FDE Portfolio Project Planner

A Practical Guide to Building a Forward Deployed Engineer Portfolio

1. Understand What FDEs Need to Demonstrate

Forward Deployed Engineers operate at the intersection of software engineering, solution architecture, product thinking, and customer delivery. A portfolio project should therefore tell a complete story: who had the problem, what constraints shaped the solution, how the system was built, how it was deployed, and what value it created. The sections below define the evidence your project should provide.

1.1 Software Engineering

Your project must demonstrate that you can build maintainable production-oriented software rather than a one-off prototype. Reviewers should be able to understand the repository, run the solution with reasonable effort, and see evidence of sound engineering decisions.

- **Code quality:** use clear naming, modular components, consistent formatting, and concise comments where logic is not obvious.
- **Architecture:** separate user interface, business logic, data access, and external integrations where appropriate.
- **Testing:** include unit tests for core logic and integration tests for critical workflows.
- **Developer experience:** provide setup instructions, sample environment variables, seed data, and repeatable commands.

- **Decision-making:** document important trade-offs, such as speed versus extensibility or managed services versus custom components.

Example: an AI-assisted support triage application might contain a web interface, a workflow service, a rules module, an LLM adapter, and a ticketing-system connector. Tests could verify ticket classification, priority rules, malformed inputs, and fallback behavior when the model is unavailable.

1.2 APIs and Data Integration

FDE work often involves connecting systems that were not designed to work together. Your project should show that you can consume, transform, validate, and expose data through well-defined interfaces.

- Integrate at least one realistic external API, SDK, webhook, event stream, or sample enterprise system.
- Handle authentication, pagination, rate limits, timeouts, retries, duplicate events, and partial failures.
- Validate incoming data and map it into a consistent internal model.
- Design useful API endpoints with clear request, response, and error contracts.
- Use mock services or sandbox accounts when real enterprise access is unavailable.

Example: a service-desk assistant can receive a webhook from a ticketing platform, retrieve user or asset context, classify the incident, and send a recommended action back through an API. The portfolio should explain how duplicate webhooks and unavailable downstream services are handled.

1.3 Cloud and Deployment

A repository alone does not prove that a solution can be operated. Deploy the application to a cloud or hosted environment and make the deployment reproducible.

- Package the application using containers or a clearly documented runtime.
- Define configuration separately from code and keep secrets out of the repository.
- Automate build, test, and deployment steps through a CI/CD workflow.
- Include health checks, structured logs, and basic operational metrics.
- Document expected cost, scaling assumptions, and how the environment can be removed safely.

Example: deploy the user interface as a managed web application, the API as a container service, and the database as a managed data store. A pull request can trigger tests, while an approved merge triggers deployment to a demonstration environment.

1.4 AI and Agentic AI

If the project uses AI, it should solve a defined task and not merely add a chat interface. Show how the model receives context, uses tools, produces structured outputs, and remains under appropriate human control.

- Define the model's role, instructions, available tools, and prohibited actions.
- Ground outputs in approved data and identify when the system should abstain.
- Use structured output validation before downstream actions are executed.
- Evaluate quality using a test set that includes normal, ambiguous, and adversarial cases.
- Track latency, cost, failure rate, and task-success measures.
- Require human approval for high-impact or irreversible actions.

Example: an incident-response agent may summarize an issue, retrieve relevant runbooks, recommend a priority, and draft next steps. It should not close a ticket or trigger a production change without authorization. A useful evaluation set would include missing details, conflicting signals, prompt-injection attempts, and unavailable knowledge sources.

1.5 Security and Reliability

Security and reliability should be visible design concerns, not final-page disclaimers. Explain the risks that matter for the use case and the controls that reduce them.

- Apply least-privilege access and separate user, service, and administrative permissions.
- Protect secrets, sensitive logs, customer data, and personally identifiable information.
- Validate inputs and outputs, especially at API and AI-tool boundaries.
- Use safe retry behavior, idempotency, timeouts, circuit breakers, and graceful degradation where relevant.
- Create an audit trail for important actions and approvals.
- Describe backup, recovery, monitoring, and incident-response expectations.

Example: if an AI assistant recommends a payroll-related incident as critical, the application should record the evidence, model version, rule result, reviewer decision, and final action. If the AI service fails, the incident should remain available for manual triage rather than disappearing from the workflow.

1.6 Customer Discovery

FDEs must translate customer conversations into requirements. Your case study should show how you explored the current process before proposing a solution.

- Identify stakeholders, users, decision-makers, administrators, and affected teams.
- Ask how work is performed today, where delays occur, and what exceptions are common.
- Separate stated feature requests from the underlying operational problem.
- Capture constraints such as data residency, integration limits, approval steps, budget, and implementation time.
- Define success measures with the customer instead of inventing them after development.

Example discovery questions:

- What event starts the current workflow, and what marks it as complete?
- Which step consumes the most time or creates the most rework?
- What information do users need but struggle to obtain?
- Which actions require human approval, and why?
- What would improve within 30 days if this solution worked?

1.7 End-to-End Delivery

The portfolio should connect discovery, design, implementation, deployment, adoption, and measurement. Avoid presenting isolated technical features with no delivery narrative.

- **Discover:** summarize the current state, users, pain points, constraints, and baseline.
- **Define:** write a focused problem statement, scope, acceptance criteria, and non-goals.
- **Design:** create architecture, data-flow, threat, and failure-path views.
- **Build:** implement thin vertical slices that deliver usable value early.
- **Validate:** test technical behavior with representative scenarios and obtain user feedback.
- **Deploy:** release through a repeatable process with monitoring and rollback guidance.
- **Adopt:** provide documentation, onboarding, and operational ownership.
- **Measure:** compare results with the original baseline and record lessons learned.

Portfolio evidence checklist: problem brief, requirements, architecture diagram, annotated repository, API contract, test evidence, deployment link or recording, security notes, operational runbook, user feedback, impact metrics, and a retrospective.

2. Choose Your Portfolio Project

Select a project that is narrow enough to complete but rich enough to demonstrate customer-facing engineering. The best choice contains a real workflow, multiple system boundaries, operational constraints, and a result that can be measured. It does not need to be a large product; a polished vertical slice is more persuasive than an unfinished platform.

2.1 Project Idea

Write the idea as a solution hypothesis rather than a list of technologies. Start with the workflow and outcome, then explain the technical approach.

Template: Build a solution that helps [target user] complete [important task] by [core capability], using [key integrations or technologies], while meeting [important constraint].

Example: Build an AI-assisted incident triage workspace that helps service-desk analysts classify incoming tickets, retrieve approved runbooks, and draft response steps by integrating a ticketing API, a knowledge repository, and an auditable AI workflow, while keeping escalation decisions under human control.

Selection criteria:

- Can a reviewer understand the problem in less than one minute?

- Does the project include meaningful application logic rather than only a model call?
- Can you demonstrate at least one integration and one deployment workflow?
- Are success measures observable with synthetic, public, or safely anonymized data?
- Can you build a credible minimum viable version in four to eight weeks?
- Does the project create opportunities to discuss failures, trade-offs, and customer feedback?

2.2 Customer Problem

Describe the problem from the customer's perspective, including the current workflow, friction, impact, and evidence. Avoid defining the problem as the absence of your preferred technology.

Weak problem statement: "The customer does not have an AI agent."

Stronger problem statement: "Service-desk analysts spend significant time reading unstructured tickets and searching across multiple runbooks. Inconsistent triage delays escalation of high-impact incidents and increases avoidable reassignment."

Problem statement template: [User or team] struggles to [job to be done] because [root causes or constraints]. This leads to [measurable operational or business impact]. Existing approaches fall short because [specific limitations].

- Record the current process in five to ten steps.
- Identify bottlenecks, handoffs, duplicate work, and exception paths.
- Gather baseline measures such as handling time, error rate, completion rate, or wait time.
- State assumptions explicitly and note how you would validate them with a real customer.
- Define non-goals to prevent the portfolio project from expanding indefinitely.

2.3 Target User

Choose a primary user with a specific job, environment, and level of expertise. “Business users” is too broad. Secondary users can be included, but the main workflow should optimize for one clear persona.

Example primary persona: a Level 1 service-desk analyst who handles a high volume of incidents, works under response-time targets, can view approved troubleshooting information, but cannot make high-risk production changes.

User profile prompts:

- What outcome is this person responsible for?
- What systems and information sources do they use today?
- What decisions are they authorized to make?

- What makes the workflow difficult during busy or high-severity periods?
- What accessibility, language, device, or training needs should the design consider?
- What would make the user trust or reject the proposed solution?

Also identify supporting stakeholders such as the platform administrator, security reviewer, operations manager, data owner, and executive sponsor. Explain how their needs influence the design without allowing every stakeholder request to become part of the first release.

2.4 Business Use Case

Convert the customer problem into a bounded use case with actors, triggers, inputs, actions, outputs, rules, and success conditions. This makes the work testable and helps reviewers see how technology supports the business process.

Example use case: AI-assisted incident triage

- **Actor:** service-desk analyst.
- **Trigger:** a new incident is created through the portal or API.
- **Inputs:** incident description, affected service, user context, recent related incidents, and approved runbooks.

- **Process:** validate the ticket, classify category and urgency, retrieve relevant knowledge, generate an evidence-linked recommendation, and present it for review.
- **Output:** proposed category, priority, assignment group, response draft, confidence indicator, and supporting evidence.
- **Business rules:** payroll-impacting or safety-critical incidents require explicit escalation; low-confidence outputs must be reviewed manually.
- **Success condition:** the analyst approves or edits the recommendation and the result is written back with an audit record.

Suggested scope:

- **Minimum viable product:** ingest a ticket, retrieve context, generate a structured recommendation, collect approval, and write the result back.
- **Stretch capability:** detect related incidents, recommend a major-incident candidate, or provide multilingual summaries.
- **Non-goals:** autonomous production remediation, replacement of the ticketing platform, or ingestion of unrestricted sensitive data.

2.5 Why the Problem Matters

Close the project-selection section with a credible value case. Connect technical work to user experience, operational performance, risk, and business outcomes. Use ranges or clear hypotheses when verified data is not yet available.

- **User value:** less searching and re-entry, clearer guidance, and faster completion of routine steps.
- **Operational value:** more consistent classification, fewer reassignments, and improved response times.
- **Risk value:** stronger approvals, traceability, data handling, and escalation discipline.
- **Business value:** reduced downtime, better service quality, or greater capacity without proportional staffing increases.
- **Learning value:** evidence about where AI helps, where deterministic rules perform better, and where human judgment remains essential.

Measurement example: compare a baseline set of incidents with the assisted workflow. Track median triage time, first-time assignment accuracy, recommendation acceptance rate, escalation recall for critical cases, average AI cost per ticket, and the percentage of outputs requiring correction. Pair quantitative measures with short user interviews to understand trust and usability.

Project choice decision: score each candidate idea from 1 to 5 for customer relevance, technical depth, integration realism, security and reliability learning, measurable impact, data availability, and feasibility. Prefer the idea with balanced evidence across all categories rather than the most fashionable technology.

Portfolio Project Definition Worksheet

- **Working title:** _____
- **Solution hypothesis:** _____
- **Primary customer problem:** _____
- **Target user:** _____
- **Current workflow:** _____
- **Core business use case:** _____
- **Key integrations:** _____
- **AI or agent role, if applicable:** _____
- **Human approval points:** _____
- **Security and reliability constraints:** _____
- **Success metrics:** _____
- **MVP scope:** _____

- **Non-goals:** _____
- **Eight-week delivery milestone:** _____

Completion checkpoint: Before development begins, you should be able to explain the target user, problem, workflow, value, constraints, MVP, and success measures in a two-minute project pitch. If any part remains vague, conduct another discovery pass or reduce the scope.

3. Define the Technical Requirements

Technical requirements translate the chosen customer problem into concrete system needs. They should identify what the solution must connect to, store, process, protect, and operate. For an FDE portfolio project, the goal is not to select the largest technology stack; it is to show that every component has a clear purpose and that the design can survive realistic enterprise constraints.

3.1 Data Sources

Start by listing the information required to complete the user workflow. For each source, document its owner, format, quality, sensitivity, refresh frequency, and method of access. This prevents the application from depending on data that is unavailable, unsafe to use, or unsuitable for the intended decision.

- **Operational data:** tickets, orders, cases, transactions, events, or workflow records.
- **Reference data:** service catalogues, product lists, organizational structures, policies, or configuration records.
- **Knowledge data:** runbooks, frequently asked questions, manuals, resolved cases, and approved guidance.
- **User and identity data:** role, team, region, entitlement, or preferred language.

- **Telemetry data:** logs, traces, usage events, model results, approvals, and feedback.

Example: an AI-assisted incident triage project may use synthetic incident records, an approved runbook collection, a service catalogue, and historical resolution labels. It should not import unrestricted employee details or confidential production logs merely because they are available.

Data-source questions:

- Who owns the source and who can authorize its use?
- Is the data structured, semi-structured, or unstructured?
- How current must it be for the use case?
- What fields are mandatory, optional, unreliable, or sensitive?
- How will missing, duplicated, stale, or conflicting records be handled?
- Can public, synthetic, or anonymized data support the portfolio demonstration?

3.2 APIs and Integrations

Define each system boundary and the contract used to cross it. An integration requirement should describe the business purpose, direction of data flow, authentication method, expected volume, latency target, and failure behavior.

- **Inbound integrations:** REST requests, webhooks, file uploads, scheduled imports, queues, or event streams.
- **Outbound integrations:** status updates, notifications, ticket changes, knowledge retrieval, or analytics events.
- **Contract design:** required fields, data types, versioning, validation rules, response codes, and error messages.
- **Resilience:** timeouts, retries with backoff, idempotency keys, dead-letter handling, and rate-limit management.
- **Testing:** mocks for local development, sandbox environments, contract tests, and failure simulations.

Example API flow: a ticketing platform sends a new-incident webhook. The application validates its signature, stores the event, retrieves allowed context through the ticket API, requests an AI recommendation, waits for analyst approval, and sends an update back. If the write-back fails, the approved result remains queued for retry and is visible to an operator.

Minimum API documentation: include an endpoint list, sample requests and responses, authentication expectations, common failure codes, retry behavior, and one sequence description showing the full workflow.

3.3 Database

Select storage based on access patterns, consistency needs, relationships, search behavior, and operational effort. A relational database is often a strong default for workflow state and audit records; object storage may suit documents; a search or vector index may support semantic retrieval. Do not add multiple databases unless the use case clearly benefits from them.

- **Core entities:** users, cases, recommendations, approvals, source references, integration events, and audit entries.
- **Relationships:** define how records connect and which referential rules must be enforced.
- **Lifecycle:** specify creation, update, archival, retention, and deletion requirements.
- **Performance:** identify high-frequency queries and the indexing or caching they require.
- **Protection:** encrypt data in transit and at rest, restrict access, and avoid storing unnecessary sensitive fields.
- **Recovery:** document backup frequency, restoration approach, and acceptable data-loss window for the demonstration.

Example schema: an *Incident* record stores the source identifier and normalized fields; a *Recommendation* record stores structured AI output, confidence, model version, and evidence references; an *Approval* record stores the reviewer decision; and an *AuditEvent* record captures important state changes.

Design check: reviewers should be able to trace a final user-visible action back to the input record, rule result, model output, source evidence, and human decision without exposing secret credentials or unnecessary personal data.

3.4 AI/LLM Components

Define each AI component as a bounded capability with a measurable purpose. Separate tasks that require probabilistic language understanding from deterministic rules that should always behave consistently.

- **Model tasks:** summarization, classification, extraction, grounded question answering, or response drafting.
- **Context strategy:** specify which records, documents, or retrieved passages may be provided to the model.
- **Prompt design:** define the role, task, output schema, constraints, refusal conditions, and examples.
- **Tool use:** identify allowed read and write operations, required parameters, and approval gates.

- **Validation:** parse outputs against a schema and reject missing, malformed, unsupported, or unsafe results.
- **Evaluation:** create representative test cases and measure accuracy, groundedness, escalation recall, latency, cost, and user acceptance.
- **Fallbacks:** provide manual processing, deterministic defaults, or a safe retry path when the model is unavailable or uncertain.

Example allocation of work: use deterministic rules to guarantee that incidents affecting payroll during a critical processing window receive mandatory review. Use the LLM to summarize the description and retrieve relevant runbook passages. The model may recommend a priority, but a validated rule and user approval determine the final update.

Agent boundary: list what the agent may observe, reason about, recommend, and execute. For a portfolio project, begin with read-only tools and reversible write actions. High-impact actions should require explicit confirmation and produce an audit event.

3.5 Tools and Technologies

Choose technologies that support the requirements and that you can explain confidently. A coherent, maintainable stack is stronger portfolio evidence than an unnecessarily complex collection of fashionable services.

- **Frontend:** a web interface or lightweight dashboard suitable for the target user's workflow.

- **Backend:** a language and framework that support API development, validation, testing, and background jobs.
- **Data:** a relational database for workflow state, plus document or vector storage only if required.
- **Integration:** REST clients, webhook handlers, queues, schedulers, or an automation platform where justified.
- **AI:** a model provider or local model, prompt templates, retrieval logic, output schemas, and an evaluation harness.
- **Delivery:** source control, issue tracking, containerization, automated tests, CI/CD, cloud hosting, monitoring, and documentation.

Example stack: a React interface, Python API, PostgreSQL database, background worker, managed LLM endpoint, vector-enabled retrieval for approved runbooks, container-based deployment, and a CI/CD pipeline. Equivalent technologies are acceptable if the architecture and trade-offs remain clear.

Selection rule: for each tool, complete the sentence: "We selected this because the requirement is _____; the main trade-off is _____; and the simpler alternative would be _____." This demonstrates engineering judgment rather than brand familiarity.

3.6 Authentication and Permissions

Authentication proves identity; authorization determines what that identity may do. Define both for human users, service accounts, and external integrations. Use least privilege and make sensitive actions explicit.

- **User authentication:** use a recognized identity provider, standards-based sign-in, or a clearly marked demonstration mechanism.
- **Service authentication:** use managed identities, workload identities, OAuth credentials, or scoped API keys stored in a secret manager.
- **Role-based access:** define roles such as analyst, reviewer, administrator, and auditor.
- **Object-level rules:** determine whether users can view or modify only assigned records, team records, or all records.
- **Agent permissions:** grant each tool only the read or write scope needed for its assigned task.
- **Session controls:** address expiration, token validation, logout, and protection from unauthorized reuse.
- **Auditability:** record sign-in events, permission changes, approvals, and material write actions.

Example permission model: an analyst can view a ticket and edit an AI draft; a reviewer can approve high-severity recommendations; an administrator can configure integrations but cannot silently approve business decisions; and the AI service identity can retrieve approved knowledge but cannot read unrelated repositories.

Technical Requirements Worksheet

- **Required data sources and owners:** _____
- **Data sensitivity and retention:** _____
- **Inbound interfaces:** _____
- **Outbound interfaces:** _____
- **Primary database and key entities:** _____
- **AI tasks and evaluation measures:** _____
- **Core technology stack:** _____
- **User roles:** _____
- **Service and agent permissions:** _____
- **Failure and fallback requirements:** _____

Completion checkpoint: A reviewer should be able to follow the data from its source, through each API and processing step, into storage, through any AI component, and

finally to an authorized user action. Every component should have an owner, a purpose, and a safe failure path.

4. Plan the Build

A build plan converts the requirements into a sequence of demonstrable outcomes. Plan around thin vertical slices that connect the interface, backend, data, integrations, and operational controls. This reduces the risk of finishing many isolated components without producing a usable end-to-end project.

4.1 Problem Statement

Restate the problem in a concise, evidence-oriented form before planning development. The statement should identify the user, the task, the obstacle, the impact, and the boundaries of the project.

Template: [Target user] needs to [important job], but [current obstacle] causes [measurable impact]. The project will address [defined scope] while excluding [non-goals] and respecting [key constraints].

Example: Level 1 service-desk analysts need to classify and route incoming incidents quickly, but incomplete descriptions and fragmented runbooks create delays and avoidable reassignment. The project will assist triage, evidence retrieval, and response drafting while excluding autonomous remediation and requiring human approval for critical escalations.

Problem-statement quality checks:

- It describes a customer outcome, not a preferred technology.

- It is narrow enough to deliver as a working portfolio project.
- It includes an observable baseline or a plan to establish one.
- It names constraints that materially affect the design.
- It can be tested without access to unsafe or confidential production data.

4.2 Proposed Solution

Describe the solution as an end-to-end workflow and explain why it is appropriate for the problem. Include the expected user experience, system behavior, human decisions, integrations, and measurable result.

Example proposed solution: Provide an analyst workspace that receives a new incident, validates and normalizes its fields, retrieves approved service and runbook context, generates a structured triage recommendation, and presents the recommendation with evidence. The analyst can approve or amend it before the system writes the result back and stores an audit record.

Solution summary should cover:

- The trigger that starts the workflow.
- The primary user interaction and expected decision.
- The data and systems involved.
- Which steps are deterministic and which use AI.

- Where approval, exception handling, and fallback occur.
- The outcome delivered to the customer.
- The metrics used to judge whether the solution helps.

Trade-off example: live integration with an enterprise ticketing system creates a stronger demonstration but adds authentication and sandbox dependencies. A mock connector can accelerate early development, provided the final interface contract is realistic and the limitation is documented.

4.3 System Architecture

Create an architecture that is easy to explain and supports the critical quality attributes: security, reliability, observability, maintainability, and cost control. Start with a logical view before selecting deployment products.

Suggested logical components:

- **User interface:** displays the case, evidence, recommendation, confidence, and approval controls.
- **API or application service:** validates requests, enforces authorization, coordinates workflow state, and exposes endpoints.
- **Integration adapters:** isolate ticketing, identity, notification, and knowledge-system contracts.

- **Workflow or job processor:** handles long-running calls, retries, and asynchronous updates.
- **Rules engine:** applies deterministic business rules and mandatory escalation logic.
- **AI orchestration layer:** assembles approved context, invokes the model, validates structured output, and applies guardrails.
- **Data layer:** stores workflow records, recommendations, approvals, references, and audit events.
- **Observability layer:** captures logs, traces, metrics, alerts, and AI evaluation signals.

Example request flow:

1. A new incident arrives through a signed webhook.
2. The API validates the request and records an idempotent event.
3. The application retrieves permitted ticket and service context.
4. The rules engine evaluates mandatory conditions.
5. The retrieval component selects approved runbook passages.
6. The LLM produces a schema-constrained recommendation with evidence references.

7. The user interface presents the result for validation.
8. An authorized user approves or edits the result.
9. The connector updates the source system and records the outcome.
10. Metrics and feedback are emitted for operational and quality review.

Architecture evidence to include: a context diagram, one component diagram, a sequence or data-flow view, trust boundaries, technology choices, failure paths, and a short list of architectural decisions. A static image is useful, but the accompanying explanation should show why each component exists.

4.4 Key Features

Prioritize features according to the customer workflow and evidence they add to the portfolio. Each feature should have a user outcome, acceptance criteria, dependencies, and a definition of done.

Must-have features:

- Secure sign-in and role-aware access.
- Case ingestion through an API, webhook, or realistic mock connector.
- Normalized case view with input validation.
- Retrieval of approved contextual information.
- Structured AI recommendation with citations to supporting evidence.

- Deterministic rules for mandatory escalation scenarios.
- Human review, edit, and approval workflow.
- Write-back or exported result with an audit trail.
- Tests, logs, health checks, deployment instructions, and a safe fallback path.

Should-have features:

- Feedback capture on recommendation usefulness and correctness.
- Operational dashboard for latency, failures, cost, and approval rate.
- Configurable thresholds, prompt versions, and feature flags.
- Notification when a high-impact case requires review.

Could-have features:

- Related-case clustering, multilingual summaries, or automated test-data generation.
- Limited agent tool use for reversible, low-risk updates.
- Administrator view for knowledge-source freshness and connector status.

Example acceptance criterion: Given a valid incident and available approved knowledge, when an analyst opens the workspace, the system presents a schema-valid recommendation and supporting references within the defined response-time target.

The analyst can edit and approve the result, and the source record and audit log reflect the authorized outcome exactly once.

4.5 Development Milestones

Organize milestones around usable increments rather than technical layers. Each milestone should end with a demonstration, test evidence, and a decision about what to change next.

Illustrative eight-week plan:

- **Week 1 — Discovery and scope:** finalize the persona, workflow, problem statement, assumptions, baseline, success measures, non-goals, and demonstration data.
- **Week 2 — Architecture and foundations:** create diagrams and decision records; initialize the repository, development environment, CI checks, database migrations, and basic security model.
- **Week 3 — First vertical slice:** ingest one case, validate it, store it, display it, and complete the workflow without AI.
- **Week 4 — Integration layer:** implement the external connector, mocks, contract tests, retry behavior, and observable error handling.
- **Week 5 — AI capability:** add retrieval, prompt templates, structured outputs, guardrails, evaluation cases, and deterministic escalation rules.

- **Week 6 — Human workflow and security:** add role-based review, approval, audit events, secret management, and negative authorization tests.
- **Week 7 — Deployment and validation:** deploy the solution, add monitoring and runbooks, conduct usability tests, measure outcomes, and resolve critical defects.
- **Week 8 — Portfolio packaging:** finalize documentation, architecture views, demonstration script, results, limitations, retrospective, and repository cleanup.

Milestone exit criteria:

- The targeted user flow works from beginning to end.
- Acceptance criteria and critical automated tests pass.
- Known limitations and risks are recorded.
- Security and reliability checks appropriate to the milestone are complete.
- The feature can be demonstrated with repeatable data.
- Documentation reflects the current implementation.

Build Planning Worksheet

- **Final problem statement:** _____
- **Proposed solution summary:** _____
- **Primary user journey:** _____

- **Architecture components:** _____
- **Critical trust boundaries:** _____
- **Must-have features:** _____
- **Should-have features:** _____
- **Explicit non-goals:** _____
- **Milestone demonstrations:** _____
- **Definition of done:** _____
- **Top three delivery risks:** _____
- **Portfolio evidence to capture:** _____

Completion checkpoint: The build is ready to begin when the first vertical slice is clear, the architecture supports that slice, the must-have features are prioritized, major risks have owners or mitigations, and every milestone ends with evidence that can be shown in the final portfolio.

5. Make It Production-Ready

A portfolio project becomes significantly more credible when it can be operated, observed, secured, recovered, and evaluated—not merely demonstrated on a developer laptop. Production-ready does not mean building for unlimited scale. It means defining realistic service expectations, automating repeatable operations, protecting the system, and showing how it behaves when dependencies or AI components fail.

5.1 Deployment Environment

Define separate environments so development activity does not interfere with the version used for testing or demonstration. For a portfolio project, local, test, and production-like demonstration environments are usually sufficient.

- **Local:** optimized for rapid development with mock integrations, seed data, and simple startup commands.
- **Test:** used by automated integration tests and configured with non-sensitive test credentials.
- **Demo or production-like:** deployed from an approved branch, protected by authentication, monitored, and populated only with safe data.

Keep environment-specific settings outside the code. Document required variables, allowed origins, identity-provider settings, model endpoints, database connections, feature flags, and retention periods. Never commit real secrets or customer data.

Example: the incident-triage application runs locally against a mock ticketing API. The hosted demonstration uses a sandbox connector, managed database, approved runbook set, and restricted identity tenant. The same application image is promoted between environments while configuration changes separately.

Environment readiness checklist:

- Region, data residency, and availability expectations are recorded.
- Environment names and ownership are clear.
- Configuration and secrets are managed separately.
- Test data can be reset without affecting demonstrations.
- Deployment, rollback, backup, and environment removal steps are documented.
- Costs and resource limits are visible and controlled.

5.2 Docker/Cloud Setup

Containerization makes the runtime repeatable and helps reviewers reproduce the project. Keep images small, non-privileged, and deterministic. Use cloud-managed services where they reduce operational effort without hiding important engineering decisions.

- Create one container image per independently deployed service.

- Use a fixed base-image version, multi-stage builds where appropriate, and a non-root runtime user.
- Exclude credentials, local files, and unnecessary build artifacts from the image.
- Expose a health endpoint and define startup, readiness, and shutdown behavior.
- Pass configuration at runtime rather than baking it into the image.
- Scan dependencies and images for known vulnerabilities.

Example cloud setup: deploy the frontend to a managed static or web-hosting service, the API and worker as containers, the relational database as a managed service, and approved documents in private object storage. Use a managed secret store and a hosted monitoring service. A load balancer or gateway terminates TLS and routes traffic only to healthy instances.

Infrastructure automation: define cloud resources with infrastructure-as-code or an equally repeatable deployment script. A clean environment should be creatable from documented prerequisites without manual configuration drift.

CI/CD example:

1. A pull request runs formatting, static analysis, unit tests, dependency checks, and image build validation.
2. An approved merge builds a versioned image and publishes it to a registry.

3. The pipeline deploys to the demonstration environment, applies safe database migrations, and runs smoke tests.

4. If health checks fail, the release stops or rolls back to the previous working version.

5.3 Monitoring and Logging

Observability should answer three questions: Is the service available? Is it performing correctly? Is it delivering a useful customer outcome? Combine technical signals with workflow and AI-quality measures.

- **Logs:** emit structured records with timestamp, severity, service, environment, request or trace identifier, event name, and safe diagnostic context.
- **Metrics:** track request rate, error rate, latency, queue depth, dependency failures, database health, and resource utilization.
- **Traces:** follow a request across the API, retrieval process, model call, database, and external connector.
- **Business signals:** track completed triage flows, approval rate, user corrections, first-time assignment accuracy, and processing time.
- **AI signals:** track model and prompt version, token usage, cost, invalid-output rate, groundedness, abstention, and evaluation results.

Example dashboard: show the number of incidents processed, median and high-percentile response time, workflow completion rate, integration failures, AI-output validation failures, approval rate, and estimated model cost. A second view can break errors down by dependency and release version.

Logging safeguards: redact authorization headers, tokens, passwords, personal details, and full prompt context when it may contain sensitive data. Store only information needed for operations and audit, and apply a defined retention period.

Alert examples: sustained request failure, queue backlog above a threshold, database connectivity loss, unusual authorization failures, sudden AI-cost increase, or a sharp rise in invalid model outputs. Each alert should identify an owner and link to a response procedure.

5.4 Security Considerations

Create a lightweight threat model that identifies valuable assets, trust boundaries, threat actors, misuse paths, and controls. The security section should be specific to the architecture rather than a generic checklist.

- **Identity and access:** enforce authenticated access, least privilege, role checks, short-lived credentials, and protected administrative actions.
- **Secrets:** use a secret manager, rotate credentials, and prevent secrets from entering code, images, logs, or screenshots.

- **Data protection:** minimize collection, classify data, encrypt it in transit and at rest, and define retention and deletion.
- **Application security:** validate inputs, encode outputs, restrict file types and sizes, protect sessions, and limit cross-origin access.
- **Supply chain:** pin dependencies where practical, scan packages and images, review licenses, and protect the build pipeline.
- **Network controls:** expose only required endpoints and restrict database, storage, and administration access.
- **Auditability:** record permission changes, approvals, connector updates, and other high-impact events.

AI-specific controls:

- Treat retrieved documents, user text, and tool responses as untrusted input.
- Separate system instructions from external content and test for prompt injection.
- Allow-list tools and data sources; validate every tool parameter.
- Require evidence for claims and abstain when approved evidence is insufficient.
- Prevent the model from directly executing high-impact or irreversible actions.

- Version prompts, models, guardrails, and evaluation sets to support reproducibility.

Example threat: a malicious ticket description instructs the model to ignore its rules and disclose private runbooks. The system should treat the description as data, retrieve only sources permitted for the current user, validate the response, and reject output containing unauthorized content.

5.5 Error Handling

Design failure behavior before deployment. Errors should be classified, observable, safe for users, and recoverable where possible. Do not expose stack traces, secret values, or raw provider responses through the interface.

- **Validation errors:** explain which input is missing or invalid and allow correction without losing work.
- **Authentication or authorization errors:** deny access consistently and log enough context for investigation.
- **Dependency errors:** use timeouts, bounded retries with backoff, circuit breakers, and clear service-unavailable responses.
- **Duplicate events:** use idempotency controls so retries do not create repeated updates.

- **Asynchronous failures:** retain failed work in a visible queue or dead-letter path for review and replay.
- **AI failures:** reject invalid schemas, unsupported claims, unsafe content, or low-confidence responses and route the case to manual handling.
- **Unexpected errors:** assign a correlation identifier, preserve safe diagnostics, and display a concise user message.

Example fallback: if the model endpoint times out, the analyst still sees the original incident, deterministic escalation flags, and relevant keyword-based runbook results. The interface states that AI assistance is temporarily unavailable and allows manual completion.

Error-handling record: for each critical dependency, document the likely failure, user-visible behavior, retry policy, data-preservation method, alert, owner, and recovery procedure.

5.6 Testing and Evaluation

Use a layered approach that tests software correctness, system integration, security, reliability, usability, and AI quality. Link important tests to acceptance criteria and production risks.

- **Unit tests:** validate rules, transformations, permission logic, and output parsers.

- **Integration tests:** verify database operations, API contracts, identity flows, queues, and external connectors.
- **End-to-end tests:** exercise the primary workflow from case ingestion through approval and write-back.
- **Security tests:** cover unauthorized access, privilege escalation, injection, secret exposure, unsafe uploads, and dependency vulnerabilities.
- **Reliability tests:** simulate timeouts, rate limits, duplicate events, unavailable dependencies, and recovery after restart.
- **Performance tests:** measure response time and throughput at realistic demonstration volumes.
- **Usability tests:** observe representative users completing important tasks and record confusion, errors, and trust concerns.

AI evaluation set: include clear cases, ambiguous descriptions, missing fields, conflicting evidence, unseen wording, prompt-injection attempts, irrelevant documents, and high-impact escalation scenarios. Record expected behavior before running the evaluation.

- Classification or routing accuracy
- Recall for cases that require escalation
- Evidence-supported response rate

- Invalid structured-output rate
- Human acceptance and correction rate
- Latency and cost per completed workflow
- Quality difference between model, prompt, or retrieval versions

Release gate example: deploy only if all critical workflow and authorization tests pass, no unresolved high-severity vulnerability remains, escalation recall meets the agreed target, and the rollback process has been tested.

Production-Readiness Worksheet

- **Environments and owners:** _____
- **Deployment and rollback method:** _____
- **Container and cloud controls:** _____
- **Service-level indicators:** _____
- **Alerts and response owners:** _____
- **Top security threats and controls:** _____
- **Critical failure fallbacks:** _____
- **Release test suite:** _____
- **AI evaluation thresholds:** _____

- **Known production limitations:** _____

Completion checkpoint: The solution is production-ready for its stated scope when it can be deployed repeatably, monitored meaningfully, operated without exposed secrets, degraded safely during failures, recovered through documented procedures, and released only after measurable technical and AI-quality checks pass.

6. Document the Project

Project documentation is the narrative layer of the portfolio. It should help a technical reviewer understand the implementation while also helping a customer-facing reviewer understand the operational problem and result. Write the case study as evidence of judgment: explain what you learned, what you chose, why you chose it, what failed, and what changed because of the work.

6.1 Customer Problem

Open with the customer's world rather than the technology. Summarize the user, workflow, pain point, baseline, constraints, and desired outcome. If the project is based on a simulated customer, state that clearly and distinguish tested facts from assumptions.

Recommended structure:

- **Context:** the organization or scenario, operating environment, and affected workflow.
- **Primary user:** the person performing the work and the result for which they are responsible.
- **Current state:** the steps, systems, manual work, and handoffs used before the solution.

- **Pain points:** delays, errors, inconsistent decisions, poor visibility, risk, or unnecessary cost.
- **Evidence:** baseline measures, interview observations, sample records, or documented assumptions.
- **Constraints:** time, system access, data sensitivity, approval rules, budget, and deployment limitations.
- **Success definition:** measurable technical and customer outcomes.

Example: service-desk analysts manually reviewed unstructured incidents and searched separate runbooks before selecting a category and assignment group. The project hypothesized that an evidence-linked triage assistant could reduce handling time and improve consistency, while preserving human approval for high-impact decisions.

Avoid: overstating impact, presenting assumed numbers as measured results, or claiming that lack of AI was the customer problem. The technology is part of the response; the problem is the outcome the customer struggles to achieve.

6.2 Technical Decisions

Record important decisions in concise architecture decision records. Each record should explain the context, options considered, selected approach, consequences, and conditions that would justify revisiting the choice.

Decision record template:

- **Decision:** what was selected.
- **Context:** the requirement, constraint, or risk that made the decision necessary.
- **Options:** credible alternatives that were considered.
- **Rationale:** why the selected option best matched the project's needs.
- **Consequences:** benefits, costs, limitations, and new responsibilities.
- **Revisit when:** the scale, requirement, evidence, or constraint changes.

Example decision: store workflow state and audit events in a relational database. The project requires consistent relationships among incidents, recommendations, approvals, and source updates. A document database could accelerate schema changes, but the relational design simplifies traceability and transactional updates. This decision should be revisited if event volume or unstructured record diversity becomes the dominant concern.

Decisions worth documenting: synchronous versus asynchronous processing, database choice, managed versus self-hosted infrastructure, retrieval method, model selection, authentication approach, agent permission boundaries, deployment platform, observability tooling, and build-versus-buy choices.

6.3 Trade-Offs

Strong portfolios acknowledge that every design choice optimizes some goals at the expense of others. Describe the alternatives fairly and connect the choice to the customer context.

- **Speed versus extensibility:** a focused workflow may deliver sooner but support fewer future use cases.
- **Accuracy versus latency:** additional retrieval or model passes may improve quality while increasing response time and cost.
- **Automation versus control:** automatic updates reduce manual work but increase the need for safeguards and rollback.
- **Managed service versus customization:** managed services reduce operations but can increase platform dependence.
- **Live integration versus mock integration:** a live sandbox improves realism but may reduce reproducibility for reviewers.
- **Data richness versus privacy:** more context may help recommendations but expands exposure and retention risk.

Example trade-off statement: the first release used retrieval from a small approved runbook set rather than enterprise-wide search. This reduced coverage but made

authorization, freshness, evaluation, and evidence traceability manageable within the portfolio timeline.

Where possible, quantify the trade-off. For example: “The second model pass increased median response time in the test environment but reduced unsupported recommendations in the evaluation set.” If measurements are not available, label the statement as a hypothesis and explain how it would be tested.

6.4 Challenges

Explain the most meaningful technical and delivery challenges, not every minor defect. Use a situation–action–result pattern to demonstrate troubleshooting and adaptation.

- **Situation:** what happened and why it mattered.
- **Diagnosis:** evidence gathered, hypotheses tested, and root cause identified.
- **Action:** the code, architecture, process, or scope change made.
- **Result:** what improved and how it was verified.
- **Lesson:** what you would repeat or change in future customer delivery.

Example challenge: semantically similar runbook sections produced duplicate and sometimes conflicting evidence. The solution added document metadata, deduplication, service-based filtering, and a maximum context budget. Evaluation results were then compared before and after the change, and the remaining limitation was documented.

Useful challenges may involve unclear customer requirements, unreliable APIs, poor source data, identity configuration, database migration, cloud quotas, prompt injection, model variability, latency, cost, or conflicting user needs.

6.5 Failure Cases

Document failure cases as first-class portfolio evidence. Include what the user experiences, what the system records, and how recovery occurs. Distinguish prevented failures, detected failures, tolerated failures, and accepted limitations.

Failure-case template:

- **Trigger:** the condition that causes the failure.
- **Expected behavior:** the safe system response.
- **User experience:** what the user sees and can do next.
- **Telemetry:** the log, metric, trace, or alert produced.
- **Recovery:** automatic retry, manual replay, rollback, or fallback workflow.
- **Residual risk:** what remains possible and why it is accepted.

Examples:

- The ticketing API is unavailable; the approved update is queued, the analyst sees a pending status, and an alert is raised after the retry threshold.

- The LLM returns malformed output; schema validation rejects it and the case moves to manual triage.
- Retrieved evidence conflicts; the system displays the conflict, lowers confidence, and requires review rather than choosing silently.
- A user attempts an unauthorized approval; the request is denied, no business record changes, and an audit event is created.
- A duplicate webhook arrives; the idempotency key prevents a second incident workflow.
- A prompt-injection phrase appears in source text; the content remains untrusted, tools stay restricted, and the adversarial test verifies no unauthorized action occurs.

Failure demonstration: include at least one controlled failure in the portfolio demo. Showing a timeout, graceful fallback, correlation identifier, and recovery path can be more persuasive than showing only the happy path.

6.6 Final Outcome

Conclude with a balanced account of what was delivered and what the evidence shows. Separate implemented capability, measured performance, user feedback, remaining limitations, and recommended next steps.

Outcome structure:

- **Delivered:** the working workflow, integrations, AI capabilities, controls, and deployment assets.
- **Measured:** changes from baseline or evaluation results, with sample size and test conditions.
- **Observed:** user feedback, usability findings, and operational behavior.
- **Not delivered:** deferred features and explicit non-goals.
- **Limitations:** data coverage, scale, model behavior, sandbox constraints, or incomplete validation.
- **Next steps:** the highest-value improvements required for a broader pilot or production rollout.

Illustrative outcome: the project delivered a deployed incident-triage workflow with sandbox ingestion, approved knowledge retrieval, structured recommendations, deterministic escalation rules, human approval, auditable write-back, and operational monitoring. On the documented evaluation set, results are reported for routing accuracy, critical-case recall, groundedness, latency, cost, and human correction. Claims about production savings remain hypotheses until validated with real operational data.

Portfolio presentation package:

- A one-page executive case study
- A detailed technical README

- Architecture and data-flow diagrams
- Setup, deployment, rollback, and operating instructions
- API examples and sample data
- Test and AI-evaluation results
- Security, privacy, and threat-model notes
- A three-to-five-minute demonstration recording
- A limitations and lessons-learned section

Project Documentation Worksheet

- **Customer context and problem:** _____
- **Baseline and success measures:** _____
- **Most important technical decisions:** _____
- **Major trade-offs:** _____
- **Top challenges and lessons:** _____
- **Critical failure cases:** _____
- **Capabilities delivered:** _____
- **Measured results:** _____

- **Known limitations:** _____
- **Recommended next steps:** _____

Completion checkpoint: The documentation is complete when an unfamiliar reviewer can understand the customer problem, run or observe the solution, follow the architecture, evaluate the evidence, see how failures are handled, and distinguish measured outcomes from assumptions and future work.

7. FDE Portfolio Checklist

Use this checklist as a final quality gate before publishing or presenting the project. A strong portfolio does not need to be perfect, but every claim should be supported by visible evidence. Where an item is incomplete, state the limitation and describe the next step instead of hiding it.

7.1 Real-World Problem

The project should address a recognizable customer workflow with a clear user, pain point, and business consequence. Reviewers should understand why the problem deserves attention before they see the architecture.

- The primary user and job to be done are specific.
- The current workflow, bottlenecks, and exception paths are documented.
- The problem statement is based on evidence or clearly labelled assumptions.
- Constraints such as time, access, privacy, approvals, and budget are visible.
- The MVP and non-goals keep the project focused.
- Success measures connect to user, operational, risk, or business value.

Evidence to show: discovery notes, workflow map, persona, baseline, problem statement, success criteria, and scope statement.

Example: rather than "build an AI support bot," define the problem as inconsistent incident triage caused by incomplete requests and fragmented runbooks, resulting in slower response and unnecessary reassignment.

7.2 API/Data Integration

The solution should connect realistic systems and demonstrate disciplined handling of data across boundaries.

- At least one inbound and one outbound interface are implemented or realistically simulated.
- API contracts define fields, types, authentication, responses, and failure codes.
- Incoming data is validated, normalized, and mapped to an internal model.
- Timeouts, retries, rate limits, pagination, and duplicate events are addressed where relevant.
- Data ownership, sensitivity, freshness, and retention are documented.
- Mocks, sandbox services, and test data allow reviewers to reproduce the workflow safely.

Evidence to show: API specification, sample payloads, sequence flow, integration tests, mapping rules, and a controlled dependency-failure demonstration.

7.3 Production Deployment

A deployed solution should be repeatable, observable, and recoverable. A stable demonstration URL or recording is useful, but the deployment process matters as much as the final screen.

- The application runs in a production-like cloud or hosted environment.
- Configuration is separated from code and secrets are protected.
- Containers or documented runtimes produce consistent results.
- CI/CD automates build, test, packaging, and deployment steps.
- Health checks, database migrations, rollback, backup, and cleanup are documented.
- Resource limits, expected cost, and scale assumptions are stated.

Evidence to show: deployment architecture, pipeline file, versioned release, infrastructure definition, health endpoint, rollback result, and operating runbook.

7.4 AI/Agent Capabilities

AI should perform a bounded, useful task and operate within explicit permissions. The portfolio should explain why AI is appropriate and where deterministic logic or human judgment is safer.

- The model task and expected structured output are defined.

- Context comes from approved sources and evidence is traceable.
- Prompts, models, retrieval settings, and guardrails are versioned.
- Tool access is allow-listed and parameters are validated.
- Low-confidence, unsupported, malformed, or unsafe outputs are rejected or escalated.
- High-impact actions require human approval.
- A manual or deterministic fallback exists when the AI component is unavailable.

Evidence to show: prompt template, tool contract, sample outputs, evaluation set, approval flow, audit event, adversarial tests, and fallback demonstration.

7.5 Security

Security evidence should reflect the actual architecture and data. Include controls for people, services, integrations, and AI components.

- Authentication and role-based authorization are enforced.
- Service identities and API credentials have least-privilege scopes.
- Secrets are stored outside code, images, logs, and screenshots.
- Sensitive data is minimized, encrypted, retained deliberately, and deleted safely.
- Inputs, uploads, outputs, and tool requests are validated.

- Dependencies and container images are scanned.
- Important actions and permission changes are auditable.
- Prompt injection, unauthorized retrieval, and unsafe agent actions are tested.

Evidence to show: threat model, trust boundaries, permission matrix, security-test results, vulnerability report, data-handling note, and residual-risk statement.

7.6 Evaluation

Evaluation should prove both software correctness and customer usefulness. Report the test conditions and sample size so results can be interpreted honestly.

- Unit, integration, end-to-end, security, reliability, and usability tests are included.
- Critical acceptance criteria map to automated or repeatable manual tests.
- The AI evaluation contains normal, ambiguous, missing-data, adversarial, and high-impact cases.
- Metrics cover quality, latency, cost, failures, human acceptance, and customer outcome.
- Baseline and post-solution results use comparable conditions.
- Failed cases are analyzed rather than removed from the final report.
- Release thresholds are defined before final evaluation.

Evidence to show: test plan, automated test report, evaluation dataset description, metric definitions, results table, error analysis, user feedback, and release decision.

7.7 Documentation

Documentation should serve both technical and non-technical reviewers. It must be current, navigable, and honest about limitations.

- The repository opens with a clear project summary and quick-start path.
- Architecture, data flow, trust boundaries, and key decisions are explained.
- Setup, configuration, test, deployment, rollback, and troubleshooting steps are complete.
- API contracts and sample data are included.
- Security, privacy, monitoring, and failure behavior are documented.
- Measured outcomes are separated from hypotheses.
- Trade-offs, challenges, lessons, and next steps are visible.
- The demonstration script tells a concise customer-to-outcome story.

Evidence to show: executive summary, README, diagrams, decision records, runbook, test evidence, case study, demonstration recording, and limitations section.

7.8 End-to-End Ownership

The final check is whether the portfolio demonstrates ownership across discovery, engineering, deployment, adoption, and improvement. FDEs are expected to bridge gaps rather than hand unresolved problems from one specialist to another.

- You can explain how customer discovery changed the requirements.
- You made and documented technical choices instead of assembling disconnected tools.
- You built the critical workflow from input to customer-visible outcome.
- You handled integration, identity, data, AI, security, and operational concerns.
- You tested failure paths and can recover the service.
- You gathered user feedback or defined a credible validation plan.
- You measured outcomes and identified what should happen next.
- You can deliver a concise executive explanation and a detailed technical deep dive.

Final portfolio scorecard: rate each subsection from 1 to 5. A score of 1 means the capability is claimed but not demonstrated; 3 means a working implementation exists with partial evidence; and 5 means the implementation, rationale, tests, operational controls, and measurable results are all available. Strengthen low-scoring areas before adding more features.

Completion checkpoint: The portfolio is ready to present when a reviewer can move from the customer problem to the deployed outcome, inspect supporting evidence, observe at least one failure path, and understand what you personally owned and learned.

8. Portfolio Project Ideas

The following ideas are designed to demonstrate customer-facing engineering rather than isolated AI features. Each can be adapted to a domain such as IT operations, financial services, human resources, procurement, compliance, or internal enablement. Use synthetic, public, or safely anonymized data and clearly identify assumptions.

8.1 Customer-Support AI Agent

Concept: build an agent-assisted support workspace that classifies incoming requests, retrieves approved guidance, drafts a response, and recommends routing while keeping consequential decisions under human control.

- **Customer problem:** support representatives spend time interpreting incomplete requests, searching disconnected knowledge, and reassigning incorrectly routed cases.
- **Target users:** frontline support representatives, escalation reviewers, knowledge managers, and team leads.
- **Core workflow:** ingest a case, validate fields, classify intent and urgency, retrieve evidence, draft a response, request approval where required, and update the source system.
- **Integrations:** ticketing API, knowledge repository, identity provider, notification service, and analytics store.

- **AI role:** summarization, classification, grounded retrieval, response drafting, and explanation of recommendations.
- **Deterministic controls:** mandatory escalation rules, restricted categories, service-level timers, and authorization checks.
- **Security focus:** protect customer information, restrict knowledge access, resist prompt injection, and audit every write-back.
- **Evaluation:** routing accuracy, critical-case recall, evidence support, handling time, correction rate, latency, and cost per case.

MVP: process synthetic tickets through one channel and one knowledge source, present an evidence-linked recommendation, collect agent approval, and record the result.

Stretch goals: related-case detection, multilingual drafting, sentiment-neutral communication guidance, knowledge-gap reporting, or a low-risk automated status update.

Strong demonstration moment: show a normal case, an ambiguous case that triggers a clarification request, and a malicious case whose embedded instructions are ignored.

8.2 Document-Processing Pipeline

Concept: create a secure pipeline that receives business documents, extracts structured fields, validates them against rules, routes exceptions for review, and exports approved records to a downstream system.

- **Customer problem:** teams manually read repetitive forms, invoices, applications, claims, or compliance documents and re-enter information into operational systems.
- **Target users:** operations analysts, reviewers, data-quality specialists, and process owners.
- **Core workflow:** upload or receive a document, scan and classify it, extract fields, validate values, flag missing or conflicting information, obtain approval, and export a structured record.
- **Integrations:** object storage, upload API, email or queue intake, validation service, database, and downstream business application.
- **AI role:** document classification, field extraction, summarization, and explanation of uncertain values.
- **Deterministic controls:** schema validation, totals reconciliation, date and identifier checks, duplicate detection, and confidence thresholds.
- **Security focus:** malware scanning, file-type restrictions, encryption, retention, field-level redaction, and reviewer permissions.
- **Evaluation:** field precision and recall, document-level completion rate, manual correction rate, processing time, cost, and exception quality.

MVP: support two document types with a fixed schema, extract selected fields, display source references, allow corrections, and export validated JSON or CSV.

Stretch goals: handwriting support, multi-page table extraction, duplicate-document matching, multilingual forms, or rules that vary by customer or region.

Strong demonstration moment: process a clean document, then process one with a missing field and mismatched total to show exception routing and audit history.

8.3 Enterprise Knowledge Assistant

Concept: build a permission-aware assistant that answers operational questions from an approved knowledge set, cites exact supporting passages, identifies conflicting guidance, and abstains when evidence is insufficient.

- **Customer problem:** employees search across policies, runbooks, manuals, and project documents but struggle to find authoritative and current answers.
- **Target users:** service teams, operations staff, new employees, compliance analysts, or project teams.
- **Core workflow:** synchronize approved sources, parse and index content, apply access metadata, retrieve relevant passages, generate an answer, display evidence, and collect feedback.
- **Integrations:** enterprise content repository, document storage, identity provider, search or vector service, and feedback store.
- **AI role:** query interpretation, grounded answer generation, synthesis across permitted sources, and clarification questions.

- **Deterministic controls:** document access filters, freshness checks, source prioritization, citation validation, and abstention rules.
- **Security focus:** permission-aware retrieval, tenant isolation, sensitive-content filtering, prompt-injection defense, and limited logging of user queries.
- **Evaluation:** retrieval relevance, answer correctness, citation validity, unauthorized-content leakage, abstention quality, latency, and user usefulness.

MVP: index a small approved collection, support authenticated questions, return evidence-linked answers, and provide "not enough information" behavior.

Stretch goals: conflicting-policy detection, source-freshness alerts, expert escalation, multilingual answers, or a knowledge-gap dashboard.

Strong demonstration moment: ask one answerable question, one question whose sources conflict, and one question about restricted content to prove both usefulness and access control.

8.4 Data Integration Platform

Concept: build a lightweight integration service that ingests records from multiple sources, validates and transforms them into a canonical model, reconciles duplicates, and publishes reliable downstream events or reports.

- **Customer problem:** operational teams rely on inconsistent data from APIs, files, and legacy systems, creating duplicate records, reporting delays, and reconciliation effort.
- **Target users:** integration engineers, operations analysts, data stewards, and application owners.
- **Core workflow:** ingest data, validate schema, transform fields, match entities, quarantine exceptions, publish accepted records, and expose status and lineage.
- **Integrations:** REST API, scheduled file import, webhook, queue, database, and analytics destination.
- **AI role:** optional assistance for mapping suggestions, anomaly explanations, or classification of unstructured exception notes.
- **Deterministic controls:** schema contracts, reconciliation rules, idempotency, lineage, replay, and data-quality thresholds.
- **Security focus:** scoped connectors, encrypted transfers, secret rotation, field-level minimization, and auditable data access.
- **Evaluation:** accepted-record rate, duplicate detection, transformation accuracy, reconciliation time, end-to-end latency, replay success, and failed-event recovery.

MVP: ingest one API feed and one file source, transform both into a shared model, identify duplicates, quarantine invalid records, and publish accepted data through an API.

Stretch goals: self-service mapping, schema-version compatibility, event streaming, lineage visualization, or AI-assisted mapping reviewed by a data steward.

Strong demonstration moment: introduce a duplicate, malformed record, and unavailable destination to show idempotency, quarantine, retries, and replay.

8.5 Workflow Automation Agent

Concept: create an agent that coordinates a multi-step business process across systems, gathers required information, recommends actions, requests approvals, and executes only authorized low-risk steps.

- **Customer problem:** employees manually copy information between systems, chase approvals, and monitor status across long-running processes.
- **Target users:** operations coordinators, service managers, procurement analysts, onboarding teams, or compliance reviewers.
- **Core workflow:** receive a request, identify required steps, retrieve context, validate prerequisites, generate a plan, obtain approval, call tools, monitor completion, and escalate exceptions.

- **Integrations:** request portal, email or messaging, task system, identity directory, document repository, and business application APIs.
- **AI role:** classify requests, extract requirements, generate a bounded execution plan, summarize status, and draft user communications.
- **Deterministic controls:** workflow state machine, approval policy, allowed action catalogue, budget or risk thresholds, and rollback rules.
- **Security focus:** least-privilege tool credentials, step-level authorization, confirmation for consequential actions, separation of duties, and complete audit logging.
- **Evaluation:** task completion rate, approval accuracy, workflow duration, exception rate, unauthorized-action prevention, tool-call success, and human effort saved.

MVP: automate one bounded workflow such as employee-access requests, supplier-document follow-up, or low-risk service fulfilment with two integrations and one approval gate.

Stretch goals: parallel tasks, policy-aware routing, SLA prediction, dynamic replanning after a failed tool call, or an administrator view of agent actions and exceptions.

Strong demonstration moment: show the agent completing an approved low-risk task, pausing for a restricted action, and recovering when one integration is temporarily unavailable.

Project Idea Comparison

Choose the project that gives you the best balance of customer relevance, technical depth, safe data access, demonstrability, and completion feasibility.

- **Best for conversational AI and human-in-the-loop design:** Customer-Support AI Agent.
- **Best for extraction, validation, and measurable accuracy:** Document-Processing Pipeline.
- **Best for retrieval, access control, and grounded answers:** Enterprise Knowledge Assistant.
- **Best for APIs, data modelling, lineage, and reliability:** Data Integration Platform.
- **Best for agent orchestration, approvals, and cross-system ownership:** Workflow Automation Agent.

Selection exercise: score each idea from 1 to 5 for access to realistic data, customer evidence, integration depth, AI relevance, security learning, measurable evaluation, deployment feasibility, and personal interest. Select the highest balanced score, then reduce its scope until the MVP can be completed and demonstrated end to end.

Conclusion

An effective FDE portfolio project demonstrates more than technical fluency. It shows that you can discover a meaningful customer problem, convert ambiguity into requirements, design and integrate a secure system, apply AI responsibly, deploy and operate the solution, evaluate outcomes, and communicate decisions clearly.

The strongest project is not necessarily the one with the most services, models, or features. It is the one that provides the clearest chain of evidence from customer need to working outcome. A focused, reliable vertical slice with realistic integrations, measurable evaluation, explicit trade-offs, and honest limitations will usually be more persuasive than a broad prototype that cannot be operated or explained.

Final action plan:

1. Select one project idea and define its user, problem, use case, baseline, and non-goals.
2. Write the technical requirements and identify all data, API, identity, and AI boundaries.
3. Design the smallest end-to-end architecture that can deliver measurable value.
4. Build in vertical slices and capture evidence at every milestone.
5. Add security, observability, failure handling, testing, and deployment automation before expanding scope.

6. Evaluate the finished workflow against predefined technical and customer measures.

7. Package the result as a concise case study, reproducible repository, operating guide, and demonstration.

8. Use the FDE Portfolio Checklist to identify gaps and strengthen the weakest evidence.

Final reminder: present what was actually built and measured, distinguish assumptions from facts, and be prepared to explain not only how the solution works but why each decision was appropriate for the customer. That combination of engineering depth, customer judgment, and end-to-end ownership is the defining signal of a strong Forward Deployed Engineer portfolio.

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