The new
software generation

The true value of Gen AI in software development

Capgemini

As Gen AI takes the world of software engineering by storm, reports are emerging of huge productivity gains and mass adoption. But is this really the case? *New research from the Capgemini Research Institute (CRI)* brings the value of generative AI into focus.

Early predictions

Software is vital to modern business, and not just for "software companies." When we talk about software, we include consumer software, as well as the enterprise software that powers every company today.
Less visible is the ubiquitous embedded software that keeps countless devices and organizations running smoothly. In all its forms, software engineering is undergoing a massive shift.

When generative AI made its debut on the public stage, three applications captured the public's imagination:

- Writing, including some of the most stunning displays of artificial intelligence ever witnessed.

- Visual imagery, with amazing abilities to create images using written prompts.

- Coding, which was revolutionary in providing intelligent code suggestions and automating repetitive tasks.

Now that generative AI has been in the public sphere for well over a year, a more subtle and accurate assessment of its abilities is possible. Our new research explores the last category – coding – or, more broadly, the impact of Gen AI on software engineering. We examine which predictions are proving correct, near-correct, and what was missed.
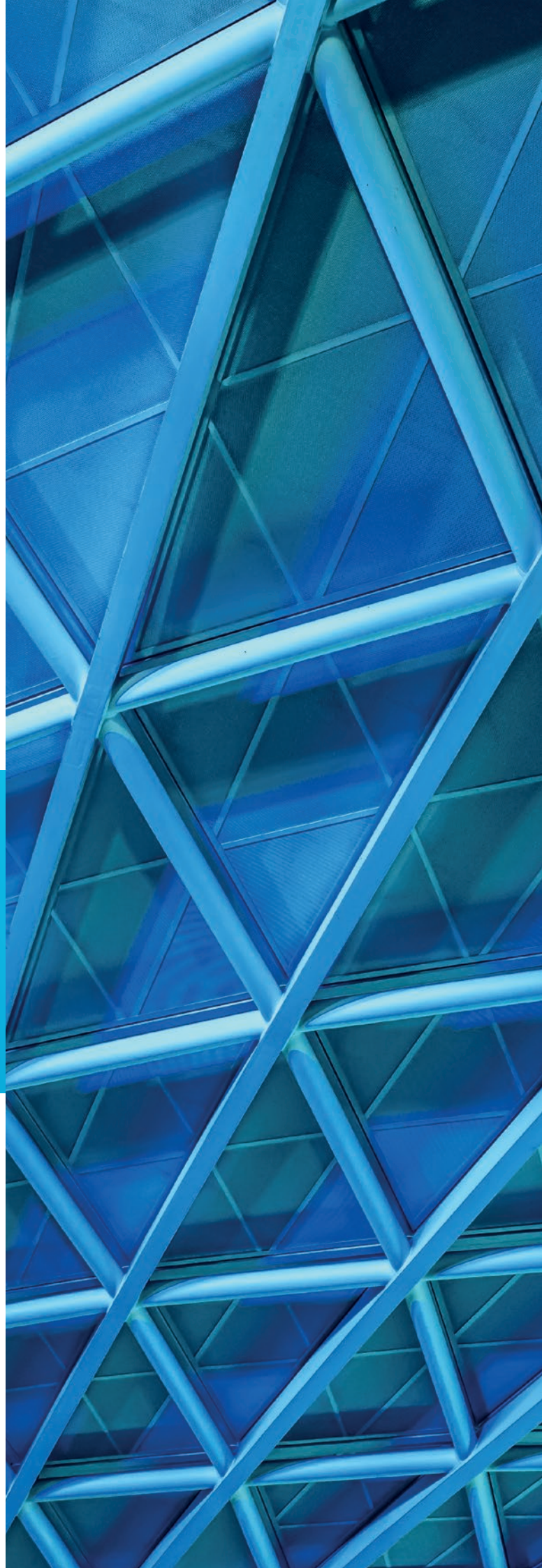
Testing our hypotheses

We've been watching and working this space closely, and for practically every aspect of software development, we've seen someone, somewhere, testing Gen AI to improve the process. Our casual observations raised many questions. Among them:

- How will generative AI impact the various stages of the software development lifecycle (SDLC)?

- How can organizations quickly adopt and scale generative AI to drive productivity and innovation?

- How will generative AI impact software engineers' ways of working?

- What are the challenges for software engineering and how best can we manage the risks associated with generative AI?

- How can organizations effectively measure and quantify the productivity gains achieved through generative AI?

- How can generative AI be leveraged to introduce new, higher-quality standards in software development processes, rather than just accelerating existing practices?

- How will generative AI impact the setup of software development teams?

To find answers, the Capgemini Research Institute *recently interviewed* 1,000 senior executives (director level and above) and 1,000 software professionals (including architects, developers, testers, and project managers) from organizations with over $1 billion in annual revenue to understand how generative AI is currently being used and its future potential. In early 2023, Capgemini also launched a global initiative to experiment with generative AI use cases, measuring its impact on typical software tasks through a standardized protocol. The results are being consolidated into a repository for internal and external benchmarking. Together, this research and experimental data provide valuable insights into how organizations are already leveraging Gen AI and the opportunities it presents going forward.

The time-saving potential of Gen AI

One of the first predictions was time saving. We saw a great number of forecasts, with some even suggesting up to 50% faster code development. In reality, it is less. Our published report finds that organizations using generative AI have seen a 7–18% productivity improvement in the software engineering function. This is highest for specialized tasks such as coding assistance, with 34% as the maximum potential for time savings, and 9% on average.

We predict that these modest initial productivity gains will increase with proper training and tool refinement overtime, but currently, time saved does not appear to be the primary benefit of generative AI in software development. So, what is? To find out what's driving Gen AI adoption, the first clue is who's using it.

An invisible revolution?

Currently, 27% of organizations are running some sort of generative AI pilot. But only 11% of organizations are currently using generative AI to assist with software development tasks. The remaining majority are at an earlier stage.
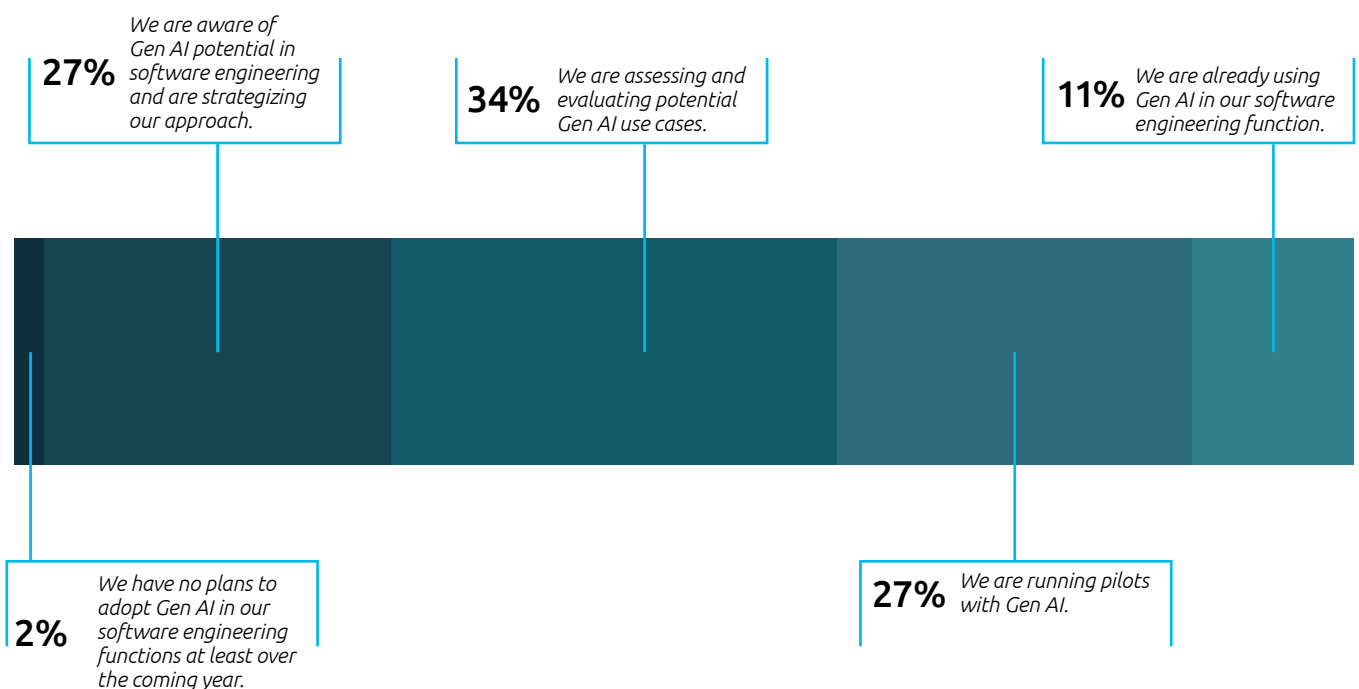
There is a clear value in leveraging Gen AI in SWE, but the quality of the output is contextual

In considering the productivity gains to be achieved from using Gen AI for SWE, it's important to keep in mind that these gains vary considerably, depending on the context. For example, the choice of tools has an impact. Some more general Gen AI tools are very capable of creating code, while other use cases (coding-specific user interfaces, or the ability to integrate into development environments), requires specialized Gen AI tools.

Likewise, a Gen AI coding assistant with strong results on a simple front-end application won't necessarily provide the same advantage if the code is full of complex business terms.

Level of adoption of generative AI in software engineering

27% *We are aware of Gen AI potential in software engineering and are strategizing our approach.*

34% *We are assessing and evaluating potential Gen AI use cases.*

11% *We are already using Gen AI in our software engineering function.*

2% *We have no plans to adopt Gen AI in our software engineering functions at least over the coming year.*

27% *We are running pilots with Gen AI.*

In contrast, 46% of software developers are already using Gen AI. They're using it to assist with coding, testing, updating, and designing. They're using Gen AI to help analyze large amounts of data, including customer reviews, market research, and industry best practices, identifying user preferences and translating them into functional and system requirements. Developers are cleaning up old code and reducing technical debt. And for the most part, they're doing it independently. Gen AI adoption today is coming overwhelmingly from the ground up.

Developers know they have discovered a powerful new technology and have set about adapting it to support their everyday needs. We know that, because 63% of these workers use Gen AI unofficially. (More on that later!) First, what benefits are these software developer innovators realizing?

Gen AI is complementing employees

In a report brimming with good news, this may be the brightest: software developers are using Gen AI because it makes their jobs more enjoyable. 69% of senior software professionals and 55% of junior software professionals report high levels of satisfaction from using generative AI for software development. Part of this is likely due to the self-driven way in which developers are using Gen AI. (Naturally, if you're using a new tool of your own volition, you'll seek out ways to make your work lighter and more enjoyable.) But mostly, it's because Gen AI has an unparalleled ability to augment and complement employees.

Gen AI excels at painstaking tasks. Let's look again at creating documentation (the specialized task with the greatest timesaving). Some developers are now using Gen AI to help track changing requirements and validate requirements documentation by analyzing it for completeness and clarity. Any time saved in validating is time that developers can use for tasks which bring higher value and greater personal fulfillment.

Not only does Gen AI complement employees – employees complement Gen AI. This may be most true in the case of "hallucinations," which refer to Gen AI's propensity to occasionally produce false responses.

In one example, a law firm was using ChatGPT to prepare legal briefs, only to realize that the cases the AI was suggesting didn't exist. They were "bogus judicial decisions with bogus quotes and bogus internal citations." For Gen AI to be a trustworthy tool, it needs human assistance.

Another challenge in using Gen AI is in the area of self-fulfilling prophecy. Based on limited input together with the LLM, the generated artefacts of the SDLC (e.g. design, code, test code and data) may look perfectly fine, but do not reflect the intent of the business.

Together, Gen AI and skilled professionals are creating unprecedented value, transforming specialized knowledge into shared expertise accessible to all. Our survey bears this out, with 49% of respondents stating that Gen AI is helping them create better quality code.

Gen AI has an unparalleled ability to complement employees.

Gen AI is improving collaboration

Offloading painstaking tasks was widely predicted from the start. But the most cited benefit of Gen AI in software development in our report came as a surprise: 78% of software professionals believe that generative AI is likely to improve collaboration between business and technology teams.

For an engineer to explain a detailed task to someone new to the subject is a special skill. There's even a dramatic sounding name for the phenomenon. "The curse of knowledge" refers to the difficulty that a very knowledgeable person faces when trying to put themselves in the shoes of a person who lacks that knowledge. Where to start, what context is needed, which terms need to be defined – it's difficult, and often frustrating on both sides. That over three-quarters of software professionals see potential for better collaboration thanks to Gen AI is very good news.

The importance of defined architecture in AI-driven code generation

The importance of defined architecture in AI-driven code generation

We couldn't write this paper without also addressing the impact of Gen AI on software architecture. Generating code without a well-defined architecture can lead to significant long-term challenges, particularly concerning repeatability and scalability. Conversely, when developers establish a robust architecture and apply effective prompt engineering, especially with the use of Gen AI, the code generation process becomes more consistent and produces higher-quality outputs.

Generative AI plays a crucial role in maintaining this consistency by integrating compliance standards directly into the code generation process, ensuring that the resulting code not only meets technical requirements but also adheres to necessary regulatory guidelines.

By laying a strong architectural foundation and leveraging Gen AI, developers can produce more reliable and maintainable code, ultimately enhancing the effectiveness and sustainability of their software projects.

Gen AI also acts as a sort of translator between technical specifications and business requirements. It can automatically generate documentation, user stories, and even code snippets based on business inputs, making it easier for business stakeholders to articulate their needs and for developers to understand and implement them. By enhancing clarity and mutual understanding, Gen AI fosters more effective teamwork and drives successful project outcomes in software engineering. However, as we'll discuss later, without a well-defined architecture the benefits of Gen AI can quickly turn into liabilities.

And is Gen AI replacing people?

What about the great fear that Gen AI will replace jobs? We're happy to report that that has not been the case. A mere 4% of organizations plan to use Gen AI to reduce their headcount – the lowest stat in the entire report. In contrast, 50% of organizations aim to develop new software features, and 47% plan to use Gen AI to upskill their employees. Many organizations are creating new jobs: AI Developer, Gen AI Architect, AI Platform Architect, Prompt Engineer among them. However, beyond these new positions, there's also a growing demand for an evolution of existing roles and skills – for example Software Engineers who are accomplished in prompt engineering. The current picture of Gen AI for employees and organizations is remarkably positive all around, so is there anything to worry about?

Wait, did you say 63% of developers' Gen AI tools are unapproved?

Yes, let's get back to that statistic, because it says a lot. First off, it indicates a level of risk that cannot be ignored. And in the public sector and the insurance industry, that number rises to nearly nine in ten Gen AI users working with unauthorized tools and solutions. This could bring serious legal, functional, and security consequences.

There's also another fact curled up inside that 63%. Presumably, employees are using unapproved Gen AI tools because they're not getting tools with sufficient capabilities from their employers. This is where our picture of Gen AI in software development today really takes form. What we see is an industry where employees are surging ahead, faster than the organizations they work for. An impressive 41% of surveyed employees have upskilled themselves enough to use generative AI for their work. Of that group, 40% have paid for their courses – an indication of how much they value the knowledge. However, this also indicates that they are not getting the training they feel they need from their employers.

51% of senior executives believe that leveraging generative AI in software engineering will require significant investment in upskilling and cross-skilling of software workforce. Yet only 39% of organizations have a generative AI upskilling program for software engineering.

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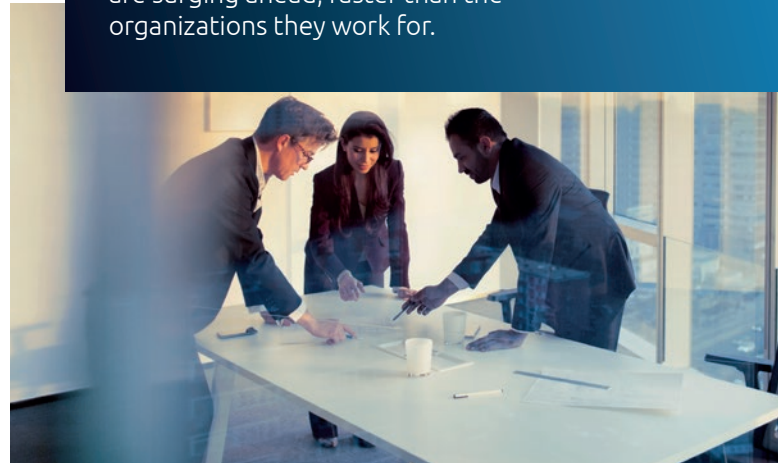
Introduction to generative AI for software engineering

- Legal security, ethical concerns

Generative AI for software engineering tool-based pathways

- Introduction to various tools
- Prompt engineering
- Conversational software engineering
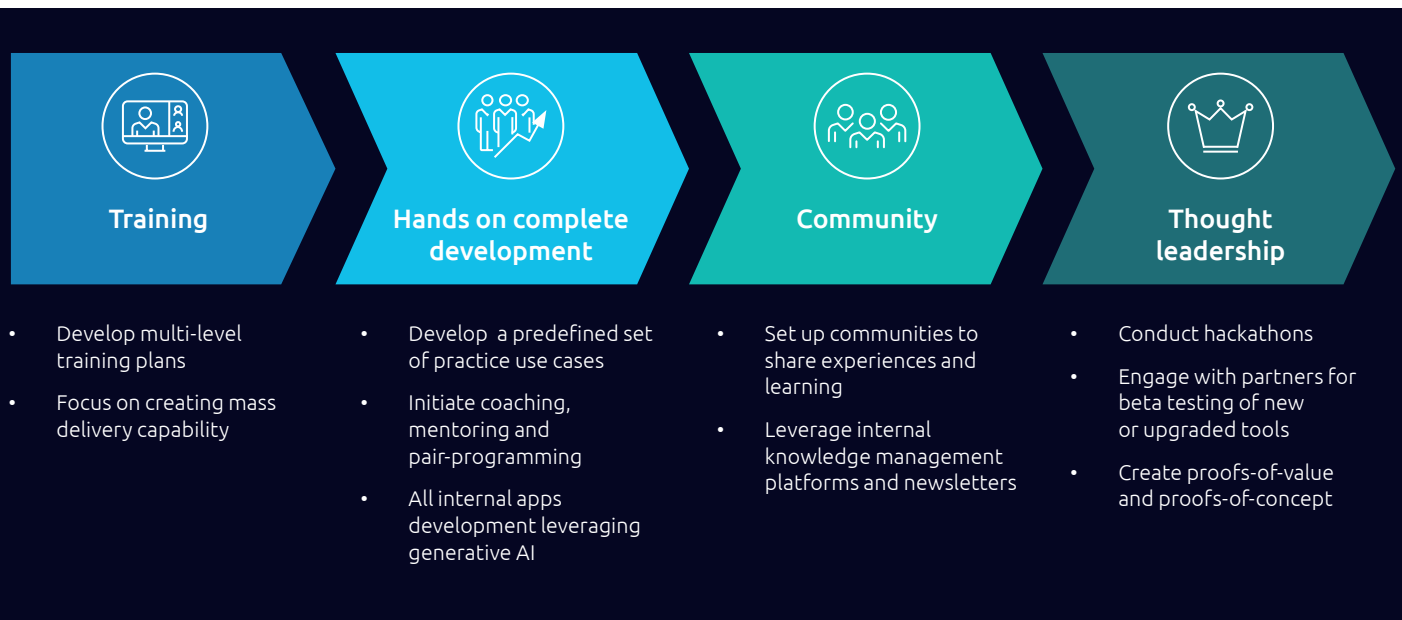- Use cases across software engineering lifecycle
- Certifications

Generative AI for software engineering LLM-based pathways

- Introduction to generative AI LLMs
- Advanced prompt engineering
- LLM use cases across software engineering lifecycle
- Certifications
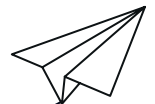
Blueprint of a training program to impart generative AI skills to software teams.

However, training is not enough to create a true culture of learning. This chart shows a blueprint of a mobilization plan to develop Gen AI delivery capability:

Training	Hands on complete development	Community	Thought leadership
• Develop multi-level training plans • Focus on creating mass delivery capability	• Develop a predefined set of practice use cases • Initiate coaching, mentoring and pair-programming • All internal apps development leveraging generative AI	• Set up communities to share experiences and learning • Leverage internal knowledge management platforms and newsletters	• Conduct hackathons • Engage with partners for beta testing of new or upgraded tools • Create proofs-of-value and proofs-of-concept

The burning question is: how can organizations and their employees work together to reduce unnecessary risk, and get the most value out of generative AI? We believe creating a culture of learning is one important step.

Strengthening foundations with Gen AI in SWE

Renaming Gen AI for SWE to SWE augmented by Gen AI emphasizes the critical role of solid software engineering (SWE) and project management practices in achieving scalable results. Gen AI can enhance development, but quality gates, individual accountability, and structured processes remain essential. Developers are still responsible for the code, even when assisted by AI tools. Management should focus on enforcing quality checkpoints and fostering behaviors that ensure reliable outputs. Additionally, integrating continuous and automated testing alongside AI-driven development accelerates innovation while maintaining high standards. The fusion of Gen AI and rigorous SWE foundations ensures sustainable, high-quality outcomes.

Harnessing employees' success with Gen AI

Gen AI provides countless opportunities to rethink software engineering and business in general. But inspiration is only the first step. The task of scaling up those new ideas and turning them into secure, value-adding parts in a complex system belongs to management. So how can an organization make that happen?

There's one step so important, we're putting it before step one: prioritizing Gen AI adoption. That means securing the necessary time and money to explore, collaborate, test, and scale. If time and money are not budgeted for at the start, they won't be there when you need them. Solutions are evolving fast, so organizations need to be prepared to course-correct accordingly. Organizations that try to adopt Gen AI without a prioritized plan will be trampled by organizations who made it their priority. solutions are evolving fast – so organizations need to be prepared to course correct accordingly.
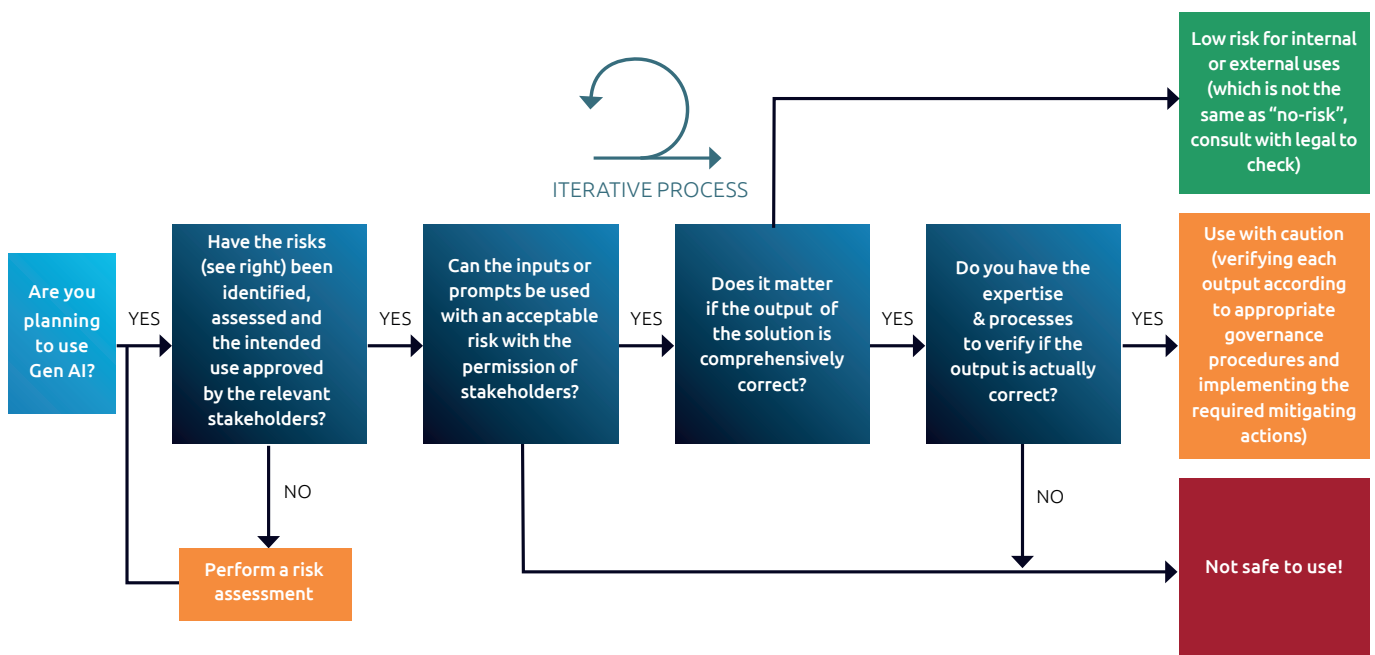
Now, on to step one.

Step 1: Pick winners

At this early stage of Gen AI innovation, quick wins with high impact come first. Down the road, your employees' more complex ideas will benefit from the lessons learned in this round. Our full report goes further into the process of identifying strong candidates. It's a recipe with many chefs involved, so establishing clear roles and responsibilities up front will be crucial. Some of these quick wins might be related to specific technologies, use cases to implement, people decisions.

Step 2: Mitigate risk

Risks include security, IP and copyright issues, and code leakage. For each use case selected, organizations should start with a risk assessment and involve their legal, IP, cybersecurity, and data protection experts early on. Inform all stakeholders about potential risks, ascertain acceptable risk levels, and simulate the potential impact if any risks manifest.

ITERATIVE PROCESS

Are you planning to use Gen AI?

YES → **Have the risks (see right) been identified, assessed and the intended use approved by the relevant stakeholders?**

NO → **Perform a risk assessment**

YES → **Can the inputs or prompts be used with an acceptable risk with the permission of stakeholders?**

YES → **Does it matter if the output of the solution is comprehensively correct?**

YES → **Do you have the expertise & processes to verify if the output is actually correct?**

YES → **Use with caution (verifying each output according to appropriate governance procedures and implementing the required mitigating actions)**

Low risk for internal or external uses (which is not the same as "no-risk", consult with legal to check)

NO → **Not safe to use!**

Step 3: Prepare for impact

Most changes are incremental. Generative AI allows us to transform entire systems, which is a level of disruption that people should be actively prepared for. The number one way to get people on board for change is to involve them, so they feel like they're part of the transformation – or even more than that, they feel onboarded, valued and kept informed. Listen to the concerns that employees have and take them seriously. And we've aren't necessarily talking about developers or testers here; think more broadly legal, management, workers councils etc.

Some questions that management can discuss, and cascade down to their people:

- How can we select the right use cases with high value and easy implementation?

- How will we measure value realization from the start?

- What will the impact on our daily work look like?

- What kind of skills are needed, and how can we upskill and train our employees?

- Which of our company's data (including confidential and proprietary data) do we want to make accessible to our Gen AI tool?

Cultivating a culture of learning and change

In the fast-evolving landscape of generative AI, fostering a culture of continuous learning and adaptability is crucial. Employees must be encouraged to view AI-driven changes not as threats, but as opportunities for growth. By embedding learning into the organization's DNA, businesses can ensure their teams remain agile, curious, and ready to embrace new technologies. Regular upskilling, open communication, and creating safe spaces for experimentation allow employees to stay ahead of industry shifts. A proactive learning culture empowers individuals to contribute to AI transformation, fostering innovation and resilience in the face of change.

Step 4: Implement, test, repeat

When adopting a new technology, the finish line is the start of a new race. Don't pin too much on any one moment – the goal is to keep moving and keep improving. Some call this test and learn.

That said, extracting meaningful insights can be a daunting task in a world inundated with data. Therefore, establishing a measurement framework is essential. This serves as a navigational aid in a vast sea of information, guiding teams from raw data to actionable decisions. Measuring the performance of Gen AI ensures that it meets the desired objectives, whether that's improving efficiency, enhancing accuracy, or reducing costs. It also helps identify areas for improvement, guiding further development and optimization. And it provides accountability, demonstrating the value and return on investment to stakeholders.

Measurement also allows us to quantify attributes, which enables us to compare, analyze, and understand things more effectively. It allows for progress tracking and performance evaluation, and provides data-driven insights that inform decision-making processes.

Step 5: Make change permanent

Imagine two companies, let's call them A and Z.

Company Z has invested heavily in generative AI research and are confident that they've selected the top use cases for scaling. They allocate resources and get to work. They're convinced that they've chosen the state-of-the-art use cases, so they put all their effort into developing them, and make no plans for future innovation.

Company A takes a different approach. They test the waters with a few simple, high-impact ideas, learn from the process, and approach the next use cases with stronger capabilities. They expect today's applications to be the start of a long journey of innovation, and they allocate resources to keep that innovation moving.
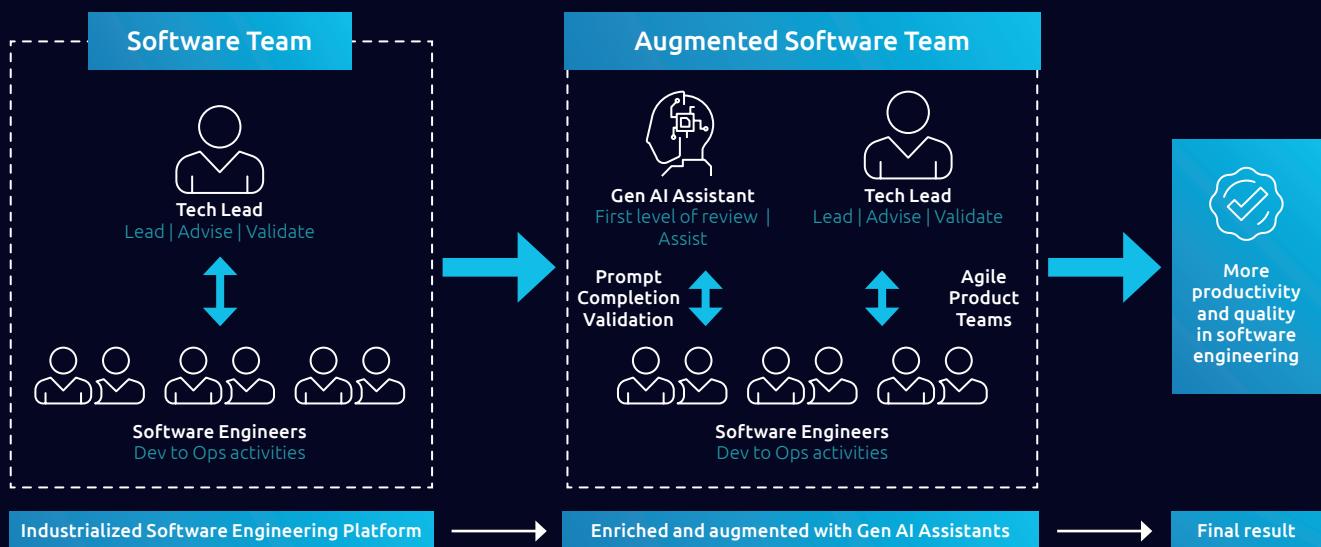
Both companies are getting ahead. But Company A is going one step further – they're laying the groundwork to stay ahead. Which company do you think will be in the lead ten years from now? Which would you rather work for?

Gen AI's role in software development is becoming clearer. But the future belongs to organizations that prepare for change.

Augmented software teams will replace traditional team structures

AI-augmented software teams combine the expertise of human developers with the advanced capabilities of AI systems to enhance various stages of the software development lifecycle. Team members individually work with Gen AI to get the desired output, leveraging the AI's capability and features while ensuring human creativity. After Gen AI prompt engineering and code completion, team members review each other's work enhancing result quality. A senior member oversees the work, as a final review and validation, promoting a smooth workflow and healthy team dynamic.

Software Team

Tech Lead
Lead | Advise | Validate

Software Engineers
Dev to Ops activities

Augmented Software Team

Gen AI Assistant
First level of review | Assist

Tech Lead
Lead | Advise | Validate

Prompt Completion Validation

Agile Product Teams

Software Engineers
Dev to Ops activities

More productivity and quality in software engineering

Industrialized Software Engineering Platform → Enriched and augmented with Gen AI Assistants → Final result

AI-augmented software teams offer several benefits:

- Enhanced efficiency through automation: Utilizing AI-powered tools automates routine tasks like repetitive code generation, testing, and debugging, freeing developers to concentrate on more innovative and high-impact endeavors. Team leads gain time to focus on strategy and on ensuring scalable, resilient architecture.

- Code quality: Through the analysis of extensive data sets, AI algorithms can detect patterns and potential code issues, resulting in enhanced code quality and fewer errors. Additionally, the ability of AI to generate unit tests increases test coverage, which in turn enhances the overall quality of the code.

- Accelerated time-to-market: AI-augmented teams expedite the software development lifecycle by automating time-consuming processes, enabling quicker iterations and deployments.

- Balanced decision-making: AI can analyze vast amounts of data to provide insights and predictive analytics, aiding developers in making more informed decisions and improving the strategic planning of projects.

To sum up, AI-augmented teams automate repetitive tasks, improve decision-making, and accelerate coding and testing. We predict that within the decade, AI-augmented software development teams will be the industry standard.

The future of Gen AI in software development

The sparks of change are all around us. But which organizations have the skills to catch those sparks, nourish them, and let them grow? What use cases, what resources, what goals – these are all important. But how an organization manages new ideas is the key. There's a reason the world remembers Thomas Edison, and not the slew of other talented inventors who made similar discoveries. They all had the "what," but Thomas Edison understood how to take a new technology, perfect it, scale it, and share it with the world.

The fact that so many software developers around the world, in companies of all sizes, have picked up the torch of change on their own is remarkable. Software developers have taken Gen AI innovation as far as they can. Now it's up to their organizations to help carry that torch across the finish line.

Read our full report on the role of Gen AI in software development here.

Authors

Frederic Beaufils
COO, Global Cloud & Custom Applications

frederic.beaufils@capgemini.com

Stephane Girard
CTO, Global Cloud & Custom Applications

stephane.girard@capgemini.com

Jiani Zhang
Chief Software Officer, Capgemini Engineering

jianiz.zhang@capgemini.com

Antoine Aymer
CTO, Quality Engineering, Sogeti

antoine.aymer@sogeti.com

Thilo Hermann
Deputy CTO, Global Cloud & Custom Applications

thilo.hermann@capgemini.com

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