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The Evolution of CAD and Engineering tools

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From what I hear from many people, back in the good old days we did not have computers. As an engineer and draftsman how could this be? All we use is computers to design and draw instructions to build our equipment and make sure things will fit together when it arrives on site. So how has the way we design and document changed over the last 20 years?

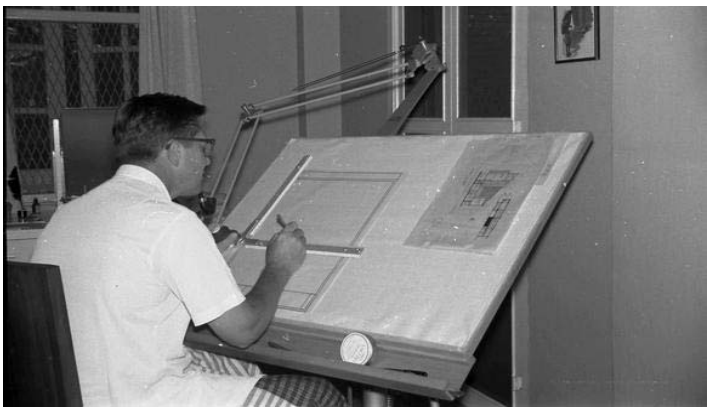

Figure 1 Drafting – The good old days!

From my copy of "Marks Handbook" dated 1941, computing machines had ceased to be a luxury item, but were expensive and thus the type of machine needed to be selected for the type of work to be done. You could add, with or without listing, or you could do calculations involving multiplication and division. The last type of machine was fed the information using punched cards to define the calculation to be carried out. You still see this type of computer in the old sci-fi movies.

On entering the workforce in the eighties, the first exposure to computers was seeing engineers do structural analysis. The engineer would develop a list of numbers that defined a steel structure and enter these into a computer terminal that would be connected to a bureau where calculations were done. There was no graphical interface to see what the initial list of numbers meant and great care was needed as each computer run was quite expensive and time consuming.

At this time the concept of CAD was only related to design in all but the largest engineering houses, where CAD drafting started to be seen. We all drew on the drawing board and developed skills in writing consistently and laying out a drawing as a piece of art that clearly relayed enough information to manufacture with minimum effort by the draftsman. Manual drawings became an expression of the draftsmans craftsmanship and skill.

For more complex projects, there was a skilled group of workers who would make a scale version of each component to show that there were no clashes and demonstrate to customers what the final product will look like. These scale models were pieced from a catalogue of plastic items and glued and fastened together. Again an area of pride for the workers who could express their skills and pride in workmanship.

Enter the PC

By the late 80's we saw the development of the personal computer and corresponding move towards readily available CAD design and drafting systems. We all worked in DOS environment and learned *Fortran* and *Basic* to write our own programmes. We also saw the move towards graphical representation of tabular data input in our design softwares. CAD drafting packages at this time were glorified drawing boards with very simple graphical input.

There were two main directions in drafting packages.

We had the high end packages like *Eagle* driven on dual screen main frame computers with very high capital cost. These could produce good quality high intensity drawings.

We also had the development of AutoCad. AutoCad went in a different direction in being developed to run on the simplest and cheapest computers and making itself fully available to all users as a low cost basic drafting package.

As Microsoft developed a new operating system called Windows we saw a rapid change in the way of design and drafting packages. Graphical input methods improved and thus the software became simpler to understand. We also saw increased computer power and storage capabilities that gave opportunity for more powerful software. By the early nineties, drawing boards were disappearing and being replaced by PC workstations. We started to design in 3D as the software made this possible with improved interfaces. We began to lose the art of design and developed more automated processes to carry out the same work. Having the *"recession we needed to have"* at this time also helped to drive towards reduced levels of employment while maintaining work volumes. We saw work teams reduce up to 40%.

Please welcome...3D

We are now heading into the next revolution in design. We are seeing the big push into 3D modelling. This allows us to use the computer to simulate the final product and develop the manufacturing drawings.

Figure 2 3D application in use

The theory here is to have only one source of the information that is used by each of the disciplines of engineering and drafting. In some areas the need for draftspersons is questioned, just let the engineer do it all.

There are powerful packages that can design everything from the humble bolt and nut through to Boeing 777 aeroplanes.

These are powerful packages that are reported to help eliminate errors and clashes. But are they?

Are these packages the panacea we are told they will be? First impressions of these packages are that they represent to the designer very highly detailed information and assist in viewing in real time what is happening.

- They can give us an accurate answer to 16 decimal places regarding the placement of an object in a plant.
- They can confirm the mass of a completed item and confirm how we will connect it to the adjacent items.
- It can even tell us the size of the fastener needed. From this one package we can get cutting lists and order all the items needed to manufacture.

We can even programme steel cutting tools to profile our beams and plates ready for joining.

But can we tell what will happen when the fabricator works within the allowable tolerances of typically +/-3mm?

Can we tell what happens when we compress our gasket to develop a seal on our pipes? These questions still need to be answered. These are not logical questions with a black and white response. We need to still think and evaluate the reality of construction and the variability of workmanship and materials. This skill is being lost when we totally rely on the infallibility of computers. We still need to think and use our skills and experiences to develop smart and practical solutions.

With the start of CAD in the engineering offices there was the regular cry of we would never get rid of the good old drawing board. 2 years ago I tried to give away my drawing board and could not find any takers. You do not see them anymore. We also do not see the trade of model maker in our engineering houses, the computer operator has replaced these. Even drawing cabinets are disappearing as we are moving to printing in A3 maximum and electronic image transfer between organisations. We need less space and can produce more work in a shorter time frame with smart use of the tools available.

What happens now?

What we do need to remember is *"What is it we need to produce"?* We need to produce clear instructions on flat 2D pieces of paper to enable our manufacturing contractors to correctly understand what the final product will look like and what special instructions must be followed. We still need to clearly give written dimensions etc to minimise incorrect interpretation of how to manufacture. The means to get to this end may be changing, but the end result is still the same. Pieces of paper with lines and text to describe something. Yes we can use computer images and walkthroughs in our powerful softwares to help explain how the plant will operate to the end user. These are replacing the humble models we used to make separately from the drawings. We can also give clearer instructions on how to maintain and operate equipment before it is fully manufactured and thus reduce the amount of changes needed during commissioning to make the plant operable. There are great features we can gain using the latest tools that were not available to us in the past.

We do need to keep our skill levels up when driving these new tools to ensure we still do get achievable outcomes and not lose ourselves in chasing tight tolerances and inflexible operations.

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