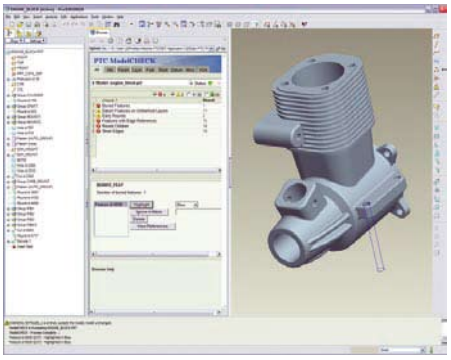
Design Reuse:

The Key to Building Better Products Faster

Design reuse has come a long way from the days of searching for part numbers and recording data in paper notebooks. Today's methods are far easier and much more efficient – adding needed speed to the entire product development process.

Regardless of industry, geography, or size, every product development company – and pretty much every design engineer – can benefit from design reuse. By using the design of an existing part or assembly as a starting point for a newer part or assembly, you can save time while reducing the risk of making fundamental design errors.

Design reuse can also help you, the design engineer, to improve the overall quality of an evolving design by leveraging the expertise and engineering value that was invested into the original design. a complex digital infrastructure. No doubt, as CAD has matured, so have the technologies, such as Internet-based networking, that support product development collaboration. Yet, collaboration can still be a significant challenge for any product development company, regardless of size.



During design preparation, the ModelCHECK capability of Pro/ENGINEER verifies that the design is built to specification and informs you of errors, warnings, or other pertinent information.

The Problem: Optimizing Design Reuse

Challenges of Design Reuse

At its most basic level, design reuse works 'opportunistically'. That is, you're assigned a new job, and you may recall that the part you'll be designing is similar to a part that already exists. You start by finding the existing part – perhaps by searching your CAD database by part number – and then you go from there. With your new design underway, you probably keep a notebook of corresponding contextual information for your new part or assembly. You might record information such as: temperature ranges within which it will operate; results of vibration analysis; sizes and types of bolts or other connectors; and other pertinent information.

A year later, when your organization is adding a new product to that particular line, it's up to another designer to remember your part, search on its part number, retrieve it – along with any additional documentation you might have scanned from your notebook-and then go to work on the next version. And, that new designer will probably ask for your accompanying notes.

Search Limitations

Back in the previous century, searching by part number and scanning paper documentation was close to state-of-the-art for design reuse. Today, it's anything but. The fact is, the time you must spend searching and scanning deprives you of product design excellence for a number of reasons.

First of all, searching from memory or by part number is a hit-or-miss proposition. You may or may not find a usable part file, depending on the quality of your CAD database. As well, you may not find the best variation for your purposes; the only way to do that is to search all relevant part numbers and then try to determine the one that is optimum for your purposes. If you're designing a part for use in a jet airliner, for instance, you'd want a part that handles vibration, heat, and other conditions especially well - but you might be hard-pressed to find out which part satisfies these criteria.

Although the part that you do eventually find may be the most recently produced, it may not be the best part to use. There could be a half-dozen ECOs associated with that part - changes that the parts database doesn't know about. True, you might be better off starting with a previous part design-but you won't know that unless you're lucky enough to find out about the ECOs either by word of mouth or by searching an ECO (or field-service) database.

Non-Digital Documentation

"Mid-sized companies need to rethink their plans for design reuse...Taking into account how a model can be later reused during the product development process results in a model that has flexibility built in."

Sector Insight, October 2007
Aberdeen Group

Even today, with the simplicity and ubiquity of engineering calculation software, many small and medium-size companies still rely on handwritten documentation - scanned into the CAD database along with the model - to describe the design intent and functional properties of part and assembly models. This method can cause problems in several areas.

Compared to digital data storage, manual data entry can waste time and invite inaccuracy. Handwritten notes are often difficult to read. As well, the new designer might want to substitute different values, say for vibration tolerance. Now it's up to you to read the results of the original designer's revised calculations. With digital storage, messy handwriting isn't an issue, and recalculating values is automatic and error-free.

Beyond these issues, non-digital storage means that no matter what functional information accompanies the part model, it cannot be used to help search electronically for the model; in other words, it can't be turned into a category that's visible to the search engine. By contrast, digital storage enables the new designer to search on a variety of functional parameters - from temperature ranges to usage context (e.g., supercharged engines only) - and thus he/she has a better chance of finding the best part or assembly to use as the starting point for the new design.

The Solution: Building a Reuse Library of Metadata

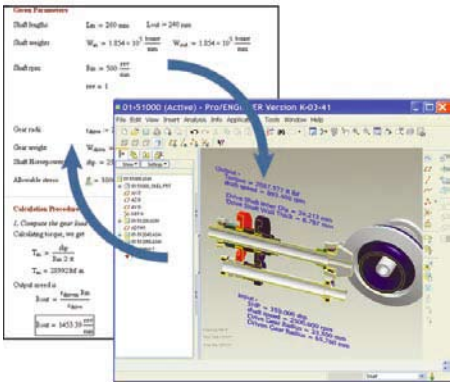
'Opportunistic' design reuse will always play a part in product development, but today's best practice strategies are more about planning ahead by creating categories and indexes to build up a library, and then putting search tools in place to automate information retrieval. To build the library, it's important to practice solid 'hygiene' by standardizing on names and labels wherever possible, and by creating search categories that can facilitate searches based on functional attributes as well as geometry features.

Functional attributes will come from digital documentation that's embedded into and associated with part models. This information can include everything from recommended bolt and thread sizes for interconnections, to test and analysis results, to manufacturing and assembly instructions, to notes about design intent and expected usage environments. Additionally, part metadata may be the basis for performing attribute searches.

From a higher-level point of view, the reuse library will typically be fed by data that comes from product development processes, such as detail design, product validation, and change management. Detail design will produce information on geometry decisions, design intent, and usage expectations; product validation creates data on simulation and testing; and change management creates info on ECOs, instructions for fixing problems, and so on.

With the data in place, you can then create categories for the search engines. The categorization process will be continuous. Plus, it will take into account your business's evolving needs and objectives, and it will let you continually fine-tune your categories to be more closely aligned with your own product development strategies.

Vendor Perspective:
Data Reuse Using Pro/ENGINEER® and Windchill®



PTC's Pro/ENGINEER 3D CAD (computer-aided design) software supports design reuse in a number of ways because it captures geometric information and keeps it with the model for the entire life of the part or assembly. Pro/ENGINEER also simplifies the capture of text and numerical data–that is, the information you write in your notebook–through either Microsoft® Excel® or PTC's Mathcad® software (for recording and sharing engineering calculations).

As information is being captured, Pro/ENGINEER lets you determine which parts of an assembly might be good candidates for reuse, and then helps you create a family table for each of those parts. For instance, lets say an assembly contains a number of different-size cylinders.

You would create a family table for the basic cylinder model, and then use that table as the basis for all the cylinders in the assembly. This saves time over having to reinvent the wheel, so to speak, when designing all of the cylinders. Plus, the family table makes it simple for another designer to find and modify that part for reuse. The table also encourages naming and organizing of parts hierarchies, so they fit comfortably within the company's parts library.

For search automation, you'll want to use tools that can search CAD files as well as PLM (product lifecycle management) databases. For users of Pro/ENGINEER, there is an included search tool called ModelCHECK™ which makes it easy to search for similarly shaped CAD data. Also, ModelCHECK canbe invoked during design preparation to check the completeness and robustness of your part metadata associated with the part you've chosen for reuse. To do this, ModelCHECK verifies that all necessary parameters are defined; it then checks to see if any company-standard modeling notes are missing; and it lets you request reports on the part and its geometry, and informs you of errors, warnings, or other pertinent information.

For enterprise-level searching, PTC users can employ select Windchill capabilities. For example, Windchill ESI provides a turnkey integration with ERP solutions such as SAP, and Windchill Info*Engine allows for integration of Windchill and other enterprise systems for accessing information such as part cost of inventory levels.

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