Overcoming COVID-19 Obstacles

Advancing Collaborative Engineering, Simulation and Industrial Digitalization

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In traumatic times like these, industrial companies look for solutions that can quickly meet business needs given disrupted work environments. The COVID-19 virus has driven the sudden, global lockdown of almost all businesses. In many instances, companies have needed to radically reorganize their business operations, shifting most, if not all, traditional activities and processes from on-premise to work-at-home. Beyond the immediate crisis, it is unlikely that companies will return to what was the 'status quo' before the COVID-19 lockdown. Rather, a new 'normal' will emerge to execute, manage and control business operations at businesses that depend on the core competencies of design and engineering

An increased volume of remote work sets different demands on business leaders and managers to lead business operations delivering increasing business performance. Ever since the beginning of the internet age, nearly 25 years ago, remote collaborative design and engineering has captured attention. Also, there has been a growing demand for improved efficiency in industrial change programs with increasing focus on digitalization and automation. Industry 4.0 and its counterparts around the world are examples of such initiatives.

Overcoming COVID-19 accelerates the adoption of technologies and initiatives that allow for working with social distancing as a priority. Remote design and engineering, digitalization, automation, plus adoption of machine learning and robotic process automation (RPA) encourage a more productive social distancing work environment. This is key because strict social distancing will be with us anywhere from 6 weeks to 1.5 years, depending on the country affected, recurrences of COVID-19, or any other virus effects.

One of the most significant changes will be the R&D work environment. R&D labs involve designers, engineers, lab technicians, and other science-related professionals who work in close proximity. Some companies have already staggered work schedules along with more stringent hygiene in R&D labs to makes social distancing possible with fewer chances of infection. Concurrently, social distancing encourages the priorities summarized on Figure 1.

The opinions of "Time to Implement", "Maturity", and "Relative Cost to Enable" are relative and qualitative because actual costs will vary by company. For example, remote collaboration tools have been available to engineers and designers since the late 1990s. The tools have matured significantly over that time, the costs are competitive for the offerings, and substantial experience exists using them. So, the tools can be adopted over the near term. In contrast, the category "governance and supporting technologies" is relatively new, the supporting software has been receiving increasing attention over the past 8-10 years, the technology is going through notable innovation, and adopters are going through a learning curve. Given its importance for the post-COVID-19 world, manufacturers should seek out expertise in adopting it and the attendant change management required. The following paragraphs provide brief analyses of each of the 10 priorities.

Remote Collaboration

Globally, the most commonly used collaboration tools for designers and engineers are email, skype, and WebEx. While these offer fundamental communication and sharing capabilities they are limited in their ability to interact with a design while collaborating with co-workers. Also, they have little capability for maintaining traceability of how designs evolve. This traceability is important for productivity and making incisive design decisions that impact manufacturability, quality, and ability to maintain and repair products during their service life. In industries such as aerospace & defense, automotive, and life sciences industries (e.g. medical devices, pharmaceuticals), government regulations mandate such traceability for health and safety concerns.

Software companies have been promoting remote design collaboration tools ever since the beginning of the internet age. These tools come in the form of Product Data Management (PDM) software and real-time collaboration software that allow for traceability – at least from product concept through release. PDM software and real-time design collaboration software allow remote users to work either real-time or at different times yet keep the state of a design synchronized. This ability to work remotely while maintaining the integrity of design progress supports social distancing.

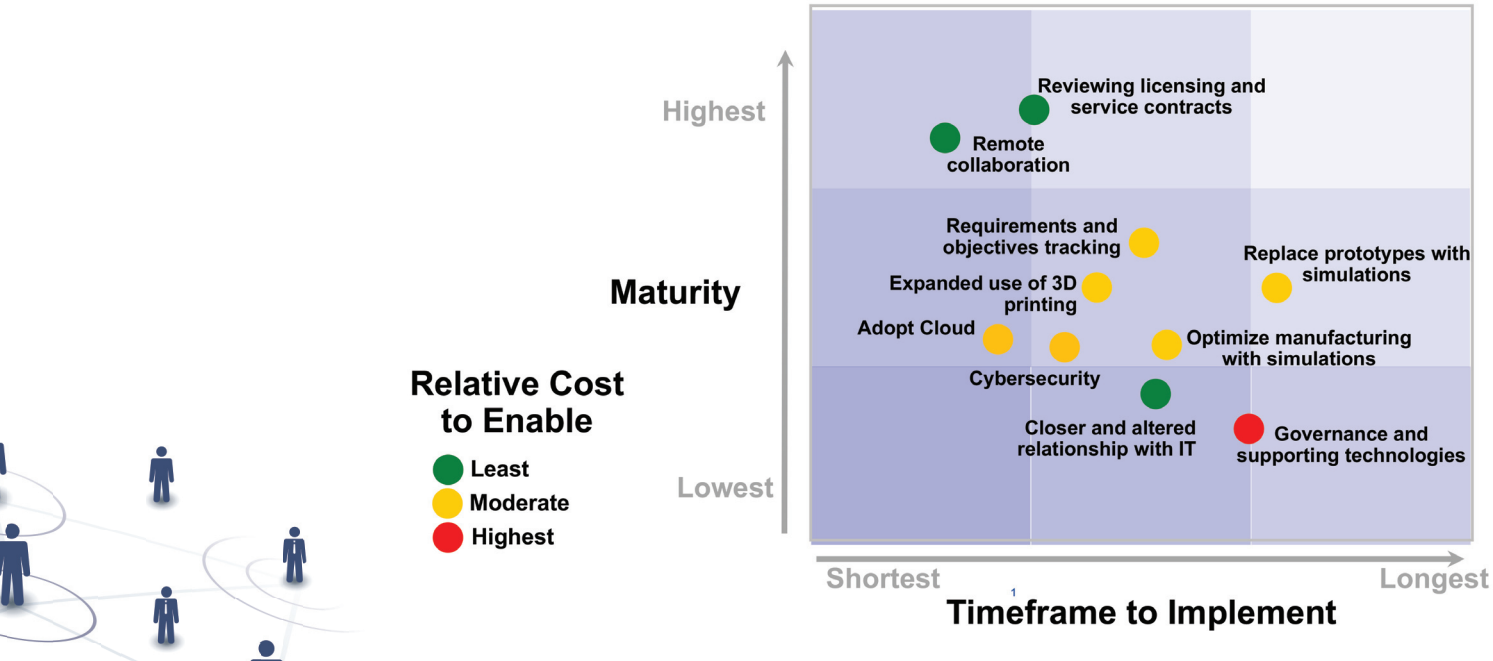

Figure 1. Top 10 Initiatives to Address Engineering and Design Covid-19 Needs

Replace Prototypes with Simulation

Given its lower costs compared to building many prototypes and the ability to re-use models for many more virtual tests than could ever be conducted via physical testing, simulation has always promised to replace prototype testing. In some industries such as aerospace, automotive, and industrial machinery, design and engineering work could not be done competitively without simulation tools. Besides the cost and time benefits over physical prototyping, simulations can be done by teams remotely and reliably with the right simulation governance structure, processes, and practices in place.

If reliable simulations were conducted remotely, businesses could reduce the amount of testing- including prototype testing- required. This would allow for reduced presence of workers in R&D and testing labs, enabling a sufficient amount of social distancing and reduced design costs.

Optimize Manufacturing with Simulation

Simulating manufacturing operations refers to creating and executing predictive models of key facets of manufacturing activities. These activities span machine tool operations, chemical processes and work cell ergonomics. They also extend to movements of parts, materials, and ingredients across supply chains and throughout plants. The simulation models can be 1D, 2D, or 3D depending on the manufacturing activity.

Simulating manufacturing operations offers insight into optimal placement, use, and scheduling of resources to ensure that the extent of human activities and the interactions of humans with other humans and their work environment remains safe from COVID-19 and OSHA (the US Occupational Safety and Health Administration) perspectives. So, these types of simulations can help manufacturing engineers and planners design manufacturing operations for safer yet productive operations.

Requirements and Objectives Tracking

Requirements management and objectives tracking capabilities capture the needs for product or system performance, manufacturing, regulatory compliance and service. Comprehensive capabilities capture requirements that change due to changes in customer needs, or to reflect discoveries during the design process that can improve products, deliver them faster, improve quality or produce them at lower cost. Requirements management and objectives tracking should be more than just a checklist of features and functions to be fulfilled. It should reflect the relationships among requirements and include insight into the user experience with the final product or system. Equally as important, companies should explore what solutions allow them to enter and track regulatory/quality requirements with alerts for noncompliance.

This will be important to have at an enterprise level when engineers and designers work remotely. Experience has taught companies that when individuals use spreadsheets to maintain requirements, the requirements on each spreadsheet can become inconsistent with those on other spreadsheets or fall out of date. An enterprise system that users can access from remote locations avoids those situations that can cause costly errors.

Governance and Supporting Technologies

Governance ensures faster and cheaper product design while maintaining and improving the reliability, quality and performance of the product through its lifecycle. It accomplishes this by its connection of product development, manufacturing, delivery, and service activities to the goals and strategies for the company's economic, quality, engineering information and manufacturing ecosystem. Also, increased volatility, economic pressures, changing suppliers, and more demanding customers increase the risk for missed purposefulness in design and simulation activities. Correct simulation governance mitigates this and ensures consistency between simulation tasks, conditions, resource experience, solution relevance, objectives, and measures of success. [1], [2], [3], [4].

Work-at-home creates staffing and training challenges including knowledge preservation and transfer. Not only is the execution of business activities affected, but importantly the management and control of development, engineering, production and service processes can also suffer. Among the various types of governance possible, simulation governance is especially needed to define and follow-up (measure) delivery of corporate [design] goals, needs, expectations and boundary conditions for simulation, including: framework for verification, validation, and uncertainty quantification of simulation for a geographically dispersed workforce. How adherence to these and other well-documented correct simulation governance principles with the reliability of corporate simulation processes, tools, methods are measured should be clarified by the simulation governance strategy. [5], [6], [7]

Expanded use of 3D Printing

3D printing (3DP) refers to the use of 3D printers to "print" objects from a variety of materials ranging across laminations of papers, plastics, ceramics, metals, and even biomaterials. While it has been historically used to create prototypes, 3DP is increasingly used in manufacturing to produce custom parts, tooling and fixturing. During the COVID-19 pandemic, 3DP is being used to produce face masks and other items useful to care givers.

3D printing reduces the degree of inter-dependencies across people to produce and deliver things. Consequently, it contributes to social distancing. While 3D printing prototypes and industrial parts shows great

promise, users must learn technical aspects of designing parts for 3D printing along with overcoming the challenges of using different types of 3D printers. Use of 3D printing service bureaus can be an alternative to printing 3D parts at-home or on premises.

Closer and Altered Relationship with IT

Successfully adapting to a new post-COVID-19 work environment requires a closer partnership between the new product development organization and the IT organization. Over the past 20 years, IT has been slowly evolving from a provider of IT infrastructure and supporter of back office applications such as email, financial systems, and customer relationship management applications that support sales and service. The current crisis requires that the IT organization and business operations teams responsible for activities such as new product development teams, manufacturing operations, and supply chain prioritize closer working relationships.

CIOs and IT leaders need to educate themselves better on the priorities of such business operations so they can and collaborate with them on options to support them for more socially distant but collaborative work activities. Otherwise, "shadow IT" (business applications and infrastructure that are managed and utilized without the knowledge of the IT department) will grow more rapidly. Business leaders and operatives must engage the IT organization in discussions on business priorities, but they must demand fast action. Yet they must brainstorm with CIOs on IT obstacles and be open to considering recommendations from the IT organization as well.

Adopt cloud

Feedback from engineers and designers shows mixed results on performance of engineering and design applications over a virtual private network (VPN). Sustained work beyond the immediate COVID-19 crisis requires greater compute power and network performance than that possible over a VPN. The cloud is the most practical and obvious source for that compute power, network bandwidth, and scalable storage.

However, adopting the cloud will require some planning. Among key priorities, if users need to access models and data from on-premise databases, means must be worked out to access that data and make it accessible on the cloud. The IT organization and users must validate performance of the applications-in-question on the cloud and response times to access and visualize data. Decisions need to be made about where results will be stored and accessed for ongoing use – the cloud or on-premise databases. Provisions need to be made if a multi-cloud strategy is necessary. Data security is also a priority – particularly for industries with regulations mandating data protection.

Cybersecurity

As a growing number of engineering and design applications move to the cloud, security concerns are a top priority. One challenge is the constant growth of technologies, strategies and new vendors. Some cloud service providers will offer cyber security capabilities. Engineering managers must share with CIOs the cybersecurity requirements of the work they are doing. Cloud service providers offer cyber security measures but these may not be adequate for the work being conducted via the cloud.

CIOs must take ultimate responsibility for the sufficiency of cybersecurity. Given the rapid pace of innovation in cybersecurity, work-at-home engineers and designers need to be prepared for frequent updates to security configurations. Caution must be practiced to ensure that cybersecurity is adequate but does not interfere with the performance of business applications.

Reviewing Licensing and Service Contracts

In the midst of the COVID-19 crisis, some engineering and design application providers are offering special flexible license terms and conditions, free software, and free support over the next few months to accommodate the challenges that their customer currently face adjusting to work-at-home. Users should take advantage of these offerings to ease into the new ways of working. However, users must be prepared that as we reach a new 'normal' involving a new mix of work-at-home and work-on-premise, software providers will resume licensing terms and conditions that demand higher licensing fees. Users must prepare for this eventuality by reviewing licensing terms and conditions and negotiate the best terms and conditions with limits on subscription price increases during contract renewals.

Conclusions

The COVID-19 pandemic will accelerate many important, long delayed trends such as digitalization, integrated flow of product information, and collaborative applications. It also moves industry closer to IT. This is driven by work-at-home and significant disruptions in external business environments (suppliers, customers, partners). Change projects need to be successful and simulation governance must be correctly implemented to reduce the impact of extreme volatility and deliver quality, volume, results [8].

The post COVID-19 engineering environment will pose new demands on availability, integrity, usability of product data due to fundamental changes in the predictability of business operations, and requirements from product development, production and service activities. The entire industrial digitalization ecosystem will be impacted. The new reality elevates the importance of simulation and its environment is critical to step up speed, capacity, availability, performance and reliability of design, engineering, manufacturing processes and systems.

There are well-known connected principles including Simulation Governance, Data Governance, Simulation Management and Simulation Data Management and Product Lifecycle Management. [9] However, their definitions often shift even at large engineering companies and manifest themselves through the IT software landscape and its implementation in different projects in the business and IT organization on strategic and operational levels. Reviewing and updating the definition and implementation of these principles is essential for engineering companies to avoid post COVID-19 pitfalls and maximize gains from opportunities. [10], [11], [12].

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