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Legacy Systems Portfolio Dossier

Needletail, CloudWars and eShopOnWeb. Read-only technical due diligence with engineering analysis.

MERIDIAN HOLDINGS · TECHNICAL DUE DILIGENCE · SURVEY OF 2026-09-06

Read-only legacy systems assessment · Evidence-backed · Local-first methodology

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Needletail, CloudWars and eShopOnWeb. Read-only survey of 2026-09-06, with engineering analysis.

Prepared for Meridian Holdings' engineering leadership: the managers and team leads who will plan and run the work. An executive brief for the CTO and lead architects is produced separately from the same artifacts. Every technical figure in this document traces to a named survey artifact (see the Evidence Appendix). Business context that the survey cannot see is marked *Assumption*. Effort figures are planning bands, not quotes.

Provenance labels used throughout, matching the source Dossiers: **AUTOMATED** (tool-measured), **PARTIAL** (tool-measured, human-judged), **MANUAL** (human work the tool informs). Rules lifted from code are additionally marked **INFERRED**: they state what the code does, not why.

HOW TO READ THE LABELS

- | | |
|------------------|--|
| AUTOMATED | Tool-measured. Traceable to a named artifact. |
| PARTIAL | Tool-measured, then judged by an engineer. |
| MANUAL | Human work the survey informs but does not perform. |
| INFERRED | Lifted from code with file and line. States what, not why. |
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1. Executive summary

What Meridian owns. Three .NET systems. Two are from one lineage: Needletail, a small data-access library (3 modules, 29 files, one author, 2016 to 2025), and CloudWars, a web application (36 modules, 166 files) built in August 2013 that consumes Needletail at a 2013 version. The third, eShopOnWeb, is unrelated to them: a .NET 8 e-commerce application (14 modules, 318 files, 641 commits by 83 authors) with a live test suite. The survey found no dependency between eShopOnWeb and the other two.

The three findings that matter.

1. **Nothing in the portfolio will be on a fully supported runtime by the end of the year.** Three legacy projects are already end-of-life (two CloudWars projects since 2016-01-12

legacy projects are already one of the (five CloudWars projects since 2026-05-12), Needletail's test application since 2026-05-12), five CloudWars projects are maintenance-only, and eShopOnWeb's single target, .NET 8, leaves support on 2026-11-10, about nine weeks after this survey.

2. **Verification is absent where it is needed most.** No test reaches any of the nine legacy areas. eShopOnWeb has 45 test files reaching 5 of 6 areas; the sixth, its administration client, is also where 16 of its 37 migration-risk coding patterns sit. Across the portfolio, 63 patterns must be cleared before behaviour can be pinned.
3. **Each system's core is one person's work, and the code records what it does, not why.** Needletail's hottest files are 100% one author's; CloudWars' configuration files 100% and 83%; eShopOnWeb's 22 of 25 concentrated files belong to one author, with activity down to 17 commits since 2024. The survey lifted 168 rules across the three systems and found one that the code enforces two ways.

The recommended first move is a Confirm and Characterize phase on all three systems, run alongside a deadline-driven runtime move for eShopOnWeb: interview the five authors who hold the history, resolve 118 package references against a live advisory feed, decide the Needletail version policy, clear the patterns that block pinning, pin the ten areas that need it, and retarget eShopOnWeb before 2026-11-10. Planning band: **11 to 20 engineer-weeks**: 2 to 3 of shared confirmation, 5 to 9 to characterize the legacy pair, 4 to 8 to characterize and retarget eShopOnWeb.

What it buys. A behavioural baseline on all three systems, a known security posture, the authors' reasoning on record, uninterrupted vendor support for the one system that still has it, and the four mechanical opportunities the survey identified delivered as a first checkable result. Declining leaves the legacy pair changeable only by unverified edits and puts eShopOnWeb out of support within the quarter.

2. What we examined, and how far it goes

Scope. Three repositories, surveyed read-only on 2026-09-06: `needletail-dossier`, `cloudwars-dossier` and `eShopOnWeb`. Nothing was built, executed or modified.

Method. An automated static survey produced thirteen sections per system, from inventory and dependency lifecycle through history, business rules lifted from code, testability, migration-risk coding patterns, a proposed

migration wavefront and a ranked list of opportunities. A human analysis (this document) sits on top.

The tool-driven figure. All three source Dossiers report **58% tool-driven by section weight**: 4 sections AUTOMATED, 7 PARTIAL, 2 MANUAL. The other 42% is human work the survey informs but does not perform:

SECTION	COVERAGE	WHAT THE HUMAN DOES
D2 Contracts and integrations	PARTIAL	Maps who breaks if a contract moves
D5 Business rules from code	PARTIAL	Decides which lifted rules matter
D5b Tribal knowledge	MANUAL	Interviews the authors for the <i>why</i>
D6 Testability and pinnability	PARTIAL	Judges whether each area can be pinned
D7 Modernization wavefront	PARTIAL	Turns the wave proposal into a recommendation
D8 Validation strategy	MANUAL	Writes the per-phase proof plan
D10 Knowledge base	PARTIAL	Adds interview-sourced entries
D11 Opportunities	PARTIAL	Funds, sequences or declines each item
D12 Coding practices	PARTIAL	Decides which patterns to clear before transformation

Confidence boundary. A static survey sees files, references, manifests and commit history. It does not see runtime behaviour, production data flows, actual usage, deployment topology, operational practice, or anything held only in people's heads. Four limits are specific to this survey:

- **No package advisory was checked in any system.** CloudWars' 41 references sit in pre-SDK `packages.config` manifests; eShopOnWeb's 77 were read statically because package restore was not run. "0 outdated, 0 advisories" in the source data means "not checked", not "clean".
- Runtime lifecycle comes from an offline snapshot dated 2026-09-03. A

runtime whose stated end-of-support date has passed is reported as end-of-life; that is why .NET 9 appears as end-of-life below.

- Needletail's code and commit history live in different checkouts. History figures come from the origin repository (17 commits); file counts from the export (29 files). Three historical components (`Needletail.Scaffold` , `Generator` , `SampleModel`) are not in the export.
- "Reaching tests" counts test files that touch an area. It is not a coverage percentage.

3. The portfolio at a glance

AUTOMATED (D1, D3, D4) and **PARTIAL** (D5, D6, D11, D12) figures, with human interpretation.

	NEEDLETAIL	CLOUDWARS	ESHOPONWEB
Modules / files	3 / 29	36 / 166 (7 projects, 28 vendored package folders)	14 / 318 (6 source projects, 4 test projects)
Module-level dependencies	1	17	30
Public surface	24 types, 124 methods, 2 areas	56 types, 121 methods, 7 areas	250 types, 244 methods, 7 areas
External integration points	2	1	32 (16 HTTP, 16 database)
Runtime targets	netstandard2.0 (active); net9.0 (end of life, 2026-05-12)	5× net45 (maintenance); 2× net40 (end of life, 2016-01-12)	net8.0 for all 10 projects, active, end of support 2026-11-10
Packages	2 (both outdated, 0 advisories)	41 from <code>packages.config</code> ; advisories not checked	77 references, 49 names, 50 central versions; advisories not checked
Test files / areas reached	0 / 0 of 2	0 / 0 of 7	45 / 5 of 6

History	17 commits, 1 author, 2016-08 to 2025-01	24 commits, 3 authors, 2013-08 to 2015-04	641 commits, 83 authors, 2017-03 to 2025-01
Business rules lifted	43 (0 conflicts)	20 (0 conflicts)	105 (0 conflicts; 1 rule enforced two ways)
Migration-risk patterns	12 across 6 principles	14 across 4 principles	37 across 4 principles
Clusters / proposed waves	2 / 2	31 / 5	5 / 6
Opportunities	4 (1 mechanical)	15 (2 mechanical)	6 (1 mechanical)
Knowledge entries (distinct / observations)	18 / 22	29 / 32	50 / 53

Interpretation. The legacy pair is one problem with two faces. Needletail is small, structurally simple and still active, but one author, one 1,691-line file holding all 41 of its guards and all 12 of its migration-risk patterns, and no tests make it a single point of failure. CloudWars has not changed in eleven years, sits on runtimes that stopped receiving fixes in 2016, keeps game state in static fields, and consumes Needletail at a version thirteen years behind the library.

eShopOnWeb is a different kind of asset. It is layered, tested and centrally configured; the survey found only six opportunities and none is a platform rewrite. Its risks are a calendar (one runtime target with nine weeks of support left), a concentration of untested and hard-to-test code in one area (the administration client), and a history in which 83 authors mostly touched configuration while one wrote the commercial path.

4. Findings that change decisions

4a. Unsupported and expiring runtimes AUTOMATED , D3

What the data says. Against the snapshot of 2026-09-03: `CloudWars.Engine` and `CloudWars.Glue` target .NET Framework 4.0, end of life since 2016-01-12; Needletail's `TestApp` targets .NET 9, end of life since 2026-05-12; five CloudWars projects target .NET Framework 4.5, maintenance-only with an end date bound to the Windows lifecycle; eShopOnWeb's `Directory.Packages.props` sets `net8.0` for all 10 projects, a long-term-

support release with support ending 2026-11-10. Needletail's library targets .NET Standard 2.0, an API contract that inherits its consumer's lifecycle.

What it means. Three projects cannot receive vendor security fixes today, and the whole of eShopOnWeb joins them in nine weeks. The eShopOnWeb move is one central edit across 10 projects, so the constraint is time, not scope. In CloudWars, `Engine` is a worker role with an author note "TODO: instantiate the proper factory" at `WorkerRole.cs:34`, and `Glue` is a single class named `Class1` with no dependency edges, apparently an empty placeholder.

What it costs to leave alone. Any vulnerability disclosed against those runtimes, or against CloudWars' 2013-era stack (ASP.NET MVC 4.0.20710.0, Web API 4.0.20710.0, DotNetOpenAuth 4.1.4.12333, jQuery 1.9.1, Newtonsoft.Json 4.5.11), or against eShopOnWeb's 8.0.x package family after November, has no vendor remediation path.

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which systems are internet-facing and which process personal or payment data. eShopOnWeb's account, two-factor and public-API surfaces suggest it does, which makes 2026-11-10 a compliance date.

4b. The verification gap AUTOMATED , D6; pinnability judgment PARTIAL

What the data says. Needletail (22 files scanned) and CloudWars (73) have zero test files; all nine areas are test deserts. eShopOnWeb (245 files scanned) has 45 test files reaching `ApplicationCore` (27 tests), `Web` (17), `Infrastructure` and `PublicApi` (5 each) and `BlazorShared` (2); `src/BlazorAdmin` (20 source files) is reached by none.

What it means. In the legacy pair, no change can be verified before release except by undocumented manual testing; this blocks the runtime fixes in 4a. In eShopOnWeb, the runtime move can be verified everywhere except the administration client. The I/O evidence says pinning is feasible: eight of nine legacy areas and all six eShopOnWeb areas are rated "likely pinnable"; `CloudWars.Game` (61 I/O sites, 44 time-dependent) is rated "pin at seams". Section 7 adds the patterns inside the code that each test must be designed around.

What it costs to leave alone. Every change to the legacy pair, and every change to eShopOnWeb's admin client, is an unverified edit to production.

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whether any manual regression checklist exists for the legacy pair, and whether the eShopOnWeb admin client is used by Meridian staff in production.

4c. Knowledge concentration AUTOMATED , D4; interview targets PARTIAL , D10

What the data says. Needletail: 17 commits by one author; `SqlClientEngine.cs` (8 commits) and `DBTableDataSource.cs` (6) are 100% that author's work and change together half the time. CloudWars: 24 commits by three authors, 23 in August 2013; `Web.config` is 100% one author's (5 commits) and the project file 83% (6). eShopOnWeb: 641 commits by 83 authors, but 22 of its 25 concentrated files belong to one author, who holds 100% of `BasketService.cs` (10 commits), `CartController.cs` (8) and `Basket.cs` (7) and 90% of `AccountController.cs` (20); two more belong to the author of the Azure infrastructure templates and one to the author of the authorization constants. eShopOnWeb activity was 95 commits in 2023 and 17 since. The seeded knowledge bases carry 14 open questions of the form "who besides [author] understands [file]?": 2, 2 and 10.

What it means. In each system, one person's absence removes the ability to explain why the core files are the way they are. In CloudWars that person last touched the code over a decade ago; in eShopOnWeb the commercial path (basket, cart, catalog, account) is one person's work and activity is falling. Needletail's history also references components (`Needletail.Scaffold` , `Generator` , `SampleModel`) absent from the export; only the author can say quickly whether they moved into the `Needletail.Mvc` package CloudWars imports.

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whether the five dominant authors are available to Meridian.

What it costs to leave alone. Every week without interviews raises the chance the answers are lost. The survey ranks capturing them as days of effort in all three systems: the cheapest and most perishable item in this plan.

4d. The dependency picture AUTOMATED , D3, with a stated blind spot

What the data says. Needletail: 2 references, both behind current, no known advisory (`Microsoft.Extensions.Configuration.Json` 3.1.32 against 10.0.11; `System.Data.SqlClient` 4.8.6 against 4.9.1). CloudWars: 41 references across three `packages.config` files, unresolved; three are Needletail packages (`Needletail.DataAccess` 1.0.0.3 in all three manifests, `Needletail.DataAccess.Migrations` 1.0.0.2, `Needletail.Mvc` 1.0.0.3), the rest a 2013-era ASP.NET MVC 4 stack with Entity Framework 5.0.0. eShopOnWeb: 77 references across 10 projects, 49 names, versions from a central file, unresolved; a current-generation stack (ASP.NET Core, Entity Framework Core and Identity 8.0.2, FluentValidation 11.9.0, MediatR 12.0.1), with three out-of-step versions worth a look (`BlazorInputFile` 0.2.0, `System.Security.Claims` 4.3.0, `Microsoft.VisualStudio.Azure.Containers.Tools.Targets` 1.19.6).

What it means. The posture of 118 package references is unknown, not clean. Resolving them is hours to days of mechanical work and precedes every runtime move, because the eShopOnWeb 8.0.x family and CloudWars' 38 stack packages change version with the target.

What it costs to leave alone. An unknown number of published vulnerabilities in two web applications with external login.

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whether CloudWars is deployed anywhere today. If not, its cost is zero until it is.

5. The shared components

PARTIAL (D5 usage tables and D1 graphs are automated; the reading is human).

Needletail and CloudWars: the question is version policy, not consolidation. CloudWars uses Needletail: 8 imports and 3 qualified call sites across `CloudWars.DataAccess`, `CloudWars.Entities` and `CloudWars.Game`. The repository class `CloudWarsDB.cs` imports the library at lines 5 and 8; the entity classes `Challenge.cs`, `Match.cs` and `MatchUnit.cs` import Needletail's attribute namespace at line 5, which is how the library marks table keys. CloudWars does not reimplement Needletail; its `CloudWars.DataAccess` project (2 types, 31 methods) is a repository layer built on it. Two other Needletail packages are present but not used the same way: `Needletail.Mvc` is imported in two controllers (4 imports, 0 qualified references) and `Needletail.DataAccess.Migrations` appears only in the manifest.

CloudWars pins `Needletail.DataAccess 1.0.0.3`, a 2013-era release, while the library was still being changed in January 2025 and now targets .NET Standard 2.0 with asynchronous interfaces, transactions and dynamic entities. Every change since 2013 is either absent from CloudWars or was re-made by hand. The choice:

- *Track current Needletail.* CloudWars gains the library's later changes and future package updates. Cost: the 31 repository methods must be characterized first, and their class holds its state in static fields (Section 7), which must be made instance-scoped before those tests can run in isolation.
- *Stay pinned.* No work now; every upstream fix stays missing, and the next security patch to Needletail must be back-ported by hand to a 2013 build.

The graph favours tracking: `DataAccess` sits in wave 3 with only `Entities` beneath it, and both are rated "likely pinnable". Deciding this is hours of judgment (C-O10). What remains unknown: whether anything besides CloudWars consumes Needletail (one consumer found),

and where the source for the two other Needletail packages lives (only binaries found).

eShopOnWeb: an internal shared project at the bottom of the graph. BlazorShared (21 files: models, interfaces, attributes, authorization constants) is consumed from five areas with 26 qualified references, and its authorization constants are referenced from the infrastructure layer's identity seed (AppIdentityDbContextSeed.cs:18 , :29). The domain core ApplicationCore carries a project reference to it (1 edge). The wavefront places BlazorShared alone in the last of six waves: nothing beneath it, four modules directly on it. Any change to it moves last and touches everything. The survey found no dependency cycle in this run, and no dependency between eShopOnWeb and the legacy pair.

6. Business rules the code enforces

PARTIAL (D5). Every rule below is **INFERRED**: lifted from source with file and line evidence, stating what the code does and not why. The survey found **0 comment/code conflicts** in all three systems and **one rule enforced two ways** in eShopOnWeb; where a conflict exists, the code is authoritative.

Needletail (43 rules): two state vocabularies and 41 enforced guards, all in one file.

KIND	WHAT THE CODE DOES	EVIDENCE
State vocabulary	A filter combines with AND or OR; ordering is ASC or DESC	Engines/Enums.cs:8 , Engines/SQLTokens.cs:9
Guard	Rejects a blank connection-string name or table name; a missing connection string, provider or engine	DataSourcees/DBTableDataSource.cs:97 , :101 , :120 , :129 , :171 , :175
Guard	Isolation level cannot change until the transaction is committed	DBTableDataSource.cs:235
Guard	Insert and update reject a null item or an undeterminable primary key	DBTableDataSource.cs:501 , :510 , :549 , :558
Guard	Query methods reject null or blank select, where, filter and name arguments (27 further sites)	DBTableDataSource.cs:602 to :1122

CloudWars (20 rules): three vocabularies, 11 validation limits, 3 thresholds, 3 author notes.

KIND	WHAT THE CODE DOES	EVIDENCE
State vocabulary	A command is one of eight states (NotYourTurn, ChallengePlayer, ChallengeAccepted, StartGame, EndGame, PlayerOnline, PlayerOffLine, GameAction); a game action one of five (PlayerReady, UnitMoved, Attack, ShotMade, ShotMissed)	CloudWars.Common/Other/Enums.cs:8 , :21
Validation limit	User name and password required; password length rule of 100; confirmation must match (11 rules)	Models/AccountModels.cs:32 to :87
Threshold	The worker role compares an elapsed time against 30 seconds; a display name over 50 characters is handled specially	CloudWars.Engine/WorkerRole.cs:135 ; Controllers/PlayerController.cs:39 , :65
Author note	"TODO: instantiate the proper factory"; "TODO: tell the client that the other player is not online"	WorkerRole.cs:34 ; Controllers/GameController.cs:213

The rules that make CloudWars a game (turn order, damage, win conditions) are not in a form the survey can lift; they exist in method bodies and in people. One hygiene finding: the web project declares code under a misspelled namespace, `ClourWars.Web`, at `Code/GameHelper.cs:9`, which the survey classifies as an external library; any rename must account for both spellings.

eShopOnWeb (105 rules): 1 vocabulary, 50 limits, 32 guards, 12 thresholds, 10 author notes.

DOMAIN	WHAT THE CODE DOES	EVIDENCE
Catalog	An item needs a name and description; price between 0.01 and 1000 on create, 0.01 and 10000 on update ; creation	BlazorShared/Models/CatalogItem.cs:19 to :35 ; PublicApi/CatalogItemEndpoints/UpdateCatalogItemEndpoint.cs:45 ; PublicApi/ImageVali

	refused if the name exists; images limited to 512000 bytes; 10 items per page	
Basket	Quantity cannot be negative; checkout refused on an empty basket	Web/Pages/Basket/BasketItemViewModel.cs:13 ; ApplicationCore/Extensions/GuardExtensions.cs:12
Accounts	Email required and well-formed; password length rule of 100; confirmation must match; two-factor codes length 7 (37 limits); 28 guards in the manage controller refuse to act when the user cannot be loaded or an identity operation fails	Web/ViewModels/Account/*.cs , ViewModels/Manage/*.cs , Web/Controllers/ManageController.cs:50 to :495
Sessions and caching	Cookie validity 60 minutes; admin user cache refreshed every 60 seconds; default cache 30 seconds; seeding retries up to 10 times	Web/Configuration/ConfigureCookieSettings.cs:10 ; BlazorAdmin/CustomAuthStateProvider.cs:16 ; Web/Extens: Infrastructure/Data/CatalogContextSeed.cs:50

The rule enforced two ways. The catalog price cap is 1000 in the shared model and the create request, and 10000 in the public API's update request (CatalogItem.cs:27 against UpdateCatalogItemRequest.cs:20). Both are live; which limit applies depends on which path a request takes, and no comment records which is intended (E-O6).

Author notes that describe unfinished production work. Of eShopOnWeb's ten, four matter: "TODO: Don't use this in production" and "TODO: Change this to an environment variable" at ApplicationCore/Constants/AuthorizationConstants.cs:7 and :10 ; "TODO: Wire this up to actual email sending logic" at Infrastructure/Services/EmailSender.cs:12 (email is a stub); and "replace IMemoryCache with a distributed cache if you are in multi-host scenario" at Web/Configuration/RevokeAuthenticationEvents.cs:11 and Web/Areas/Identity/Pages/Account/Logout.cshtml.cs:13 (sign-out revocation is per host). CloudWars' two TODOs mark the worker role's factory and the offline-opponent

message. Triaging them is an opportunity in both systems (C-O11, E-O5).

The why requires interviews. Nothing above records why a price cap is 1000 or 10000, why a cookie lasts 60 minutes, or why a CloudWars turn times out at 30 seconds. Those answers, and any rule living only in someone's head, are the MANUAL half of this section (D5b), scheduled in Phase 0.

7. What makes these systems hard to change

PARTIAL (D12). This is not a style review. The survey reports only patterns with a direct line to "you cannot safely transform this yet"; formatting and naming are excluded, and vendored third-party code is skipped. The consequence column is the report's own wording. These are items to clear *before* a transformation, not during it.

Needletail: 12 patterns, 6 principles, all in `Needletail.DataAccess` .

PRINCIPLE	COUNT	WHERE	MIGRATION CONSEQUENCE (REPORT'S V)
Dependency inversion	3	<code>DBTableDataSource.cs:155</code> (DirectoryInfo); <code>NeedletailFactory.cs:14</code> , <code>:19</code> (SqlCommand, SqlConnection)	Cannot be exercised without the real dependency, so cannot be pinned before migration or swapped afterwards
Avoid shared mutable state	3	<code>DBTableDataSource.cs:35</code> (Locks); <code>SQLTokens.cs:10</code> , <code>:13</code>	Shared across every test in the process characterization tests are hardest to wr against exactly this
Method length	2	<code>DBTableDataSource.cs:95</code> (130 lines); <code>:859</code> (GetMany , 831 lines)	Too long to characterize with a focused migrated whole and verified by eye
Keep interfaces narrow	2	<code>GetQueryForPagination</code> , 7 parameters, <code>DBMSEngineBase.cs:25</code> , <code>SqlClientEngine.cs:17</code>	Easy to transpose two arguments of the type, which no compiler catches
File size	1	<code>DBTableDataSource.cs</code> , 1,691 lines	Every diff is one no reviewer can fully v
Fail visibly	1	<code>Entities/DynamicEntity.cs:38</code> , exception caught and discarded	A migration that breaks this path produ error and no log line

CloudWars: 14 patterns, 4 principles. Concentration: DataAccess 8, Game 5, Engine 1.

PRINCIPLE	COUNT	WHERE	MIGRATION CONSEQUENCE
Avoid shared mutable state	10	DataAccess/Sql/CloudWarsDB.cs:19 , :29 , :39 and 7 more (_Matches , _MatchUnits , _PlayerUnits , _Players , _VanillaUnits , _PlayerNotifications , _Challenges , _initializer , _initializerLock , _isInitialized)	Tests cannot run in is
File size	2	Game/Scripts/jquery.validate-vsdoc.js (1,292 lines), jquery.validate.js (1,249)	Diffs no reviewer can
Method length	1	Engine/WorkerRole.cs:30 (Run , 88 lines)	Migrated whole and \
Dependency inversion	1	DataAccess/Queue/MessageRepositoryBase.cs:39 (StreamReader)	Cannot be pinned be

eShopOnWeb: 37 patterns, 4 principles. Concentration: src/BlazorAdmin 16, src/Infrastructure 8, src/Web 7, tests 4, src/BlazorShared 1, src/PublicApi 1.

PRINCIPLE	COUNT	WHERE	MIGRATION
Avoid shared mutable state	13	BlazorAdmin/JavaScript/JSInteropConstants.cs:5 to :9 and Helpers/RefreshBroadcast.cs:12 ; Web/Views/Manage/ManageNavPages.cs:9 to :17 ;two test helpers	Tests cannc
Do not block on asynchronous work	12	BlazorAdmin/Services/CatalogItemService.cs (9 sites, :51 to :88); PublicApi/AuthEndpoints/AuthenticateEndpoint.cs:46 ; two test files	A known de an async mi moves toge
Method length	8	Eight generated Entity Framework migration and snapshot files under Infrastructure/Data/Migrations and Infrastructure/Identity/Migrations (165 to 296 lines each)	Migrated wl
Dependency inversion	4	BlazorAdmin/Program.cs:23 , Web/HealthChecks/ApiHealthCheck.cs:24 , HomePageHealthCheck.cs:25 (HttpClient); BlazorShared/Models/CatalogItem.cs:65	Cannot be p

(StreamReader)

Where the refactoring budget goes. Needletail: one file. CloudWars: the data-access layer, whose repository class keeps game state in static fields; no characterization test of it can run in isolation until that state is instance-scoped or resettable. eShopOnWeb: the administration client, which is at once the only untested area and the home of 16 of 37 patterns, including nine synchronous waits in one service. Two rows need a human reading: the eight long eShopOnWeb methods are generated migration code and are regenerated rather than refactored, and the two oversized CloudWars files are jQuery scripts committed inside the web project, replaced under C-014.

What the absences mean. CloudWars and Needletail show no sync-over-async; eShopOnWeb shows no swallowed exceptions, no wide interfaces and no oversized files. That is a statement about these checks, not a clean bill of health: the survey says a pattern's absence is not a claim the code is idiomatic.

8. Improvement and modernization opportunities

PARTIAL (D11). The survey derived 25 opportunities: 4 for Needletail (N), 15 for CloudWars (C), 6 for eShopOnWeb (E), each with evidence, an effort band and a nature. **Mechanical** items are safe and repeatable once tests exist; **judgment** items need a decision. Effort bands are the survey's.

Mechanical (4). The cheapest credibility a first phase can buy.

#	OPPORTUNITY	WHY IT MATTERS	EFFORT
E-03	Resolve 77 package references against a live advisory feed	Precedes the runtime move; turns "not checked" into known	hours
C-03	Resolve the legacy package manifest against a live advisory feed	Same, for 41 pre-SDK references	days
N-04	Update 2 outdated packages	Each year behind makes the next update larger	hours
C-012	Stop committing 28 vendored dependency folders	Hides the real dependency set; copies drift	hours

Judgment (21), in the survey's consequence order per system.

#	OPPORTUNITY	WHY IT MATTERS	EFFORT
E-01	Retarget eShopOnWeb off .NET 8 before 2026-11-10	Calendar risk: on that date all 10 projects lose vendor fixes at once	weeks
C-01	Move 2 CloudWars projects off the end-of-life runtime	No vendor fixes exist for net40	weeks
N-01	Move Needletail's test app off the end-of-life runtime	.NET 9 support ended 2026-05-12	weeks
C-02, N-02, E-02	Pin behaviour in 7, 2 and 1 untested areas	Nothing can be shown safe until this exists	weeks each
C-04, N-03, E-04	Capture what the dominant authors know	The reasoning is otherwise unrecoverable	days each
C-08	Extract seams in CloudWars.Game	61 inline I/O sites cannot be substituted in a test	days
C-09	Plan the exit from 5 maintenance-only targets	The gap to a supported platform widens yearly	weeks
C-010	Confirm the version policy for Needletail.DataAccess	Pinned to 2013 while the library moved on (Section 5)	hours
C-011, E-05	Triage 3 and 10 author notes	Each marks work an author knew was unfinished; one says "don't use this in production"	days each
E-06	Settle the rule the code enforces two ways	Both price caps are live; no record of which is intended	hours
C-05, C-06, C-07	Entity Framework, ASP.NET MVC and Web API to their Core successors	A platform rewrite of CloudWars; justified only if it has a product future	months each
C-013, C-014, C-015	DotNetOpenAuth, jQuery 1.x and Newtonsoft.Json to maintained successors	Unmaintained or attribute-sensitive; login flows re-verified	days each

Pinning is classed as judgment because Section 7 shows what each test must be designed around.

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Meridian's intent for CloudWars. If it is to be retired or frozen, the three "months" items do not apply.

9. Recommended sequence

PARTIAL (D7 wave proposals and D11 effort bands are automated; the phasing and bands are human judgment). *Bands are engineer-weeks, to be refined after Phase 0.*

The survey's wave proposals order modules by dependency direction, consumers first. Two judgment calls apply. A runtime retarget of CloudWars' core cluster runs the other way (Common first, since everything references it). And eShopOnWeb's retarget is exempt from wave order altogether, because its target is declared once; the calendar, not the graph, sets its place. The plan therefore runs two tracks: the legacy pair, and eShopOnWeb with a hard date.

PHASE	TRACK	WHAT HAPPENS	DELIVERS	EXIT CRITERION	BAND
0. Confirm	Both	Interview the five dominant authors and whoever last released each system; confirm every <i>Assumption</i> ; resolve all 118 package references; decide the Needletail version policy; triage the 13 author notes; settle the price cap; capture any manual regression practice	N-03, N-04, C-03, C-04, C-010, C-011, C-012, E-03, E-04, E-05, E-06	Every Section 11 question has an owner; the version policy is written down	2 to 3
1. Characterize	Legacy	Clear the blocking patterns (instance-scoped state in CloudWarsDB ; seams in Game ; injected connection factories in Needletail), then pin all nine areas	N-02, C-02, C-08	Zero legacy test deserts; pinnability judgment per area; Section 7 shared-state and dependency rows closed or accepted	5 to 9

Phase	Product	Task	Code	Test	Timeline
1e. Characterize	eShopOnWeb	Replace the nine synchronous waits and the static state in BlazorAdmin ; pin the area at its 7 network and 4 time seams; extend reach where Phase 0 shows it thin	E-02	Zero test deserts; the full suite green on .NET 8 as the baseline	2 to 4
2e. Runtime move	eShopOnWeb	Change the central target to the next long-term-support runtime; update the 8.0.x family per the advisory report; re-run the suite	E-01	Suite unchanged on the new target; 0 unsupported runtimes; completed before 2026-11-10	2 to 4
2. Needletail lift	Legacy	Move TestApp off .NET 9; publish a current package	N-01	Suite unchanged; a confirmed consumer builds against the new package	1 to 2
3. CloudWars runtime lift	Legacy	Retire Glue if confirmed empty; retarget Engine , then Common , Entities , DataAccess , SpaceBattle , Game ; migrate manifests; replace packages as the advisory report dictates	C-01, C-09, C-013 to C-015 as needed	Suite passes on the new targets; zero open advisories	6 to 12
4. Platform replacement (conditional)	Legacy	If CloudWars has a product future: Entity Framework Core, ASP.NET Core MVC and controllers	C-05, C-06, C-07	Phase 1 suite passes on the new platform	months

Phases 0, 1, 1e and 2e are the first funding decision: 11 to 20 engineer-weeks, of which the eShopOnWeb track is 4 to 8 plus its share of Phase 0, and must finish its runtime move by November. Needletail's 821-line method is deliberately not split before it is pinned; that is the

November. Needletail's CSI the method is deliberately not split before it is pinned, that is the change the survey warns "quietly changes behaviour".

10. How each phase would be proven

MANUAL (D8), written from the survey's stated method: pin current behaviour, transform, prove parity.

PHASE	"DONE" MEANS	EVIDENCE PRODUCED	SIGN-OFF
0	Every Section 11 question has an owner and, where answerable, an answer	Three advisory reports; interview transcripts filed as expert-testimony entries; the version-policy decision; the note triage; the price-cap decision	Meridian engineering lead
1, 1e	Every area has reaching tests and a pinnability judgment; blocking Section 7 rows closed	Test census re-runs showing 0 deserts; coding-practices re-runs showing the shared-state, sync-over-async and dependency rows gone or accepted; suites in source control	Engineering lead, against the interview findings
2e	Every eShopOnWeb project builds and every test passes on the new target	Dependency inventory re-run: active runtime, 0 open advisories; unchanged suite results; build log, dated before 2026-11-10	Security owner (advisories); engineering lead (suite)
2	Needletail builds on a supported runtime and a consumer runs on the new package	Green build; 0 end-of-life runtimes; unchanged suite	Consumer owner, in their own environment
3	All seven CloudWars projects build on supported targets with a clean, checkable manifest	Dependency inventory re-run; unchanged suite results	Security owner; engineering lead
4	CloudWars behaves identically on the new platform	Phase 1 suite passing; a parity run of any manual checklist from Phase 0	Engineering lead and product owner

Each phase re-runs the same survey that produced this document, so the "after" evidence is in the same format as the "before".

11. What we do not yet know

The survey raised these questions and cannot answer them. Each has a method.

QUESTION	WHY IT MATTERS	HOW TO ANSWER
Who besides the sole author understands <code>Needletail.DataAccess/Engines/SqlClientEngine.cs</code> and <code>DataSources/DBTableDataSource.cs</code> ?	100% of 8 and 6 commits; the second holds 1,691 lines and all 41 guards	Interview (knowledge-base open questions)
Who besides the dominant author understands <code>CloudWars.Game/Web.config</code> and <code>CloudWars.Game.csproj</code> ?	100% of 5 and 83% of 6 commits	Interview (knowledge-base open questions)
Who besides the dominant author understands <code>eShopOnWeb's BasketService.cs</code> , <code>CartController.cs</code> , <code>Basket.cs</code> , catalog context and seed, and product view?	100% of 10, 8, 7 and 6 commits; the commercial path	Interview (nine knowledge-base open questions name this author)
Who besides their authors understand <code>eShopOnWeb's infra/ templates (100% and 83%)</code> and <code>BlazorShared/Authorization/Constants.cs (80%)</code> ?	The cloud deployment and the role names the identity seed depends on	Interview (one is a knowledge-base open question)
Which price cap is intended, 1000 or 10000? Were <code>eShopOnWeb's</code> four production notes resolved in deployment?	The code enforces both; the notes say "not for production"	Interview; deployment configuration
Why are <code>CloudWars'</code> thresholds 30 seconds and 50 characters, and what do its TODOs leave unfinished?	The lifted rules say what, not why	Interview; runtime observation
Is <code>CloudWars</code> deployed? Is <code>eShopOnWeb</code> deployed, where, and on how many hosts?	Decides whether 4a and 4d are live exposure or	Meridian operations