

# **A Guide to Selecting a Mechanical CAD System for Small and Medium Businesses (SMB)**

A whitepaper by TechniCom

March 2010

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## Introduction

This paper is a follow on and update of TechniCom's previous paper published in February 2005. In that paper we discussed "Selecting a CAD/CAM/CAE/PDM system" and noted that selecting such a system is no easy task. Today, five years later it is still no easy task to select a comprehensive engineering and product development system, yet it is crucial to the success of ANY business, be it small or large.

Our goal with this paper is to help people make better decisions when selecting software solutions to improve product development and engineering performance. This paper can provide you with a logical and orderly approach, which, if followed, will allow you to select the proper 3D *mechanical* Computer Aided Design (CAD) system for your company. In this paper, different than many others we have seen, we provide guidance for mid-sized businesses rather than large-scale enterprises.

In many areas of this paper we stress the importance of making strategic decisions, both short-term and long-term. Readers should keep this in mind. Any decision making tool, be it for product development or business strategy, is only as good as long as it fits the company strategy and directions. We repeat, a tool that seems technologically advanced but does not fit the company needs cannot succeed. We will explore this further, a bit later.

This paper is sponsored (partially paid for) by PTC. We agreed to write it because that PTC assured us that it would be completely unbiased -- and they have upheld this agreement. Why would they do so? Because they feel comfortable that small and medium business customers evaluating such systems will often decide upon PTC offerings, providing that customers have a rational approach to making such a decision. This paper provides such a rational approach. PTC and the authors know that no single solution is right for all customers.

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## Executive Summary

This paper defines a well thought out, logical and orderly process to select a new CAD system. We focus our energy in this report on the process of justifying a new system and making decisions based on business needs first, then developing the technical and functional requirements to support those business needs. The best we can do in a paper of this length is to provide overview guidance to customers making such a decision. We have tried to distill our years of expertise into this paper. We hope you will find the methodologies presented by the author clear and usable.

First we discuss a CAD system, why it is important and why a company might consider switching to a new one. Then we launch into the how-to of going about the selection and many things to consider along the way.

Over the years, we have observed and been involved with the complexities of such a decision. We can only provide you with our sage advice and recommendations of a process to follow. It is up to you to work with our recommendations and bend them to fit your company. Notice I said, bend, not discard. We take you from the early decision stage, show you how to get started in organizing for the process, and guide you through the various stages.

The process follows a suggested path to develop requirements in order to judge the software that best fits your needs. We suggest

the development of management requirements, leading to functional requirements, then to technical requirements, and give guidance on how to work with vendors to make the final decision. We conclude with advice on what such a system should cost and some suggestions for implementation. The appendix contains some interesting advice on a technique for evaluating vendor proposals.

Good luck with your decision and remember, "Fortune usually smiles on the well prepared."

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## The Selection Process

### ***Defining a CAD system***

First let's quibble about what to call a CAD system. For our purposes, we are discussing a mechanical engineering design system. Such a system allows designers, engineers, and others to design mechanical parts and assemblies (objects or models) in 3D, to document them with 2D drawings, to analyze basic properties of the objects, and to share these objects with others during the design process. In addition, there is often a need for specialized analyses, such as FEA, mechanism, plastics, composites, visualization, and other types. To optimize its effectiveness, some type of workgroup data management allows users to store and access the data in various ways that allows them to find data they need, re-use existing designs, and collaborate with others while protecting key intellectual property (IP). We differentiate workgroup data management from another commonly used term called product lifecycle management (PLM), a more encompassing and vastly more complex technology. For this paper, workgroup data management encompasses those activities within the engineering – design department until the product is released to production. At that time, many companies will then transfer overall control of the product data to a PLM or enterprise resource planning (ERP) system.

So, for the purpose of this discussion, a CAD system shall include 3D and 2D design, inherent analysis, connection to specialized analysis, an integrated CAM system, and a workgroup product data management (PDM) system.

*If your funding and business objectives are primarily engineering driven, then you should give more weight to CAD. If your company intends to perform less direct engineering and instead make more use of design partners and outsourcing, then you might want to consider a solution that is lighter on CAD and more focused on collaboration using a PLM solution.*

For the purposes of this paper, we assume the reader's objectives are primarily engineering driven and thus in need of a CAD system.

### ***Why consider a new CAD system?***

The continuing onrush of both new hardware and software technology during the last few years, along with the pervasive reach of the Internet provides a unique opportunity to use such a CAD system as the fundamental basis to greatly improve how your company operates.

The good news is that such CAD systems today offer enormous power at very reasonable costs. However, CAD systems now reach into many more corners of a company, and as such need careful planning. At one

*A mechanical CAD system is the most important tool of product development.*

*Properly implemented, a CAD system **supports** the business plans.*

*If a modern CAD system is integral to your company's future product development, then a careful rational decision must be made that does its utmost to insure that such a system meets both your current and future needs.*

time, CAD systems were the sole domain of engineering, for use in developing and documenting new products. The other departments, such as manufacturing, testing, procurement, and suppliers, received this data and used it and modified it independently of the original data. Alas, if you couldn't read the data, you needed to rebuild it in whatever format pleased you. In fact, this mirrored the way companies worked in the good old days of slow speed, paper based systems.

In the last decade many forces have changed the way we need to work today. Among these are the need for speed in bringing products to market; the need for world class quality; the requirement to operate in a global economy where customers, vendors, and even engineering can be anywhere in the world; and cost - where customers can compare prices anywhere in the world by simply browsing the Internet.

Successful product development in today's global market requires a comprehensive strategy for your engineering and product development system. In the following sections we discuss how to determine if you need a new system. Chief among the questions you must ask yourself are: "When did you last make a major change or update your CAD software? Was it within the last 3 -5 years?" This seems like a short time, but consider that in those 5 years computers have advanced 100 fold in speed and CAD software has often seen five releases of the products. If you agree that the primary tool supporting your product development is important in keeping your company competitive, then it's time to re-examine this tool, **because a mechanical CAD system is the most important tool of product development.** Notice that I said a tool -- this is important. It is a tool, but only a tool. A business must focus on its business; it needs to determine what the proper business process is. Then it must consider the tool to meet the process and requirements. It's not about strategy; it's about the business of running the business. **A well-implemented tool will support the business plans. This is the fundamental message of this paper.**

For smaller companies, selecting the right solution can be difficult due to limited resources available for the evaluation process. A structured, well thought out process is critical to these smaller businesses.

Instead, in many cases, selecting a PLM system tends to be done at too low a level, with poor consideration of company strategic issues, with little understanding of the product development environment and any proposed improvement, and with little idea of expected ROI or metrics. Is this a problem? Yes! If such a system is integral to your company's future product development, then a careful rational decision must be made that does its utmost to ensure that such a system meets both your current and future needs.

### ***A rigorous technique to select a CAD system***

To address the challenge of selecting a new CAD system, TechniCom, in this paper, describes a rational, well-organized approach for a CAD system selection process. It all starts with the business objectives in mind, starting with a determination of whether a new system is warranted or not. This encourages a business case that carefully ties the software strategy to the strategy of the business as a whole.

**Without this business alignment, the selection process will likely be focused strictly on the technical merits of the software system and disregard evaluation criteria that are critical to the successful implementation (and return on investment) of the PLM solution.**

*Aligning the selection process to the business needs will avoid focusing strictly on the technical merits of the software system.*

After determining the need and building the business case for the new solution, the author recommends a number of steps to organize and conduct the evaluation process. Assembling the proper team for the selection is an important step, including the development of a cross-functional team and an executive steering committee to drive the process. This team will quantify the company management requirements, functional requirements, technical requirements, and integration requirements. Then this team will drive the process to select a vendor partner and a solution based on these requirements.

The paper further identifies a process to evaluate potential vendor partners, including the importance of the vendors' long-term strategy in addition to current offerings. The evaluation should include an assessment of the vendor's ability to support the company during the implementation and beyond, including an understanding of design strategy of the company and the ecosystem of partners and solutions that are aligned with the potential software vendor. Finally, the paper identifies a number of potential solution providers and offers some advice on how much a company should plan to spend on a solution of this kind to help ensure a realistic cost for the business case.

Selecting a CAD system is an important process, and one that can provide a tremendous boost to the business if done correctly. The steps in this paper are designed to ensure that the system selected can be readily implemented to achieve business value, and try to eliminate misperceptions, poor evaluations, and inherent biases that could lead to late surprises in the implementation or use of the solution. By following these steps, companies can be comfortable that they will be able to achieve the top-line growth and product improvements they seek from a new CAD solution.

### ***Selection technique summary***

We suggest a multi-step approach to the selection process that builds on our logical and successful recommendations in the past:

- Determine the need
- Assess the as-is system and the business objectives for the to-be system
- Organize the evaluation
- Determine management requirements
- Determine functional requirements
- Determine technical requirements
- Determine integration requirements
- Evaluate a potential vendor partner
- Select a system and vendor partner
- Implement and monitor the strategy

These are explained in more detail in the sections below.

### ***Setting the stage for getting started***

As consultants and industry pundits who have observed and been involved with many such decisions, we know selecting a new CAD system is a difficult process. The bigger and more complicated the company, the more difficult it seems to be; conversely, smaller companies have fewer technical resources. CAD systems today offer enormous power at very reasonable costs because of advancing

*A CAD system can provide a tremendous boost to the business. These steps can ensure that the system achieves your desired goals!*

*CAD: a fundamental capability enabling modern product development.*

*Today's computer and networking technology allows CAD systems to reach into many more corners of a company, and need careful planning.*

hardware and software. Precisely because of this, CAD systems reach into many areas of a company and are no longer thought of as just engineering systems, but more as a fundamental capability enabling modern product development.

While promising to transform product development, a CAD system must both fit the company environment and allow for a re-thinking about or a transformation of product development processes. The benefits should greatly outweigh the costs and disruption to your operations while changing to a more modern system.

Readers who follow the techniques suggested in this paper will be rewarded with a "best fit" solution.

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## 1. Determine if you need a new system

Answer these questions to see if you need to change or improve:

- When did you last make a major change or update your CAD software? Was it within the last 3 -5 years?
- Are your engineers/designers primarily designing using 3D?
- If you are an engineer to order (ETO) or make to order (MTO) company, are you using automated product configurators or automated design software?
- Are you happy with your product quality?
- Do you spend a lot of time and money producing physical prototypes?
- Is your engineering design cycle short enough?
- Are your engineering methods captured to insulate your development department from future turnover?
- Can your design management easily evaluate progress on key projects?
- Can you easily coordinate a global development effort?
- Are you happy with your product development times and the time it takes to bring products to market?
- Do you respond to a high percentage of RFP's in a timely fashion?
- Are your development and go-to-market costs in line with your competitors?
- Are you able to interact with global suppliers in the design phase as well as you should?
- If need be, can you exchange design data with your customers and/or suppliers? In this exchange, can you retain the security of intellectual property on your key product data?
- Are your engineering and manufacturing bills of material kept synchronized?
- Can you effectively access and use portions of prior designs in new products or projects?
- Do your overall product related company metrics compare favorably with others in your industry?

*If you answer "No" to **any** of these questions you are operating with a deficient CAD or product development system.*

If you answered "No" to **any** of these questions you are operating with a deficient CAD or product development system. We suggest that you read through the following steps carefully to determine whether to improve what you have or to change systems and what benefits you can expect.

### ***It's a business decision, not a technical decision!***

*Remember this during the entire project: It's a business decision, not a technical decision!*

You need to develop a business case for upgrading or replacing the existing CAD system. In order to do so, you will need to map how well the existing system fulfills your business plan. What are the gaps between what you want to accomplish as a business and what the existing systems are able to support? Are you paying too much for support of point solutions or custom systems? Do you have the integrated solution that your business demands? How can you improve your design processes with a modern CAD system?

Most companies that have not invested in the new generation of solutions for developing and engineering products suffer from inefficient and non-integrated systems. For you to operate as a leading company you will need to make the evolution from standalone tools to integrated suites. For you to properly plan (and justify) your efforts you need to determine where the gaps lie. These are the business-level gaps, and should be reflected in business level metrics to support your new business strategy. Once this is done, you can specify the fundamental requirements for new system that fills those gaps and can grow for the future.

### ***Select a cross functional team***

A good evaluation is based on a strong plan and a strong team. Understand in advance the approach that you will take to the evaluation, the selection of the new system, and the approval of the new system.

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## **2. Organize the Evaluation**

Your system will touch many aspects of your business. New approaches to developing products demand a much broader level of participation than past approaches. Make sure your team has representatives from Engineering, Product Management, and the Program Office (if you have one). But also include Procurement and Manufacturing representation. Also, consider including Sales if your business involves any make to order (MTO) or configure to order (CTO) products. Remember that the people you want from each department must be respected. You need to ask departmental management for people you "can't afford to spare" for the project, not someone that is transitioning out of the company or on a performance improvement plan. Respect is critical.

You must support this team with a strong steering committee. This committee should be made of respected business leaders that can make decisions that stick, and should represent major functional business areas in the same way that the team does.

### ***Vendor interaction***

*Make sure the vendor's references are similar to your company size, and understand how much time and money their implementation cost.*

Provide potential vendors with your requirements, have them show you your data and processes as they exist today and how they can exist tomorrow. It's OK to have vendors show you general demonstrations, you can learn a lot from them. But you should also see your data and your business reflected in the system before committing.

Check references. Find companies like you that are running the vendors' software. The vendors will provide references, but you should also find some on your own. Consultants can often help here by tapping into their networks.

Special considerations for mid-sized businesses: make sure the references are your size, and understand how much their implementation cost in terms of investment and resources.

*A properly staged implementation plan delivers ROI at every stage.*

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### **3. Determine Management Requirements**

Now we must get more specific and translate the proposed new operating environment into specific system requirements as they affect a new CAD system. This is necessary because if, for instance, you decide that an important objective is faster time to market, you cannot buy a system that does just that. If you were able to do so, you would have to alter your business to fit a generic model. To preserve the uniqueness of your business, instead, your company's techniques and processes will need to be analyzed to understand what aspects of your process need to be and can be improved. This first step involves deciding what business or management requirements are most important. The following steps involve translating these desired business improvements into functional and technical requirements into more "engineering speak." Even later theses can help you decide on an implementation plan by selecting the more important requirements so you can develop a staged implementation plan that delivers ROI at every stage.

#### ***Differentiating management and technical requirements***

The later stages in the selection process of a CAD system identify key requirements that the system must meet. Such requirements are an outcome of deciding upon the primary goals and the critical business aspects that will be improved, and what timeframe according to the implementation plan. You can expect to have the system for at least five years; picking the right system can have an enormously positive impact on your competitiveness.

#### ***Sample management requirements***

The requirements for the new CAD system can be divided into management requirements and technical requirements. *Companies have a tendency to make such a decision based solely on technical merits. We strongly urge management to be involved in assuring that the business aspects not be ignored.* We suggest the following as management requirements to be considered. You should add your own, depending upon your business situation.

*Business benefits, personnel, software vendor relationships, a skilled pool of potential hires, customer and vendor collaboration, future flexibility as the business changes, references, technical support need to be the concern of top management.*

- The benefits of the proposed overall system solution will meet my business objectives and be a cost effective solution at all stages of implementation. Some potential benefits to consider can accrue from: more competitive products, lower priced products, better quality products, faster to market with new products, higher profit margin, maximum design reuse, and lower scrap rates.
- Management should feel confident that their personnel can implement the solution in a timely fashion and that it will deliver the desired results.
- Management should feel comfortable that they have or can develop a long-term relationship with the software vendor and have good local support.

- There is an availability of local skilled users and consultants to augment company skills.
- The system can be run successfully in the event of personnel changes.
- Consideration should be given to exchanging data or inter-operating with evolving vendor/supplier/OEM/purchasing and outsourcing relationships.
- The system should allow future flexibility if the company operations change.
- Take into consideration that the data and designs generated by the system may need to survive and be useful for many years.
- Because of the long duration of the vendor relationship, the software vendor viability and product leadership are critical. Management should have an excellent comfort level that any selected vendor will continue to be an industry leader.
- Your competitors are using similar systems effectively.
- There should be excellent references of the specific software vendor in similar businesses to yours.
- The vendor/sales agent provides good availability of technical support for software errors, training, and assistance with proper software usage.

### ***A complex business demands a correspondingly complex CAD system***

To assess what type of CAD system you will need, it is important to understand the nature of your business in regard to potential CAD system complexity. In general, the more complex your company, the more complex the systems needed to support your operations. You will find that some CAD systems are more comprehensive than others in terms of their growth capabilities, their scalability, and their application or initiative coverage. Unlike CAD systems of the past, comprehensive does not necessarily mean more costly and difficult to install and maintain. Don't let possible complexity deter you. If you have a complex problem, then do not expect to realize your expected benefits with a limited solution. If your needs call for a more comprehensive system, then consider one. The reverse is also true. Your goal is to get a system that fits your needs. The following are some of the things to consider when judging your company complexity. Each item lists possible answers in increasing complexity order.

*Some ways to measure business and related design complexity.*

- Manufacturing locations – one location, a few, or many
- Complexity of products – simple products with few subassemblies with few supplier parts; modest number of supplier parts; products with many engineered parts, multiple subassemblies and extensive supplier parts
- Variety of products – limited, medium, or large variety
- Product types – standard products, configure to order, engineered to order
- Sensitivity of products - to price, to physical factors like weight or strength
- Use of suppliers and supplier interactions –uses only standard off the shelf, some custom designed supplier parts, extensive custom designed supplier parts

*A complex business environment demands a more complex solution.*

- Customer/Supplier relationships – independent or customers dictate documentation and designs in specific formats
- Design locations - one, a few, many
- Existing CAD systems – single vendor, multiple vendors
- Need to import CAD from other systems – limited, extensive, extensive and need to synchronize with external customers or suppliers
- ERP system is installed and operational and manages the production cycle - no, yes, automatic interface desired
- MES (manufacturing execution systems) installed – no, yes, automatic interface desired
- Design through manufacturing process - design only, manufacturing only, design through manufacturing
- Product regulatory requirements – limited, some, extensive (for instance, for medical use)
- Prototyping and testing processes – few needed, some testing required, extensive testing needed (for high risk related products)
- Size of IT staff - small or non-existent to a few
- Data management existing now - file system only, central vaulted storage with limited access, corporate wide controlled vault with full collaborative capability
- Documentation required to customers – little other than drawings and material lists, full 3D data, interactive assembly instructions
- Product life cycle - very short <12 months, short 12 to 24 months, medium term 24 to 48 months, long 48+ months
- Corporate structure or corporate complexity - stand alone company, part of a division of a corporation, division of corporation, multi-division corporation operation

For this evaluation, independent consultants can prove particularly useful. They will be able to provide industry expertise as well as an independent view of how well your existing systems “measure up” to industry leaders. Another good source of information might be to use vendor or reseller consultants, or tools such as PTC’s Value Roadmap, a well-defined approach to selecting business alternatives, best practices and their resulting system requirements.

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## **4. Determine Functional Requirements**

*Function follows form, or in this case, function follows the business management strategy.*

Now that you have a business strategy in place and have determined the need for a new system, it is time to start laying out requirements. Where should these requirements come from? You can find RFP (request for proposal) templates in a number of places, and some vendors may even provide you with one. These tend to be bottoms-up requirements, and can be very detailed. Start with your business strategy and develop a set of high-level requirements. Base these high level requirements on what you want to accomplish in your business, and ensure the software is designed to support you.

There are clearly some basics that must be in place for the system to function. Most systems will have these, and it will not help you differentiate solutions. To start with, we suggest that you look at the business initiatives you need to support, any special requirements

demanded by your industry, any regulatory requirements your system must fulfill, requirements driven by the size of your business, and special considerations for your business.

### **Requirements by business initiative**

It is important to understand these in advance in order to pick the right solution and vendor partner. If the solution doesn't address the right scope of functions, then you will likely have to develop custom systems to extend the core. Consider what the system needs to do in order to improve your product profitability and competitive position, and list those. Even if only a limited scope is planned for the initial implementation, consider the need for these in the future. Some initiatives to consider include:

- Collaboration with customers and partners
- Product portfolio management, product modularity
- Design reuse
- Standard product development processes
- Reduced physical prototypes
- Reduced production scrap and rework
- Lean engineering.

*Some functional initiatives you may want to consider to improve your engineering design process.*

*"If you can't describe what you are doing as a process, you don't know what you're doing."  
W. Edwards Deming*

### **Industry requirements**

Some industries require dramatically different capabilities, while other industries simply put higher emphasis on specific elements of the solution. For example, the aerospace industry needs much greater traceability on configuration management than a less regulated industry. An apparel company needs to understand product line planning much differently than other industries. An entire chapter could be written for each industry, but one important way to evaluate this is to set a requirement that the system is being used successfully in your industry.

### **Regulator and sustainability requirements**

Some industries and businesses are also subject to specific regulatory requirements. These can include document retention policies, security approaches, and other demands. Check with a consulting company and some of your peers to understand what these are. Check with your customers to see if they have any specific regulatory (or non-regulatory) requirements for your system.

Sustainability software seems to be rapidly making its way directly to CAD systems, allowing design engineers to make early decisions that impact the environment. Such items might include choices about material types, locations of build plants, efficiency of vendor facilities, and others.

### **Special considerations for small to medium-sized businesses**

As a smaller business, you will not want to develop detailed CAD expertise in-house at first. Don't let this delay your implementation. Consider contracting with your local reseller to provide regular coverage at your location until you build up company expertise.

Also consider the availability of already skilled personnel, perhaps at local universities or training centers.

### **Special considerations for your business**

What makes you unique? Remember, innovation and product development are key to your success. Don't hamper that part of your

business. If there are unique ways in which you calculate specifications or collaborate with suppliers, make sure you understand them and how the system will support them.

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## **5. Determine Technical Requirements**

Beyond the functional capabilities of your system, you should consider the impact of the product architecture and its technical underpinnings. If the product meets the functional needs but won't perform as expected or drives unnecessary inefficiency or cost, the overall implementation and benefits will be at risk.

As a start, we urge that you re-examine your existing authoring system, keeping in mind many of the requirements below.

### ***System architecture***

The system should be scalable (has the power to grow without changing systems) to meet both current and intermediate future needs. Scalability should include an understanding of your products (product complexity, design approach, number of components) as well as your design process (number of Engineering users, number of non-Engineering users, desired level of collaboration and partner involvement). The system allow for full associativity so that changes to one geometric form can update all other related files and documents. It should allow for seamless data interoperability with downstream applications that are driven from engineering data. Vendors usually support this via API's or an open data structure. Most important, since you will have significant intellectual property in the system, it must be reliable. The quality of the system design must be modern, web based, have a solid underlying data structure, and support service oriented architecture (SOA) and cloud computing in the future.

### ***Hardware and network requirements***

The hardware environment should provide for scalable architecture. Upgrading hardware should not require substantial, if any, downtime. Users should plan for a multi-site architecture that is immune to geographic specific interruptions. Ideally, multiple sites should each be individually capable of operating the entire operation, under short notice. This probably means automatic off-site backups, data redundancy, and network duplication

### ***Geometry creation and manipulation***

Geometry should be able to be easily created and modified; the geometry also should allow for all necessary information for manufacturing (such as tolerance information added to the model); productivity, usability, and reliability are of primary importance. Such creation and modification of product geometry must be productive, providing tools to the users that allow them to readily create the desired shapes and forms.

Top down design (aka creation of product structure and preliminary geometry layout) is essential.

Assembly creation and manipulation - even your largest desired assemblies should be able to be easily created and viewed with adequate performance. Important characteristics of assemblies include easy placement of parts, interference checking between parts, ability to create lightweight assemblies and envelopes of assemblies, the ability to manage various techniques for managing

multiple configuration options, the ability to facilitate teams working concurrently on different parts of the assembly and ease of creating and maintaining Bills of Materials.

Creating and maintaining engineering drawings - should be fully associative and easy to create and maintain from the 3D representation; they should meet the required drawing standards; allow full and complete annotations for production and allow markups.

### ***Manufacturing and tool design***

Should allow production-level NC (such as for milling and turning) toolpath generation; analysis of the manufacturing results from the model; toolpath generation as automatic as possible; support manufacturing engineering planning within the same model format; allow two way support for tolerance analysis. Should also allow all the required tooling to be designed and, if applicable, support mold design and analysis, and progressive dies.

### ***Digital prototyping***

Often confused with simulation, digital prototyping goes beyond simply creating product designs in 3D. It gives product development teams a way to assess the operation of moving parts, to determine whether or not the product will fail, and see how the various product components interact with subsystems—either pneumatic or electric. By simulating and validating the real-world performance of a product design digitally, manufacturers often can reduce the number of physical prototypes they need to create before a product can be manufactured, reducing the cost and time needed for physical prototyping. Many companies use Digital Prototyping in place of, or as a complement to, physical prototyping. (Cit: Wikipedia)

### ***Simulation and analysis***

Allows analysis from simple to complex FEA analysis, has automatic mesh generation via preprocessing, includes post processing for easy analysis of the results, and supports many types of analysis directly from the model. Should support maximum usage by design engineers before involving simulation experts. Should provide built-in linear analysis. System should also provide for integrated complex analysis modules from vendor or third parties.

### ***Extended or Third Party Applications***

System has a wide variety of native or integrated applications to extend system to fit user needs; applications of interest should seamlessly integrate with system; and ideally third party support should originate with system vendor. System vendor supports an open philosophy so third party applications can easily be added.

### ***Interfacing/communication***

Supports all required industry standards for translating product data between systems; supports Web-based viewing and model synchronization (assuring that you are working on the latest model); has tools for Internet based concurrent engineering; integrates and communicates with primary systems (CAD, CAM, PDM, CAE, ERP, SCM, CRM, MES, etc.)

### ***Product Data Management***

Installs easily as add-on if desired to improve on file based management; supports data vaulting and change control easily; allows for use of user-defined and standard attributes for finding and storing non-geometric data; maintains relationship among all CAD/CAM/CAE

files; allows storage or connection to non-CAD data. Provides critical support for collaboration, common libraries and design templates, engineering changes, workflow, and product re-use.

### ***Collaborative design***

Supports new product introduction, change management, concept development, detailed design, product validation, variant design, design collaboration, design outsourcing, component management, technical illustrations; provides engineering management control of processes.

### ***Graphics/display***

All models should be able to visualize the most complex models easily with excellent performance. Today, high resolution displays are the norm and users should plan on providing at least a display of 1920X1080 pixels for those creating models. Perhaps slightly smaller for casual users. Again, bigger and faster are better, with likely little increased cost.

### ***User interface***

Should be easy to learn; easy to remember; consistent across functions (at a minimum by user role); be customizable; have good help documentation and training tools; be obvious to use; and be productive. Ideally there should be external training tool suppliers.

### ***Search***

Search should be based on indexing and provide rapid results. This is particularly important for making maximum use of existing designs. Most existing searches use text such as for part names or part numbers, or some other textual descriptions saved with the part or assembly. Results that yield multiple results for geometry should display easy to browse thumbnail graphic images. Newer technologies are also being designed to search for similar geometry.

### ***Systems issues***

Excellent disaster recovery mechanisms; easy to install and customize; company hosted or externally hosted; internal resource requirements needed – administration, backups, software upgrades; software maintenance needed and cost of such; support provided by vendor. Migration to cloud technology is in its infancy. We are beginning to get a taste of what this may become in the future. But, it is a bit early to tell where this is going and what benefits it may bring. All leading vendors are likely to have their own leanings.

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## **6. Determine Integration Requirements**

### **Why the need?**

Your new system will not work in a vacuum. There are a number of special requirements that go beyond functional and technical specifications of the individual components. How will this system support tasks that cross applications, either within the solution itself, third party software, or into your PLM, ERP or manufacturing systems? No one system today supports every customer design need. Undoubtedly you will find third party software or hardware that will make your system unusually productive. The system you decide on should demonstrate its effectiveness. Look at the vendor conferences

for their variety of vendors; examine the variety of third party products applicable for your business and your product initiatives.

Today's product development processes involve both engineering and downstream departments. Does the design process fit in well with the overall project context? Is it possible to understand both the commercial considerations of product development (costing, sourcing) along with the technical aspects? If not, manual processes may be required to prevent a disjointed view of the product, or risk a purely engineering-centric development process without buy-in from downstream departments.

### ***Sample requirements***

Integration across the full product suite - Is the solution itself integrated? Are the different "modules" or functions in the system built on a common architecture or pre-integrated? Do they share a common data model and/or database? If not, additional work will be required to support product development by cross-functional teams.

Integration to enterprise applications - How will products be released to manufacturing? How will change orders be evaluated and executed? If you are using an ERP system, are you prepared to support manual integration or develop your own approach if the vendor does not provide it?

Increasingly products incorporate mechanical, electrical and software components. Thought must be given to transferring data from one to the other for 3D layouts as well as for full scale digital prototyping with all these components interacting with each other, See the Mechatronics discussion above.

These capabilities span both functional and technical considerations, and in today's environment must be called out for special attention.

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## **7. Evaluate Potential Vendor Partners**

Your software selection needs to consider more than the software. Consider the fact that you are not only selecting a software solution, but you are also selecting a business partner. Before you select a system, you need to understand your company. Some things that you should consider:

### ***Potential vendor considerations***

Vendor Strategy. This is not a short-term decision, and should be based not only on the software that the company has in place today, but also the future direction and strategy of the prospective vendor partner. Understand the company's philosophy towards supporting your business.

Industry Support. Does the vendor support your industry? For example, do they have many customers that are similar in nature to your company? If so, future enhancements will likely be beneficial to your company.

Vendor partnership approach. How does the vendor work with customers? Do you have a voice in the user community that will help influence product and company direction?

Support requirements. For example, if you are a global business you should ensure support is offered (directly or through a partner) in the

geographies you require. If you are a large business and can afford the risk of supporting the software yourself, then this may not be as big a concern. But for small to medium sized businesses, the support infrastructure of the vendor (and the vendor’s ecosystem of partners) can be critical.

Financial Requirements. Do you require financing? Are they willing to work within your budget? Are their licensing and maintenance terms flexible? Can network licensing reduce overall costs? Do they offer special enterprise licensing across geographies?

Vendor Ecosystem. Consider the company that your prospective vendor keeps. Examine the complementary software partners and consulting partners that are aligned with your prospective vendors.

Market Position. The software vendor’s revenue or growth should place it in a leading position; good reference sites should be available; the vendor should have regular and well-attended user-group meetings.

You may want to filter vendors early based on high level partnering requirements, regardless of their software. You should avoid the risk of your company “falling in love” with a system only to discover that the vendor can’t support your business.

**Other functions or categories of software related to CAD that should be considered**

Rapid prototyping

**Table of select vendors and their product development software offerings**

The following table lists a few of the leading CAD suppliers to the SMB industry and their primary products.

<b>Vendor</b>	<b>Primary Products</b>	<b>Related PDM system</b>	<b>URL</b>	<b>Company Revenue</b>
Autodesk	Inventor	Vault	<a href="http://www.autodesk.com">www.autodesk.com</a>	\$2 Billion+
Dassault Systemes	SolidWorks	Workgroup PDM Enterprise PDM	<a href="http://www.3ds.com">www.3ds.com</a>	€1.325 billion
Siemens PLM	Solid Edge	Teamcenter Express	<a href="http://www.siemens.com/plm">www.siemens.com/plm</a>	Unstated; \$1.2 Billion Est; Siemens \$115 Billion
PTC	Pro/ENGINEER	Windchill ProductPoint Windchill PDMLink	<a href="http://www.ptc.com">http://www.ptc.com</a>	\$1 Billion

Simulation or digital prototyping

*Third party software extends the vendor offerings, often from software suppliers with special expertise. Tight integration with the primary vendor software is especially useful.*

Design automation software  
Plastics mold design and analysis  
Sheet metal design  
Mechatronics (simulation of electrical and mechanical control systems)  
Sustainability evaluation software

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## 8. What a new system should include and cost

**It should include** the following short list of the major items that you should plan on for your new system:

- New or upgraded (or existing if you already have a fabulous CAD/CAM/CAE system) software for design, manufacturing, analysis, data management, and advanced specialty applications as needed.
- New or upgraded data management and collaboration software (PDM) including vaulting; advanced functions to automate and track the workflow for such processes as ECO's, product release and other items of workflow control; management reporting of product and programs status.
- A connection to existing or planned ERP (Enterprise Resource Planning) and MES (Manufacturing Execution) systems.
- Relevant third party software that augments and is fully integrated or interfaced with the CAD system under consideration.
- External Internet access to design and product data with sufficient security to protect your intellectual property (IP). Modern digital rights management systems (DRM) offer good control for data sent outside the secure PDM/PLM system.
- Training of users and support personnel.
- Customization of the new software or special programming.
- Conversion of existing design data—only if absolutely necessary or beneficial. Don't convert it all. Just what you need.
- New computer hardware. Get the biggest and fastest and the most expandable you can afford. The last thing you want is for your design department to be dependent on slow, unreliable hardware, especially considering that it is one of the smallest CAD related investments you will make.
- Rethinking of your processes and a probable reorganization. You will definitely need to rethink your information and product flows to take advantage of the system benefits. Consider evaluating your design process by taking advantage of lean design and special consultants familiar with your most vexing problems.
- Better communications (high speed network and Internet access).
- Server(s) to store collaborative product data with high availability and security. Cloud computing might be a possibility for this in the near future.
- A rethinking of your paper approval and engineering change procedures.

*Think "outside the box" to improve your processes.*

- As wide as possible access to the design and product data. Generally access should be planned for three types of personnel: data authors, approvers, and viewers. While authors of CAD type data will require specialized software, approvers and viewers should be able to use web-based software at much lower cost.
- External consulting for implementation and on-going improvements.

### ***It should cost ...***

We recommend that you update to the latest Microsoft Windows system, with the fastest hardware you can afford. Don't try to skimp here - for between \$2,000 and \$3,000 USD you can get an excellent workstation.

Unless there are unusual circumstances, most small-medium businesses can have their design requirements met by SMB (often also called mid-range or mainstream) CAD software, which generally costs between \$4,000 USD and \$8,000 USD per seat plus about 25% of the acquisition cost for annual software maintenance. Plan on equipping all persons who create or change design data with a seat. Lower cost alternatives are available but usually have limited functionality. In our opinion, these costs are so far below engineering personnel costs that it becomes unimportant compared to the expected benefits. *If this is not the case for your business, then you need to rethink the benefits.*

Limited analysis software may be available free for the most basic analysis (linear -stress). To simulate products more in-depth, you may want to consider advanced analysis software, able to dig deeper, which starts at about \$5,000 per seat. A few seats are generally enough.

Manufacturing software generally concerns itself with programming NC toolpaths for milling machines or lathes. Such software starts at \$5,000 for milling, somewhat less for turning. Don't forget to ask the software provider whether special postprocessors are required and what they might cost.

Product Data Management software (PDM) allows all approved persons access to the product data via collaboration. These costs vary widely and unless you have only one or two users and want to rely on standard file management software, you should plan on using the vendor's PDM software. *The ability to manage engineering data effectively, particularly as it changes, will be a critical underpinning of a modern architected system!* Costs should range from \$500 to \$2,500 per active user for the initial software cost plus annual maintenance.

Consulting and training from the vendor or reseller should be built into the anticipated costs. This will obviously vary depending on the number of people and their skill levels in your organization. Make sure you have allowed enough time and education to make the transition. Also, consider having a "leader" or highly skilled person for each functional area, to advise and assist others. Some vendors also offer "fast start" programs to get their systems operational quickly. These bundled approaches often include software, training, customization, and data conversion and are an excellent way to get started and up to speed quickly, thus realizing your ROI and the projected benefits faster. Don't be surprised to be spending upwards of \$100,000 for startup consulting and training.

You will have to also allow for lost time until your personnel are up to speed on the new system.

*You should plan on using the vendor's PDM software. The ability to manage in-process engineering data effectively as it changes during the design process, will be a critical underpinning of a modern CAD system! For post release control, consider interfacing to a PLM or ERP system*

## 9. Select a System and Vendor Partner

When you reach this stage, you should have decided upon the major opportunities available by improving your product innovation, product development, and engineering operations. You should have defined the primary goals and the critical business aspects that will be improved. You should also have an understanding of how to sequence the implementation. The system selected must be scalable for all stages of the implementation, both in regards to functionality as well as usage volume. It can be expanded, but its overall functionality and architecture should suffice for all stages. Pick a solution that you can live with for some time to come, the solution's capabilities and product roadmap must line up with your strategy, and ideally be a step or two ahead of your current needs.

### ***Extending your requirements by adding related benefits allows best vendor selection***

You now also know the requirements the system must meet, both management and technical. Now it is time to select a system to solve those issues. Here are the steps:

Confirm or refine the management, functional, technical, and integration requirements.

For each requirement, provide its related benefit. If you cannot determine a benefit then the requirement is not important enough. Delete it. This avoids being buried by a huge list of technical requirements with only minor importance. We suggest limiting the critical requirements to less than 20 in each of the four categories.

Prioritize the requirements, management and technical, using benefits to prioritize the requirements. Lacking detailed benefits for each requirement, you might also consider prioritizing the requirements by grouping them into 4 groups categorized as: must have, important, like to have, could live without.

Allocate the budget.

*Don't forget the need to provide a benefit for each requirement.*

### ***With expected benefits and budget allocated, it's time to select a vendor***

Solicit detailed proposals from a few vendors (maximum of 3). Remember that you are not only selecting a software solution, but you are also selecting a business partner. As stated before, you may want to filter vendors early based on high level partnering requirements, regardless of their software. For example, if you are a global business you should ensure support is offered (directly or through a partner) in the geographies you require. If you are a large business and can afford the risk of supporting the software yourself, then this may not be as big a concern. But for small to medium sized businesses, the support infrastructure of the vendor (and the vendor's ecosystem of partners) can be critical. You may want to avoid the risk of your company "falling in love" with a system only to discover that the vendor can't support your business.

Test that the proposed systems meet the functional, technical, and integration requirements through operational tests and piloting.

Test that the proposed system passing the functional requirements meets the technical requirements. Consider using either one or more of

the following techniques: a benchmark, a paper analysis, or installing trial systems in-house with a properly trained internal person aided by a vendor support person. You might instead consider “loaning” a system and using vendor supplied on-line training augmented by local support. The latter is a good way to evaluate what post installation support might be like. Keep in mind, however, that users trained on a particular system tend to become zealots for that system.

Evaluate the ability to meet the requirements.

Select the winner.

### ***Special hints***

Suggested technical requirements are highly dependent on your industry and where your company fits in the value chain. How your company weights the technical requirements will prove to be critical in the selection. Don't forget the need to provide a benefit for each requirement. Certain departments will have different priorities for the same item. You will need to allow for this.

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## **10. Implement and Monitor the Strategy**

Even the best selection process in the world will prove useless if the system is not properly implemented. Critical to a successful implementation are developing a strategic implementation plan and allocating the proper people, time, and budget.

### ***Bits of wisdom to help during implementation***

While implementation is beyond the scope of this paper, we offer a few pieces of wisdom:

- Assemble a cross-functional implementation team, with representation from inside and outside of Engineering
- Choose the best talent to drive the team.
- Review the strategic goals and associated benefits of the CAD with the team members frequently, especially for multi-year plans.
- Be careful when reviewing vendor proposals and demos. Make sure you evaluate vendor responses without the vendors there and evaluate according to how well they meet the technical and functional specifications. Don't overly complicate the evaluation. Record a rating for each criteria and why you gave it the grade you did. Develop a team consensus. Contact TechniCom if you need help with this.
- View the implementation as a program. Divide the implementation into a few (three or four) manageable steps, each with a defined, measurable benefit, but that provide a tangible step towards the to-be product development vision.
- Allocate the proper resources and budget to accomplish each phase.
- Appoint a specific executive with responsibility for each phase.
- Prepare a reasonable work plan, with planned contingency for risk
- Provide the proper conceptual, business process, and software training for the users

*Following these bits of wisdom  
may keep you out of longer term  
trouble.*

*A lack of continuing metrics and  
monitoring causes many a well  
intentioned system to fail!*

- Monitor and measure the results based on PLM project goals.
- Be mindful of slippages and address the reasons rapidly
- Always be ready to re-assess your progress --**don't forget** that after the goals are known and eventually the engineering tools (CAD, CAM, analysis, and PDM among others) are selected and installed, the metrics must be continually monitored to assure that management objectives are being met, and to take corrective action if not.

### ***How to get more help***

For small to medium businesses, the implementation can be even more challenging. You likely don't have resources dedicated to process improvement or a "center of excellence" where you investigate and experiment with new processes and tools. At this critical point, you need to make the hard decision to make the right resources available. Look to the evaluation team as a guide, hopefully these people were not the people that every department could spare. They were respected leaders of the business from different functional areas. **As you begin your re-engineering of the engineering department journey, recognize that the implementation team has the future of the business in their hands, and don't under invest in talent.**

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## **About the Author**

### **Raymond Kurland**

Raymond Kurland is president of TechniCom Group LLC and its principal consultant and editor. His firm, founded in 1989, specializes in analyzing MCAD and PLM systems and has been involved in reviewing and comparing such software since 1987. Ray frequently consults with both vendors and users. Ray has degrees in Engineering from Rutgers University and from NYU. His career included stints with Bell Telephone Laboratories, IBM, and Dassault Systemes. Ray can be reached at [rayk@technicom.com](mailto:rayk@technicom.com).

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## **Appendix: A sample objective scoring method**

We propose that you use an objective scoring methodology that allows measuring the extent to which each proposed system can meet your company's requirements, enabling you to objectively distinguish between competing systems. Our experience proves that this method can eliminate many of the subjective valuations often used, avoiding nasty surprises in the implementation process.

A matrix scoring methodology, if used with the proper weightings for your company needs, can be highly effective. It is often desirable to add, for each requirement, its priority (weight), and vendor compliance (we suggest using a scale of 0 to 10, with 10 being perfectly meets the requirement and 0 being totally non-compliant). If you are having trouble objectively entering the weights, consider using outside resources. Weighting these requirements will depend upon your

industry and where your company fits in that industry value chain. For example, a company producing automotive dies will have different requirements than will a company producing automotive engines, even though they are in the same industry. Likewise, a company producing low cost consumer products will be far different than a company

producing high cost white goods such as refrigerators.

***How to score vendor compliance with requirements***

As stated before, to evaluate compliance score, consider using either one or more of the following techniques: a benchmark, a paper analysis, or installing trial systems in-house with a properly trained internal person aided by a vendor support person. You might

<b>Management Requirements</b>	<b>Importance (Weight) (0-100)</b>	<b>Vendor Compliance (0-10)</b>	<b>Score (Wt*comp)</b>
Requirement A			
Requirement B			
Requirement C			
...			
Total Management Score			
<b>Technical Requirements</b>	<b>Importance (Weight) (0-100)</b>	<b>Vendor Compliance (0-10)</b>	<b>Score (Wt*comp)</b>
Requirement A			
Requirement B			
Requirement C			
...			
Total Technical Score			

also consider "loaning" a system and using vendor supplied on-line training augmented by local support. The latter is a good way to evaluate what post installation support might be like. **Keep in mind, however, that users trained on a particular system tend to become zealots for that system.**

Use as many requirements as necessary. Ensure that the importance weighting numbers in the importance column total to 100. Compliance score reflects how close the tested system comes to compliance for each requirement with a weight. If desired, management and technical requirements can be combined.

We welcome all advice and comments about these techniques. Feel free to write the author at: rayk@technicom.com.

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***For more information about PTC and its offerings to small and medium sized businesses contact the company via its website at <http://www.PTC.com/go/smb>***