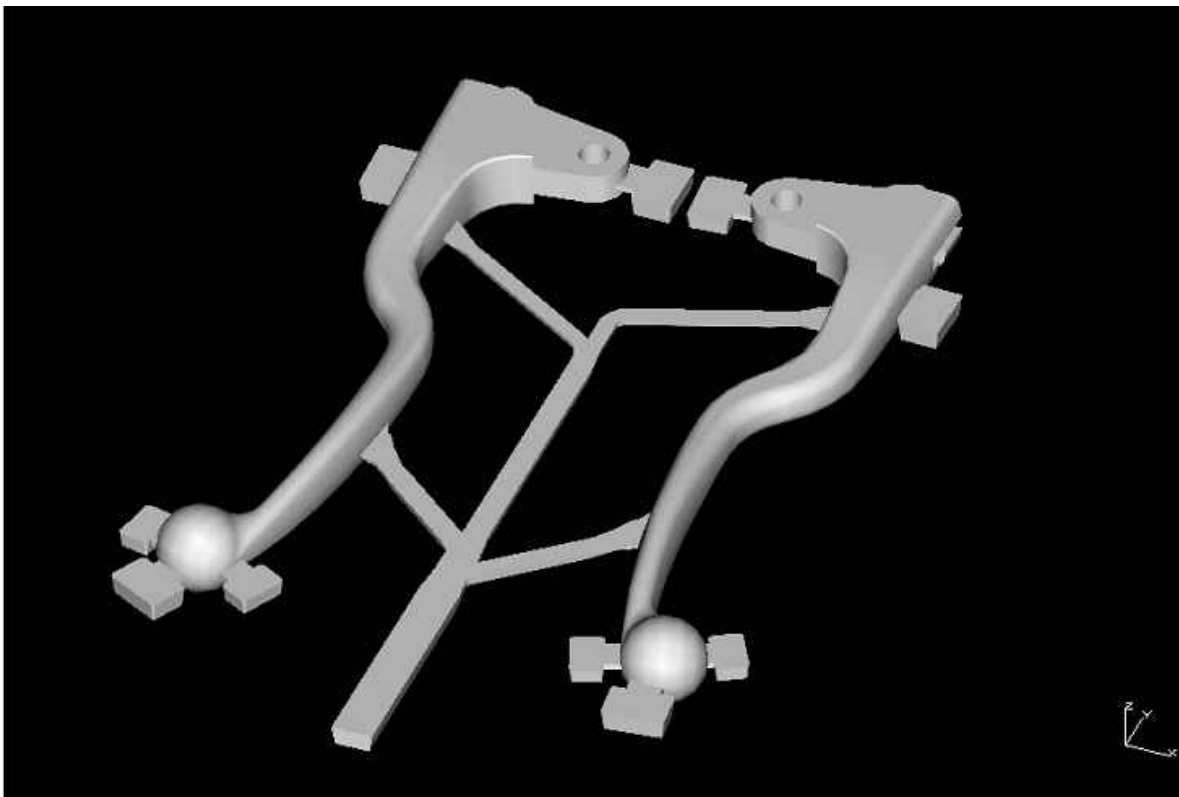
9. **Analysis of Gate, runner, ejector pins and cooling line etc.**



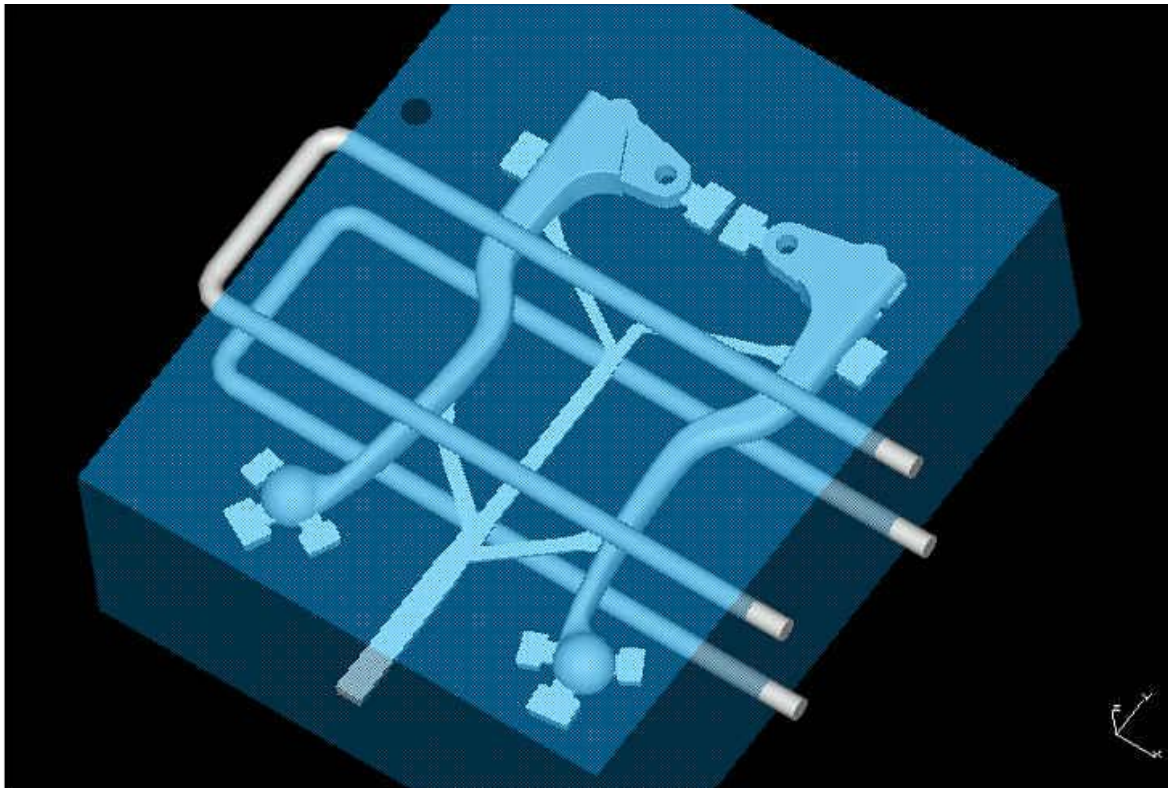
9a. Benefits of diecasting analysis:

- ✓ Shorter Design Lead time
- ✓ Reduced die trials
- ✓ Automatic Gating Feature creation
- ✓ Optimises runner and gate weight, resulting in improved yield
- ✓ Automatic Runner and Overflows creation
- ✓ Reduction in rejection rates due to better filling of casting
- ✓ Automatic calculation, systematic editing & built-in intelligence
- ✓ Shorter lead times - Die development

9b. DIECASTING PART WITH GATE AND RUNNER



9c. COOLING CALCULATION



10. NC data generation

CNC milling of core, cavity and other die parts to the final size can be done with help of carbide cutters available in various shapes and sizes. Some time CNC machining is required to be done on assembly of core / cavity, sliders, core inserts etc. to get better matching. CAD/CAM software can Generate associated machining data for any CNC machine. NC data should be made for core and cavities block of H13 / H11 material as per following setup:

Roughing program - keeping 0.5 ~1.0 millimeter material

Semi finish program – keeping 0.2 ~0.3 millimeter material

Local area program (semi finish) - keeping 0.2 ~0.3 millimeter material

Finishing program - keeping 0.02 ~0.05 millimeter material for polishing if required

We must take care of sharp corners and keep provision for electrodes. Electrode can be used in a single stage or multi stage as per requirement.

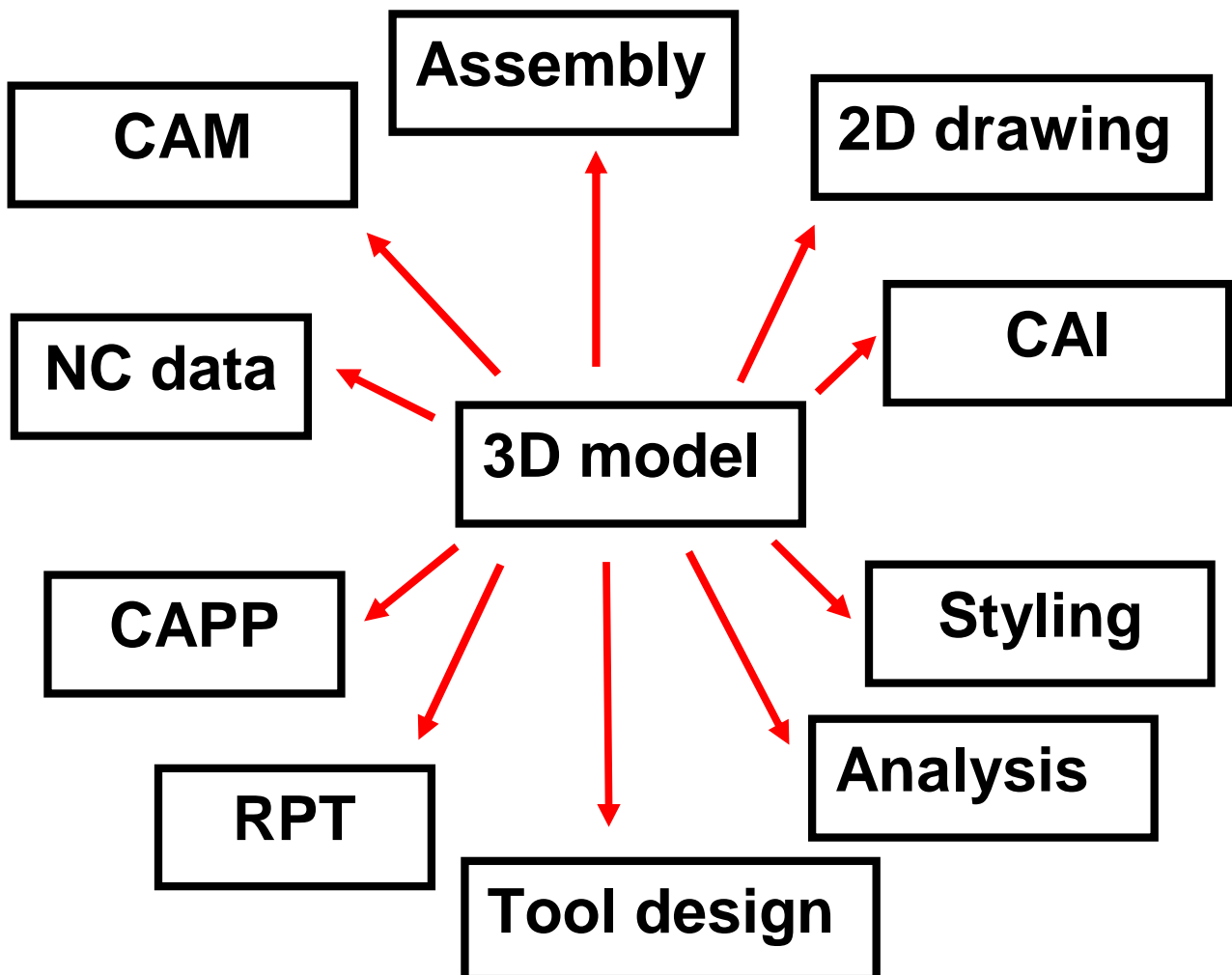
Die components with regular shapes can be made by conventional method, up to final shape and size and can be fitted directly to the die.

11. Rapid prototyping

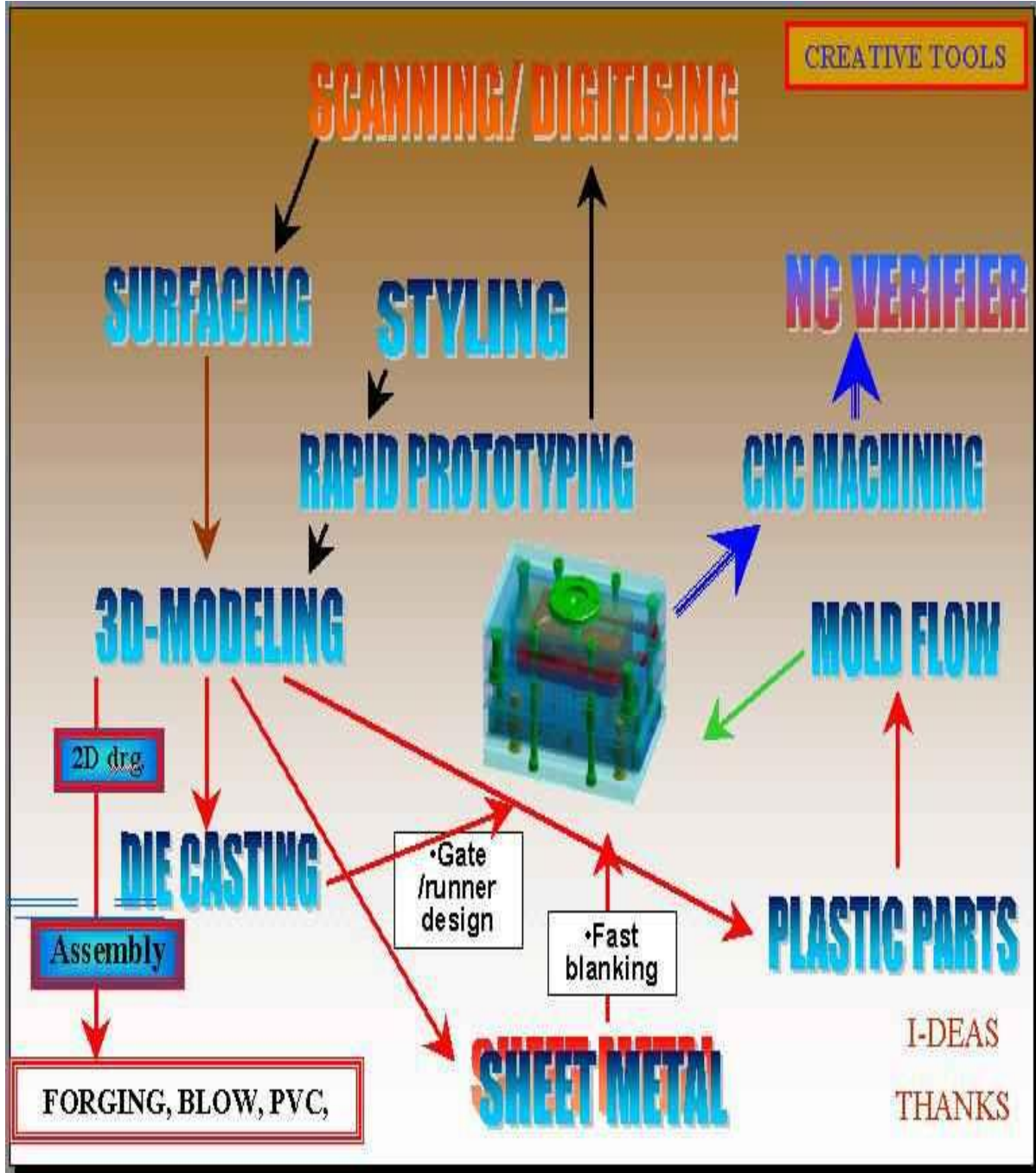
Rapid prototyping is a very strong tool in product development. CAD model can be directly transferred in to a physical model in plastic, paper and copper etc.. this physical model can be used as a part of the mechanism and various tests can be performed to check the efficiency of the mechanism. In case some changes are required to be done, CAD model is modified and cycle is repeated till the desired efficiency is achieved. This is the cheapest method for any new development.

12. Concurrent engineering

CAD/CAM/CAE/CAI/CAPP and many other activities can go simultaneously after preparation of 3D model. This saves lot of time in various activities.



Overview of CAD/CAM technology



Conclusion

Conventional tool design practice is to make general assembly detail drawing of tooling, which is very laborious process prone to errors. Just one error out of hundreds of dimensions can create lot of problem and cause delay in manufacturing, so it should be 100% correct which is possible only with the help of bi-directional associated 3D modeling software.

This associated 3D modeling software automatically constructs following:

- ✓ Associated 2D detail drawing of part
- ✓ Associated 3D model of core, cavity, sliders, electrodes etc.
- ✓ Alternate options of tool design
- ✓ Associated 2D detail drawing of die assembly & die parts
- ✓ Easy modification in part, hence automatic modification in 2D part drawing, tool design, tool detailing and NC data etc. This will increase the 100% productivity in die designing and faster die manufacturing.

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