RECOVERING FROM THE TRENDS ERODING ENGINEERING PRODUCTIVITY

LIFECYCLE INSIGHTS

ENGINEERING'S PRODUCTIVITY IS ERODING

It's no fault of their own, mind you.

The *product development process* is getting more complex, as far-flung suppliers now supply key design contributions as well as components. *Products* are likewise becoming more complicated, as they include more electronics, software, and connectivity to the Internet of Things (IoT), and thus require more coordination between domain experts across disciplines. *Regulations* are growing both in number and complexity, forcing manufacturers to carefully follow procedures and document their compliance.

The impact of these changes is tangible for engineers.

Today, process complexity demands that each engineer tightly coordinate their work with customers, stakeholders in manufacturing, service, sourcing, and sales, and an ever-increasing number of suppliers. Increased product complexity means that no engineer designs a product, system, or a component alone. Instead, specialists in different engineering fields collaborate together as a team to make decisions. Regulatory compliance now demands that manufacturers institute more processes to mitigate legal and regulatory risk. It's no surprise that engineers simply can't get as much done as they could in the past. Their time is now splintered across a thousand tasks.

Engineering's productivity is eroding.

However, some software providers have begun to take notice and make changes. A new wave of data management systems is emerging to provide the right capabilities for the task at hand. Applied correctly, organizations can use these systems to release designs at higher rates, boost the innovation of their products, avoid prototype failures, and resolve quality issues far earlier in development.

Ultimately, the purpose of this eBook is to examine all of these issues. It delves headfirst into the topic by examining three trends that are eroding engineering's productivity and technologies that counter those trends, with a focus on this new wave of Right-Sized Cloud-Based PDM. So, sit back and take it in. The erosion of engineering productivity isn't as irreversible as you might think.

THE THREE TRENDS ERODING ENGINEERING PRODUCTIVITY

Engineering has always been a challenging job. However, in recent years, is has become increasingly difficult to deliver high quality designs on schedule due to three main trends. This section examines each of these trends to understand how they are eroding engineer productivity and what is needed to combat them.

THE DEMOCRATIC NATURE OF TECHNICAL DESIGN

The increasing complexity of products is well documented. The trend of electronics miniaturization results in heat management issues and more requirements for low power components. Sensors must be placed so they can capture key readings without hindering mechanical performance. Network antennas must be positioned to avoid electro-magnetic interference. Data streamed off products must be delivered to secure storage. Above it all, these different aspects of the product must work together in a seamless system to achieve top level requirements. Designing IoT-enabled products is a tall task.

However, the effect of this trend on engineering productivity isn't quite as well documented. Simply put, products aren't designed by individual engineers anymore. The transition from individual decision makers to groupthink design amongst teams of specialized engineers has already happened. Further complicating the matter is the expanded outsourcing of system responsibility to suppliers, so that teams are spread across the globe in different technical centers. While necessary, this *fragmentation of design* carries serious implications for engineers. Modern design requires high levels of communication, collaboration, and consensus while still demanding deep technical expertise in specific fields.

To counter the erosion of individual engineering productivity that results from these new responsibilities, organizations need new critical capabilities that facilitate these efforts, including:

- **All engineering teams need a single, current view to product data.** Given the need to coordinate technical design efforts, all engineering team members need to be looking at the same product information and data for their recommendations.
- **Communication and collaboration must happen in context of the design.** Executing development requires the successful navigation of highly technical issues. Therefore, all engineering team members not only need access to the same single view to product data, also the ability to collaborate *in that context*. This removes any potential for miscommunication or misunderstanding.
- **Participants need to securely and easily share product information and data with external participants.** Given the supply chain nature of design, some participating organizations will need to selectively and securely share only part of their designs with others to protect their intellectual property.
- **Accessibility of product information and data is paramount, regardless of format.** Specifically, no design chain is homogeneous in its use of CAD applications. The resulting multi-CAD data representing the design needs to be viewed and managed in the design chain.

THE INFLUENCE OF BROADER CONSIDERATIONS

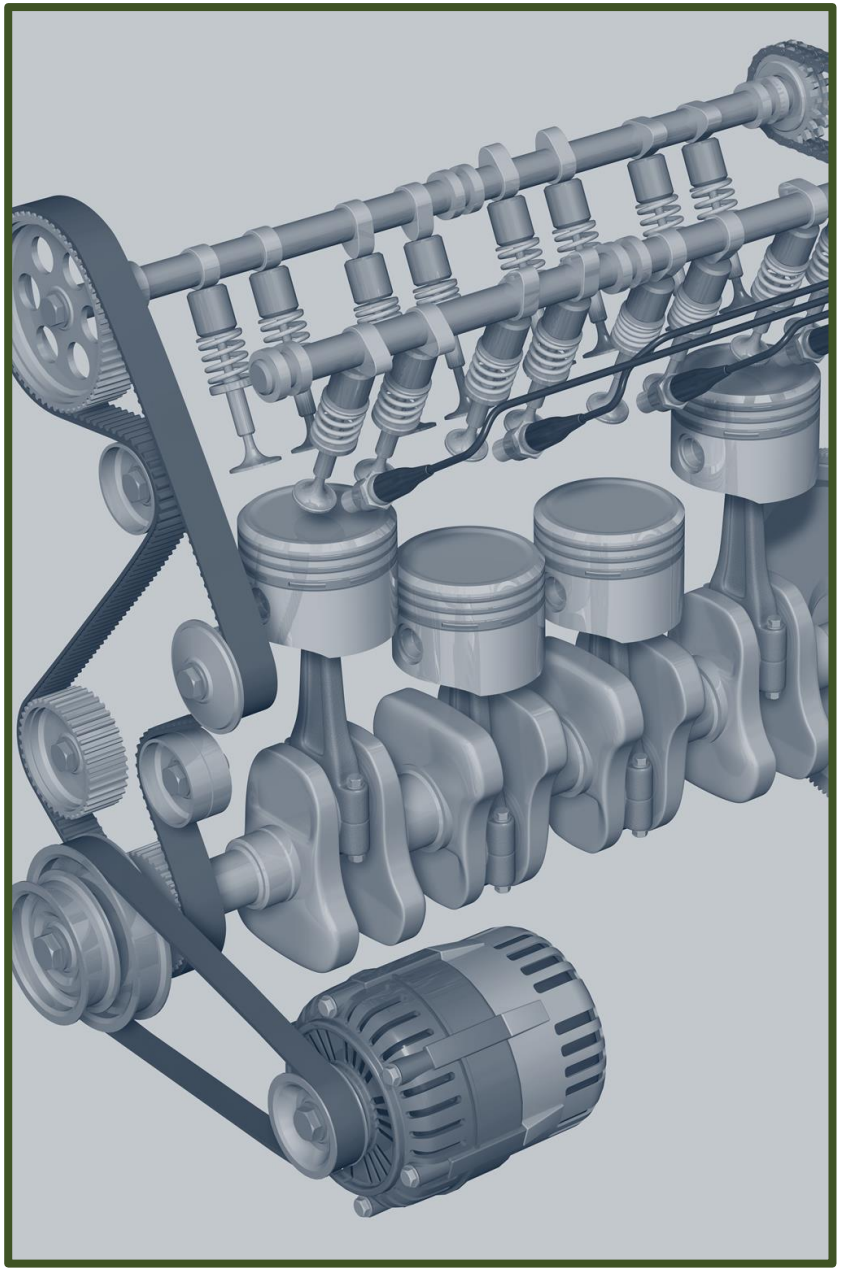
Design work today isn't just democratic in terms of technical design; it's also heavily influenced by broader considerations. Products are no longer just developed with form, fit, and function in mind. Identifying supplier sources in geographic regions around the world is often key. Manufacturing methods and how they vary per local conditions must be taken into account. Cost of goods against Bill of Materials (BOMs) directly affects profitability. Service feasibility and replacement parts are crucial as some companies consider new business models. Privacy and security of data storage is an emergent issue in the era of IoT-enabled products. Engineering today is no longer just about finding a feasible design that satisfies form, fit, and function needs. Ultimately, this all translates into the revenue and margin growth of the company.

While these changes are a necessity, the rising influence of broader design undoubtedly erodes engineering productivity. Fundamentally, these non-engineering participants need to understand the intent of the engineer's design before they can provide feedback or suggest changes. In turn, that means engineers must communicate their design intent clearly and concisely. Furthermore, they must enable the participation of all those stakeholders, demonstrating the technical nature of the design on the screen or with images, further reducing the time they can dedicate to design.

Once they have received feedback, engineers become the hub of collaboration amongst all stakeholders. They must consolidate feedback, not only against the initial design but also against successive iterations. In some cases, they must run complex trade studies to find just the right mix of design variables that satisfy both the technical needs and the broader requirements, as well.

For engineers, this can be a debilitating effort that slows development to a crawl. To counteract this effect, a new set of organizational capabilities is needed, including:

- **All development stakeholders need access to product information and data.** This enables a 'self-service' model where they can find what they need without requiring an engineer to provide access.
- **All development stakeholders need the ability to engage and digest technical designs.** Specifically, they need to open, view, and interrogate designs like 3D models. This allows them to understand the characteristics of the design and enables their feedback.
- **Engineers need access to product information that exists in other IT systems.** Feedback from participants in other departments will often be documented in other IT systems like ERP, Purchasing, Manufacturing Planning or other IT systems. Such access means they can independently see feedback, accelerating the development process.
- **The organization needs to automate, track, and manage the company-wide design review process.** This enables a closed loop process that reminds and enforces broader participation without manual effort.



THE BURDEN OF PROCESS COMPLIANCE

Markets for products today are fraught with regulatory and legal risk. In some cases, customers not only have requirements for the product itself, but also for *how* a product is designed and *how* its performance is validated. In other cases, industry regulations demand documentation and due diligence in design.

The demand for such compliance can manifest as new processes and procedures in engineering. Sometimes that translates to the documentation of a product's progression through design and test. Other times, that means creating detailed reports on a product's material composition, specifically banning certain materials. In other circumstances, proof of design due diligence for public safety is required. Some industries demand that products be decommissioned and disassembled in specific steps. Many manufacturers are starting to lay out privacy and security measures for IoT-enabled products, forcing them down the supply chain.

In response, many organizations have defined and documented processes that engineering must follow. It's often simply seen as the painful cost of doing business. The impact of complying with these processes on engineering productivity can be profound. Process steps must be followed closely, requiring familiarity from engineers. The right data representing the design must be stored as as-released or as-produced configurations. Engineers must generate documentation, often in very specific formats, as well. Errors along the way translate into vast amounts of rework. All in all, time dedicated to these tasks is less time applied to design.

Though there are many serious implications of process compliance for engineers, a group of new organizational capabilities can help mitigate or even nullify its impact, including:

- **Engineers need notification and access to the compliance processes.** A key part of following any process is having quick and easy access to the process steps. Doing so allows engineers to more closely comply with the process with minimal extra effort.
- **The organization needs to automate, track and manage individuals' activities in the process.** Many organizations go to great lengths to document their planned processes. Yet when it comes actually following the process, many fail because of the sheer manual effort required to track its compliance. Organizations need the capability to automate, track, and manage who has and has not completed the proper steps in the process. In this way, process compliance can be ensured.

TAKEAWAYS

When it comes to protecting, and perhaps even recouping, engineering productivity, technology can be a big part of the solution. Engineering already leverages a number of well-known technologies, such as Computer Aided Design (CAD) and Computer Aided Engineering (CAE) to develop better designs quickly and more easily. However, in the context of eroding engineering productivity, technologies are needed to enable the following organizational capabilities:

- All development stakeholders need access to product information and data.
- All development stakeholders need the ability to engage and digest technical designs.
- Engineers need access to product information that exists in other IT systems.
- The organization needs to automate, track and manage the company-wide design review process.
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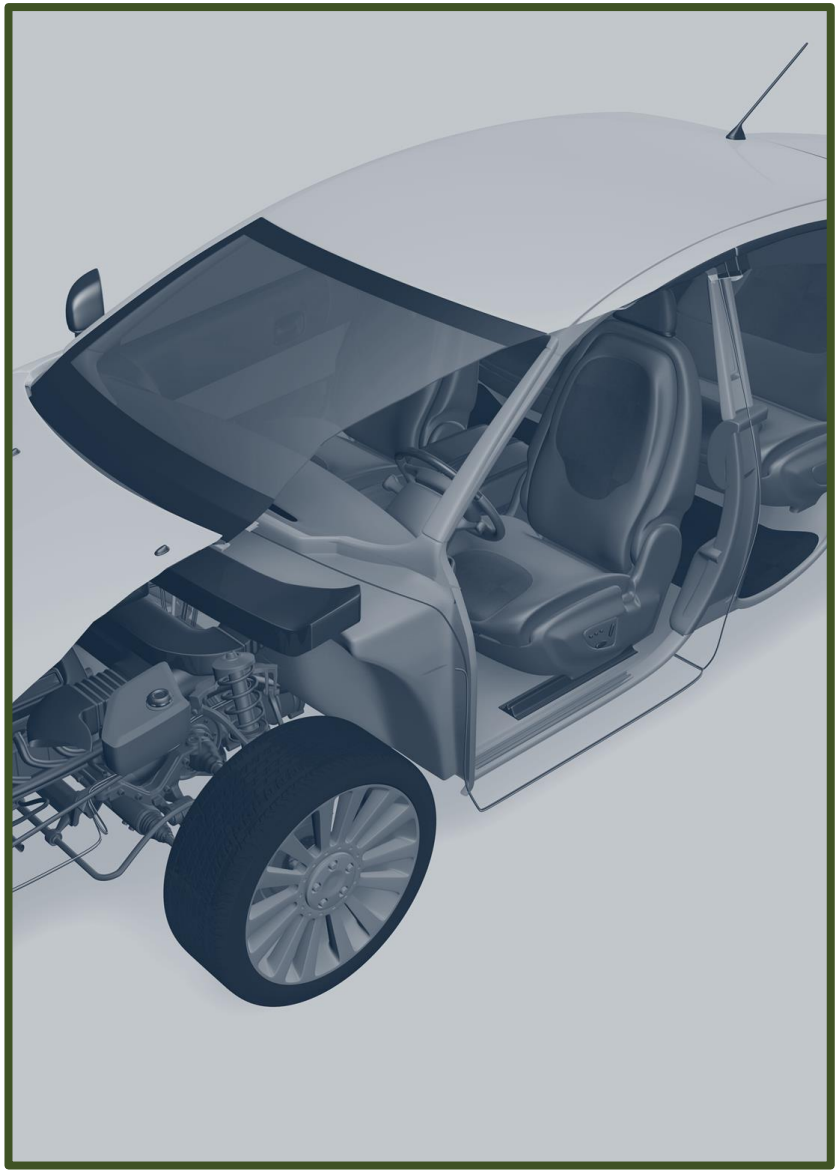

THE TROUBLE WITH EMAIL AND SHARED DRIVES

Does it take an IT system to collaborate with product data and run development processes? *Actually, the answer is no.* At the most basic level, organizations can accomplish these tasks with two basic technologies: product data can be accessed and shared using network shared drives, and processes can be driven using email. However, there are some serious shortcomings to leveraging these technologies, including:

- **Accessing and sharing product information and data via networked shared drives requires extensive manual effort.** Access rights must be set on files and folders for specific users and groups. Furthermore, today's operating systems don't understand this data. To them, they are just another file. As a result, technical data like 3D models must be opened with CAD software. That is simply a non-starter for non-engineering participants.
- **Emails routing process approvals and tasks can be ignored, deleted or lost in inboxes.** Using such an approach requires manual tracking of the process by an individual to keep it on schedule. Furthermore, any email attachments can quickly be outdated, meaning some stakeholders are working from the wrong information.

To be honest, engineering and broader product development have been run on email and shared drives for decades. However, these technologies significantly add to the engineer's workload and introduce a greater opportunity for error.

PDM SYSTEMS: KEY CAPABILITIES TO CONSIDER

If your engineering team is using CAD software, then your organization has likely at least heard of Product Data Management (PDM). This server-based software centrally manages such product data and information for that specific CAD application extremely well, offering a number of advantages, including the following:

- **PDM systems understand product data, structures and information**. These systems provide visibility of the information in the CAD file to anyone in the company. The structure or Bill of Material (BOM) can be extracted from such data and used across the company as well.
- **PDM systems provide visualization of CAD design data.** This functionality enables anyone in the company, including engineers and non-technical stakeholders alike, to view and review 3D models for their own purposes or design review.

While these solutions often share a set of common capabilities, some key capabilities are not always included. The types of functionality covered in this section specifically provide a means to improve engineering productivity and should be strongly considered.

MANAGEMENT OF MULTI-CAD DATA

There's no way around it: almost every engineering organization has to deal with CAD data in a plethora of formats. Some PDM systems focus on managing data from a single CAD system. Although they do that particular task well, this means that multiple PDM systems are required to manage all of the design data in a supply chain. That's a source of pain for everyone.

These new PDM systems, however, offer a range of data management capabilities that address today's multi-CAD reality.

- **Management of design data from a variety of CAD applications.** This capability allows these systems to understand the product information embedded in 3D models and other types of design data, regardless of CAD format. Furthermore, they can manage product structures composed of multi-CAD design data.
- **Visualization of design data from a variety of CAD applications.** This allows users to access, review and mark up a 3D model without requiring a CAD application. This is key to allowing development stakeholders to independently access consumable design data and provide their feedback without the assistance of engineers.

Dealing with design data from a variety of CAD applications can be a source of pain during the product development process. These capabilities ease that burden by managing the complexity of multi-CAD design data for engineers.

EASY ACCESS AND COLLABORATION IN CONTEXT

Several intriguing advantages come in the form of access and collaboration:

- **Accessibility, Anytime and Anywhere:** Because the system is based in the cloud, anyone that is formally invited can access the data as needed. This covers access from work, but also means gaining access to information on devices like smart phones and tablets while traveling or from home. Furthermore, external parties like suppliers access the data the same way.
- **State-of-the-Art Security and Backup:** Protecting product intellectual property and safeguarding it from loss is essential. That is why cloud-hosting companies hire legions of the most talented and experienced security professionals available. From a technical perspective, your product data is more safely stored in these cloud-based systems than behind your company's firewall. Furthermore, backups are often instantaneous, almost always allowing for some type of recovery from data loss.
- **Collaborating based on a Single View to Product Data:** With everyone accessing a single view to product data stored securely in the cloud, everyone can collaborate on it. That means that there is no more mixing up out-of-date email attachments. Furthermore, such cloud-based systems can support real-time collaboration. As people add their feedback, others can see it immediately.

These characteristics translate into very real advantages for an organization. Engineers, external stakeholders, and non-technical stakeholders can all work securely against the right data anytime and anywhere.

FLEXIBLE INTEGRATIONS IN THE IT ECOSYSTEM

An outstanding need of engineers and other stakeholders in product development is the integration of their data management system into the IT ecosystem. It is crucial for handing over the engineering BOM to manufacturing, but is also important for running design reviews for company-wide considerations. Right-sized cloud-based PDM systems offer some advantages in this regard.

- **Availability of out-of-the-box integrations to other widely used IT systems.** These integrations can be configured to exchange information back and forth with other IT systems in support of development activities.
- **Capabilities to quickly and easily connect to various other IT systems using known protocols.** This provides a way to connect to other IT systems that are not covered by out-of-the-box offerings.

Don't be mistaken: engineers and other development stakeholders have and always will be able to get information from other IT systems. The question becomes how *taxing* will the effort be on their product development responsibilities. The capabilities offered by Configurable PDM systems make it far easier, and frankly, far more feasible.

CLOUD-BASED ACCESS AND SUBSCRIPTION COSTS

New services based in the cloud are coming out every day. There's no doubt that the computing power and space available on the cloud is compelling. Furthermore, it makes sharing information with others very easy. When applied to engineering and broader product development, some interesting advantages emerge.

- **Subscriptions with Right-Sized Commitments:** Traditional PDM or PLM systems require a costly upfront capital expenditure. With a cloud-based system, organizations can pay a subscription cost on some regular basis that can be budgeted as an operational expense. This stands in stark contrast to the large upfront capital expense needed to purchase perpetual software licenses. The finances are more easily arranged and require minimal commitment. Just as importantly, these costs are easier to predict and to get approved by executives.
- **No Deployment:** In the past, if you were to deploy a PDM or PLM system, you would install the software system on a local server inside your firewall. You'd then go through the process of configuring and customizing your system. With a cloud-based system, you can essentially use it out-of-the-box.

From a financial and IT perspective, these new systems promise some real benefits. They are easier to deploy and maintain, and they require less of a fiscal commitment upfront.

THE IMPACT OF RECOUPING ENGINEERING'S PRODUCTIVITY

There are myriad issues undermining engineering productivity today. However, the next generation of PDM solutions offers great promise to mitigate those issues by managing multi-CAD data, offering easy access and collaboration, and providing flexible integrations into the IT ecosystem. Furthermore, these systems are increasingly offered through the cloud, and they can be acquired through subscriptions. Ultimately, though, executives need to understand what tangible benefit the organization reaps by recouping engineering productivity from these issues. There are a range of such benefits, including:

- **Higher On-Time Design Release Rates:** Design schedules are getting shorter while engineers are asked to do more and more. Yet with the right system in place, engineers can find the right designs to reuse in less time. That means they spend less time recreating something that already exists. By eliminating such unnecessary rework, engineers can ensure their designs are released on time, which often results in products being launched on time.
- **Better Designs, Increased Innovation:** Because engineers are trying to keep up with such tight schedules, they often go with the first feasible design they discover. By using the right system, engineers can eliminate a number of non-value-added tasks and dedicate more time to explore additional design alternatives and options. That increases the likelihood of not only finding a better design, but an innovative one.
- **Fewer Failed Prototypes and Change Orders:** Errors that originate in the design cycle can absolutely wreck the rest of the development process. Multiple rounds of failed prototypes add excessive costs, eating away at the development budget. Change orders return to an engineer's desk, further disrupting their productivity and interrupting the entire company's routine. This is an area where the right system not only saves time, but hard monies as well.
- **Reduced Cost of Goods:** Recouping some of an engineer's time from unnecessary tasks offers the opportunity to explore many improvements on designs, one of which can be cost. With more time in the design cycle, engineers can take a closer look at manufacturing methods and sourced components to see where costs can be cut. Reducing this kind of recurring expense can have a dramatic impact on the profitability of the product, thereby directly improving company margins.
- **Earlier Resolution of Quality Issues:** Employing the right system not only helps engineering, but other departments as well. Manufacturing, sourcing, service, and many others can gain earlier access to designs. Manufacturing can start assessing production processes. Service can look at ease of maintenance. Sourcing can begin to look at potential suppliers. With earlier access, those organizations can get a head start on many issues that are often problematic downstream.

SUMMARY AND CONCLUSION

It's an unfortunate reality: engineering's productivity is eroding. Three trends have put more responsibilities on engineer's plates, distracting them from design. These include:

- **The Democratic Nature of Technical Design:** Engineers must make groupthink design decisions with technical specialists across technical centers and the supply chain.
- **The Influence of Broader Considerations:** Engineers must also involve a variety of other stakeholders in design decisions to make products viable from a company-wide perspective.
- **The Burden of Process Compliance:** Regulatory and legal risk is driving the need to comply with more rigid and documented product development processes.

Left unchecked, these trends will consume an increasingly unfair share of an engineer's time. However, if specific capabilities are put in place, those trends can be reversed. The result:

- Engineers, development stakeholders, and external participants **access a single, integrated view of product information and data**.
- Engineers **access product information that exists in other IT systems**.
- The organization **automates, tracks, and manages processes across the company**, including design review and regulatory processes.

In years past, these capabilities have been supplied by a variety of technologies, including email and shared drives, CAD-dedicated PDM and PLM systems.

However, new PDM systems with the right capabilities are starting to emerge. They provide the important functionality that help engineers recoup productivity, including the following:

- **Cloud-Based Access and Subscription Costs:** These new systems are based in the cloud, negating the need to install and customize the system locally. Also, they use a subscription model instead of upfront purchases.
- **Easy Access and Collaboration in Context:** These systems are based in the cloud, where they are accessible anywhere and anytime to invited members. They allow anyone to collaborate in the context of product data.
- **Flexible Integrations in the IT Ecosystem:** Connections to other systems also are available out-of-the-box or can be quickly set up.
- **Management of Multi-CAD Data:** Such systems allow users to manage and visualize design data from a variety of CAD applications, especially non-technical roles without access to CAD or CAE software.

Too often, many have assumed that engineering's eroding productivity is simply the cost of doing business. However, there are powerful new systems now that counter that trend.

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