New era of valve design and engineering

In this article, we will look at a few of the emerging technologies that define the 4th industrial revolution. We will try to understand what the technology is and how it is changing the world of product design and engineering—specifically in regards to valves. We will also discuss how the valve industry can respond to these technology trends.

By Vijay Mali

Valve flow performance using Autonomous Valve CFD application.

The 4th industrial revolution is upon us. Irrespective of what is the approach of individual business leaders, the whole industry is going at a rapid pace to adapt to this "so-far the biggest industrial revolution in the history of mankind."

This revolution is paving its way for an exciting future in design, engineering, and manufacturing. What we are witnessing today is the convergence of multiple technologies including Artificial Intelligence, Generative Design, Virtual and Augmented Reality, Additive Manufacturing, IoT and Digital Twin. We are witnessing the new era of complete product life cycle starting from customer requirements to product engineering, production, and operations. Many organizations from automotive, aerospace, biomedical and industrial equipment are already using this as an opportunity to seize competitive advantage and establish the leadership in the market.

Compared to the advancements and innovations happening in other industries, the valve industry seems to be stagnant over the last few decades. Few valve industry leaders are investing in this future and exploring additive manufacturing, IoT and AI. It's time to take a serious stand. If not acted upon, this revolution might become disruptive for many businesses.

The opinions expressed here are based on my analysis and understanding of both the advanced technologies and the valve industry. If the article helps/contributes/initiates the thought process of "how can we use these technologies for valve industry" amongst industry leaders, I will consider this as a huge success of the article and my efforts. These are my personal thoughts and anyone who feels aligned or otherwise, is welcome to discuss this further with me and my team.

Change is here

Brought on by the industrial revolution—followed a 100 years later by the digital revolution—computer aided design and engineering are two breakthroughs that define our age.

Computer-aided Design (CAD) refers to the use of computer systems in the assistance of the creation, modification, and analysis of a design. Computer-aided engineering (CAE) is the use of computer software to simulate the performance of a product to improve the design or facilitate solving engineering problems for various industries. The application of software may include simulation, validation, and optimization of products, processes, and manufacturing. Originally, CAE began with the idea of first thinking of the design and then simulating whether that design will work properly or not. Now we have come to a stage where CAE is being used even before the design is drawn.

These techniques have caused a drastic change in the way product design and engineering is carried out. The computer speed

has gone through many transitions and what was available at a dedicated super-computing facility, is now available at individual designers' desks. The research codes and techniques which were available at the research facility and academic institutes are now available as easy-to-use products. Over the last seven decades, the design environment has changed drastically. The use of a computer, CAD and CAE tools have become an integral part of the process. The tools and techniques have become more sophisticated and started providing more and more insights into the product design and performance. The way computing power and products are progressing, we will see designers evaluating almost all design combinations to get a true optimum product design.

Custom designs than off-the-shelf products

As a result of this revolution in technology, the valve industry is witnessing the changing landscape of customer demand and supply. The industry is witnessing the paradigm shift in customer behavior. With process control becoming more sophisticated, the customer has access to the huge data about various process parameters. There is an overgrowing demand for process optimization. Every day, the process industry is challenged by bringing the optimized product with a minimum possible cost. The valve is critical and many times the final component in the process control, and that the reason why there is a huge demand for optimized valve performance. The "off-the-shelf" valve demand is reducing day-by-day and customers are
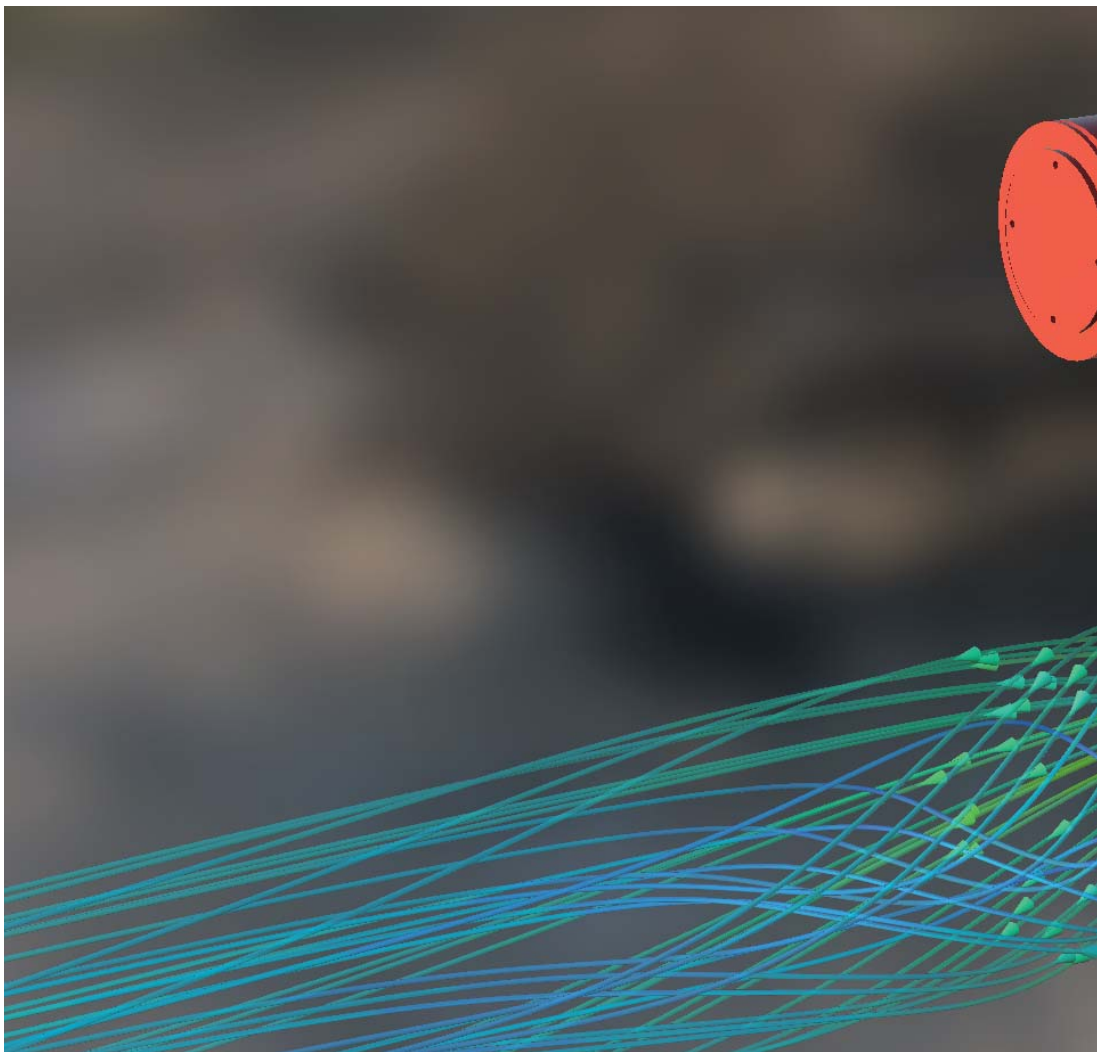
expecting the trailer-made, customized valve which will meet their specific requirement. Because of this paradigm shift in customer demand, many industry leaders in the past are struggling to acquire minimal market share today. Various stringent norms like fugitive emission are being imposed, which demands to relook at the legacy valve designs methods and define the product road map to tackle these stringent industry norms and overgrowing customer demand.

## Response of valve industry for these technology trends

The valve industry needs to respond to these latest technology trends to make sure that the industry is not leftover or behind what's happening around. Or to put it more empowering context, the valve industry needs to use these technologies to tackle the current and future demands of customers and the market. The companies need to use these technologies and trends to create

a unique position in the market and be a market leader.

I have been working with the valve industry over the last 10 years. During our CFD consulting days, we worked with various valve companies and provided the design and analysis services. Over the last two years, I am interacting with the industry leaders and designers for our autonomous valve CFD product. Through my interaction with industry, what I have understood is, many of the valve companies have incorporated CAD and CAE methodologies in the design and engineering workflow. Few companies are doing this in-house and many are getting it done through consultants. Over the years, companies have transitioned themselves from 2D drawing to 3D CAD and analytical methods to CAE methods. Many companies have developed their own design methods based on their legacy data and design practices. Few have the central "expert teams" which comes in the play when something new is to be done. So far,
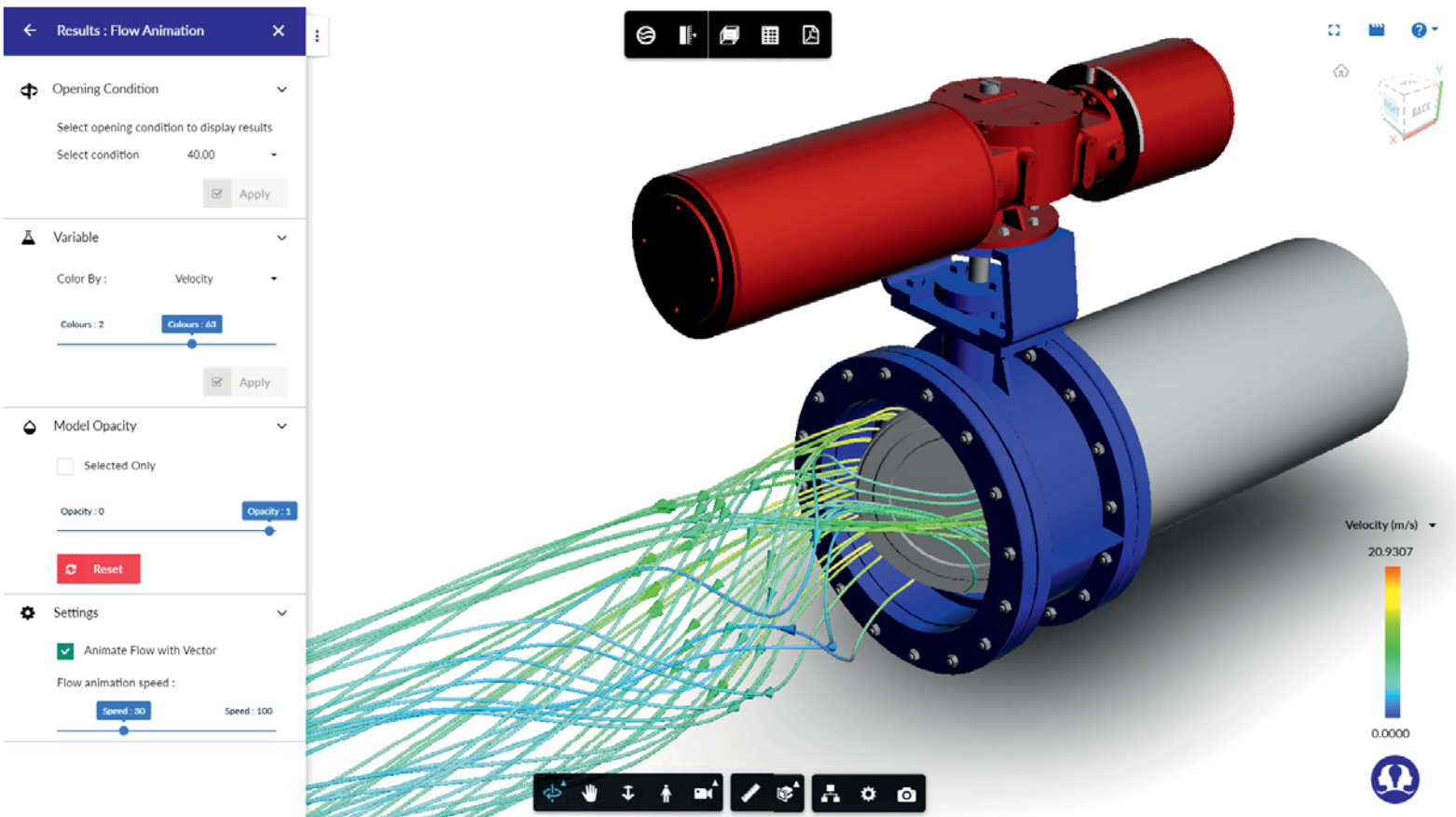
simulationHub's interface for valve design and testing.

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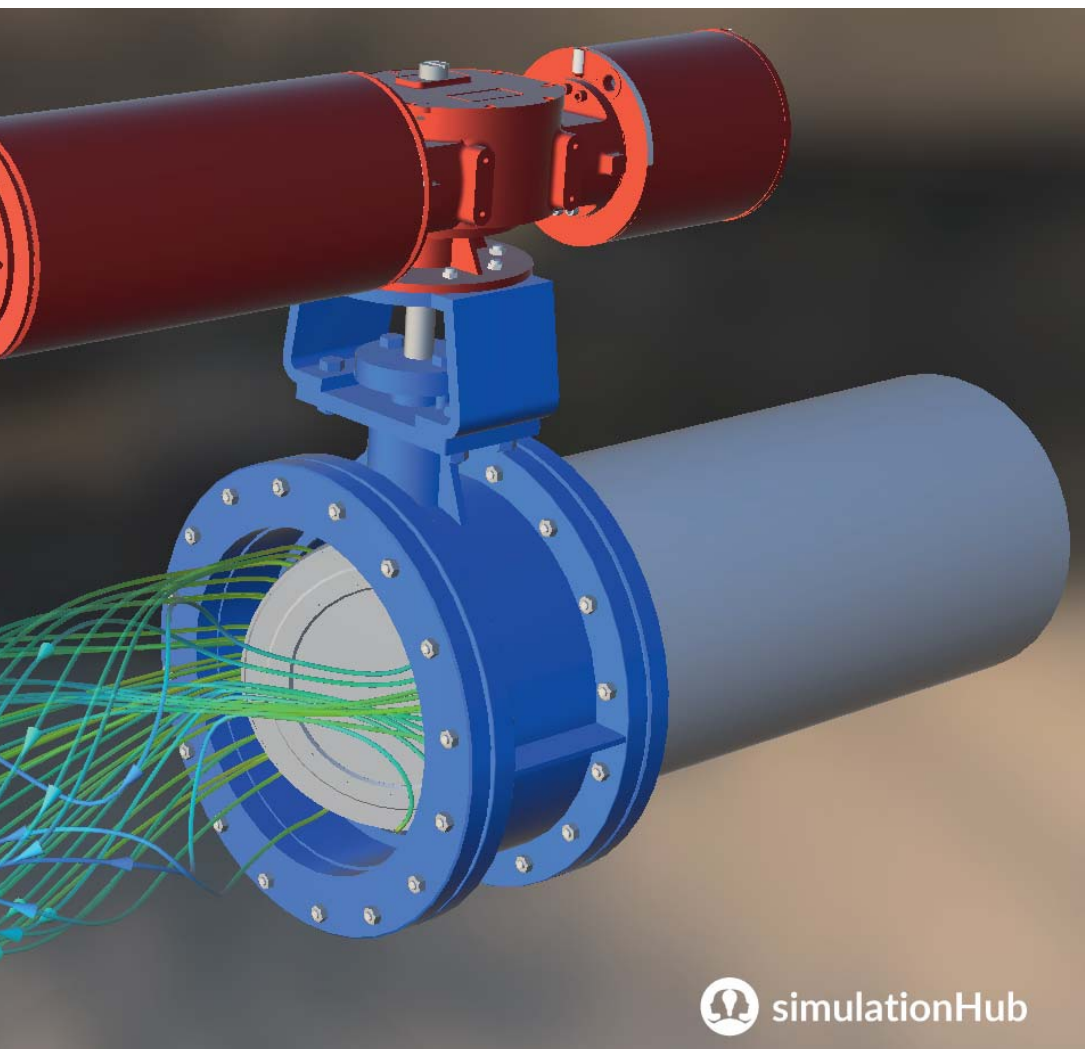
the companies have adapted to the changing environment of valve design and engineering.

Overall what I have noticed is that the advancements in the valve industry happen at a slower and more evolutionary pace than what happens in technology-intensive industries like automobiles and aerospace. That might be one of the reasons why I see few examples of the actions on these new technology trends, this new era of product design and engineering. I see a lot of things happening on smart valves, research work in fugitive emission, wireless actuators and IoT. I also see some of the examples of using additive manufacturing like Ramén Valves, GE Oil & Gas, Mesto, Bray. But not much happening in generative design, ML and artificial intelligence.

Considering the growing demand in the customized products, tight limits on the product cost and churching timelines on R&D and product development, it's time to look at these advance technologies seriously. I believe it's time to look for an alternative approach to satisfy the need of the future.

What can we do?

So, the question is, how do the valve industry can respond and leverage this new technology? Although there is no standard roadmap or answer to this question, here are some of the things that the industry leaders can do:

Be informed and spend time learning

Know what is coming, be informed. If you really don't know what is coming, it will never be on your radar until it disrupts your business. By knowing what will or might happen, you can better prepare yourself. You can define your actions and reactions very well. By knowing what is coming, you won't be caught off guard if there is sudden change in the way things are done. Ask your team to spend some time learning about the new technology. Encourage and reward skill development. It takes time to learn what's on the cutting edge, but the innovation driven by your teams through emerging tools make it worth.

Understand change in customer and competitor behavior

Keep an eye on how the customer needs are changing. Your product might be satisfying the current need of the customer. But what will be their future needs, and do you have a technology to satisfy future needs. One of the best places to look at is your competitor. This may not always work, and it will not really help to establish market leadership, but this might be a good place to look for technology trends.

Ask: what if we don't adapt?

It's just as important to understand your business as it is to understand the technology you're considering implementing. Ask some honest question:
- ► Can the competitor beat us using the advance technology? If yes, where and what will be the business impact?
- ► Which inefficiencies in our company would most benefit from the application of technology?
- ► Is the current state of technology enough to solve future problems?
- ► Do we have the right culture to adapt to emerging technology?
- ► Is the technology we're interested in is useful or it's just exciting?

Have a growth mindset

You need to take a long-term view of technology. The transition will not happen overnight. And, once the new technology is introduced into the organization, it will stay for a long time. So have a growth mindset in-terms of adopting the technology. Plan the roadmap for at least 5 to 10 years.

This article represents an abridged version of a post originally published on simulationHub's website. To read the full text, please visit: https://www.simulationhub.com/blog/new-era-of-valve-design-and-engineering

Planning and priority

You need to strategically plan the transition. Adapting the new technology should not be a tactical decision, rather it should be a strategical decision. Make the discussion around the adoption of new technologies a large part of your yearly and quarterly planning. Get everyone involved in finding out how new technology could solve one of your core business problems.

Balance between present and future

You cannot disrupt your existing way of doing things. You need to take care of the present, the present work orders, the present customer needs. You need to introduce new technologies slowly in the process. That would need a meticulous plan. There might be resistance to adapt to new technologies. You need to help your team to visualize the future and help them to live the designed future not the default future. You also need to create a correct blend of existing and new technologies and expose that to all the team members.

Experiment and prototype

You can plan for the experiment, but you will not come to know the results before the experiment is completed. You need to try the new technology, experience the benefits and limitations. The best way to do this is by creating prototypes. Identify the business problem. Create a small project around this problem and use new technology to solve the problem. Even if technology cannot solve the problem, you will come to know more about it, you will surely be able to identify the problems which can be solved with this technology. So, experiment and prototype around the new technology.

These are general guidelines about getting ready for future technologies. This is applicable across all industries. The leaders in the valve industry need to think and can use these guidelines to crate the technology transition roadmap.

About the Author
Vijay is CTO and Co-Founder of CCTech, a parent company of simulationHub's product Autonomous Valve CFD. Vijay has 15 years of experience working on CFD and has provided design and analysis solutions to various valve industries. In the current role, Vijay is involved in setting up a technology road-map at simulationHub's R&D, and Center of Excellence division. Since the beginning of Vijay's professional career, he has a passion for making high-end technology accessible to common users and designers. simulationHub's Autonomous Valve CFD application is an attempt to bring the CFD and advanced technologies in the hands of all valve designers. Vijay is deeply involved in achieving this goal. Vijay holds M.Tech in Aerospace Engineering from IIT Bombay and has a keen interest in multi-disciplinary design optimization.