



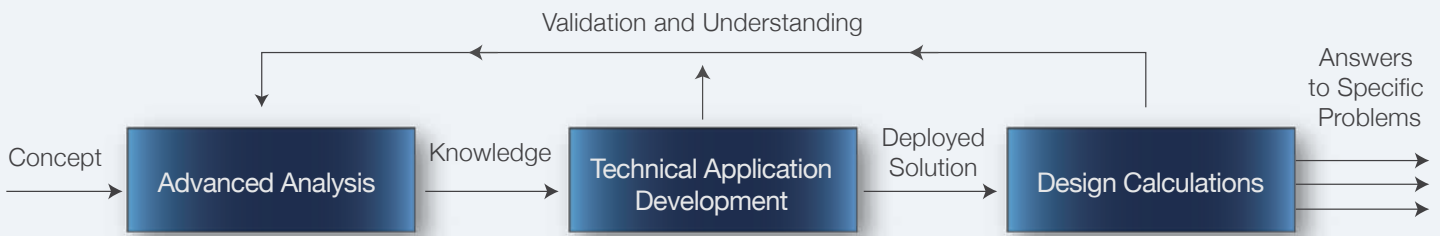
# From Concept to Deployment:

Preserve Knowledge, Manage Innovation, Accelerate Solution Development

We at Maplesoft™ have learned a lot in our 25 years of operation as a developer of technical problem-solving tools. During that time, we have seen such tools dramatically change the way technical organizations advance their knowledge and turn that knowledge into commercially-profitable innovations. It is arguable that many products and technologies that weren't even thought of 25 years ago, which today are taken for granted, would not have seen the light of day without tools like Maple™.

As part of a study to understand just what effect Maple has had over the last 25 years, we surveyed our client base about their use of Maple. Our customers include a wide range of organizations, such as engineering companies, scientific research laboratories, developers of space and defense systems, manufacturers of electronic devices, financial institutions – all organizations that require mathematics to solve problems critical to their business. While the variety of applications was staggering, and ranged in complexity from relatively simple to highly advanced, one major observation emerged clearly from the data. We were able to characterize the way in which mathematics is being utilized – who is using it, what for, and how – within any technical organization.





## Mathematics Use in Technical Organizations

Established research labs, tech start-ups, financial institutions, manufacturers - no matter the company, mathematics usage in technical organizations can be put into three broad categories: advanced analysis, application development, and design calculations.

### Advanced Analysis

The “Advanced Analyst”, a term we use to cover such roles as research scientist, scientific investigator, physicist, etc., is charged with investigating advanced phenomena that require the understanding and application of mathematical principles to develop a theoretical solution. The Advanced Analyst typically has a Ph.D. and is tasked with first defining the basic mathematical relationships involved in the problem, then combining them in an appropriate way by applying complex mathematical techniques to arrive at a solution.

Advanced Analysts have been the traditional users of tools like Maple and some of its greatest fans. Through the powerful symbolic computational techniques embodied in the Maple environment, the full-featured programming language and intuitive user interface, the Advanced Analyst has been able to perform in a matter of hours the types of investigations that would have taken weeks, or even months, using pen and paper. In fact, since pen and paper was the only alternative before software like Maple was developed, Maple enabled these Advanced Analysts to solve problems they never would have even attempted to do without it.

Furthermore, prior to the existence of Maple, the knowledge acquired through this work would have been captured in a technical paper. More than likely, it would have been consigned to the organization’s technical library, where it would have gathered dust until someone had the need - and the energy - to search out the paper, digest the information contained in it, and then turn it

into something useful - presumably in the form of (at that time) a Fortran program.

With the advent of Maple, that knowledge became immediately useable and useful. One only has to search for “Maple”, together with a description of almost any technical problem, and it quickly becomes apparent that work in Maple to help solve that problem has already been published. Maple users all over the world regularly share their solutions with the entire community. This is an immense benefit for our clients and a great source of pride for us.

This means that, instead of languishing in a technical library, the knowledge developed by the Advanced Analyst is instantly usable by people elsewhere in the organization. In particular, it is now available to those responsible for developing technical applications.

### Technical Application Development

The “Solution Developer” has historically been someone with an interesting mix of domain knowledge and the ability to write a computer program that solves commonly-encountered technical problems. Twenty five years ago, this would have been the young, newly-qualified engineer who had some computer-programming skills, a pile of technical papers and a copy of *Numerical Recipes*.

Over time, technical solution development tools have evolved from Fortran and QuickBASIC programs to more application-

specific tools like MATLAB®, Octave, S-plus, and PV-WAVE®. Over the last few years, it has been gratifying to discover how many of our larger clients have chosen to use Maple to apply the work of the Advanced Analyst, giving their Solution Developers a way to encapsulate that knowledge and apply it directly by creating valuable software solutions. These solutions can be anything from optimized code that will be embedded in another software program to a point-and-click end user application that allows non-technical people to select some options and get a result.

Over this same time period, the feedback from our clients has evolved beyond “Maple is great! I can use it to develop my ideas into a solution mathematically... and then I implement it in MATLAB®/ Octave/S-Plus...” Now, our clients are saying “Once I have derived my solution, I can simply develop the numerical routines and user interface to deliver a solution for use by others, without leaving the Maple environment.”

This is particularly rewarding to hear because this is exactly what we set out to do. We want Maple to be the tool that captures the knowledge developed by the Advanced Analyst, with all the rigor that entails. At the same time, we want to provide a rich environment that enables the Solution Developer to deliver that knowledge in a readily-usable form and still maintain the connection back to the original work in a natural and traceable way. Anyone who has been asked to take over the maintenance of an in-house solution developed using more “traditional” methods, such as an Excel® spreadsheet, will immediately understand what an advantage this would be! The opaqueness of solutions like Excel becomes a serious problem when it comes to making changes or even understanding the assumptions that went into the solution in the first place.



## Concept to Deployment with Maple

Maple provides a complete, rapid solution development environment for thousands of technical organizations.



### Advanced Analysis

- Intuitive problem entry
- Powerful symbolics
- Advanced numerics
- Data import/export and plotting
- Rich environment for technical documentation

### Technical Application Development

- Powerful, flexible language
- Parallel computation
- Advanced code development tools
- Built-in numeric algorithms (for example, signal processing and optimization)
- Data import/export and plotting
- Connectivity with other tools (for example, CAD)
- Code generation for use in other applications
- User interface development tools

### Design Calculations

End users can access easy-to-use solutions via:

- The free Maple Player
- Online through a MapleNet web server
- Maple

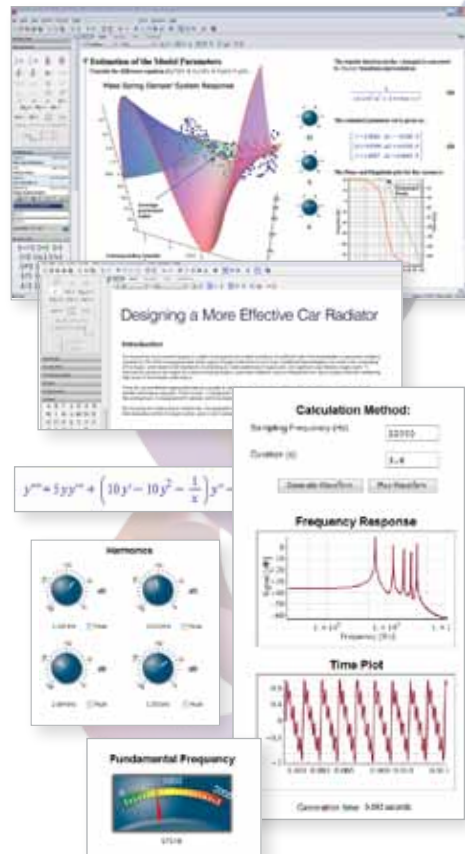
These deployed solutions provide:

- Intuitive user interface – no knowledge of Maple required
- Easy entry of equations and data
- Meaningful presentation of results
- Illuminating visualizations
- Print-ready documents

Once the solution has been successfully developed and tested, it can then be deployed in user-friendly forms to end users.

### Design Calculations

The “End User” is typically someone whose primary role is not to do math at all. This could mean a designer who needs to determine the specification of a component, an engineer who needs to confirm the required thickness of a pipe wall, or an insurance sales person who needs to assess the risk and cost of a policy for a customer. Typically, all they want to do is access the solution developed in the stages described above, plug in some numbers, perhaps choose some options, and use the calculated result to make a decision. Depending on the application, the tool they use could be something like a programmed solution, a Mathcad® worksheet, an Excel spreadsheet, or a web-based tool. When Maple is used, the application can be deployed over the web using MapleNet™, through Maple, or through the free Maple Player™ which allows non-Maple users to view Maple documents.



## Knowledge is a Corporate Asset

Large or small companies, simple or complex solutions – the use of mathematics in technical organizations follows the same basic pattern everywhere. Knowing this, tool developers such as Maplesoft can focus their efforts to support each of three use cases: advanced analysis, application development, and design calculations, ensuring they meet the diverse needs of each type of user.

In addition, consumers of technical software should keep these stages in mind when selecting their tools in order to make the best choices for their entire organization. By treating the knowledge gained through research as a corporate asset that needs to be carefully managed and by developing an awareness of how that asset is used throughout the organization, companies can preserve knowledge, manage innovation, and accelerate solution development.

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