



Implementing AI in machine design

Using AI in machine-design workflows to improve knowledge retrieval, concept work, documentation, and controlled engineering review.

WORKS WITH THE ASSISTANTS TEAMS ALREADY USE



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AT A GLANCE

Using AI in machine-design workflows to improve knowledge retrieval, concept work, documentation, and controlled engineering review.

Machine design teams lose hours to reading long customer requirements, searching old projects, rewriting the same documentation and preparing for design reviews. AI can take a real share of that work when it is used as a fast, fallible assistant. This playbook shows where it fits, how to set it up safely around CAD and IP, and how to run each task with request templates and checks. Calculations, safety decisions and sign-off stay with qualified engineers throughout.

WHO IT IS FOR Mechanical design leads, senior engineers and engineering managers who want practical, safe ways to use AI in machine and equipment design.

TIME TO USE 60 minutes to read; one team session to apply

What you will have at the end

- A work map showing which design tasks suit AI and where an engineer must check
- Information rules covering CAD files, supplier data and customer IP
- Request templates for requirements capture, concept exploration, standards lookup, calculation checking and documentation
- A verification routine and a simple baseline for measuring time saved and quality

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EXECUTIVE BRIEF

What AI is for in a machine design team

01



AI is useful where design work is mostly reading, structuring and writing. It is not a source of engineering truth.

A typical machine design project spends a surprising share of its hours outside the CAD model. Someone reads a forty-page customer specification and pulls out the requirements. Someone searches old projects for a similar gearbox mount. Someone writes the design basis, the review pack, the maintenance notes and the change log. These tasks are language-heavy, repetitive and tedious, which is exactly where a language model helps.



The same model is a poor place to get a bearing life, a weld size or a guard distance. It can produce a confident number that is wrong, cite a clause that does not say what it claims, or mix up units. The rule that makes AI safe in this field is simple: AI drafts, structures and challenges, and a qualified engineer calculates, decides and signs.

- Use AI to turn long documents into structured requirement lists you then verify against the source.
- Use AI to widen concept exploration and to prepare design review questions.
- Use AI to find where in your own approved standards and handbooks an answer should be, then read the source yourself.
- Use AI to check calculations for unit errors, missing cases and unstated assumptions, never to replace them.
- Do not use AI to approve a design, certify safety or decide compliance.

**THE ONE-LINE POLICY**

Nothing generated by AI enters a drawing, calculation, specification or safety file until a named engineer has checked it against a primary source and taken responsibility for it.



WORKING QUESTION

Which two design tasks last month were mostly reading and writing, and how many engineer hours did they take?

THE WORK MAP

Where AI fits across the design cycle

02

Map the tasks first. A clear split between good fits and human checkpoints prevents both timid use and reckless use.

Start with a plain list of the tasks your team performs from enquiry to handover. For each, ask two questions: is the main work language and structure, and what is the cost if a wrong output slips through? Tasks with high language content and low cost of a caught error are your first candidates. Tasks where an unnoticed error could injure someone or fail a certification are limited to support roles.

DESIGN TASK	GOOD FIT FOR AI	HUMAN CHECKPOINT
Customer requirements review	Extract requirements, flag ambiguity, list open questions	Engineer reconciles list to the source document line by line
Concept exploration	Generate alternative architecture, trade-off tables, failure questions	Lead engineer filters by physics, cost and manufacturability
Standards and design-rule lookup	Point to likely relevant sections in approved internal sources	Engineer reads the current standard text and applies it
Calculation checking	Check units, missing load cases, inconsistent inputs	Qualified engineer owns and re-derives the calculation
Supplier and component research	Summarize datasheets, build comparison tables	Engineer verifies figures against the manufacturer document
Design documentation	Draft design basis, operating notes, change summaries	Author checks every figure against model and drawings

DESIGN TASK	GOOD FIT FOR AI	HUMAN CHECKPOINT
Design review preparation	Draft checklists, anticipate questions, summarize open actions	Review chair decides what the review actually covers
Safety and risk assessment	Prompt for overlooked hazards as brainstorming aid only	Qualified person performs and signs the assessment



Reading the table

The last row matters most. AI can ask, what happens if an operator reaches in during a jam, and that prompt may surface a hazard someone missed. It cannot own the risk assessment, and it does not know your machine, your site or the current regulatory requirements. Check current requirements that apply to your product and market with your compliance function.

- Green tasks: drafting, summarizing, structuring, brainstorming. Use freely with a check.
- Amber tasks: lookups and comparisons. Use to find, then verify at the source.
- Red tasks: calculations of record, compliance decisions, safety sign-off. AI supports at most, never decides.



WORKING QUESTION

Which row of your own task list would you put in red that people may currently treat as green?



SETTING UP SAFELY

Information rules, approved tools and IP

03

Machine design data is valuable intellectual property, often held under customer confidentiality. Decide what can go where before anyone pastes anything.

Most risk in early AI use is not a wrong answer but a data leak. Engineers paste a customer drawing, a supplier quote or a proprietary mechanism description into whatever tool is open. Fix this with a short written rule that sorts information into classes and names the tools allowed for each. Keep it to one page so people actually read it.

INFORMATION CLASS	EXAMPLES	RULE
Public	Published standards titles, public datasheets, textbook methods	Any approved tool
Internal	Your design guidelines, lessons learned, templates	Approved company tools only
Customer confidential	Customer specifications, drawing process data	Only if contract allows and tool terms are checked; otherwise anonymize
Crown jewels	Novel mechanisms, unpatented designs, tooling know-how, full CAD models	No external AI tools without explicit sign-off from a named owner

Before a tool is approved

- Confirm in the vendor terms whether your inputs are retained or used for training, and what the business plan guarantees.
- Check customer contracts and NDAs for limits on third-party processing of their data.
- Decide where outputs are stored and who can see the conversation history.
- Name an owner for the tool list and a route to request additions.
- Record the date you checked the terms, because terms change.

Working with CAD and simulation data

Treat CAD models, meshes and simulation result files as the highest-risk class. A model holds geometry, tolerances, material choices and sometimes customer part numbers. If you want help with a feature or a simulation setup, describe it in words with dimensions replaced by ranges or symbols, and strip customer names, part numbers and revision data. Never upload a native file to a tool you have not cleared.



ANONYMIZE BY DEFAULT

Replace the customer with Customer A, the product with the machine, exact dimensions with symbols such as D1 and L2, and delete part numbers. If a question cannot be asked without the secret, do not ask it outside an approved environment.

WORKING QUESTION

If an engineer pasted a customer drawing into a public chatbot tomorrow, would your current rules have told them not to?



TASK PLAYBOOKS: REQUIREMENTS AND CONCEPTS

Requirements capture and concept exploration

04



These two tasks open every project. AI shortens the reading and widens the options, while the engineer keeps the filter.

Playbook 1: Requirements capture

01 Prepare the source

Use only text you are allowed to process, with customer identifiers removed. Break long document into sections so you can trace each output to a page.



02 Extract

Ask for a numbered list of requirements, each tagged as functional, performance, interface, environmental, safety, standards, or commercial, with the source section.

- 03 Flag**
Ask separately for ambiguous terms, conflicting statements, missing values and unstated assumptions. Keep this apart from extraction so extraction stays faithful.
- 04 Verify**
Check the list against the document. Count requirements in each section, confirm numbers and units, and spot-check every safety item.
- 05 Send questions**
Turn the verified flags into a clarification list for the customer or sales contact.

REQUEST TEMPLATE: REQUIREMENTS EXTRACTION

You are helping a mechanical design engineer. Below is section 4 of a customer specification. List every requirement as a numbered row: ID, requirement text copied closely, type (functional, performance, interface, environmental, safety, standard, commercial), and section reference. Do not infer or add requirements. If a statement is vague, list it under Unclear instead. Text: [paste]

Playbook 2: Concept exploration

- 01 State the problem as functions**
Write what the machine must do, the constraints and the target values you already trust, without naming a preferred solution.
- 02 Generate options**
Ask for several distinct architectures, including at least one unconventional approach, with working principle and likely failure modes for each.
- 03 Compare against criteria**
Ask for a trade-off table on criteria you set, such as cost, wear, maintainability, footprint and risk of unproven technology.
- 04 Filter with engineering judgment**
Discard what violates physics, supply realities or your manufacturing capability. Note why, so the reasoning is recorded.
- 05 Take two or three forward**
Calculate and sketch them yourself. The AI list is a prompt, not a result.

REQUEST TEMPLATE: CONCEPT OPTIONS

A machine must move 20 kg parts from conveyor A to station B, 1.2 m apart, at 30 cycles per minute, in a washdown environment. Propose five distinct mechanisms. For each give the principle, main components, two likely failure modes and one risk to check early. Then compare them on cost, wear, cleanability and complexity. Flag any assumption you made.



WORKING QUESTION

What is the last requirement set your team misread, and what would a flagged-ambiguity pass have caught?



TASK PLAYBOOKS: STANDARDS, CALCULATIONS AND DOCUMENTS

Standards lookup, calculation checking and documentation

05

Here the risk is highest and the discipline matters most. Use AI to locate, to challenge and to draft, then verify at the source.



Playbook 3: Design-rule and standards lookup

A general model may misquote clause numbers, merge old and new editions, or invent a requirement that sounds right. For this reason, the safest pattern is to give the assistant your own licensed or internal text and ask it to point to passages, rather than asking it to recall a standard from memory. Where your organization has an approved internal knowledge base, use it. Always read the clause itself and confirm the edition currently applicable to your product and market.



01 Supply the source

Provide the relevant excerpt or internal guideline you are entitled to use.

02 Ask for pointers

Ask which sections bear on a stated design question and why, quoting the exact wording.

03 Read the clause

Open the primary text and confirm the wording, edition and applicability.

04 Record the basis

Write the clause reference and edition in the design file, not the AI summary.

REQUEST TEMPLATE: STANDARDS POINTER

Using only the excerpt below, identify which clauses relate to guarding of a rotating shaft accessible during maintenance. Quote each clause exactly with its number. If the excerpt does not address the question, say so rather than answering from general knowledge. Excerpt: [paste]

Playbook 4: Calculation checking

Give the assistant your calculation as written, with inputs and method, and ask it to review rather than to compute. Common catches are mixed units, a missing load case such as start-up or emergency stop, a factor applied twice, and an assumption that appears in the result but not in the inputs. Arithmetic by a language model is unreliable, so recompute any number it questions in your own tool.

REQUEST TEMPLATE: CALCULATION REVIEW

Review this shaft sizing calculation as a checker, not a calculator. List: any unit inconsistencies; load cases that appear missing; assumptions used but not stated; steps where the method looks inappropriate and why. Do not provide corrected numbers. Calculation: [paste, with symbols not customer data]

Playbook 5: Documentation

01 Gather facts first

Collect the verified parameters, drawing numbers and decisions into a short fact sheet.

02 Draft from the fact sheet

Ask for a design basis, operating notes or change summary written only from those facts, with gaps marked.

03 Check every figure

Compare numbers, part names and revision letters against the model and drawing.

04 Own the final

The author signs. Keep the fact sheet so a reviewer can trace each statement.



WORKING QUESTION

Which calculation in your last project would have benefited from a second reader that checks units and missing cases?

VERIFICATION

Verification and review habits

06



A good habit set makes checking fast and routine. Without one, people either trust everything or give up.

Verification should scale with consequence. A rewritten meeting summary needs a skim. A tolerance table, a torque value or a clause reference needs a check against a primary source. Safety-relevant content needs a qualified reviewer regardless of who or what drafted it. Write down which level applies to which output type, so nobody improvises under deadline pressure.



Engineer checks before using any AI output

- Every number traced to a source, model or calculation you own.
- Units stated and consistent through the chain.
- Every standard or clause reference opened and read in the current edition.
- Assumptions listed and accepted by you, not just by the tool.
- Nothing in the output contradicts the drawing or the requirements list.
- Customer or confidential data was not present in the request.



Typical failure modes to look for

- 
- Confident wrong numbers, often in unit conversions or in fits and tolerances.
 - Invented or misattributed clause numbers and standard titles.
 - Plausible but physically impractical concepts, such as ignoring thermal growth or assembly access.
 - Silent omission of a requirement in a long extraction.
 - Fluent documentation that describes the intended design rather than the actual current revision.

SECOND-PASS PROMPT

Ask the assistant to list the five weakest points of its own answer and what evidence would confirm each. It will not make the answer right, but it gives your review a starting map.



For design review, keep a short log of AI-assisted items: what was drafted, who checked it, and against which source. This costs minutes and gives you an audit trail if a question arises later from a customer, a certifying body or your own quality system.

WORKING QUESTION

For your most safety-critical output, who is the named person who would answer why it is correct?



MEASURING

Measuring time saved and quality

07



Measure before and after on a small set of tasks, and track quality as carefully as speed.

Claims of time saved are cheap and unreliable. Pick three to five repeatable tasks, such as a requirements extraction, a design basis draft or a review pack. Time them as done today across several recent examples to form a baseline. Then time the AI-assisted version including the checking time, because checking is part of the job. Compare the full cycle, not just the drafting step.



METRIC	HOW TO CAPTURE IT	WHAT IT TELLS YOU
Cycle time per task	Engineer logs start and finish, including checking	Real time saved after verification
Corrections found at review	Count changes a reviewer makes	Whether quality is holding or slipping
Escaped errors	Errors found after release or in later phases	Whether checks are working
Requirements missed	Compare extraction with a second reader on a sample	Reliability of the extraction step
Reuse rate of templates	Count uses of shared request templates	Whether good practice is spreading
Engineer confidence	Short monthly pulse, 3 questions	Adoption risk and over-trust



ILLUSTRATIVE EXAMPLE

Suppose a design basis took 6 hours and the AI-assisted version takes 2.5 hours drafting plus 1.5 hours checking. The saving is 2 hours, not 3.5. These numbers are illustrative only; measure your own.



Watch for the quality side with equal care. If reviewers start finding more errors, or the same kind of error repeatedly, tighten the checkpoint or drop that use. A small, honest dataset after one quarter is enough to decide where to expand and where to stop.

WORKING QUESTION

Which task would you time this week to create a baseline you can trust?

TEAM ROUTINES

Team routines and sharing what works

08

Individual skill does not scale. Shared templates, short reviews and clear ownership do.

Engineers who find a good request template usually keep it to themselves, and engineers who make a bad mistake rarely mention it. Create a lightweight routine that makes both visible. The aim is a small, living library of tested requests with notes on what to check, plus a habit of reporting near misses without blame.

01 Create a shared template library

One page per task with the request text, the required inputs, the verification checklist and an example of a good output.

02 Hold a short monthly review

Thirty minutes: one win, one miss, one template change. Keep a log of decisions.

03 Pair on the first runs

A senior engineer sits with a newer one on the first two uses of each template to pass on the checking habits.

04 Name an owner

One person maintains the tool list, the information rules and the library, and answers questions.

05 Review the rules quarterly

Tools, contracts and team needs change. Revisit the red, amber and green list.

- Record the prompt, the date and the tool in the design file when AI contributed to a deliverable.
- Treat a near miss, such as a wrong clause caught at review, as useful data and share it.
- Train juniors to check first and trust later, because they lack the experience to feel when a number is off.
- Do not let anyone feel pressured to use AI on work they believe is unsafe to delegate.



WORKING QUESTION

Who in your team currently holds the best request templates, and how would others get them?



PITFALLS

Pitfalls and a worked scenario

09

Most failures are predictable: over-trust, leaked data, and quiet loss of engineering skill.

- Treating fluent text as correct text, especially in standards and calculations.
- Uploading customer or CAD data to unapproved tools under deadline pressure.
- Skipping the baseline, then being unable to say whether anything improved.
- Letting AI-drafted documentation drift away from the real model revision.
- Using AI to avoid learning the standard, so judgment weakens over time.
- Allowing a single enthusiast to set practice without shared rules.



 ILLUSTRATIVE SCENARIO (HYPOTHETICAL)

A small design team asks an assistant for the minimum guard opening for a conveyor nip point. It returns a clear value with a clause number. An engineer, short of time, copies it into the design basis. At review, a colleague opens the standard and finds the value belongs to a different hazard and a different edition. The fix is cheap because it was caught. The rule that follows: clause references are opened, never copied.

That scenario is invented for illustration, but the pattern is common. The tool did what it does: it produced plausible text. The control that worked was a review habit tied to a primary source. Build that habit into the process rather than relying on individual caution.



If you want help deciding where AI fits in your engineering workflow, Halden & Company offers free assessments at halden.company/assessments, and you can reach the team at halden.company/contact.

WORKING QUESTION

What is the cheapest control you could add this month that would have caught your most likely AI-related error?

30 / 60 / 90



A first quarter that produces evidence

10



Start narrow, protect the data, measure honestly, and expand only where checking holds up.

First 30 days: ground it

- Write the one-page information rules and approved tool list, covering CAD, customer data and IP.
- Build the red, amber and green work map for your own design tasks.
- Pick three repeatable tasks and record baseline times and error counts.
- Create the first two request templates: requirements extraction and design basis drafting.



Days 31 to 60: test it

- Run the pilot tasks with the verification checklist and log time including checking.
- Hold the first monthly review and refine templates from real misses.
- Add calculation-checking and standards-pointer templates with an internal source set.
- Pair senior and junior engineers on first uses.

Days 61 to 90: decide

- Compare baseline and pilot results on time, corrections and escaped errors.
- Decide which uses to scale, change or stop, and record why.
- Update the information rules and tool list against current contracts and vendor terms.
- Publish the template library and name its permanent owner.



GLOSSARY

Terms used in this publication

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TERM	MEANING
Design basis	A document stating the requirements, assumptions, standards and conditions on which a design rests.
Hallucination	A fluent output that is false or unsupported, such as an invented clause number or value.
Prompt	The instruction and context given to an AI system; also called a request.
Request template	A tested, reusable prompt with defined inputs and a matching verification checklist.



TERM	MEANING
Human checkpoint	A defined point where a named person reviews and takes responsibility before work moves on.
Primary source	The original standard, drawing, datasheet or calculation, as opposed to a summary of it.
Load case	A defined condition of forces and operation, such as start-up or emergency stop, used in analysis.
Trade-off table	A comparison of options against agreed criteria such as cost, wear and maintainability.
Anonymization	Removing names, part numbers and exact values so a request does not expose confidential information.
Baseline	A measured record of how long a task takes and how well it is done before AI is introduced.
Audit trail	A record of what was drafted, by which tool, who checked it and against which source.
Intellectual property (IP)	Proprietary designs, know-how and data that give a company competitive value and need protection.

A note on use

This playbook is general guidance for engineering teams. It is not engineering certification, legal or compliance advice. Check applicable standards, contracts and regulations with qualified people.

TAKE THE NEXT STEP

Take the free Halden assessment at halden.company/assessments, or talk to us at halden.company/contact about turning this into a plan for your organization.