Multi dimensions

David Myall, Product Development Manager at Intergraph, discusses the evolution of plant design

The early stages of project design have become increasingly relevant as the pressure to reduce development costs and to increase the accuracy of cost estimates mounts. According to the Construction Industry Institute study, over 80 per cent of a project's total cost is committed within the first 20 per cent of the total project's design time. Another study, by Independent Project Analysis Inc, showed that only four in 10 projects completely finish the front end engineering phase which produces the cost estimate. Tools that allow the engineer time to properly analyse options and to get accurate costs therefore have very high value.

Plant design has found new ways to evolve from traditional layout studies (Excel for Material Take Off (MTO), 2D CAD for plot plans and cost estimation based on internal data, heuristics and approximations) to a higher quality, more accurate 3D modelling design. The vision is for the models created during conceptual layout studies to be reused for Front End Engineering packages and even for detailed design, with no data transfer or remodelling. Even if this doesn't happen, the more accurate the 3D model, the better the cost estimate.

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data and design contractors use a combination of commercial products and in-house tools, and the 3D model is used only during conceptual design and then thrown away.

A step further in maximising the conceptual design of the plant layout is integrated 3D modelling. A better articulated and more consolidated approach, integrated 3D Modeling provides agile, flexible and reusable layout, multiplying the design options and their applicability.

The latest tools available in the market – Intergraph SmartPlant 3D and SmartPlant Layout among them – provide automated pipe routing, and a specialist simplified equipment library within the full 3D system. In turn, this provides all facilities of the full 3D system to the front end designer, including high end modelling, interference detection, model referencing, automation tools as well deliverables such as GA, MTO and piping isometrics. There is no model translation – the model developed at the front end just needs detailing.

We can recognise two main stages of the Front End Engineering process.

In the first, conceptual layout stage, many different plant layouts are considered to determine which has the best combination of capital cost and operational efficiency. It is important to have piping included because this has such an important impact – for example, the size and placement of pipe racks. The inputs to the process may be a simple Process Flow Diagram (PFD) and associated flowsheet. These studies are normally very short duration and carried out by small, specialist teams.

In the second stage, a single plant layout is chosen and is then detailed sufficiently to generate an accurate cost estimate – this may need to be within five to 10 per cent of the actual cost to allow sound business decisions to be made. An accurate pipe length and an approximate fitting count are key at this stage. An important deliverable is often a realistic model for client review. The multi-disciplinary project team is much larger, and the project may last for several months.

Projects which fail to develop a pertinent conceptual design do not achieve the desired business outcomes. The investment fails to meet their targeted returns by exceeding the expected cost and schedule targets, or failing to operate as expected. But many projects (four in 10 according to the IPA study) do not achieve completion of the conceptual stage because of time pressure and the need to keep options open for as long as possible while information is gathered.

One of the many advantages of integrated 3D modelling lies in the possibility to streamline engineering design processes while preserving existing data and making it more usable/reusable. SmartPlant 3D provides all the capabilities needed to design a plant, and then keep it as-built throughout its life cycle. This 3D solution reduces design errors, engineering changes, and rework. This 3D technology ensures design accuracy and consistency through enforcement of design rules. Enforcement of the design rules results in increased product quality and reliability, by enabling faster and more efficient creation, transfer and review of design interactions. This enables project design

80%

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teams to make more informed decisions. Integrating the auto routing and layout solution into the 3D design environment means that these rules can be applied from the earliest stages of the project, minimising rework.

3D solutions also provide tools for the continuous monitoring of design rules and notification of the impacts of change throughout the design process. They keep track of drawings that have been updated due to changes in the engineering model.

Integrated 3D modelling presents plant designers with a simple, friendly user environment with state-of-the-art graphics and powerful wizards to assist in performing even the most complex tasks quickly and easily. 3D layout planning tools provide the ability to share designs across disciplines in real time, which saves time and money, and produces a higher quality design.

In addition to providing design teams with more time to evaluate more options, more thoroughly, the advanced tools available today in the market guarantee acurate MTO and PID, 3D model for clients, automated deliverables, scalability and workshare. As they tackle the whole product life cycle, they bring forward faster beneficial production, reduce capital cost, reduce plant operation cost and allow more informed decision making.

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