Making the Case for PTC Mathcad®:
How a Small Investment Can Lead to Gains in Productivity, Accuracy and Transparency

All engineers want to work faster and make fewer mistakes, but spreadsheet limitations can result in countless hours spent on idle tasks, poor communication among team members and errors that can neither be traced nor audited.

Here's some valuable information on how PTC Mathcad calculation software can help engineers and their managers overcome their most pressing performance challenges.

More than 250,000 engineers worldwide are successfully using PTC Mathcad to save significant time, improve design accuracy, and gain the transparency needed to collaborate with colleagues.

The popular engineering calculation software from PTC – the makers of the Creo® , Windchill®, Arbortext® , and other product development and manufacturing software – delivers a powerful capability set with an easy-to-use interface that can be learned in as little as 15 minutes.

Unlike other calculation software products, PTC Mathcad's hallmarks include an intelligent units-management system, an elegant whiteboard interface, and the ability to manage four kinds of content simultaneously – mathematics, plots, images and text – for better documentation of data and design intent.

Firms that deal with electrical, mechanical, civil and other engineering disciplines use PTC Mathcad from design through verification and validation. The product easily interfaces with Microsoft® Excel® and other specialized tools, acting as the productivity glue that sticks everything together. In fact, integration with Microsoft Excel enables engineers and managers who prefer using spreadsheets for what they do best – organizing large blocks of data. PTC Mathcad also supports reading from and writing to Excel files.

Proving the ROI Benefits

The advantages of PTC Mathcad – such as increased productivity, reduced risk and continuous improvement, can be obvious to everyone in the engineering department. However, sometimes those benefits can be unclear to the people responsible for approving budgets. It's important to communicate value in terms that are meaningful for financial decision-makers. Because everyone understands the term "return on investment" (ROI), as an engineer or an engineering manager you simply need to show that the costs of switching to a superior software solution are far less than the productivity gains you're likely to receive.

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An ROI Formula

$$\frac{\left(B - \dfrac{B}{1 + E}\right) * (12 - C)}{A + (B * C * D) + F} = ROI_{1st\_year}$$

A: Cost of software and first-year maintenance
B: Monthly employee cost
C: Training time (months)
D: Productivity loss during training (percentage)
E: Productivity gain after training (percentage)
F: Cost of training sessions

The most decisive factor in the ROI estimate is the productivity gain you and your firm can achieve with the software, both in terms of direct savings and opportunities for avoiding future expenses, whether incurred for duplicating work already done, fixing mistakes, etc. While the benefits are more difficult to quantify than the costs, assumptions can be made based on other known productivity impacts, examples of previous implementations, and the educated opinions of the engineers and other stakeholders who will be most affected.

Dr. Robert Phillips, an engineer who spent much of his career reverse engineering for General Motors and is an avid PTC Mathcad user, studied the effects of productivity, time and staffing on successful project completion. Through his research on the Putnam Model, he's shown that by doubling staff efficiency, a team can reduce staffing by 7/8, cut development time in half or do a little of both. (See chart below.)

Effect of Productivity on Time and Labor Costs
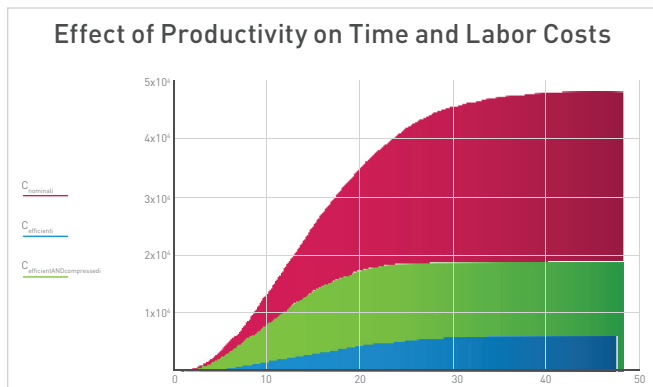
Doubling productivity allows the project to be accelerated, while reducing labor cost by ~60%

According to Alan Stevens at Rolls Royce, PTC Mathcad is the easiest to use calculation software available. "The others tend to look like complex software codes or languages."

The Real Productivity Benefits

While it's nice to have data to back up the notion that productivity gains are valuable, it's even better to know the real impact that PTC Mathcad can have on individual engineers and engineering teams. Here's an outline of some of the key benefits your organization can expect to experience:

Productivity Gain #1: Improved Engineer Productivity for Less Time Wasted on Insignificant Activities

Engineers who use a paper- or spreadsheet-based approach spend a significant portion of their time (15 to 25 percent, by some estimates) just manipulating data.

PTC Mathcad eliminates this effort and frees engineers to do more important tasks, like actual engineering. For example, unit intelligence automatically makes sure that units are carried forward in expressions and calculations.

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With Excel it took a long time to create a calculation worksheet. Not only have we saved 50 percent of our time in creating calculations, but we have improved verification and accuracy of our calculations with Mathcad."

Ji, Gu Sam
Vice Director of the Design Team, SAMHYUN PF (Korea)

Productivity Gain #2: Greater Accuracy for More Defect-free Design

When it comes to general mathematical calculations, engineers need to be careful if they use spreadsheets. Alan Stevens of Rolls-Royce points out that there are certain "peculiarities" within Excel that engineers need to be aware of, citing examples of calculation results that are always positive in Excel and always negative with finite element analysis (FEA) and computational fluid dynamics (CFD) packages. "Unclear spreadsheets can hide errors," Stevens says. "This is why engineers should turn to tools like PTC Mathcad, where a formula or equation is laid out clearly."

With PTC Mathcad, mathematical formulae and unit conversion are automatic. This can be important for avoiding mistakes that can cost a great deal if they aren't caught early in the design process.

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Hyundai Engineering has used Mathcad since 2005. When it comes to nuclear engineering, you expect no less than perfect and fast calculation."

Lee, Dong Hoon
Manager, Hyundai Engineering Co.

Productivity Gain #3: Increased Computational Power for Design Innovation

Continuous improvements to PTC Mathcad enable engineers to work with larger problems, which means that more exploration can be done in the concept phase to find the best possible designs.

As Tom Kotowski, VP of Electronics Engineering at Delphi put it, "No sane person would happily manipulate equations that are 10 pages wide. Mathcad allows us to develop concepts and do explorations that would be too painful to otherwise consider."

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By means of modifying parameter entries, we can reuse the existing calculation process in every new design or change the new calculation method. Mathcad can solve the calculation in a second based on these changes. Therefore, we don't need to rework again and again, significantly improving our productivity."

Li Wei (Doctor)
Engineering Manager, TDI Power

Productivity Gain #4: More Effective Presentations and Reports for Greater Communication, Understanding and Compliance

The PTC Mathcad interface is excellent for assisting engineers and other higher-order math users to explain what they did, why they did it and what they were thinking. This is a significant asset for one program manager at an aerospace company: "I work with engineers who think in matrices," she related. "So, when we review each others' work, I have to say to them 'Okay, this is good, but you need to explain it in a form that others can understand!'"

Engineers can print out the analysis information, email it or upload it to a website for clients to review for quality audits, or use it as supporting evidence in a report for mandatory regulatory compliance.

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Mathcad allows engineers to accomplish five days worth of calculations in one day, while leaving behind a historical footprint that can be used for bridge repair or maintenance for years to come."

John Cole
Chief Bridge Engineer, South Dakota Dept. of Transportation

Productivity Gain #5: Documentation and Transparency for Enhanced Collaboration

PTC Mathcad is used as documentary evidence, alongside text and drawings, to support engineering information such as FEA, CFD and risk-analysis calculations. The ability to document data and design intent in a transparent format is a tremendous benefit if you're trying to produce a design variant, or if you need to understand calculations made by someone who's left the company.

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Alan Stevens, the mathematical modeling and simulation specialist at Rolls-Royce who convinced the company to acquire 80 PTC Mathcad licenses, explains the importance of documentation and calculation transparency: "Excel is not well controlled and calculations tend to be written ad hoc," he says. "Most become uncontrolled as they grow in size and are poorly documented. And, if that engineer then leaves the company, somebody else has to understand that spreadsheet, which is cumbersome and over-complicated. It can be a real problem."

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Mathcad provides...a standardized way to communicate. We have manufacturing in Mexico and key vendors in China. We're doing a field trial in Korea. We need to be able to share documents that all these people will understand."

Mark Beigert
Optical Solutions

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We conduct all team calculation work and reporting with Mathcad. It makes the process so streamlined that I can't imagine work without it."

Michael Ekholm
Johnson Screens

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