Implementing Generative Design for AEC

So you're eager to accelerate your architectural design processes with a new technology, but you don't know where to start? Before you decide to tackle this project, consider the factors that may increase—or decrease—the complexity of implementing generative design.

How to Get Started with Generative Design

Generative design has made its way into AEC software and you can see the benefits right out of your reach. Find out how you can get your design firm bought into using this technology.

AEC software is undergoing a time of powerful transition. Architects are pushing the boundaries of design using a new technology called generative design (GD), which uses artificial intelligence (AI) to explore thousands of design possibilities in the time a human being can explore one. For firms striving to compete more effectively, this capability offers a path to creating better designs faster — but adopting any new technology poses challenges that can seem overwhelming.

To make those challenges less daunting, begin by considering the implementation fundamentals — your goals, project approval, training, and hardware — to get a clearer idea of how you can start using GD in your firm.

Start with the End in Sight

Ensure that you're building your project on a realistic foundation by defining, as specifically as possible, what benefits you expect to achieve from implementing GD. Ask yourself how GD might affect different components of your business: clients, competitors, areas of specialization, etc. For example, will implementing GD affect how much work you can handle, enable you take on a new type of client, or give you an advantage over competitors who aren't using the technology? Wherever possible, try to attach numerical estimates to these answers — percentages, hours, and dollars will be much more useful than "more" or "a lot" when it comes time to discuss this investment with management.

Gain Approval with Inclusion and Education

Getting buy-in from all stakeholders is key to a successful introduction of GD, as it is for any new disruptive technology. End users should feel that their needs and interests have been taken into consideration. Senior management needs to understand the value proposition. Taking the time to quantify how much time can be saved performing specific key tasks with the help of GD, can go a long way toward gaining the support of all involved. Read *How to Ask for Tech Funding* for more on how to gain management's support.

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Keep in mind that in addition to gaining approval from decision makers within your company to implement new software, hardware, and workflows, you may also need to get another kind of approval — from your clients. Those who are not used to seeing the organic shapes and patterns sometimes created by GD may need some education as to why they look the way they do. Reach out to your clients to explain how the new technology can yield more optimal designs, more quickly than ever before — making your firm the ideal partner to help them achieve their project goals.

Get Up to Speed with GD

Once you have buy-in from all the groups in your firm that will be affected, turn your attention to determining training needs.

There are multiple GD solutions on the market, but before you buy one, take a close look at your existing software. Your firm likely already uses Autodesk Revit, Bentley MicroStation, or McNeel & Associates Rhino and Grasshopper — which are the best-known software applications that have GD capabilities.

If you have no hard deadline for implementation, users who are already skilled on the general use of the software can explore the GD capabilities and gradually become familiar with how they work. In contrast, if your team is seeking to implement GD into production workflows as soon as possible, the most expedient option is to undergo training specific to GD capabilities; your software vendor can advise you about training options. There are online courses, both free and as part of a larger license or subscription. Generally these are offered on-demand. The Autodesk ecosystem in particular offers classes from resellers, from companies that specialize in training, and from their regional and global conferences. No matter which platform you use, YouTube is also a great source for ad hoc training.

Firms new to GD often start with small projects, such as a visible partition or an office floor plan. The experience will pave the way for eventually integrating GD into all parts of the project. Using GD tools on a small portion of a larger project does not break the BIM workflow.

Evaluate Hardware and Explore Options

GD and the other new software and data forms driving AEC innovation may enable dramatic results, but they also place intense performance demands on co s. Desktop computers

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Where to Begin?

Use YouTube to get started quickly. Here are just a few to jumpstart your GD knowledge base.

Use Autodesk Revit 2021: Generative Design.

Autodesk Dynamo:
Dynamo from BIM Automation to Generative Design – Part 1 of 4.

Bentley OpenBuildings: OpenBuildings GenerativeComponents Tutorial Series | Introduction – Interface and Basic Knowledge.

McNeel & Associates Grasshopper: Generative design with Grasshopper in BricsCAD BIM l BricsCAD Webinar

McNeel & Associates Grasshopper: Generative Design in Grasshopper – Part 1, Parametric model and analysis.

McNeel &Associates Rhino: Generative Design in Rhino 3d (+Rhino Inside).

purchased for drafting may not be suitable for these new technologies. GD recalculates algorithms hundreds of thousands of times; how fast they run depends on computer performance.

Make sure your workstation can handle the increased computational workload of GD technology. A computer that has hit its limit and works, but with long delays, creates a workflow bottleneck. Initial use of GD on small projects will also help your team discern if any computers in the firm need to be upgraded. The bottom line is that if a computer's performance is sluggish when running GD software, it should be upgraded or replaced. Read *The Right Technology Solution for Generative Design* for more on your technology needs.

The Next Steps

Innovation is a journey as much as it is a decision. Taking advantage of generative design is no different. With a plan in place – including upgraded workstations as needed – you can turn enthusiasm for a new disruptive technology into a practical workflow improvement. ◆

Recommended Rig for Generative Design

To carry out GD tasks using such tools as Rhino Grasshopper, Project Refinery, and Generative Design for Revit, Z by HP recommends the:

Z4 Desktop with   — or —   **ZBook Studio with**

- Intel® Core™ i9 processor with 12 cores
- NVIDIA® Quadro RTX 4000 graphics
- 1TB NVMe storage
- up to 64GB of memory

Click here for more on Z4 Desktop.

- Intel® Core™ i7 processor with 6 cores
- NVIDIA® Quadro RTX 3000 graphics
- 1TB NVMe storage
- up to 32GB of memory

Click here for more on ZBook Studio.

The Right Technology Solution for Generative Design

Follow our quick software and hardware checklists to help ensure your generative design solution package is up to the task.

❶ Select Software

Most leading AEC software vendors offer generative design (GD) in some form. Some are integrated, but most are an add-on module that you will need to invest in or access. Those packages that offer GD technologies include, but are not limited to:

- Autodesk Revit with Generative Design (for subscribers of AEC Collection with Revit 2021
- Autodesk Dynamo for Revit (for single-product subscribers of Revit 2021)
- Bentley Systems MicroStation OpenBuildings with GenerativeComponents
- McNeel & Associates Rhino with Grasshopper
- Nemetschek Vectorworks with Marionette
- Nemetschek Graphisoft

If your software is not listed above, contact the company to see if there is a GD add-on from your vendor before investing in a separate product.

Note: The output of a GD module is CAD data that can be read by your CAD application; therefore, not every person in the organization will need the add-on — only those who are actively engaged in generative design.

❷ Determine Hardware Requirements

Generative design software places intense performance demands on computers, similar to BIM and 3D design needs. How fast it runs depends on computer capabilities. Recommended specifications include:

- 64-bit, 6- to 12-core processor running a minimum of 2.6GHz
- 32- or 64GB of RAM (larger for more complex projects)
- 512GB–2TB NVMe storage
- Mid- to high-end graphics card certified by your hardware vendor.

For best performance, make sure you check what your package requires and make sure you purchase independent software vendor (ISV) certified hardware. ISV certification guarantees that the hardware you use has been optimized to work with your software and is only available from workstation-class computers.

❸ Plan for Deployment

Timing is everything. Be sure to schedule and budget for training to coincide with technology deployment.

Software training

- Staff using GD need between a half of a day and 2 days of training, depending on their current knowledge of the programs.

Hardware upgrades

- Have you secured funding? (Read *How to Ask for Tech Funding*.)
- Will you upgrade all staff at once or plan a phased installation?
- Is the budget assigned for a specific point in time, or allocated over months or quarters?
- Is IT ready to support any required hardware upgrade with adequate server and bandwidth resources?

Why Choose Z by HP?

Z by HP offers high-performance desktops and laptops designed for the work you do. We have a team of engineers and technical experts dedicated to customizing our products for what you do.

ISV Certification

We work with major AEC software vendors to test and certify our Z devices for a seamless software experience, right out of the box.

Customized Configurations

We run our devices through actual AEC workflows, and then adjust the component mix until we find the configurations that deliver outstanding performance. For detailed spec recommendations, check out our Product Finder Tool.

Optimized System Performance

Every Z desktop and laptop come with our proprietary tool—HP Performance Advisor—that fine-tunes your PC settings with an intuitive software wizard.

Optimized Graphics Performance

We work closely with graphics card vendors to certify and deliver a wide range of the latest professional GPU-based solutions — giving our customers outstanding performance on graphics-heavy workloads. ◆

Z by HP offers high-performance desktops and laptops designed for AEC.

How to Ask for Tech Funding?

Secure funding for your hardware upgrade.

Time has passed and now your hardware is lagging during day-to-day design use. You're ready to implement new technology but you need a more powerful system to run it. Finding a reason to invest in new technology is easy, but conveying the value of these investments to your superiors is more difficult.

Follow these tips — including how to translate time savings into financial terms and speak the right "language" to reach upper management — to help you get the backing you need for any implementation project.

Writing a Good Proposal = Getting the Money!

Keeping up with the demands of a quickly evolving industry is a never-ending task — AEC firms must periodically upgrade their capabilities if they want to stay competitive. This includes the workstations required for more powerful and feature-rich applications.

Problem Statement. No matter what your needs are for funding, you must start with a strong problem statement with a list of goals. This explains what the issue is that your company needs to solve and why. Good problem statements include answers to: who, what, when, where, and why. Getting the details down to these basics gives management a full picture of your proposal. It also helps define really what you're asking for.

Your problem statement can include issues such as reduced productivity due to lagging technology. Where are you losing productivity? Can you quantify it? Perhaps you need more data storage to accommodate growing project files; or you're equipping your client liaisons with virtual reality setups for a more immersive visualization experience; or your design team needs more powerful processors and graphics to take advantage of new generative design (GD) workflows.

Does the annual savings in future years pay well enough to justify the up-front investment? Don't limit your analysis to looking at just one year!

Include in your proposal why implementation would speed or benefit your workflow and in turn benefit your firm, plus consider what components are required and who would be involved. Next, put yourself in senior management's position for a moment and think about the terms that make sense to them and what they need to make an educated decision.

Return on Investment. The most persuasive tool at your disposal in this discussion is an estimated return on investment (ROI) — a prediction of how much financial benefit the company can expect to realize from money invested in implementation of new technology. That investment may include software, hardware, and training. The savings or revenue generated by using the new technology — thanks to more efficient workflows or increased workload capacity, for example — must exceed the total costs of implementing the upgrade if you want senior management to say, "Yes!"

If new technology won't increase efficiency and save money, then why bother? If the results aren't favorable, you must have an exceptional reason to pursue the project further. The numbers must make sense for your particular situation.

How to calculate ROI. To express ROI in equation form, we could say this:

$$\text{ROI} = \frac{\text{Savings} - \text{Costs}}{\text{Costs}} \times 100\%$$

Looking at the equation, you see that: Savings must be greater than the investment costs in order to achieve a positive return.

Like many new investments, the ROI may be negative in the first year as initial investment, training, and ramp-up time are factored in. The question then becomes: Does the annual savings in future years pay well enough to justify the up-front investment? Don't limit your analysis to looking at just one year! See our sample proposal on the next page.

Time and training. Timing for upgrades can be tricky. Be sure to plan to implement at a time when your team is not under a big deadline. If you want your boss to okay such a project, it must be rolled out in relation to the company's needs as well.

Set aside a day or two for training once IT has installed both software and hardware. If you need to plan a phased installation, start with your expert users first. They will be technology advocates when it's time to bring the whole team along. Plus, they can help iron out the kinks as they learn.

Sample Proposal

A&B Specialty Interiors
Proposal for Upgrading to Generative Design

Problem Statement, goals, who is impacted:
A&B Specialty Interiors is not keeping up with its competitors with options of product design. Implementing a GD tool with new workstations for all designers would help us:

- speed our design and workflow
- create exciting new designs for tables, fixtures, and finishes for our projects
- realize optimal shapes that can also lead to reduced material and shipping costs.

Investigating ROI:
Implementing technlgy will require user training and ramp-up time, as well as hardware and software updates for our marble milling machine interface so it can accept data from the GD output tool.

COSTS (INVESTMENTS)*	SAVINGS*
Software: $2,200/year	$5,500/year in raw materials
Hardware: $4,000/designer	$4,000/year in shipping
Training: $750 for a two-day course	
Productivity decrease (ramp up time): ~$1,100/designer (includes 16 hr training, 2 weeks at 25% lower productivity at $55 per hour)	
YEAR 1 COSTS: $8,050/designer	**ANNUAL SAVINGS: $9,500**
FUTURE YEAR COSTS: $2,200/designer	

Here's where the story gets interesting. In Year 1, the ROI is somewhat positive at about 18%. But then, in subsequent years, the savings explodes to 332%, making it impossible NOT to upgrade.

— **Year 1 ROI = ($9,500 - $8,050) * 100% / $8,050 = 18%**

— **Year 2–N ROI = ($9,500 - $2,200) * 100% / $2,200 = 332%**

*All numbers are estimates. Use information specific to your own company to manage expectations.

Delivering the Pitch

Once you have developed your proposal and set a meeting, it's time to deliver your pitch.

- To educate your boss about what a hardware upgrade can do for your company's workflows, you must communicate it in clear layman's terms. If you're a CAD manager or power user, you likely have a lot of jargon and technical terms in your vocabulary — now is the time to filter those out.

- Your audience has many other concerns on their agenda, so condense and keep your proposal concise! Simplify and clarify everything as much as you can, while still being thorough.

- Explain benefits in terms of efficiency and hours saved, not technical details.

- Provide a specific example or two, mentioning the impact that using the new technology could have made on a recent high-profile project, for example.

Turning No into Yes

What happens if management says no? If management turns down the department-wide rollout you've pushed for, you may be able to get approval for a smaller-scale implementation instead. Be ready with a few more examples. If you can get even one user outfitted with the new technology and the hardware to run it, that person can experiment with the impact of the technology on your firm's types of projects and document their experiences. If the results are favorable, that hands-on reporting might persuade your superiors in a way that no marketing brochure can.

Be sure to keep asking open-ended questions. "Tell me more," "What are you concerned about?" and "Are you concerned about the up-front costs or the time needed to train?"

Address each objection in turn, such as, "I understand we have a tight schedule. I believe that we can address that concern because if we take a day to train, we will end up saving time over the next month." If you address the concerns at the source, you are more likely to receive funding and support for your initiative.

Given company's budget cycles, you may need to wait a bit longer to receive funding, but keep your ideas in front of management so that your project gets a line-item on the next cycle. Keep talking about it with your users and management alike, so everyone keeps abreast of the technology as it develops. ◆

Z by HP equips AEC professionals with the powerful tools they need to fuel their creative evolution.

Find out more at hp.com/aec.