

WHAT IS AN AUGMENTED ENGINEER?

Software Engineering in the Age of GenAI

Petra Heck – Associate Professor Fontys ICT - p.heck@fontys.nl

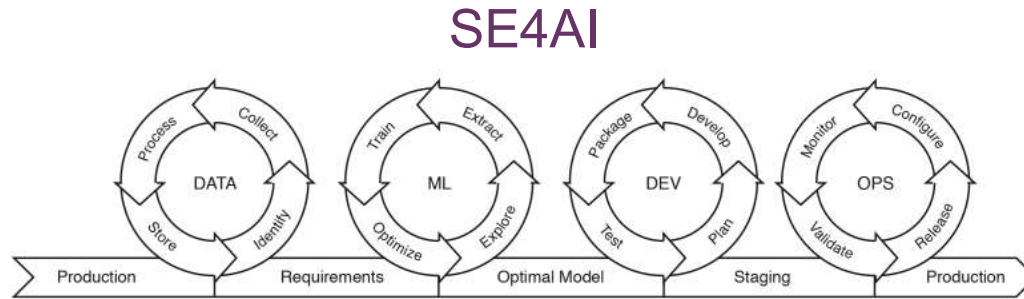
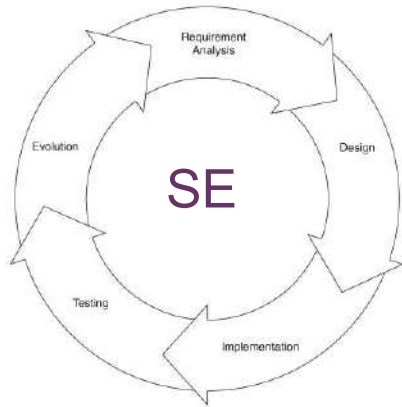
About Me

- 2002 **Software engineer** (MSc Computer Science)
- 2004 **Software quality** consultant
- 2012 Lecturer **Fontys ICT**
 - 2016 PhD “Quality of JIT Requirements” (Computer Science, AI4RE)
 - 2019 Senior researcher AI Engineering (SE4AI)
- 2025 **Associate Professor AI & Software Engineering** (AI4SE & SE4AI)



Fontys UAS Education: from SE to AI4SE

- 2012: “How to build production-ready software systems?” (SE = Software Engineering)
- 2019: “How to build production-ready AI systems?” (SE4AI = AI Engineering)
- 2024: “How to use AI to build production-ready systems?” (AI4SE = Augmented Engineering)



AI4SE = AI-Augmented Software Engineering

TECHNOLOGY TRENDS

INFLUENCING THE FUTURE OF SOFTWARE ENGINEERING AND

IT OPERATIONS

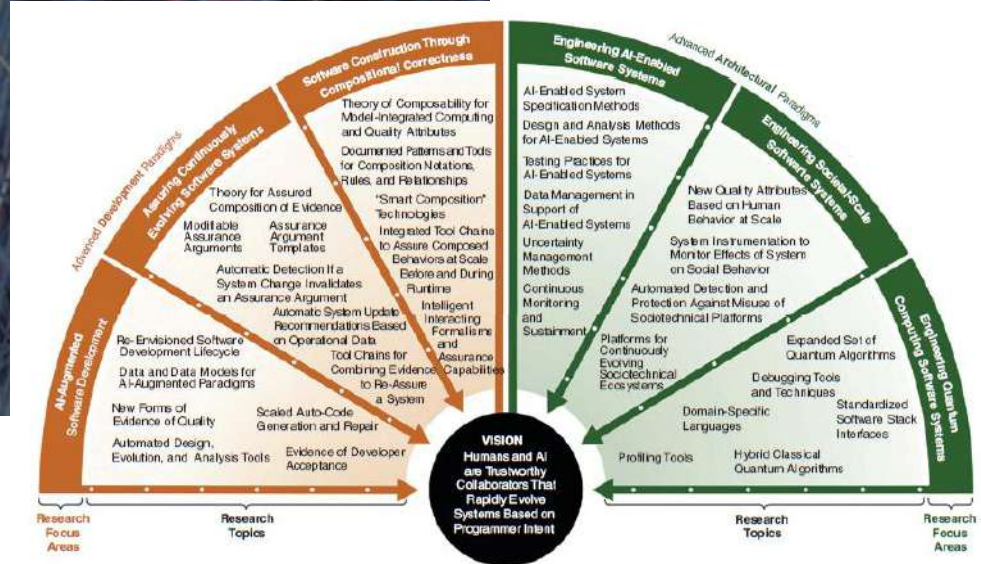
AI-Augmented Software Engineering

Progress in Simulation Technologies

Next Generation of User Interfaces

Rising Adoption of Edge Computing

Leveraging Quantum Applications



Eger, Vera & Coppari-Hollmann, Augustin & Milsztein, Aliosha & Borsutzky, Antonia & Wieser, Benedikt & Harjes, Federico & Sartor, Sebastian & Preuss-Neudorf, Felicia & Tscherniak, Isabel & Skupien, Jakub & Seidou, Jonas & Fall, Khadim & Driese, Leon & Zimmer, Linus & Stein, Lizzy & Knoll, Max & Uludoğan, Mehmet & Serbinova, Milena & Sindemann, Niklas & Maurer, Teresa. (2024).

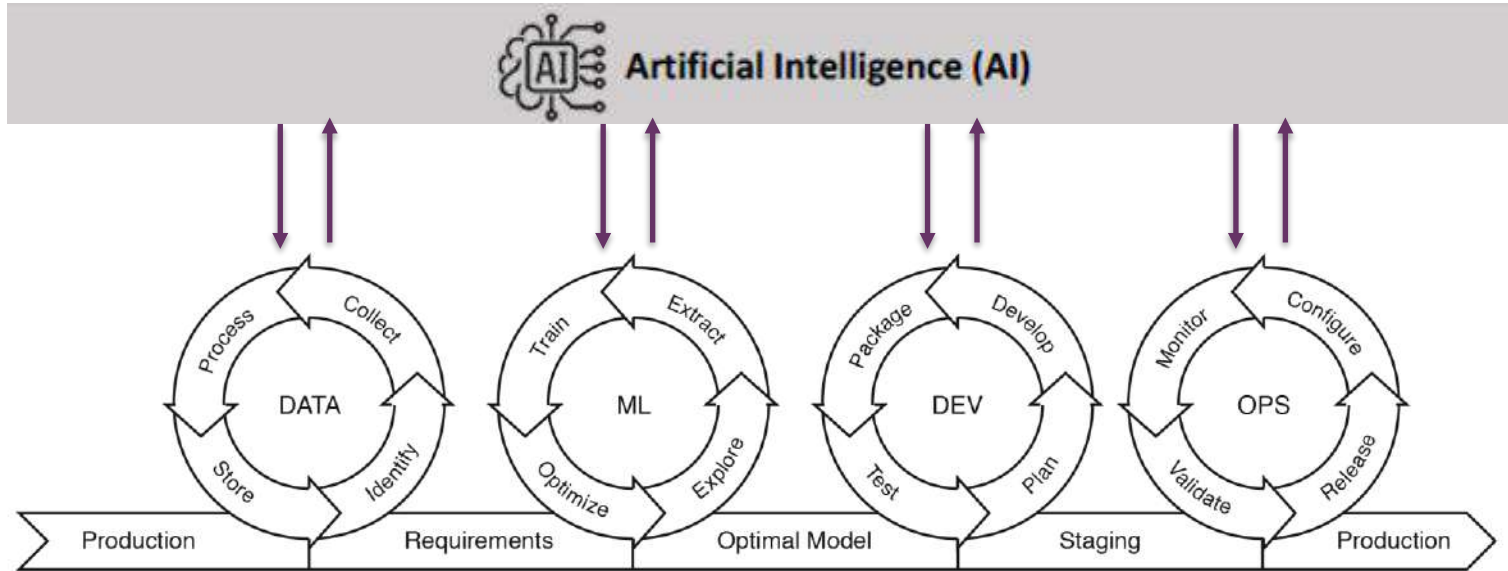
The Future of Software Engineering and IT Operations.



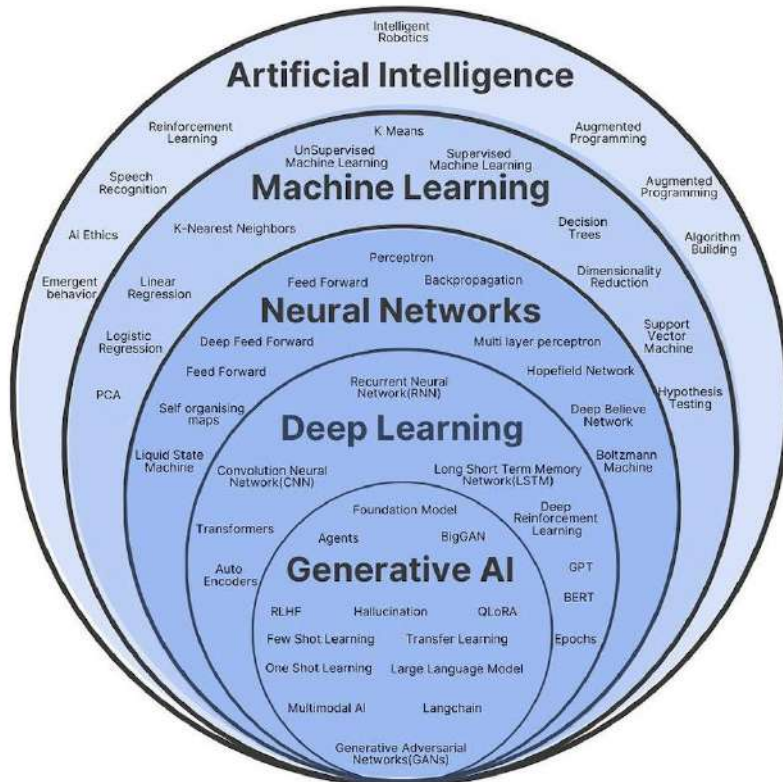
FIGURE 1. Six technical focus areas make up the research road map.

[Architecting the Future of Software Engineering: A National Agenda for Software Engineering Research & Development](#)

AI-Augmented AI Engineering (AI4AI)



AI4SE = GenAI4SE = LLM4SE



- Emulate human behavior
- Pattern detection algorithms
- Deep neural networks
- Generate content

AI4SE – STATE OF THE ART

AI for Software Engineering (AI4SE)

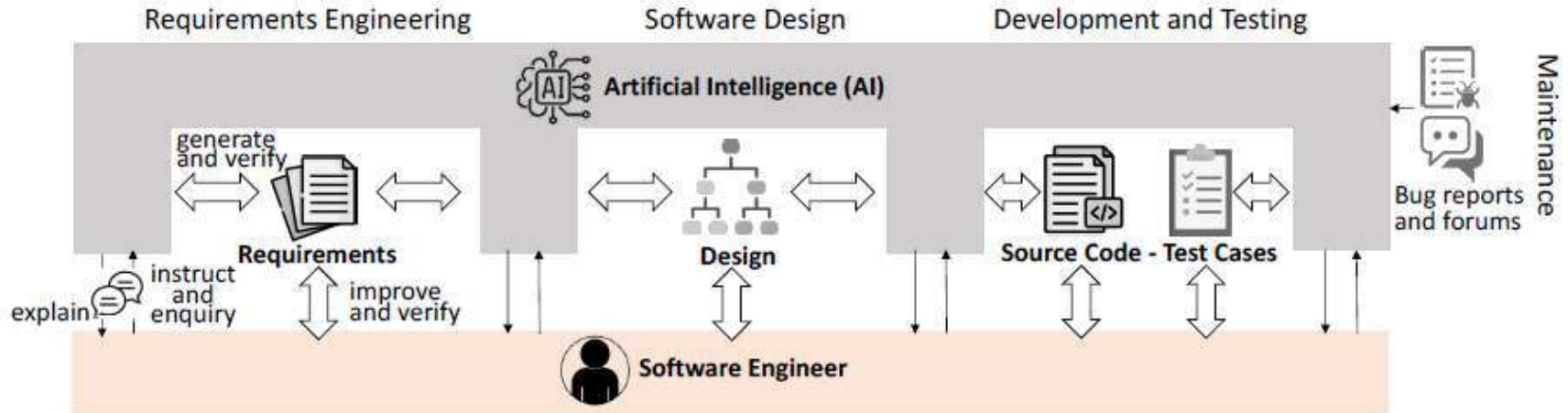
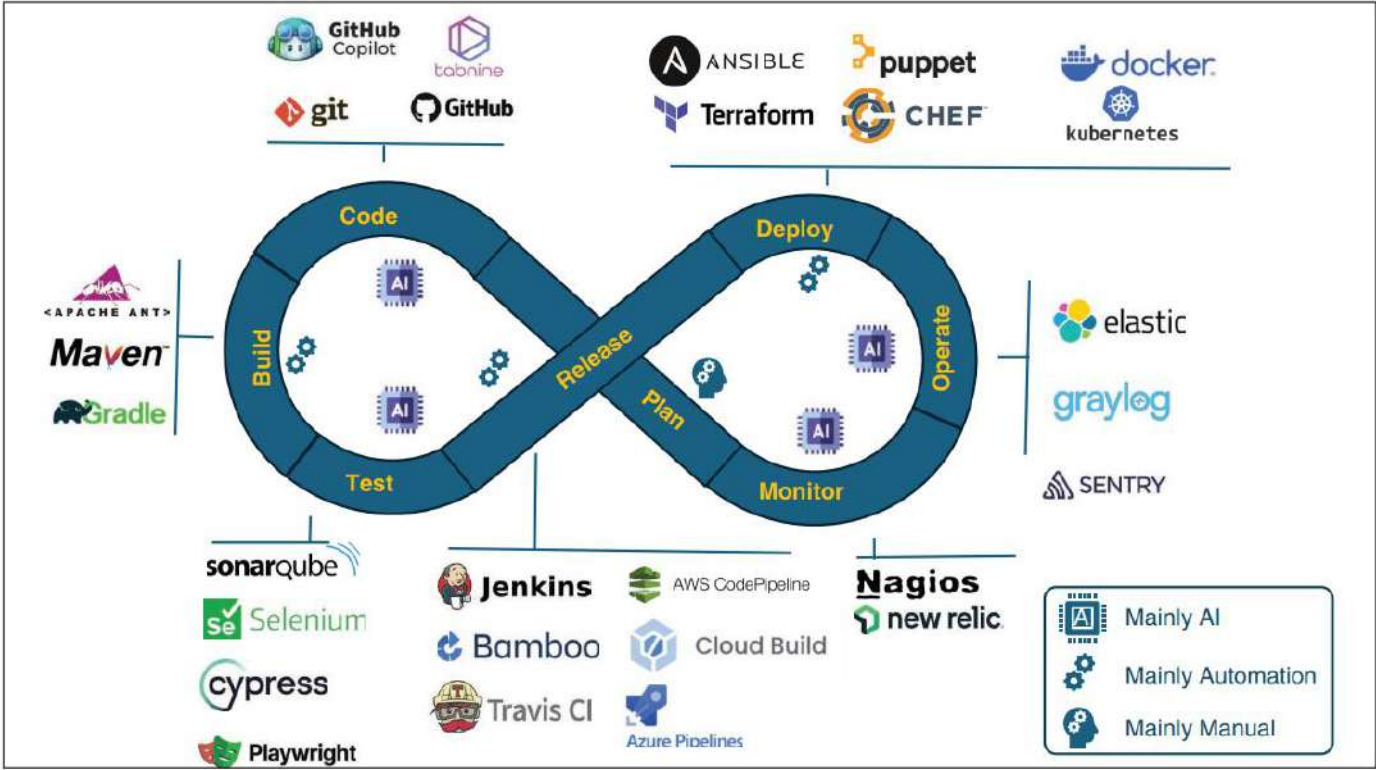


Figure 1: Logical architecture of the envisioned future symbiosis of Software Engineers and AI

DevOps 2.0



C. Ebert, G. Gallardo, J. Hernantes and N. Serrano, "DevOps 2.0," in *IEEE Software*, vol. 42, no. 2, pp. 24-32, March-April 2025



See also: <https://spectrum.ieee.org/best-ai-coding-tools>

Vibe Coding

“It's not really coding - I just see things, say things, run things, and copy-paste things, and it mostly works” (Andrej Karpathy, 2025)

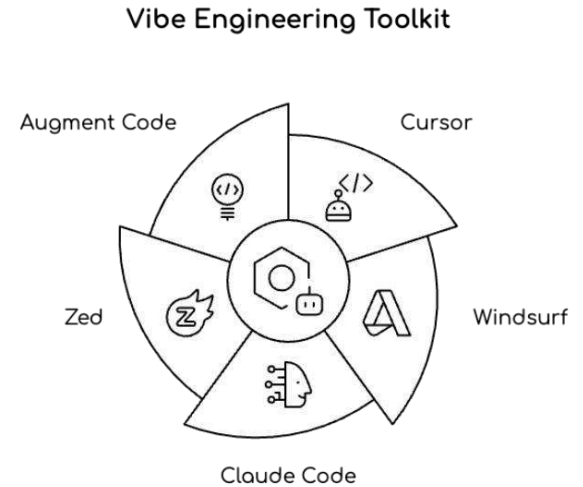
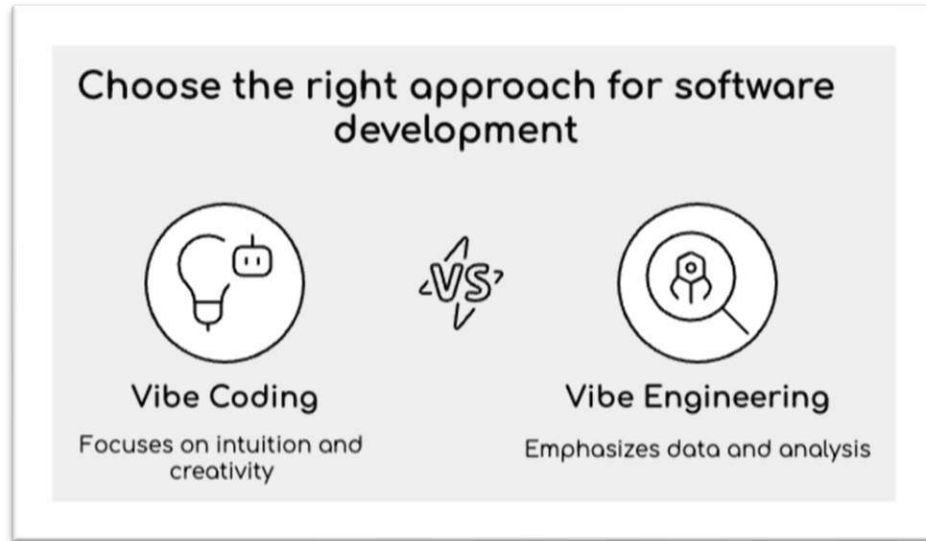
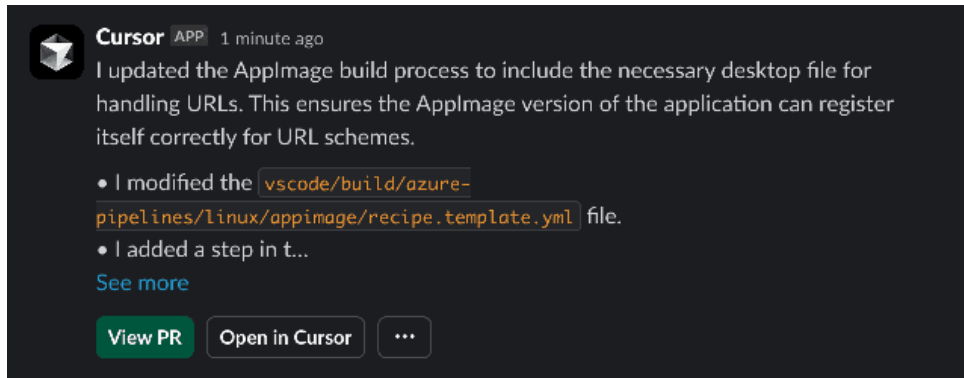
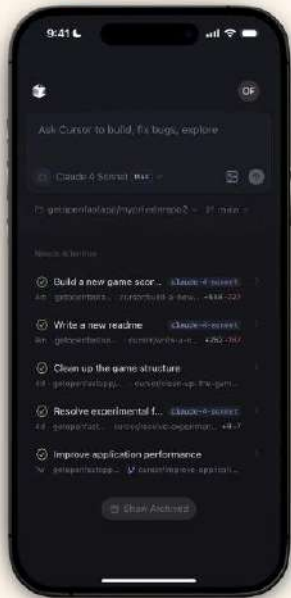


Illustration by @mrandri

Cursor Agents



<https://cursor.com/en/blog/agent-web>

AI for Software Engineering (AI4SE)

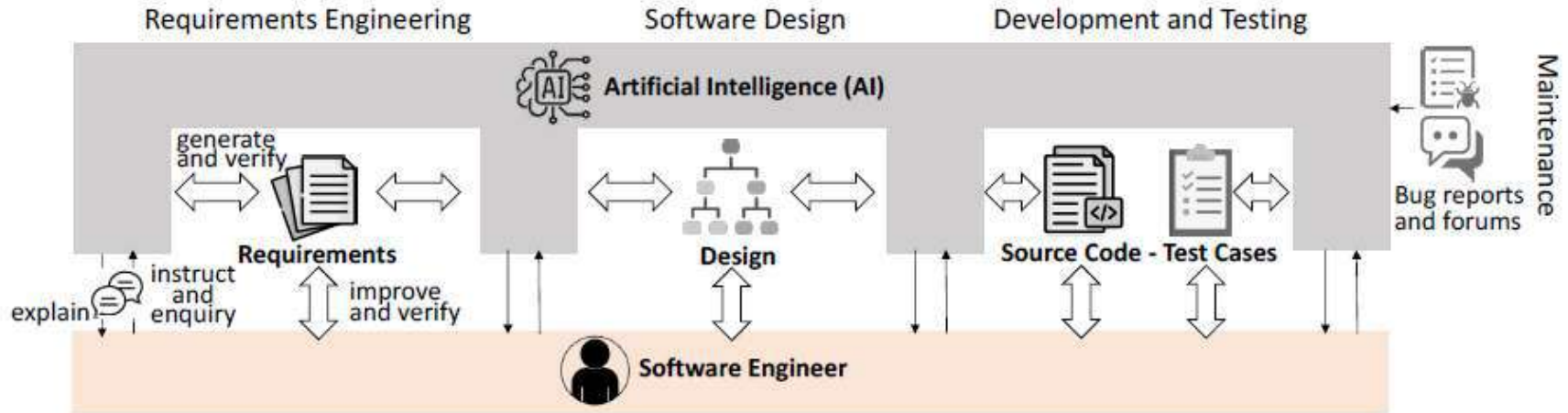


Figure 1: Logical architecture of the envisioned future symbiosis of Software Engineers and AI

GenAI for Testing – Certification ISTQB

“Generative AI is transforming how we design, execute, and manage tests”

The CT-GenAI syllabus was approved by ISTQB® on July 25, 2025.

[ISTQB® Certified Tester – Testing with Generative AI \(CT-GenAI\) Press Release - International Software Testing Qualifications Board](#)

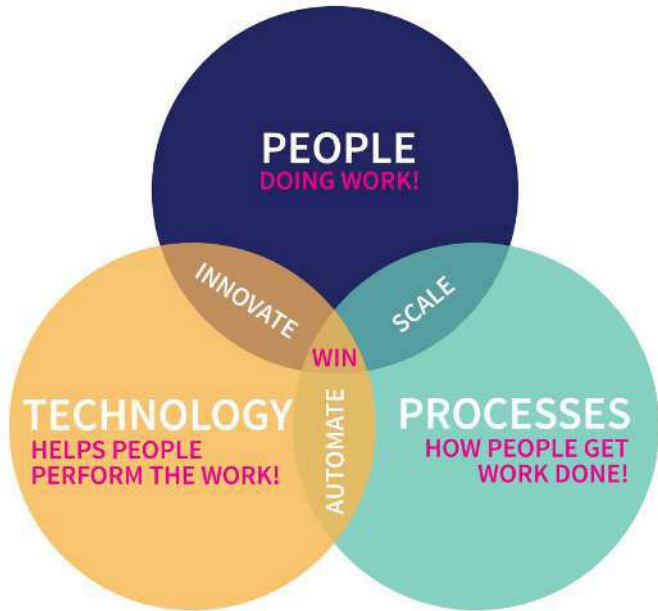


The image displays four ISTQB certification cards arranged in a 2x2 grid. Each card has a dark blue header with the certification name, a white body with the ISTQB logo and description, and a dark blue footer with a 'Read more' link.

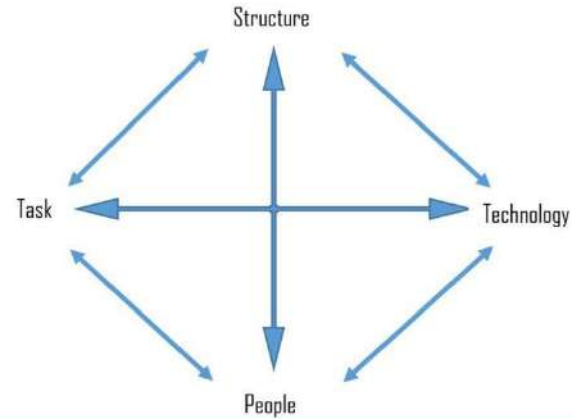
- Top Left Card:** Certified Tester Foundation Level Agile Tester (CT-AT). Specialist level. Description: "The Foundation Level Agile Tester certification provides the knowledge of the testing skills required to effectively contribute to an Agile..."
- Top Right Card:** Certified Tester AI Testing (CT-AI). Specialist level. Description: "The ISTQB® AI Testing (CT-AI) certification extends understanding of artificial intelligence and/or deep (machine) learning, most specifically testing AI-based..."
- Bottom Left Card:** Certified Tester Testing with Generative AI (CT-GenAI) [NEW!]. Specialist level. Description: "The ISTQB® Certified Tester Specialist Level – Testing with Generative AI (CT-GenAI) extends the Foundation Level and provides testing and engineering..."
- Bottom Right Card:** Certified Tester Mobile Application Testing (CT-MAT). Specialist level. Description: "The ISTQB® Mobile Application Testing (CT-MAT) certification provides an insight into methods, techniques, and tools a professional may use to test mobile applications. It covers the required..."

FUTURE OF WORK

“It is not just about technology”



[People-Process-and-Technology-Framework](#)



Leavitt's Diamond Model

[What is Leavitt's Diamond Model? | CMI](#)

Future of Work – Translational Expertise

TABLE 4-1 Impacts of Three Technological Eras on the Demand for Expertise

	Expertise Substituted/ Made Obsolete	Expertise Augmented/ Newly Demanded	Ease of Acquiring Needed Expertise
Industrial era	Artisanal expertise (e.g., weaving, shoemaking, clock-making).	<i>Mass expertise.</i> Learning rules and mastering tools for manufacturing/production and office/information tasks (“accomplishing routine tasks”).	Literacy and numeracy needed. Owing to high school movement, workers well prepared to acquire industrial era mass expertise.
Information era	Mass expertise. Expertise in learning rules and mastering tools (i.e., carrying out routine tasks).	<i>Elite expertise.</i> Combining expert knowledge with acquired judgment to make high-stakes decisions in nonstandard cases. Needed for abstract decision making, communications, and management. Elite expertise becomes the bottleneck when routine tasks are automated.	Often requires a college degree or significant post-secondary education plus years of hands-on supervised practice or apprenticeship (e.g., medical doctor, pilot). Less than one-third of workers qualified.
Artificial intelligence era	May substitute for some “elite expertise”—making it less scarce.	<i>Translational expertise.</i> Combining expert judgment with inputs and guidance from artificial intelligence to carry out “elite expert” tasks.	May require foundational training in subject expertise (e.g., law, medicine) plus acquired judgment without necessarily requiring professional levels of post-secondary education.



Future Skills

1	BEING - Relationship to Self
2	THINKING - Cognitive Skills
3	RELATING - Caring for Others and The World
4	COLLABORATING - Social Skills
5	ACTING - Enabling Change

Framework – Inner Development Goals

[\(11\) Why AI Literacy Will Go the Way of the Floppy Disk | LinkedIn](#)



Future of Jobs Report 2025



Top 10 fastest growing skills by 2030

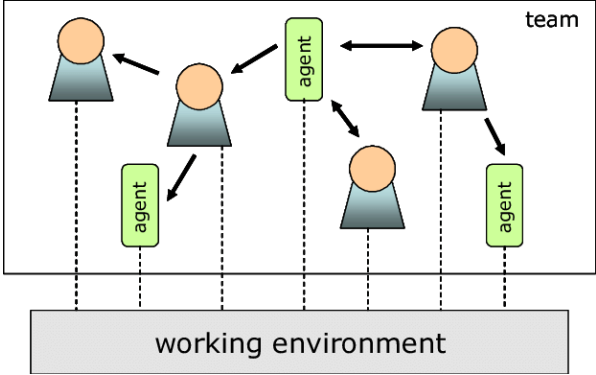
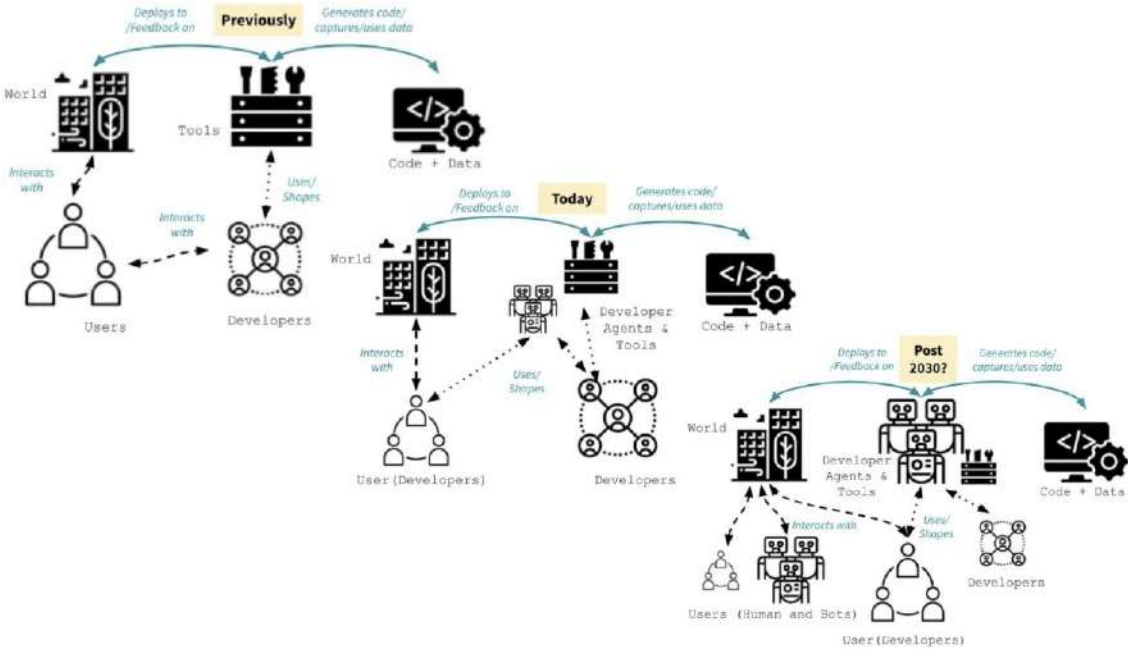
1.  AI and big data
2.  Networks and cybersecurity
3.  Technological literacy
4.  Creative thinking
5.  Resilience, flexibility and agility
6.  Curiosity and lifelong learning
7.  Leadership and social influence
8.  Talent management
9.  Analytical thinking
10.  Environmental stewardship

 Cognitive skills  Self-efficacy  Working with others  Management skills  Technology skills  Ethics

Note: The skills selected by surveyed organizations to be increasing most rapidly in importance by 2030.

Source: World Economic Forum, (2025). *Future of Jobs Report 2025*.

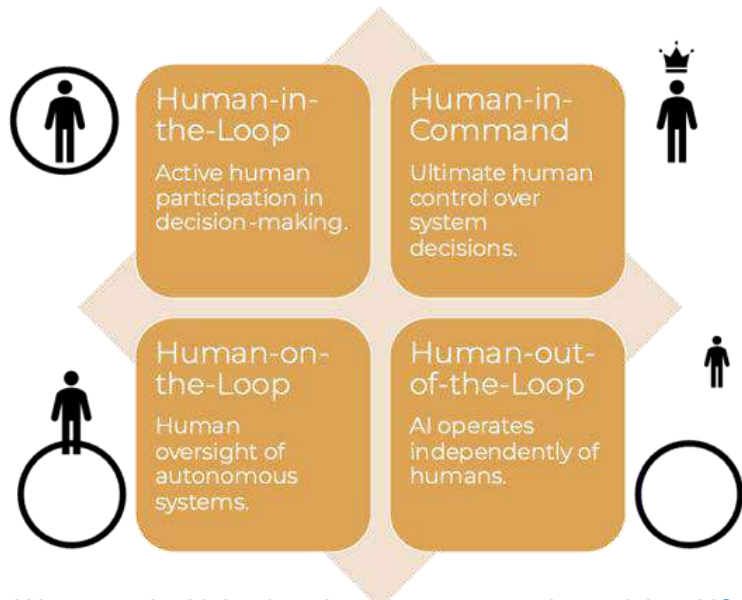
Disruptive Effects of AI on SE



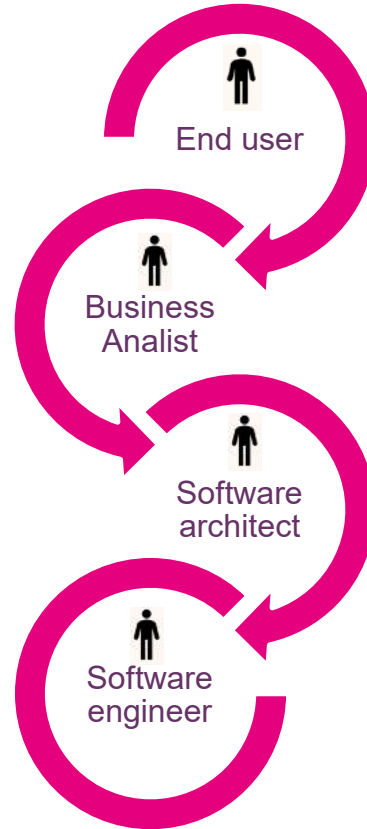
Neef, Martijn. (2006). A Taxonomy of human - agent team collaborations



From Human-in-the-loop to Human-in-the-spiral



[Wat gaat de AI Act betekenen voor onze hoogrisico AI?](#)



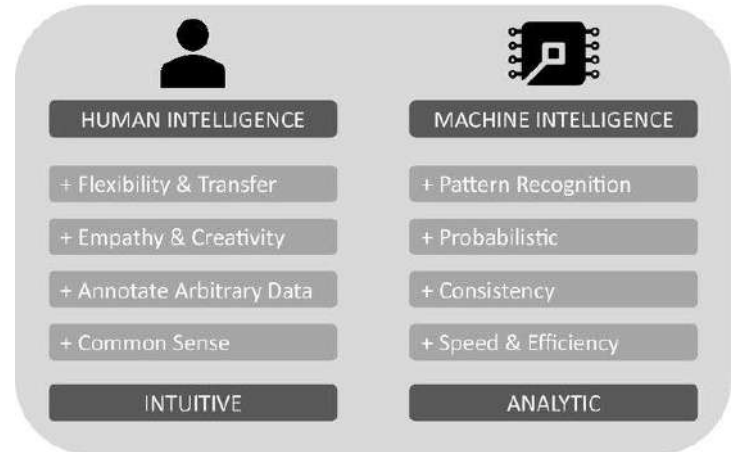
User-in-the-loop AI (UITL) is a workflow that requires users to be looped into any stage of the AI system development pipeline.

[Gartner Impact Radar for Generative AI 2024](#)

Human-AI Collaboration



<https://techybex.com/human-machine-collaboration-the-age-of-artificial-intelligence/>



<https://link.springer.com/article/10.1007/s12599-019-00595-2>

APPLIED GENAI @ FONTYS ICT

GenAI Usage Policy

We view Generative AI as both a **productivity tool and a learning tool**. This means we expect you to:

- **Achieve more** in the same timeframe: conduct deeper research, create higher-quality professional products, and engage in more profound learning
- Understand that GenAI will not reduce your study time but will **elevate the standards** we expect you to meet
- Recognize that your **future employers** will expect enhanced productivity with GenAI availability, and our educational standards reflect this reality



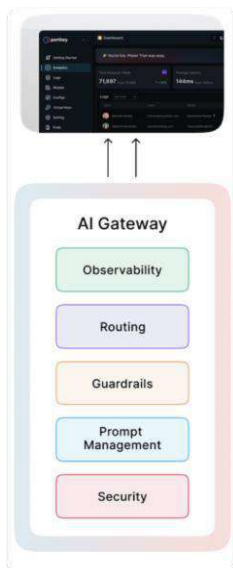
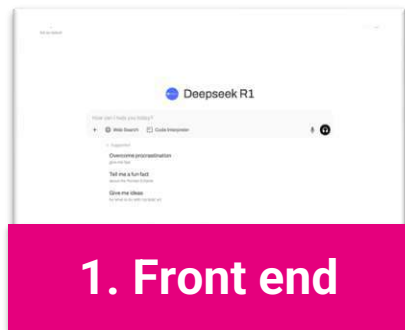
GenAI Usage Policy – GenZ version

Here's the thing about GenAI – it's basically your **productivity sidekick and learning partner** rolled into one. What does this mean for you?

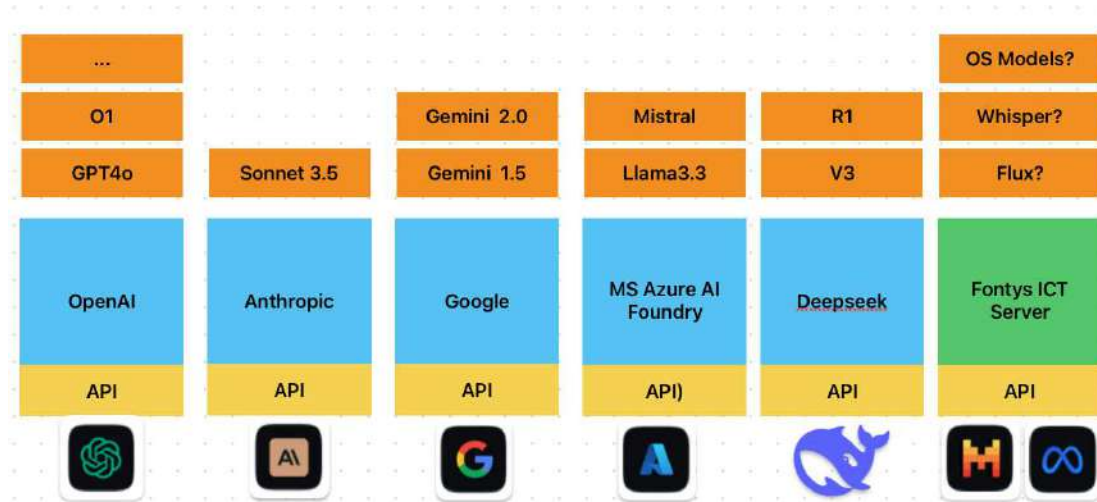
- You'll be able to **dive deeper** into research, create more impressive projects, and actually understand complex concepts better
- Plot twist: this doesn't mean less work, but rather that you'll **be producing next-level stuff** that matches what employers will expect from AI-savvy professionals
- Think of it this way: if everyone has access to GenAI in the **workplace**, the bar gets raised for everyone – including you



Fontys ICT – Infrastructure



2. Gateway

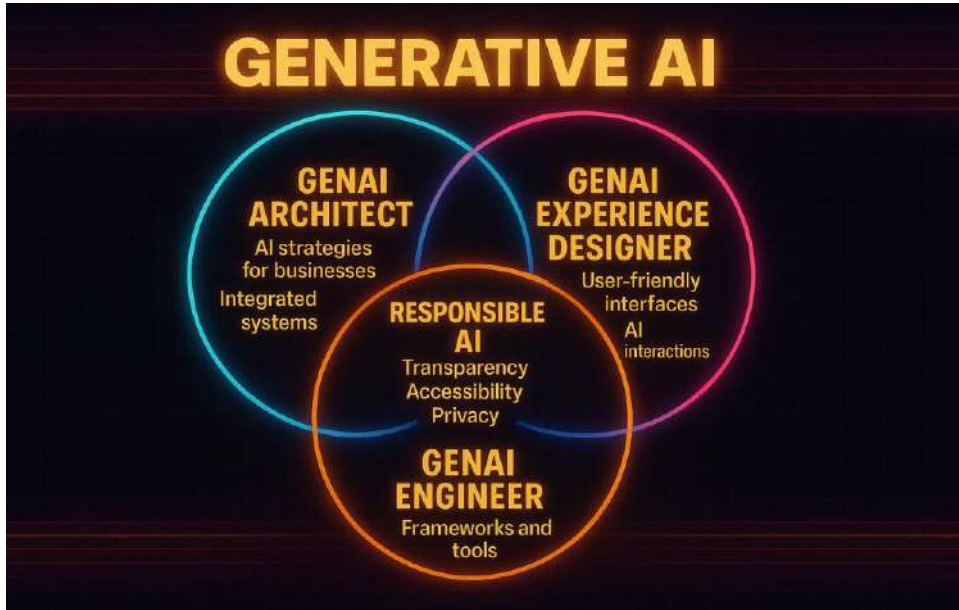


3. Modelhosting

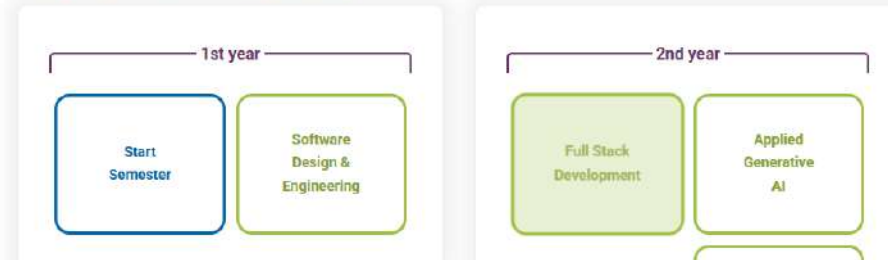


<https://chat.fontysict.nl/>

Fontys ICT – New Professional Profiles



Study programme Software Engineering



[Study Guide Fontys ICT - Applied Generative AI](#)

[What Is an AI Engineer? An Empirical Analysis of Job Ads in The Netherlands](#) -> Update for GenAI

VISION
AND
MISSION

RAISE
AWARENESS
+
INSPIRE

BASIC
UNDER-
STANDING

FACILITATE

DEEPER
UNDER-
STANDING

INTEGRATE

RECOGNIZE
+
APPRECIATE

CLEAR
POLICIES
+
GUIDELINES

COMMUNITY

CONTINUOUS
LEARNING &
EXPERIMENT

CONCLUSION

Lessons We Are Learning

- Today's impossible is tomorrows possible
- So start yesterday, learning by doing
- Rethink your SDLC, quality is paramount
- Invest in people & tools



“Augmented Engineers build better software, faster”
Let's learn together! coe-ai@fontys.nl



[Centre of Expertise AI for Society | Fontys](https://www.fontys.nl/centre-of-expertise-ai-for-society)

Questions?



> FOR SOCIETY

[Petra Heck, auteur op Fontys](#), p.heck@fontys.nl, <https://www.linkedin.com/in/petraheck/>

OTHER TRENDS

Software 3.0: Programming with NL

Software 1.0

computer code

programs

computer



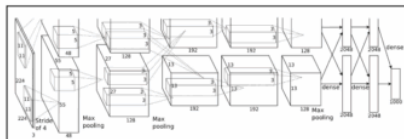
became programmable in ~1940s

Software 2.0

weights

programs

neural net



fixed function neural net

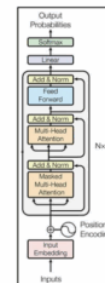
e.g. AlexNet: for image recognition (~2012)

Software 3.0

prompts

programs

LLM



~2019

LLM = programmable neural net!



[Andrej Karpathy: Software Is Changing \(Again\) - YouTube](#)

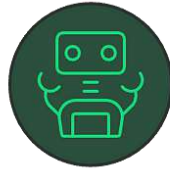
Agentic AI – Tools & Terminology

Choose the appropriate AI type for your needs



AI Agents

Automate simple tasks



Agentic AI

Make autonomous decisions









[AI Agents vs Agentic AI: What's the Difference and Why Does It Matter?](#)



Rakesh Goel  [@rakeshgoel01](#)

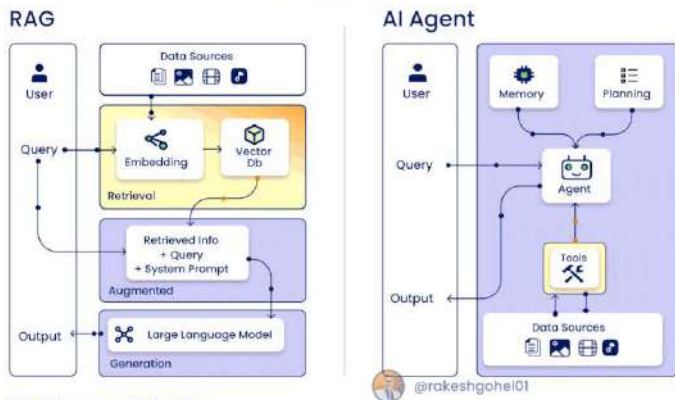
20 – AI Agent Terms

You should know

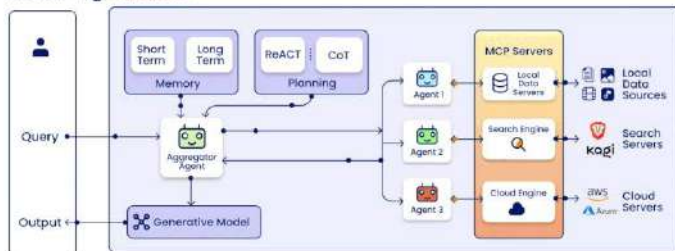
1 Agent  AI entity that uses prompts and environment to perceive and act on goals.	2 Environment  Context or sandbox where an AI agent operates and interacts with other tools.	3 Perception  The AI Agents' ability to understand and interpret environmental data.	4 Action  The current process performed by an AI agent or group of agents.
5 State  The current condition of an agent's environment or system.	6 LLMs  Large language Models - the brain behind the Agents to perform.	7 LRMs  Large Reasoning model - a reasoning type for more context based reasoning.	8 Tools  Native or Third Party APIs used by Agents to perform their task.
9 Memory  Storage for current context as well as past interactions.	10 Knowledge Base  Database for Agents' knowledge used to fuel and generate outcomes.	11 Orchestration  Process of developing agents' interaction, starting from input to output.	12 Planning  The process of an AI agent determining a sequence of actions to achieve a goal.
13 Evaluation  The assessment of an AI agent's performance, in achieving its goals.	14 Architecture  The blueprint of an AI agent, defining how its components interact.	15 CoT  A reasoning technique where an agent breaks down complex problems.	16 ReAct  A reasoning Framework for combining reasoning and acting iteratively.
17 Multi-Agent System  Multiple AI agents interacting in a shared space.	18 Swarm  Collectively exhibit intelligent behavior through self-organized interactions.	19 Handoffs  The transfer of tasks or responsibilities between Multiple AI agents.	20 Agent Debate  Engage in structured argumentation to create better outcomes.

RAG & Context Engineering

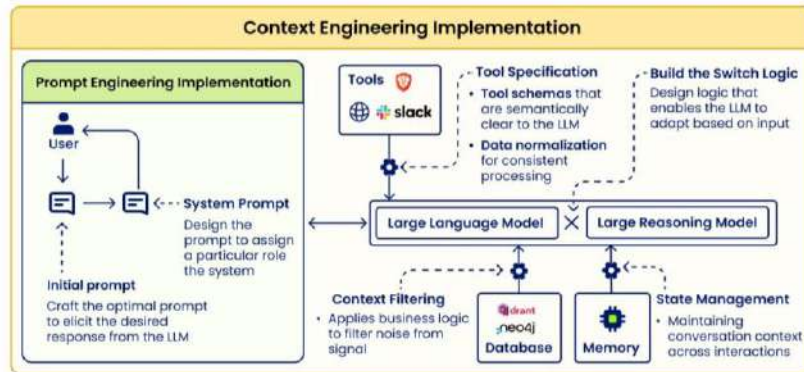
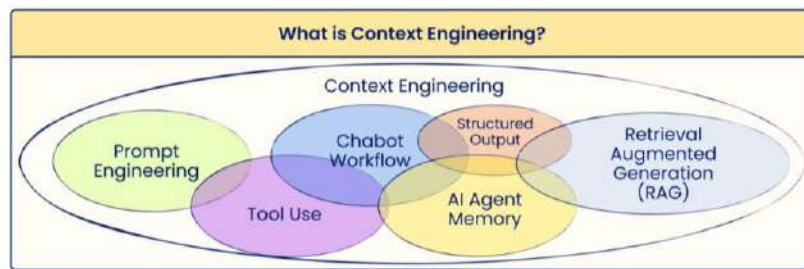
RAG vs Agentic RAG



Multi-Agent RAG



(9) Post | LinkedIn



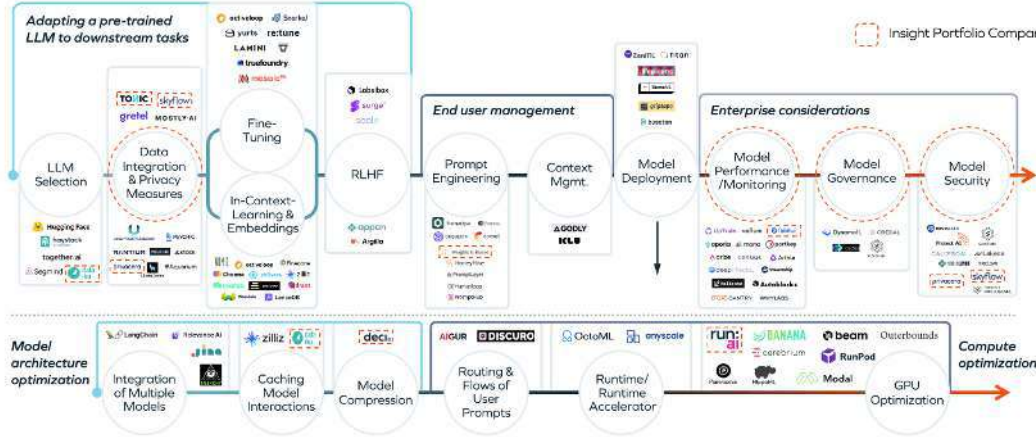
(9) Post | LinkedIn

LLMOps

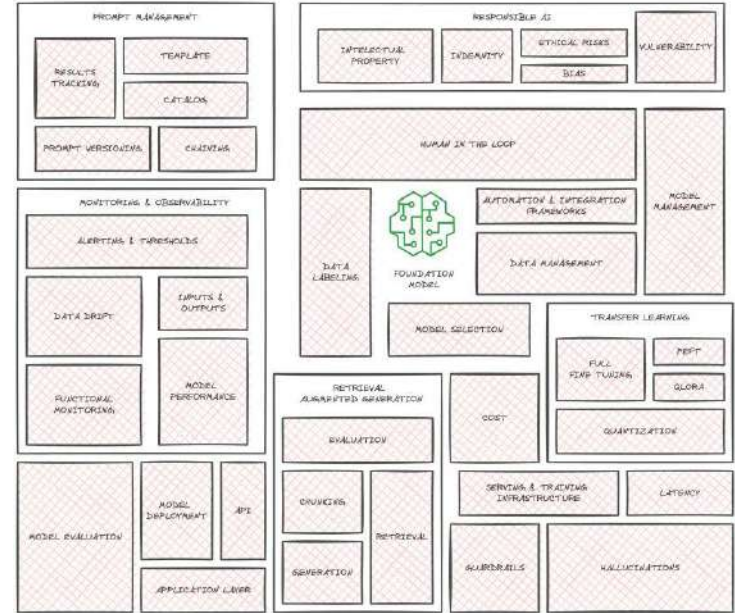
LLMOps adapts the MLOps tech stack for generative AI use cases



Insight Portfolio Company



HIDDEN TECHNICAL DEBT IN GENERATIVE AI SYSTEMS



[Navigating the LLMOps landscape: What you need to know | Insight Partners](https://fontysblogt.nl/llmops-engineering-trustworthy-llm-systems/)

<https://fontysblogt.nl/llmops-engineering-trustworthy-llm-systems/>



Visualisation by Eduardo Ordaz <https://www.linkedin.com/in/ordaz/>
Original Idea by Eduardo Ordaz (adapted from "Hidden Technical Debt in Machine Learning Systems")

AgentOps

AgentOps Patterns by Category

Category	Pattern	Description
Artefact Management	Agent Artefact Registry	Versioned store for behavioural, eval, and metadata artefacts.
Execution	Context Engine	Assembles just-enough context within budget.
	Runtime Workflow Simulator	Shadow/sandbox execution to vet plans before/during exe.
Safety & Enforcement	Guardrail Enforcement Points	Policy checks at all critical agent action points.
Monitoring & Observability	Trace Logger	Structured spans for replay and audit.
	Cumulative Risk Ledger	Append-only per-step risk signals; shows accumulation.
Evaluation-Driven Learning	Dynamic Test Case Factory	Harvests operational insights into versioned tests.
	Marginal Risk Assessor	Compares candidate vs. baseline risk.
	Agent-as-a-Judge	Evaluator agent scoring runs against contracts.
Interaction	Interactive ChatOps	Conversational queries over ops data; safe controls.
	Trust Calibration Controller	Calibrates user cues to measured reliability.
Assurance & Compliance	Assurance Evidence Factory	Sealed bundles linking artefacts to bounded claims.

