Dr. Die Cast

CAD CAM: Computer Modeling and Simulations, Your Unanswered Questions

Computer Modeling and Simulation, let's break it down.

Computer modeling is creating a full 3-dimensional part (for most of us it is a die casting) that can be viewed, sectioned, rotated, measured and "weighed". Finished assemblies can be modeled to verify clearances and functionality. While we take 3D for granted, the development was not so easily predicted.

Computer Simulation as it is used in our industry ranges from "Flow simulation", "Solidification simulation" and "Distortion or Stresses".

Software development: Early CAD (Computer Aided Design) was called "Computer Aided Drafting Software" and was 2-dimensional. It was much like the 2D physical drawings created by draftsman and designers. The data files are stored and shared electronically. Pre-internet, larger companies had dedicated data transmission lines to share data between locations several states away. Smaller companies, saved to a disk (think one or more floppy disks) and shipped them by UPS or FedEx. Later, data was transmitted via "dial-up" over a modem using an FTP (File Transfer Protocol) program. Later files were sent as attachments e-mail, but still connections were via dial-up and eventually DSL and high-speed phone and cable.

Along with CAD was the development of CAM "Computer Aided Machining", that is, the programs for CNC, Computer Numerical Controls and the computers to run the programs. CAM allowed the CNC programmer to use the data from the CAD file to program much faster. Early CNC programming was translating the data points from the 2D physical drawing into machine movement using "punch tape" (referred to as "ticker tape"). The first commercial CAM programming tool named PRONTO was developed in 1957 by Dr. Patrick J Hanratty while working at GE. He later moved to General Motors Research Laboratories where he helped to develop DAC (Design Automated by Computer).

In the mid-1960s, the Gigigraphics division of Control Data Corporation released the first "commercially available" CAD software system. It ran on a Digital Equipment Corp (DEC) mainframe computer and was priced at $500,000. Only a few units were ever sold.

Until the development of the transistor and later on microchips, mainframe computers used vacuum tubes and took up entire floors of office buildings. In the 1960s, at the world headquarters of Montgomery-Ward, the computer level and the retail showroom were the only two air-conditioned floors. The air-conditioning for the computer was essential to its survival. Programming was done via "punch-cards".

In the 1970s most CAD software development was confined to large companies such as General Motors, Ford, Lockheed, Nissan, McDonnel-Douglas, etc., working with major universities to develop the software for use in the design of their products. It was still 2D. In 1975, the French aerospace company, Avions Marcel Dassault purchased a source-code license of CADAM from the developer, Lockheed. Using the CADAM source-code, Dassault released a 3D CAD software program in 1977, named CATIA which was an acronym for "Computer Aided Three-Dimensional Interactive Application". It is widely used to this day. In 1981, Dassault signed an agreement allowing IBM to resell the CATIA CAD software.

In 1985 a new 3D CAD solid modeling software vendor arrived and introduced "Pro/Engineer" or

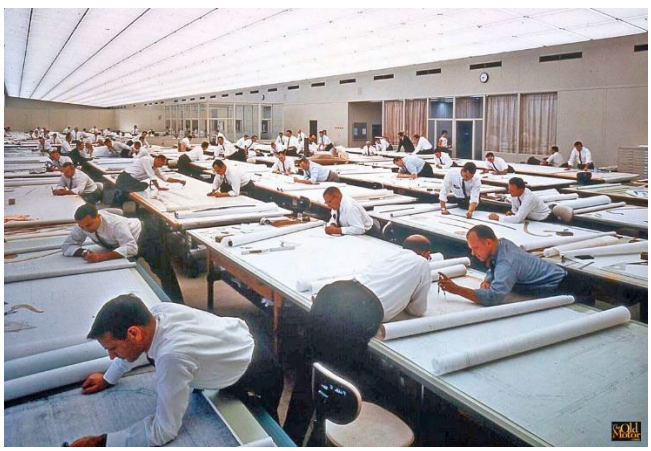

Figure 1 *– General Motors Styling department in the 1960s.*

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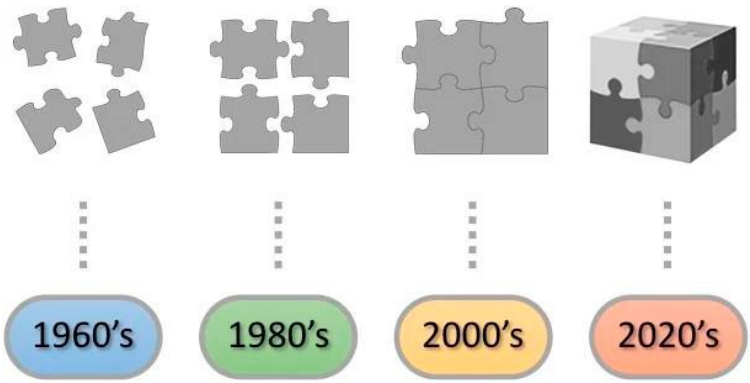

***Figure 2** – Visual representation of the contrast of today's CAD capabilities compared to previous decades.*

affectionately referred to as "Pro-E" in 1987 putting the existing suppliers on notice that they had company and were not in charge. Pro-E was based on Parasolid. The software did require a UNIX workstation so the hardware cost was still prohibitive for many companies. The leading hardware suppliers were IBM, DEC and Apollo Computer (which was acquired by HP in 1987).

Early 3D CAD was not sophisticated enough to "error-check" itself. Twenty years ago, tool shops budgeted at least 8 hours to correct the part model before it was reliable enough to be usable for programming.

3D CAD was essential to the development of a simulation program. Simulation programs demonstrate the following: Molten metal flow, metal solidification, steel expansion, stresses, etc. Computing horsepower is an essential component in order to "crunch" the numbers as the program steps through the life of each. Modern high-end PCs are able to perform multiple simulations "overnight" or in the background while still using the computer. Part of the decision-making process of selecting a simulation program is how quickly can it help you identify a potential or existing problem and how quickly can it process your proposed solution.

When asked what is the ideal skill-set for a simulation operator at least one provider stated they recommended a seasoned "process engineer". Because they understand what they are looking at. It correlates with their experience.

The "one iteration" failure: Some die casting customers insist on their supplier providing a simulation. Ultimately the supplier charges for it. If the die cast supplier only simulates to satisfy their customer and not to learn how to best design the tooling, then it has been a waste of time and money for both. The first iteration will show the skilled engineer where improvements need to be made in the metal feed system (gating), cooling and in some cases areas of the casting design that will be chronic failure points. This should be the point where the supplier needs to have a discussion with the casting designer/customer to review the design. Using the simulation to demonstrate the problem goes a long way in persuading designers and customers to consider revisions.

CAD/CAM has shortened lead times, reduced mistakes, improved quality and improved communication between suppliers and customers. None of it runs by itself. Hardware and software still need skilled men and women to operate them. Are you one of them?

CAD Timeline illustration compliments of: Fastway-CAD-CAE-Timeline.png (835×365) (fastwayengineering.com)