

# Skontro

## Software Requirements Specification

Version 1.0

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**Status:** Accepted  
**Project:** Skontro — open-source German-compliant mini-ERP  
**Repository:** <https://github.com/skontro/skontro>  
**Documentation:** <https://docs.skontro.dev>  
**License:** MIT  
**Standards basis:** ISO/IEC/IEEE 29148:2018, EN 16931, §14 UStG

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# 1 Introduction

## 1.1 Purpose

This Software Requirements Specification (SRS) defines the functional and non-functional requirements for **Skontro**, an open-source self-hostable mini-ERP for German Small and Medium Enterprises (SMEs). The document serves as the contractual basis between the Vision and Scope document (the “why” and “what for whom”) and the Software Design Document (the “how”).

The document follows ISO/IEC/IEEE 29148:2018 conventions, the current standard for software and systems engineering requirements processes (which supersedes IEEE 830-1998).

## 1.2 Document Conventions

Requirements in this document follow the format:

- **Functional Requirements** are prefixed FR-NNN and describe *what* the system shall do.
- **Non-functional Requirements** are prefixed NFR-NNN and describe quality attributes (performance, security, usability, etc.).
- **Interface Requirements** are prefixed IR-NNN.
- Priorities follow the MoSCoW convention: **Must**, **Should**, **Could**, **Won’t (this release)**.
- Each requirement specifies a **Source** traceable to the Vision and Scope document or an Architecture Decision Record (ADR).
- Each requirement specifies one or more **Acceptance criteria** that are testable.

The keywords **shall**, **should**, **may**, and **will** follow RFC 2119 conventions.

## 1.3 Intended Audience and Reading Suggestions

- **Engineers** should focus on Sections 2 and 3, especially the functional requirements catalogue and the external interface requirements.
- **Operations engineers** should focus on Sections 3.3 (Performance), 3.4 (Reliability), and Appendix A.
- **Compliance auditors** should focus on Section 3.6 (Compliance Requirements) and the references to external specifications.
- **Project reviewers and external readers** should read Sections 1 and 2 for context, then sample the requirements catalogue in Section 3.

## 1.4 Project Scope

For the complete project scope, see the Vision and Scope document at <https://docs.skontro.dev/vision/vision-and-scope/>. In brief: Skontro is an open-source mini-ERP targeting the German Mittelstand, with EN 16931-compliant e-invoicing, GoBD-aligned archival, and ML-assisted bookkeeping capabilities planned for v0.3.

## 1.5 References

1. Vision and Scope — <https://docs.skontro.dev/vision/vision-and-scope/>
2. ADR 0001 — Stack Choice
3. EN 16931 — European standard for electronic invoicing
4. BMF letter, e-Rechnung guidance (most recent version)
5. Wachstumschancengesetz, BGBl. 2024 I Nr. 108
6. §14 UStG, §19 UStG — Umsatzsteuergesetz
7. GoBD — BMF letter dated 28.11.2019
8. ZUGFeRD 2.1 specification — FeRD
9. XRechnung specification — KoSIT
10. ISO/IEC/IEEE 29148:2018 — Systems and software engineering — Life cycle processes — Requirements engineering
11. RFC 2119 — Key words for use in RFCs to indicate requirement levels

## 2 Overall Description

### 2.1 Product Perspective

Skontro is a standalone, self-hostable, multi-tenant mini-ERP. It is not a module of another system. It interacts with the following external systems and roles (a system context diagram appears in the arc42 architecture document, Section 3):

- **Tenant Users** via web browser (Chrome, Firefox, Safari, Edge — latest two stable versions)
- **Steuerberater** (tax advisor) consuming DATEV-format exports from v0.2 onwards
- **Invoice Recipients** consuming PDF/A-3 ZUGFeRD invoices via email or download
- **S3-compatible Storage** (MinIO in development, AWS S3 or Hetzner Object Storage in production)
- **KoSIT Validator** (continuous integration only, used to verify generated invoices)
- **(Future)** SMTP provider, Sentry, Stripe, Peppol access point

### 2.2 Product Functions

At v0.1.0 launch, Skontro shall provide the following high-level functions:

- User authentication, registration, and tenant onboarding
- Multi-tenant data isolation
- Role-based access control (owner, admin, accountant, viewer)
- Customer management (company and individual)
- Product and service catalog management

- Invoice lifecycle management (draft, issued, sent, paid, cancelled)
- EN 16931 / ZUGFeRD 2.1 hybrid PDF/A-3 + XML invoice generation
- Expense tracking with receipt upload (PDF, image formats)
- Dashboard with key business metrics
- Tenant settings management (company, tax, banking, invoicing defaults)

## 2.3 User Classes and Characteristics

| Class                | Description                          | Tech Level | Frequency         | Importance |
|----------------------|--------------------------------------|------------|-------------------|------------|
| Tenant Owner         | Business owner, primary admin        | Low–Medium | Daily             | Critical   |
| Accountant           | Internal or external bookkeeper      | Medium     | Daily             | High       |
| Viewer               | Read-only access (auditor, observer) | Any        | Occasional        | Medium     |
| External Auditor     | Future: read-only audit access       | High       | Annual            | Future     |
| API Integrator       | Future: programmatic access          | High       | Continuous        | Future     |
| System Administrator | Self-host operator                   | High       | Setup + as-needed | High       |

Table 1: User classes for Skontro v0.1.0.

## 2.4 Operating Environment

- **Server OS:** Linux (Ubuntu 24.04 LTS reference); any Docker-compatible distribution
- **Runtime:** Docker Engine 24+, Docker Compose v2+
- **Languages:** PHP 8.3, Node 20 LTS, Python 3.12 (Python only required for v0.3 ML service)
- **Datastores:** PostgreSQL 14+ (16 recommended), Redis 7+, S3-compatible object storage
- **Client:** Modern evergreen browser, latest two stable versions of Chrome/Firefox/Safari/Edge; responsive from 375px viewport
- **Network:** HTTPS only in production; HTTP on localhost permitted in development

## 2.5 Design and Implementation Constraints

- Must use Laravel 11 and Vue 3 per **ADR 0001**
- Must support self-hosting via `docker compose up` per **ADR 0001**
- Must produce EN 16931-compliant e-invoices for all issued invoices
- Must archive issued invoices for 10 years per GoBD (§147 AO)
- Multi-tenancy via single-database `tenant_id` discriminator (architectural decision recorded in a future ADR)
- API versioning via URL prefix `/api/v1`
- All commits follow Conventional Commits 1.0.0
- License: MIT

## 2.6 User Documentation

The following user-facing documentation shall be maintained:

- README at the repository root with quickstart
- Documentation site at <https://docs.skontro.dev> (MkDocs Material)
- API reference auto-generated from code (Laravel Scribe — OpenAPI 3.0)
- Operations runbook in `docs/operations/runbook.md`
- In-app help text on complex flows (deferred to v0.2)

## 2.7 Assumptions and Dependencies

- Postgres is available and reachable
- Redis is available and reachable
- S3-compatible storage is available and reachable
- Working SMTP infrastructure available (v0.2+ requirement)
- Customer-side Steuerberater accepts DATEV CSV (v0.2+, universal in Germany)
- Tenant administrator can configure DNS and TLS for self-hosted deployment (v0.1 documents the procedure)

# 3 Specific Requirements

## 3.1 External Interface Requirements

### 3.1.1 User Interfaces

| IR-001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Must   | UI Framework  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| <p><b>Description.</b> The system shall provide a web-based Single Page Application built with Vue 3.</p> <p><b>Rationale.</b> Aligns with ADR 0001 stack choice; meets the productivity targets of the project.</p> <p><b>Source.</b> ADR 0001.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• The frontend bundle is served separately from the backend API</li><li>• Routing is client-side using Vue Router</li><li>• State management uses Pinia</li></ul> |        |               |
| IR-002                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Should | Accessibility |
| <p><b>Description.</b> The system should conform to WCAG 2.1 Level AA for the main workflows (login, dashboard, customer list, invoice editor, expense form).</p> <p><b>Rationale.</b> German federal accessibility regulations (BFSG) progressively extend WCAG requirements; an open-source project should set a credible baseline.</p>                                                                                                                                                       |        |               |

**Source.** V&S §1.3 BO-5.

**Acceptance criteria:**

- Axe-core automated audit reports zero violations on the five main workflows
- All interactive elements reachable via keyboard
- All form fields have associated labels
- Color contrast meets WCAG 2.1 AA on both light and dark themes

IR-003

Must

*Localization*

**Description.** The system shall provide a German user interface as default and an English user interface as fallback.

**Rationale.** Target market is German Mittelstand; compliance-relevant terminology must be in German.

**Source.** V&S §3.2 Operating Environment.

**Acceptance criteria:**

- German is the default locale on first load
- Users can switch to English via a settings toggle
- All compliance-relevant fields (Rechnung, USt-ID, Steuernummer, GoBD, etc.) are preserved as German terms regardless of UI locale

IR-004

Must

*Browser Support*

**Description.** The system shall support the latest two stable versions of Chrome, Firefox, Safari, and Edge.

**Source.** V&S §3.2 Operating Environment.

**Acceptance criteria:**

- Functional tests pass on each of Chrome, Firefox, Safari, Edge (latest two versions)
- No reliance on proprietary browser APIs
- Mobile responsive design from 375px viewport width

### 3.1.2 Hardware Interfaces

Not applicable for v0.1.0. No direct hardware integration.

### 3.1.3 Software Interfaces

IR-005

Must

*Database Interface*

**Description.** The system shall persist all relational data in PostgreSQL 14 or later.

**Rationale.** ADR 0001 stack choice; jsonb support is required for storing parsed XRechnung XML in v0.2.

**Source.** ADR 0001.

**Acceptance criteria:**

- Migrations run cleanly against Postgres 14, 15, 16
- No MySQL-specific or SQLite-specific SQL is used
- All foreign keys explicit; no implicit relationships

IR-006

Must

*Cache and Queue Interface*

**Description.** The system shall use Redis 7 or later for caching, session storage, and queued job processing.

**Source.** ADR 0001.

**Acceptance criteria:**

- Redis URL configurable via environment variable
- Application degrades gracefully if Redis is temporarily unreachable (cache miss, no crash)

IR-007

Must

*Object Storage Interface*

**Description.** The system shall use S3-compatible object storage for receipt and document files.

**Rationale.** S3 API is the industry standard, supported by MinIO (local development), AWS S3, Hetzner Object Storage, Backblaze B2, and others.

**Source.** ADR 0001.

**Acceptance criteria:**

- Storage backend configurable via environment variables (endpoint, region, bucket, access key, secret key)
- All file access uses signed URLs with time-limited validity
- Files keyed by SHA-256 hash to enable deduplication

IR-008

Could

*ML Service Interface*

**Description.** The system may consume a private HTTP API exposed by a separate Python FastAPI service for machine-learning inference (receipt OCR, expense categorization, cash-flow forecasting, anomaly detection).

**Rationale.** Planned for v0.3 per V&S §2.2.

**Source.** V&S §2.2.

**Acceptance criteria:**

- The backend can call the ML service if its base URL is configured
- If the ML service is unreachable or returns an error, the dependent feature gracefully degrades (manual entry remains available)



### 3.1.4 Communications Interfaces

| IR-010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Must | <i>REST API Protocol</i>        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------|
| <p><b>Description.</b> The system shall expose a versioned REST/JSON API under the URL prefix <code>/api/v1</code>.</p> <p><b>Source.</b> (To be recorded in a future ADR on API versioning.)</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• All endpoints return JSON with the <code>Content-Type: application/json; charset=utf-8</code> header</li> <li>• All endpoints use standard HTTP verbs (GET, POST, PATCH, DELETE)</li> <li>• Error responses follow a consistent shape with <code>message</code>, <code>code</code>, and an optional <code>errors</code> object</li> </ul> |      |                                 |
| IR-011                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Must | <i>HTTPS Only in Production</i> |
| <p><b>Description.</b> The system shall accept HTTP only on localhost in development; production deployments shall enforce HTTPS.</p> <p><b>Source.</b> Standard security practice.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Production deployment runbook configures Caddy or equivalent for TLS termination</li> <li>• Application sends HSTS header with appropriate max-age</li> </ul>                                                                                                                                                                                       |      |                                 |

## 3.2 Functional Requirements

### 3.2.1 Authentication and User Management

| FR-001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Must | <i>User registration</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|
| <p><b>Description.</b> The system shall allow a new user to register an account by providing email, password, full name, company name, country code, and (optionally) a VAT ID.</p> <p><b>Rationale.</b> Self-service onboarding is critical to the self-hostable, open-source model.</p> <p><b>Source.</b> V&amp;S §2.1.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• A successful registration creates exactly one Tenant and one User in the same database transaction</li> <li>• The newly created User is assigned the <code>owner</code> role within the new Tenant</li> <li>• The response includes the user resource and a Sanctum access token</li> <li>• Duplicate email registration returns HTTP 422 with a clear error message</li> </ul> |      |                          |
| FR-002                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Must | <i>Password policy</i>   |
| <p><b>Description.</b> The system shall enforce a minimum password strength of 12 characters including at least one digit and one symbol on registration and password change.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                          |

**Rationale.** Modern password guidance (NIST SP 800-63B); reduces successful credential-stuffing.

**Source.** NFR-009 (Security).

**Acceptance criteria:**

- Registration with a password shorter than 12 characters returns HTTP 422
- Registration with a password missing digits or symbols returns HTTP 422
- The error response identifies which constraint failed

**FR-003****Must****Login**

**Description.** The system shall authenticate a user via email and password, returning a Sanctum personal access token on success.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Successful login returns the user resource and an access token
- Failed login (wrong password, unknown email) returns HTTP 401 with a generic “invalid credentials” message (no user-enumeration)
- Login is rate-limited per IP and per email (see NFR-011)

**FR-004****Must****Logout**

**Description.** The system shall provide a logout endpoint that revokes the current access token.

**Source.** Standard auth practice.

**Acceptance criteria:**

- Logout invalidates the current token only (other tokens for the same user remain valid)
- Subsequent requests with the revoked token return HTTP 401

**FR-005****Must****Rate limiting on auth endpoints**

**Description.** The system shall apply rate limiting of 5 requests per minute per IP on the login, registration, and password-reset endpoints.

**Source.** NFR-011.

**Acceptance criteria:**

- The 6th request in 60 seconds returns HTTP 429
- Response includes **Retry-After** header

**FR-006****Must****Token TTL**

**Description.** The system shall issue access tokens with a 30-day time-to-live.

**Source.** ADR (forthcoming) on auth strategy.

**Acceptance criteria:**

- Tokens expire 30 days after issue

- Expired tokens return HTTP 401

FR-007

Must

*User profile read*

**Description.** The system shall provide an authenticated endpoint that returns the current user's profile information.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Returns id, email, full\_name, locale, role within current tenant
- Does not return password hash or other sensitive fields

FR-008

Must

*Locale preference*

**Description.** The system shall persist the user's locale preference (de or en) on the user record.

**Source.** IR-003.

**Acceptance criteria:**

- PATCH to user profile accepts locale field
- Subsequent API responses honor the locale for localized error messages

FR-009

Must

*Role assignment*

**Description.** The system shall allow tenant owners and admins to assign one of four roles (owner, admin, accountant, viewer) to other users in their tenant.

**Source.** V&S §2.1; ADR (forthcoming) on RBAC.

**Acceptance criteria:**

- Role changes require owner or admin permission
- Role changes are scoped to the current tenant; cannot affect users in other tenants
- The change is audited (timestamp, actor, target, old role, new role)

FR-010

Must

*Last-owner deletion protection*

**Description.** The system shall prevent deletion or role demotion of the last user with owner role in a tenant.

**Rationale.** Prevents a tenant from being locked out of admin access.

**Source.** ADR (forthcoming) on RBAC.

**Acceptance criteria:**

- Deleting the last owner returns HTTP 409 with a clear error
- Demoting the last owner to any non-owner role returns HTTP 409

### 3.2.2 Multi-tenancy and Data Isolation

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------|
| FR-011                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Must  | <i>Tenant creation on registration</i>   |
| <p><b>Description.</b> The system shall create exactly one Tenant per successful user registration and associate the new user with that Tenant as its owner.</p> <p><b>Source.</b> V&amp;S §2.1; ADR (forthcoming) on multi-tenancy.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Tenant and User creation happen in a single database transaction</li> <li>• If User creation fails, the Tenant is rolled back</li> <li>• A unique slug is generated for the Tenant (URL-safe, derived from company name)</li> </ul>                                                                                                                                                                                                                             |       |                                          |
| FR-012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Must  | <i>Data isolation between tenants</i>    |
| <p><b>Description.</b> The system shall prevent any tenant from reading, modifying, or deleting data belonging to another tenant.</p> <p><b>Source.</b> ADR (forthcoming) on multi-tenancy.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Every tenant-owned Eloquent model uses the BelongsToTenant trait</li> <li>• The global scope filters all queries by the authenticated user's tenant_id</li> <li>• Direct ID lookup of another tenant's record returns HTTP 404 (not 403)</li> <li>• Integration test suite includes a cross-tenant isolation test for every tenant-owned model</li> </ul>                                                                                                                                                |       |                                          |
| FR-013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Must  | <i>Tenant-scoped numbering sequences</i> |
| <p><b>Description.</b> The system shall provide atomic per-tenant sequential numbering for customers (K-YYYY-NNNNN), invoices (R-YYYY-NNNNN), and expenses (E-YYYY-NNNNN).</p> <p><b>Rationale.</b> Each tenant maintains its own numbering; concurrent writes within a tenant must not collide.</p> <p><b>Source.</b> ADR (forthcoming) on numbering strategy.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Sequence numbers are atomic under concurrent writes (row-level lock or sequence table)</li> <li>• Numbers reset annually based on document date year</li> <li>• No duplicate numbers within a (tenant, document_type, year) triple</li> <li>• Concurrency test confirms 100 parallel inserts produce 100 distinct numbers</li> </ul> |       |                                          |
| FR-014                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Could | <i>Tenant switching</i>                  |
| <p><b>Description.</b> The system may, in a future release, allow users belonging to multiple tenants to switch between them within a single session.</p> <p><b>Source.</b> V&amp;S §2.2 (deferred to v0.3+).</p> <p><b>Acceptance criteria:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |                                          |

- Not implemented in v0.1.0

FR-015

Must

*Tenant settings model*

**Description.** The system shall provide a settings model per tenant containing company info, tax info, banking info, and invoicing defaults.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Settings are mutable only by users with owner or admin role
- Settings include: company name, address; USt-ID, Steuernummer, Handelsregister; IBAN, BIC, bank name; default payment terms, default tax rate, default unit, notes\_top, notes\_bottom
- USt-ID validation per BMF format (DE + 9 digits, checksum)
- IBAN validation per ISO 13616 checksum

### 3.2.3 Customer Management

FR-016

Must

*Create customer*

**Description.** The system shall allow authenticated users with at least accountant role to create a customer record of type **company** or **individual**.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Required fields: type, contact\_name; for company type, additionally company\_name
- Optional fields: address (street, postal code, city, country\_code), email, phone, VAT ID, notes
- On creation, a customer number K-YYYY-NNNNN is generated atomically
- Returns HTTP 201 with the created customer resource

FR-017

Must

*Read customer*

**Description.** The system shall provide an endpoint to retrieve a single customer by ID within the current tenant.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Returns HTTP 404 if customer ID does not exist or belongs to a different tenant
- Returns full customer resource including all fields

FR-018

Must

*Update customer*

**Description.** The system shall allow authenticated users with at least accountant role to update a customer's mutable fields.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Customer number is immutable after creation
- All other fields mutable via PATCH
- Updates audited (timestamp, actor, changed fields)

FR-019

Must

*Soft-delete customer*

**Description.** The system shall support soft deletion of customers (mark as deleted but retain in database).

**Rationale.** Customers may have associated invoices that must remain readable. Soft delete prevents accidental data loss.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Soft-deleted customers are excluded from list and search results by default
- Existing invoices for soft-deleted customers remain accessible
- Admins can restore soft-deleted customers

FR-020

Must

*List and search customers*

**Description.** The system shall provide a paginated list endpoint supporting search by name, customer number, email, and VAT ID, plus sort by created\_at, name, or customer number.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Default page size 25, max page size 100
- Search is case-insensitive substring match
- Response includes total count, current page, last page
- Excludes soft-deleted customers by default; ?include\_deleted=1 includes them

FR-021

Must

*VAT ID validation*

**Description.** The system shall validate VAT IDs against the format pattern for the customer's country code.

**Source.** EN 16931 requires a valid VAT ID on every B2B invoice.

**Acceptance criteria:**

- DE VAT ID format: DE + 9 digits, valid checksum
- AT, FR, NL, IT, ES, PL, BE, DK, SE, FI VAT ID format validated per country pattern
- Invalid format returns HTTP 422 with field-specific error
- v0.1 validates format only; online VIES verification deferred to v0.2

FR-022

Must

*EU country support*

**Description.** The system shall support customers in all EU member states for address and VAT ID fields.

**Source.** EN 16931.

**Acceptance criteria:**

- Country code field uses ISO 3166-1 alpha-2 codes (DE, AT, FR, etc.)
- All 27 EU member states selectable in UI

### 3.2.4 Product and Service Catalog

FR-023

Must

*Create product or service*

**Description.** The system shall allow authenticated users with at least accountant role to create a product or service in the catalog.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Required: name, unit\_price\_cents (integer), vat\_rate (one of 19, 7, 0)
- Optional: description, unit (default Stück), sku
- Returns HTTP 201 with created resource

FR-024

Must

*German VAT rate assignment*

**Description.** The system shall allow assigning one of the German VAT rates (19%, 7%, 0%) to each product or service.

**Source.** §12 (1) UStG (19%), §12 (2) UStG (7%), §4 UStG (0%).

**Acceptance criteria:**

- VAT rate stored as integer (19, 7, 0)
- No other VAT rates accepted in v0.1
- Reverse-charge (§13b UStG) deferred to v0.3

FR-025

Must

*Unit selection*

**Description.** The system shall support the following units for products and services, each mapped to a UN/ECE Recommendation 20 unit code for ZUGFeRD output: Stück (H87), Stunde (HUR), Kilogramm (KGM), Meter (MTR), Quadratmeter (MTK), Tag (DAY), pauschal (LS).

**Source.** EN 16931 requires UN/ECE Rec. 20 unit codes.

**Acceptance criteria:**

- Unit selectable from the seven supported values
- Each unit maps to its UN/ECE code at ZUGFeRD generation time

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------|
| FR-026                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Must   | <i>Pricing in cents</i> |
| <p><b>Description.</b> The system shall store all monetary amounts as integer cents (no floating-point).</p> <p><b>Rationale.</b> Floating-point arithmetic on monetary amounts causes rounding errors that fail EN 16931 validation.</p> <p><b>Source.</b> ADR (forthcoming) on monetary handling.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Database columns for monetary amounts use BIGINT or DECIMAL, never FLOAT or DOUBLE</li> <li>• Brick/Money or equivalent library used in application code</li> <li>• Unit prices displayed in EUR with 2 decimal places to users; stored as cents internally</li> </ul> |        |                         |
| FR-027                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Must   | <i>Archive product</i>  |
| <p><b>Description.</b> The system shall support archiving of products and services (mark as inactive but retain in catalog).</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Archived products excluded from product picker on new invoices</li> <li>• Archived products remain readable; existing invoices referencing them unaffected</li> <li>• Archived products can be unarchived</li> </ul>                                                                                                                                                                                                                          |        |                         |
| FR-028                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Should | <i>Optional SKU</i>     |
| <p><b>Description.</b> The system should allow assigning an optional SKU (stock-keeping unit) string to each product.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• SKU is optional and may be unique per tenant (not enforced as unique constraint in v0.1)</li> <li>• SKU appears on invoice line items when present</li> </ul>                                                                                                                                                                                                                                                                                        |        |                         |

### 3.2.5 Invoicing Core

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|
| FR-029                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Must | <i>Create draft invoice</i> |
| <p><b>Description.</b> The system shall allow authenticated users with at least accountant role to create an invoice in <b>draft</b> state.</p> <p><b>Source.</b> V&amp;S §2.1.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Required: customer_id; at least one line item</li> <li>• Optional: invoice_date (default today), due_date (default today + default_payment_terms), service_period_start, service_period_end, notes_top, notes_bottom</li> </ul> |      |                             |



- Returns HTTP 201 with the created invoice

FR-030

Must

*Invoice line items*

**Description.** The system shall support adding multiple line items to an invoice. Each line item references a product or service from the catalog or contains free-form description, quantity, unit, unit price, and VAT rate.

**Source.** EN 16931 invoice structure.

**Acceptance criteria:**

- Each line item has: description, quantity (decimal), unit, unit\_price\_cents, vat\_rate
- Line items can mix products from catalog and ad-hoc descriptions
- Line items immutable once invoice is issued

FR-031

Must

*Invoice totals calculation with line-level VAT rounding*

**Description.** The system shall calculate invoice totals by computing VAT per line item, rounding each line's VAT to two decimal places, then summing — never by computing VAT on the document subtotal.

**Rationale.** EN 16931 Business Rule BR-CO-17 mandates line-level VAT calculation. Document-level VAT rounding produces 1–2 cent differences that fail KoSIT validation on multi-rate invoices.

**Source.** EN 16931 BR-CO-17.

**Acceptance criteria:**

- For each line:  $\text{line\_net} = \text{quantity} * \text{unit\_price\_cents}$ ;  $\text{line\_vat} = \text{round}(\text{line\_net} * \text{vat\_rate} / 100, 2)$
- Document totals:  $\text{subtotal} = \text{sum}(\text{line\_net})$ ;  $\text{total\_vat} = \text{sum}(\text{line\_vat})$ ;  $\text{total} = \text{subtotal} + \text{total\_vat}$
- Per-VAT-rate subtotals exposed for ZUGFeRD XML output
- Unit test corpus includes a multi-rate invoice case proving line-level rounding produces a different total than document-level rounding

FR-032

Must

*Invoice state machine*

**Description.** The system shall enforce the following invoice state transitions: `draft` → `issued` → `sent` → (`partially_paid` | `paid`); any state except `paid` → `cancelled`.

**Source.** ADR (forthcoming) on invoice state machine.

**Acceptance criteria:**

- Invalid transitions return HTTP 409 with the current state in the error
- State transitions are audited with timestamp and actor
- Issued invoices are immutable for line items (only payment status can update)

FR-033

Must

Issue invoice

**Description.** The system shall provide an endpoint to transition a draft invoice to issued state. Issuing an invoice generates the invoice number (R-YYYY-NNNN), sets `issued_at` to current timestamp, and triggers ZUGFeRD PDF generation.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Issuing requires invoice in draft state
- Issuing locks line items (immutable thereafter)
- Issuing dispatches a job to generate the ZUGFeRD-compliant PDF/A-3 file (see FR-041 through FR-048)

FR-034

Must

Cancel invoice

**Description.** The system shall allow cancellation of any invoice in state `issued`, `sent`, or `partially_paid`, with a mandatory cancellation reason.

**Source.** GoBD requires reasons for state changes on financial documents.

**Acceptance criteria:**

- Cancellation requires a non-empty reason string
- Cancelled invoices appear in lists with the `cancelled` state filter
- Cancelled invoices cannot be uncanceled (immutable after cancel)
- Cannot cancel an invoice in `paid` state

FR-035

Must

Mark invoice paid

**Description.** The system shall allow recording full or partial payment against an invoice.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Recording a payment captures: `amount_cents`, `payment_date`, `payment_method` (cash, bank\_transfer, sepa\_direct\_debit, credit\_card, other), reference
- If cumulative payments equal invoice total, state transitions to `paid`
- If cumulative payments are less than invoice total, state transitions to `partially_paid`

FR-036

Must

Payment terms

**Description.** The system shall support configurable payment terms expressed in days (default 14 days, settable per tenant in settings).

**Acceptance criteria:**

- Tenant settings define a default payment term in days
- Per-invoice payment terms override the tenant default
- Due date computed as `invoice_date + payment_terms_days`

FR-037

Should

*Service period*

**Description.** The system should allow recording an optional service period (start date, end date) on each invoice.

**Rationale.** §14 UStG requires service period when service was rendered over a period.

**Source.** §14 UStG.

**Acceptance criteria:**

- Service period optional on invoice
- When present, appears on the rendered PDF and in the ZUGFeRD XML

FR-038

Must

*Notes top and bottom*

**Description.** The system shall support free-form note text above the line items table (`notes_top`) and below it (`notes_bottom`) on each invoice.

**Acceptance criteria:**

- Markdown not supported in v0.1; plain text only
- Default values configurable per tenant in settings
- Per-invoice values override tenant defaults

FR-039

Must

*Invoice numbering*

**Description.** The system shall generate sequential invoice numbers per tenant per year in the format R-YYYY-NNNNN, atomic against concurrent issuance.

**Source.** §14 UStG requires unique sequential invoice numbers; FR-013.

**Acceptance criteria:**

- Year prefix matches the invoice's issuance year
- Sequence is monotonic and dense (no gaps) within a (tenant, year) pair
- No duplicates under concurrent issuance (tested with 100 parallel issuance calls)

FR-040

Should

*Customer default payment terms*

**Description.** The system should allow setting customer-specific default payment terms that override the tenant default but can themselves be overridden per invoice.

**Acceptance criteria:**

- Customer record can have a `payment_terms_days` field (nullable)
- When creating an invoice, the precedence is: invoice-specific > customer-specific > tenant default

### 3.2.6 E-Invoicing (ZUGFeRD)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------|
| FR-041                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Must | <i>Generate ZUGFeRD XML</i>         |
| <p><b>Description.</b> The system shall generate a ZUGFeRD 2.1 EN16931-profile XML representation of each issued invoice, conformant to the EN 16931 European e-invoicing standard.</p> <p><b>Source.</b> EN 16931; Wachstumschancengesetz mandate.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• XML structure follows ZUGFeRD 2.1 EN16931 profile schema</li> <li>• All §14 UStG mandatory fields are present (see FR-043)</li> <li>• All UN/ECE Rec. 20 unit codes are correct per FR-025</li> <li>• Per-line VAT calculation per BR-CO-17 (FR-031)</li> </ul>                                                                                                                                                                                                     |      |                                     |
| FR-042                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Must | <i>Generate PDF/A-3 hybrid file</i> |
| <p><b>Description.</b> The system shall produce a PDF/A-3 conformant file containing both the human-readable invoice rendering and the embedded <code>factur-x.xml</code> attachment.</p> <p><b>Source.</b> ZUGFeRD 2.1 specification.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Output file passes verapdf PDF/A-3 conformance check</li> <li>• Embedded attachment is named exactly <code>factur-x.xml</code></li> <li>• Attachment AFRelationship is set to <code>Source</code></li> <li>• XMP metadata includes the ConformanceLevel marker</li> </ul>                                                                                                                                                                                                        |      |                                     |
| FR-043                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Must | <i>§14 UStG mandatory fields</i>    |
| <p><b>Description.</b> The system shall include all fields required by §14 UStG on every issued invoice (both in the PDF rendering and in the embedded XML).</p> <p><b>Source.</b> §14 UStG.</p> <p><b>Acceptance criteria.</b> Every issued invoice must include:</p> <ul style="list-style-type: none"> <li>• Full name and address of the issuing business</li> <li>• Full name and address of the recipient</li> <li>• Steuernummer or USt-ID of the issuer</li> <li>• Invoice date (Rechnungsdatum)</li> <li>• Invoice number (unique, sequential)</li> <li>• Description and quantity of goods or services</li> <li>• Service date or service period</li> <li>• Net amount per VAT rate, applicable VAT rate, VAT amount, gross amount</li> <li>• Any agreed price reductions (Skonto)</li> </ul> |      |                                     |

- If applicable: reference to reverse-charge (§13b UStG)
- If applicable: reference to Kleinunternehmer status (§19 UStG, v0.2)

FR-044

Must

*KoSIT validation pass*

**Description.** The system shall produce ZUGFeRD invoices that pass validation against the KoSIT validator (the official German XRechnung / ZUGFeRD reference validator).

**Source.** V&S §1.3 BO-2.

**Acceptance criteria:**

- CI pipeline runs the KoSIT validator against a corpus of at least 10 test invoices covering edge cases (single-line, multi-rate, foreign customer, no service period, large quantities)
- All test corpus invoices return zero validation errors
- KoSIT pass rate  $\geq 99\%$  per V&S success metric

FR-045

Must

*UN/ECE Rec. 20 unit code mapping*

**Description.** The system shall map internal unit identifiers to the corresponding UN/ECE Recommendation 20 unit codes in the ZUGFeRD XML output (see FR-025).

**Source.** EN 16931 requires UN/ECE codes.

**Acceptance criteria:**

- Mapping table: Stück → H87, Stunde → HUR, Kilogramm → KGM, Meter → MTR, Quadratmeter → MTK, Tag → DAY, pauschal → LS
- All seven mappings tested

FR-046

Must

*Multi-VAT-rate handling*

**Description.** The system shall correctly aggregate line items by VAT rate and output per-rate subtotals in the ZUGFeRD XML.

**Source.** EN 16931 BR-CO-17 and BR-CO-18.

**Acceptance criteria:**

- For each distinct VAT rate appearing on an invoice, the XML contains a separate `ApplicableTradeTax` block with the correct net amount, rate, and VAT amount
- Test corpus includes a three-line invoice mixing 19% and 7% rates

FR-047

Must

*Generation pipeline*

**Description.** The system shall implement an invoice generation pipeline: invoice data → InvoiceCalculator → Blade template → Browsershot (Chromium) → Ghostscript (PDF/A-3 conversion with sRGB ICC profile) → horstoeko/zugferd (embed factur-x.xml) → final hybrid file.

**Source.** ADR (forthcoming) on PDF generation pipeline.

**Acceptance criteria:**

- Pipeline runs asynchronously as a queued job

- Each step has a typed exception class for failure modes
- Generation time p95 below 3 seconds on reference hardware

FR-048

Should

*Hybrid file download*

**Description.** The system should provide an authenticated download endpoint returning the hybrid PDF/A-3 + XML file for an issued invoice.

**Acceptance criteria:**

- Endpoint returns 404 for draft invoices (no generated PDF yet)
- Endpoint returns the file with `Content-Type: application/pdf` and correct `Content-Disposition` header
- Filename follows pattern: `Rechnung-R-YYYY-NNNNN.pdf`

### 3.2.7 Expense Tracking

FR-049

Must

*Create expense*

**Description.** The system shall allow authenticated users with at least accountant role to create an expense record with vendor name, date, gross amount, VAT amount, VAT rate, category, and payment method.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Required: vendor, expense\_date, gross\_amount\_cents, vat\_rate, category
- Optional: notes, vat\_amount\_cents (auto-calculated if not provided)
- Expense number E-YYYY-NNNNN generated on creation

FR-050

Must

*Receipt file upload*

**Description.** The system shall support attaching one or more receipt files to an expense in formats PDF, JPG, PNG, WebP, HEIC with maximum file size 10 MB per file.

**Source.** V&S §2.1; GoBD requires retention of original receipts.

**Acceptance criteria:**

- MIME type validated (not just extension)
- Files larger than 10 MB rejected with HTTP 422
- Multiple receipts can be associated with a single expense

FR-051

Must

*SHA-256 deduplication*

**Description.** The system shall compute the SHA-256 hash of every uploaded receipt and detect duplicate uploads.

**Rationale.** Prevents the same receipt being attached twice (e.g., by accident or for fraud).

**Source.** V&S §2.1.

**Acceptance criteria:**

- SHA-256 hash computed server-side on upload
- Storage key in S3 is the hash (no duplicate storage)
- If a duplicate hash is uploaded within the same tenant, the API returns a warning indicating the existing expense(s) referencing that hash

FR-052

Must

*Configurable expense categories*

**Description.** The system shall maintain a per-tenant list of expense categories selectable at expense creation time.

**Acceptance criteria:**

- Default categories seeded for new tenants in German: Büromaterial, Reisekosten, Bewirtung, Software, Hardware, Telekommunikation, Werbung, Sonstiges
- Categories can be added, renamed, or archived (not deleted) by users with admin role

FR-053

Must

*Soft-delete expense*

**Description.** The system shall support soft-deletion of expenses, with the constraint that issued expenses cannot be deleted (only cancelled).

**Source.** GoBD principle of unalterability.

**Acceptance criteria:**

- Soft-deleted expenses excluded from list and reporting by default
- Original receipt files retained in storage even after soft-delete
- Restore action available to users with admin role

### 3.2.8 Dashboard

FR-054

Must

*Revenue widgets*

**Description.** The system shall display revenue figures for the current calendar month and current year-to-date on the dashboard.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Excludes cancelled invoices
- Includes only issued and paid invoices
- Refreshes on dashboard load

FR-055

Must

*Open and overdue invoices widget*

**Description.** The system shall display the count and total gross value of currently open invoices and currently overdue invoices.

**Acceptance criteria:**

- Open: state in {issued, sent, partially\_paid}, due\_date  $\geq$  today
- Overdue: state in {issued, sent, partially\_paid}, due\_date  $<$  today

FR-056

Must

*12-month timeline*

**Description.** The system shall display a 12-month rolling revenue and expense timeline as a chart.

**Acceptance criteria:**

- Bar or line chart with 12 monthly buckets ending current month
- Revenue (green) and expenses (red) shown side-by-side or stacked
- Renders below 2 seconds with demo data

FR-057

Must

*Top customers*

**Description.** The system shall display the top 5 customers by paid revenue (current year-to-date) on the dashboard.

**Acceptance criteria:**

- Sorted descending by paid revenue
- Shows customer name and paid amount
- Clicking a row opens the customer detail view

### 3.2.9 Tenant Settings

FR-058

Must

*Company information*

**Description.** The system shall allow users with admin role to maintain company information (name, address, country) for the tenant.

**Source.** §14 UStG (issuer information on invoices).

**Acceptance criteria:**

- All fields editable
- Changes audited
- Changes affect new invoices only; previously-issued invoices unchanged

FR-059

Must

*Tax information*

**Description.** The system shall maintain tax-related identifiers per tenant: USt-ID, Steuernummer, Handelsregister entry.

**Source.** §14 UStG requires one of USt-ID or Steuernummer on every invoice.

**Acceptance criteria:**

- USt-ID validated per FR-021 format
- Steuernummer format-validated per state pattern



- Handelsregister field optional, free-text format (e.g., “HRB 12345 Amtsgericht Berlin”)

FR-060

Must

*Banking information*

**Description.** The system shall maintain bank account information per tenant: IBAN, BIC, bank name.

**Source.** V&S §2.1.

**Acceptance criteria:**

- IBAN validated per ISO 13616 checksum
- BIC validated per ISO 9362 format
- Bank name free-text
- Information appears in the standard footer of issued invoices

FR-061

Must

*Invoicing defaults*

**Description.** The system shall maintain tenant-level invoicing defaults: default payment terms in days, default unit, default tax rate, default notes\_top, default notes\_bottom.

**Source.** V&S §2.1.

**Acceptance criteria:**

- Defaults pre-fill the corresponding fields on new invoices
- Defaults editable by admin role only

FR-062

Should

*User management within tenant*

**Description.** The system should allow tenant admins and owners to invite new users to their tenant (v0.2), change other users' roles, and remove users from their tenant.

**Source.** V&S §2.1.

**Acceptance criteria:**

- v0.1 supports role change and user removal but not invitation flow (deferred to v0.2)
- Last-owner protection (FR-010) applies

### 3.3 Performance Requirements

NFR-001

Must

*API response time p50*

**Description.** The system shall respond to authenticated API requests within 200 milliseconds at the 50th percentile, measured on the reference hardware (Hetzner CX22).

**Acceptance criteria:**

- Measured continuously in production via APM (e.g., Sentry Performance)
- Excludes ZUGFeRD generation (asynchronous)

|                                                                                                                                                                                                                                                                                                                                                    |        |                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------|
| NFR-002                                                                                                                                                                                                                                                                                                                                            | Should | API response time p99 |
| <p><b>Description.</b> The system should respond to authenticated API requests within 500 milliseconds at the 99th percentile on the reference hardware.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Measured continuously</li><li>• Excludes long-running asynchronous operations</li></ul>                    |        |                       |
| NFR-003                                                                                                                                                                                                                                                                                                                                            | Should | Dashboard load time   |
| <p><b>Description.</b> The dashboard should fully render in under 2 seconds on demo data on the reference hardware.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Time-to-interactive measured via Lighthouse on demo deployment</li></ul>                                                                        |        |                       |
| NFR-004                                                                                                                                                                                                                                                                                                                                            | Should | PDF generation time   |
| <p><b>Description.</b> The full ZUGFeRD invoice generation pipeline should complete in under 3 seconds at the 95th percentile for a typical multi-line invoice.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Measured in background job queue stats</li><li>• Test invoice has 10 line items</li></ul>           |        |                       |
| NFR-005                                                                                                                                                                                                                                                                                                                                            | Must   | Query budget          |
| <p><b>Description.</b> Index endpoints shall perform at most 5 database queries total (including N+1 prevention via eager loading).</p> <p><b>Source.</b> V&amp;S §1.6 R-3.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Laravel Telescope or query log assertions in feature tests verify query count</li></ul> |        |                       |
| NFR-006                                                                                                                                                                                                                                                                                                                                            | Should | CI build time         |
| <p><b>Description.</b> The full CI test suite should complete within 5 minutes on standard GitHub-hosted runners.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Backend test suite + frontend test suite + linting + type-checking + docs build</li><li>• Parallel job execution</li></ul>                        |        |                       |
| NFR-007                                                                                                                                                                                                                                                                                                                                            | Should | Concurrent users      |
| <p><b>Description.</b> The reference deployment on Hetzner CX22 should support 100 concurrent authenticated users per tenant without exceeding the p99 response time target.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Load test with k6 or equivalent confirms target</li></ul>                              |        |                       |

- Test scenario: mixed read/write workload representative of typical bookkeeping usage

NFR-008

Should

*Receipt upload throughput*

**Description.** The system should accept receipt uploads at sustained throughput of 10 concurrent uploads on the reference hardware without degrading other API performance.

**Acceptance criteria:**

- Upload pipeline streams to S3-compatible storage; does not buffer entire file in PHP memory

### 3.4 Software System Attributes

#### 3.4.1 Security

NFR-009

Must

*Password hashing*

**Description.** The system shall hash passwords using bcrypt with cost factor 12 or higher.

**Source.** OWASP password storage guidance.

**Acceptance criteria:**

- bcrypt parameter cost  $\geq 12$
- No plaintext passwords logged or stored
- Password hash never returned in API responses

NFR-010

Must

*Sanctum personal access tokens*

**Description.** The system shall use Laravel Sanctum personal access tokens for API authentication, with a 30-day token TTL.

**Source.** FR-006.

**Acceptance criteria:**

- Tokens stored hashed in the database
- Token revocation immediate on logout
- Expired tokens automatically pruned by scheduled job

NFR-011

Must

*Rate limiting on auth*

**Description.** The system shall apply rate limiting of 5 requests per minute per IP on auth endpoints (login, registration, password reset).

**Source.** FR-005.

**Acceptance criteria:**

- Implemented via Laravel rate limiting middleware
- 429 response with Retry-After header

NFR-012

Must

*HTTPS-only in production*

**Description.** Production deployments shall enforce HTTPS and send HSTS headers with appropriate max-age.

**Source.** IR-011.

**Acceptance criteria:**

- TLS termination at reverse proxy (Caddy or equivalent)
- HSTS max-age 31556952 (1 year) with includeSubDomains

NFR-013

Must

*No PII in logs*

**Description.** The system shall not log personally identifiable information (PII) in application logs.

**Source.** GDPR/DSGVO data minimization.

**Acceptance criteria:**

- Request loggers redact authentication headers, password fields, and tokens
- User emails and names not included in standard request logs
- Sentry's data scrubbing rules configured to strip PII before transmission

NFR-014

Must

*Sanitized error messages*

**Description.** Production error responses shall not expose stack traces or internal implementation details.

**Source.** OWASP error handling guidance.

**Acceptance criteria:**

- APP\_DEBUG=false in production
- Error responses contain only a generic message and error code
- Detailed errors logged to Sentry, not returned to client

NFR-015

Must

*File upload validation*

**Description.** The system shall validate uploaded files via MIME type sniffing (not just extension), size limit, and reject any file matching known malicious signatures.

**Source.** FR-050; OWASP file upload guidance.

**Acceptance criteria:**

- MIME type validated server-side via file content inspection
- Maximum 10 MB enforced
- Files stored with randomized keys (not user-controlled paths) to prevent path traversal

NFR-016

Must

*SQL injection prevention*

**Description.** The system shall use parameterized queries (via Eloquent or PDO) exclusively; no user input shall reach raw SQL expressions.

**Source.** OWASP injection guidance.

**Acceptance criteria:**

- PHPStan rule level 8 enforces no `DB::raw()` with user-controlled input
- Code review checklist includes injection check

NFR-017

Must

*Content Security Policy*

**Description.** Production responses shall include a Content Security Policy header that prevents inline scripts and external resource loading except from configured origins.

**Acceptance criteria:**

- CSP header defined at reverse proxy or application middleware
- No `unsafe-inline` or `unsafe-eval` in script-src
- Reporting endpoint configured for CSP violations

NFR-018

Should

*Secrets management*

**Description.** The system should load secrets (database credentials, S3 keys, SMTP credentials) exclusively from environment variables; secrets shall never appear in code or in the repository.

**Acceptance criteria:**

- `.env` file in `.gitignore`
- `.env.example` committed with placeholder values
- Production deploys secrets via the orchestration tool's secrets feature

### 3.4.2 Usability

NFR-019

Should

*WCAG 2.1 AA*

**Description.** The five main workflows shall conform to WCAG 2.1 Level AA.

**Source.** IR-002.

**Acceptance criteria.** See IR-002.

NFR-020

Must

*German default, English fallback*

**Description.** German shall be the default UI locale; English shall be available as a fallback locale.

**Source.** IR-003.

**Acceptance criteria.** See IR-003.

|                                                                                                                                                                                                                                                                                                                                                                                  |        |                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------|
| NFR-021                                                                                                                                                                                                                                                                                                                                                                          | Should | Dark mode                   |
| <p><b>Description.</b> The system should provide a dark mode toggle, with the choice persisted on the user record.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Toggle accessible from the main navigation</li><li>• Choice persists across sessions</li><li>• Both modes meet color-contrast targets for WCAG 2.1 AA</li></ul>                |        |                             |
| NFR-022                                                                                                                                                                                                                                                                                                                                                                          | Must   | Mobile responsive           |
| <p><b>Description.</b> The user interface shall be usable on viewport widths from 375px upward.</p> <p><b>Source.</b> IR-004.</p> <p><b>Acceptance criteria.</b> Manual test on Chrome DevTools device emulation for iPhone 13 mini.</p>                                                                                                                                         |        |                             |
| NFR-023                                                                                                                                                                                                                                                                                                                                                                          | Should | Keyboard navigation         |
| <p><b>Description.</b> All interactive elements shall be reachable and operable via keyboard alone.</p> <p><b>Source.</b> IR-002; NFR-019.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Tab order is logical</li><li>• Focus indicators visible on all interactive elements</li><li>• Keyboard shortcuts documented in the docs site</li></ul> |        |                             |
| NFR-024                                                                                                                                                                                                                                                                                                                                                                          | Should | Screen reader compatibility |
| <p><b>Description.</b> Main workflows should be navigable using a screen reader.</p> <p><b>Source.</b> IR-002.</p> <p><b>Acceptance criteria.</b> Manual testing with NVDA on Windows.</p>                                                                                                                                                                                       |        |                             |

### 3.4.3 Reliability

|                                                                                                                                                                                                                                                                                                                                                                                                         |      |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------|
| NFR-025                                                                                                                                                                                                                                                                                                                                                                                                 | Must | Daily backups |
| <p><b>Description.</b> Production deployments shall back up the database daily, with backups retained for at least 7 days.</p> <p><b>Source.</b> V&amp;S §1.5 RPO target.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"><li>• Daily <code>pg_dump</code> via cron</li><li>• Backups encrypted at rest</li><li>• Documented restore procedure in operations runbook</li></ul> |      |               |

|                                                                                                                                                                                                                                                                                                                                                                                                                           |        |                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------|
| NFR-026                                                                                                                                                                                                                                                                                                                                                                                                                   | Must   | <i>Documented restore procedure</i>    |
| <p><b>Description.</b> The operations runbook shall include a step-by-step database restore procedure verified by manual exercise.</p> <p><b>Source.</b> NFR-025.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Restore procedure tested on a staging environment with timing measured</li> <li>• Procedure documented at <code>docs/operations/backup-and-restore.md</code></li> </ul> |        |                                        |
| NFR-027                                                                                                                                                                                                                                                                                                                                                                                                                   | Should | <i>Production uptime</i>               |
| <p><b>Description.</b> The production demo should maintain uptime of at least 99% measured on a rolling 30-day window.</p> <p><b>Source.</b> V&amp;S §1.5.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Monitored by Uptime Kuma or equivalent</li> <li>• Downtime budget: ~7 hours per month</li> </ul>                                                                               |        |                                        |
| NFR-028                                                                                                                                                                                                                                                                                                                                                                                                                   | Should | <i>RPO and RTO</i>                     |
| <p><b>Description.</b> The system should have a recovery point objective (RPO) of 24 hours and a recovery time objective (RTO) of 4 hours.</p> <p><b>Source.</b> V&amp;S risks mitigation.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Backup frequency at least daily (RPO)</li> <li>• Documented restore procedure completes in under 4 hours (RTO)</li> </ul>                      |        |                                        |
| NFR-029                                                                                                                                                                                                                                                                                                                                                                                                                   | Could  | <i>Graceful ML-service degradation</i> |
| <p><b>Description.</b> When the ML service is unreachable (v0.3+), dependent features shall degrade gracefully.</p> <p><b>Source.</b> IR-008.</p> <p><b>Acceptance criteria:</b></p> <ul style="list-style-type: none"> <li>• Manual entry remains available for any field normally pre-filled by ML</li> <li>• A non-blocking warning informs the user that ML assistance is unavailable</li> </ul>                      |        |                                        |

### 3.4.4 Maintainability

|                                                                                                                                                                                                           |      |                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|
| NFR-030                                                                                                                                                                                                   | Must | <i>Test coverage</i> |
| <p><b>Description.</b> The system shall maintain test coverage of at least 70% line coverage and at least 60% branch coverage.</p> <p><b>Source.</b> V&amp;S §1.5.</p> <p><b>Acceptance criteria:</b></p> |      |                      |

- Coverage measured by Pest (PHP) and Vitest (JS)
- Coverage reports published to Codecov on every push to main

NFR-031

Must

*Static analysis clean*

**Description.** The backend codebase shall pass PHPStan at level 8 with no errors.

**Source.** Quality goal.

**Acceptance criteria:**

- PHPStan configured in CI
- Level 8 enforced
- No baseline file (every fix is real)

NFR-032

Must

*Frontend linting clean*

**Description.** The frontend codebase shall pass ESLint with the configured ruleset and Prettier with default formatting.

**Source.** Quality goal.

**Acceptance criteria:**

- ESLint and Prettier configured in CI
- No warnings tolerated (CI fails on warnings)

NFR-033

Must

*Conventional Commits*

**Description.** All commits shall follow Conventional Commits 1.0.0 format.

**Source.** ADR 0002 (forthcoming).

**Acceptance criteria:**

- commitlint configured via husky commit-msg hook
- Non-conforming commits rejected at the hook

NFR-034

Must

*ADRs for architectural changes*

**Description.** All architectural decisions touching data model, authentication, deployment, dependencies, or public API shall be recorded as ADRs.

**Source.** arc42 §9.

**Acceptance criteria:**

- ADRs stored in docs/adr/
- Pull request template enforces consideration

NFR-035

Must

*Public API versioning*

**Description.** The public API shall be versioned via URL prefix; breaking changes require a major version bump with a deprecation window of at least 6 months for any deprecated endpoint.



**Source.** IR-010.

**Acceptance criteria:**

- All v1 endpoints prefixed `/api/v1`
- Deprecation announced in CHANGELOG and via `Deprecation` header

### 3.4.5 Portability

NFR-036

Must

*Docker Compose deployment*

**Description.** The system shall deploy via `docker compose up` on any host with Docker Engine 24+ and Docker Compose v2+.

**Source.** ADR 0001.

**Acceptance criteria:**

- All services defined in a single `docker-compose.yml`
- No Kubernetes-specific or other orchestrator-specific configuration required for the reference deployment

NFR-037

Should

*Multi-architecture support*

**Description.** Docker images should be built for both amd64 and arm64 architectures.

**Acceptance criteria:**

- CI publishes multi-arch images via `docker buildx`
- Images tested on at least one arm64 host (e.g., Apple Silicon, Hetzner ARM instance)

NFR-038

Must

*Postgres compatibility*

**Description.** Migrations and queries shall run cleanly on Postgres 14, 15, and 16.

**Source.** IR-005.

**Acceptance criteria:**

- CI matrix runs tests against all three Postgres versions

NFR-039

Must

*No proprietary database features*

**Description.** The system shall not depend on Postgres-specific extensions beyond what is included in the standard distribution.

**Acceptance criteria:**

- No `CREATE EXTENSION` requiring non-standard packages
- All used extensions documented in deployment guide

NFR-040

Must

*No proprietary OS or runtime dependencies*

**Description.** The system shall not require any proprietary operating system or runtime (e.g., specific cloud vendor SDKs as hard dependencies).

**Acceptance criteria:**

- S3 access via the generic AWS SDK (which works against MinIO, Hetzner, AWS, etc.)
- No vendor lock-in code paths

### 3.5 Compliance Requirements

NFR-041

Must

*EN 16931 conformance***Description.** All issued invoices shall conform to EN 16931 European e-invoicing standard.**Source.** Wachstumschancengesetz.**Acceptance criteria:**

- KoSIT validator passes (FR-044)
- All EN 16931 mandatory business rules satisfied (BR-01 through BR-66, BR-CO-01 through BR-CO-27 as applicable)

NFR-042

Must

*ZUGFeRD 2.1 profile***Description.** The system shall use the ZUGFeRD 2.1 EN16931 profile (not EXTENDED or MINIMUM) for generated hybrid invoices.**Source.** ADR (forthcoming) on ZUGFeRD profile selection.**Acceptance criteria:**

- XML schema version 2.1 declared in output
- Profile identifier set to `urn:cen.eu:en16931:2017`

NFR-043

Must

*PDF/A-3 conformance***Description.** The generated hybrid invoice file shall conform to PDF/A-3 (ISO 19005-3:2012).**Source.** ZUGFeRD 2.1 specification.**Acceptance criteria:**

- verapdf validator passes
- sRGB ICC profile embedded
- Conformance level declared in XMP metadata

NFR-044

Must

*§14 UStG mandatory fields***Description.** All issued invoices shall include every field required by §14 UStG.**Source.** FR-043.**Acceptance criteria.** See FR-043.

NFR-045

Must

10-year archival

**Description.** Issued invoices and associated receipts shall be retained for at least 10 years per §147 AO.

**Source.** GoBD.

**Acceptance criteria:**

- Soft-deleted invoices and expenses retain their underlying files
- Periodic data-retention export documented in operations runbook (v0.2 implementation)
- Original files (receipt PDFs, invoice PDF/A-3) preserved unchanged

## A Glossary

**ADR** Architecture Decision Record. A short Markdown document recording one architectural decision.

**arc42** Architecture documentation template, 12 sections.

**DATEV** Dominant German accounting standard and software cooperative used by Steuerberater.

**Eloquent** Laravel’s object-relational mapper.

**EN 16931** European standard for electronic invoicing.

**Factur-X** French/German hybrid PDF/A-3 + XML invoice standard, equivalent to ZUGFeRD 2.1.

**GoBD** Grundsätze zur ordnungsmäßigen Führung und Aufbewahrung von Büchern, Aufzeichnungen und Unterlagen in elektronischer Form sowie zum Datenzugriff — German digital bookkeeping rules.

**Handelsregister** German commercial register; companies registered there have an HRB number.

**HGB** Handelsgesetzbuch — German Commercial Code.

**Kleinunternehmer** Small business under §19 UStG, exempted from charging VAT below a turnover threshold.

**KoSIT** Koordinierungsstelle für IT-Standards; maintains the XRechnung standard and reference validator.

**MoSCoW** Priority scheme: Must, Should, Could, Won’t (this release).

**Mittelstand** German small and medium enterprises, the economic backbone of Germany.

**PDF/A-3** PDF archival format that supports embedded files (used to embed factur-x.xml).

**Sanctum** Laravel’s first-party authentication package for APIs and SPAs.

**Skontro** German bookkeeping term: a subsidiary ledger kept alongside the main books.

**Steuerberater** German tax advisor; powerful gatekeeper in SME bookkeeping decisions.

**Steuernummer** German tax number, distinct from USt-ID.

**USt-ID** Umsatzsteuer-Identifikationsnummer; German VAT identification number (DE + 9 digits).

**UStG** Umsatzsteuergesetz — German VAT Act.

**Wachstumschancengesetz** Growth Opportunities Act 2024; introduced the e-invoicing mandate.

**XRechnung** German XML invoice format, EN 16931 profile, mandated for B2G (business-to-government).

**ZUGFeRD** Zentraler User Guide des Forums elektronische Rechnung Deutschland; the hybrid PDF/A-3 + XML invoice standard.

## B Requirements Traceability Matrix

This matrix maps each requirement to its source (Vision and Scope section or ADR) and tracks the implementation status. The matrix is populated as components are built; in this version (v1.0 of the SRS), most entries show **TBD** (to be determined) because implementation has not yet begun.

| Requirement ID | Source            | Implementation Status |
|----------------|-------------------|-----------------------|
| FR-001         | V&S §2.1          | TBD                   |
| FR-002         | NFR-009           | TBD                   |
| FR-003         | V&S §2.1          | TBD                   |
| FR-004         | Standard auth     | TBD                   |
| FR-005         | NFR-011           | TBD                   |
| FR-006         | ADR (forthcoming) | TBD                   |
| FR-007         | V&S §2.1          | TBD                   |
| FR-008         | IR-003            | TBD                   |
| FR-009         | V&S §2.1          | TBD                   |
| FR-010         | ADR (forthcoming) | TBD                   |
| FR-011         | V&S §2.1          | TBD                   |
| FR-012         | ADR (forthcoming) | TBD                   |
| FR-013         | ADR (forthcoming) | TBD                   |
| FR-014         | V&S §2.2          | Deferred (v0.3)       |
| FR-015         | V&S §2.1          | TBD                   |
| FR-016         | V&S §2.1          | TBD                   |
| FR-017         | V&S §2.1          | TBD                   |
| FR-018         | V&S §2.1          | TBD                   |
| FR-019         | V&S §2.1          | TBD                   |
| FR-020         | V&S §2.1          | TBD                   |
| FR-021         | EN 16931          | TBD                   |
| FR-022         | EN 16931          | TBD                   |
| FR-023         | V&S §2.1          | TBD                   |
| FR-024         | §12 UStG          | TBD                   |
| FR-025         | EN 16931          | TBD                   |
| FR-026         | ADR (forthcoming) | TBD                   |
| FR-027         | V&S §2.1          | TBD                   |
| FR-028         | V&S §2.1          | TBD                   |

| Requirement ID | Source             | Implementation Status |
|----------------|--------------------|-----------------------|
| FR-029         | V&S §2.1           | TBD                   |
| FR-030         | EN 16931           | TBD                   |
| FR-031         | EN 16931 BR-CO-17  | TBD                   |
| FR-032         | ADR (forthcoming)  | TBD                   |
| FR-033         | V&S §2.1           | TBD                   |
| FR-034         | GoBD               | TBD                   |
| FR-035         | V&S §2.1           | TBD                   |
| FR-036         | V&S §2.1           | TBD                   |
| FR-037         | §14 UStG           | TBD                   |
| FR-038         | V&S §2.1           | TBD                   |
| FR-039         | §14 UStG           | TBD                   |
| FR-040         | V&S §2.1           | TBD                   |
| FR-041         | EN 16931           | TBD                   |
| FR-042         | ZUGFeRD 2.1        | TBD                   |
| FR-043         | §14 UStG           | TBD                   |
| FR-044         | V&S §1.3 BO-2      | TBD                   |
| FR-045         | EN 16931           | TBD                   |
| FR-046         | EN 16931 BR-CO-17  | TBD                   |
| FR-047         | ADR (forthcoming)  | TBD                   |
| FR-048         | V&S §2.1           | TBD                   |
| FR-049         | V&S §2.1           | TBD                   |
| FR-050         | V&S §2.1, GoBD     | TBD                   |
| FR-051         | V&S §2.1           | TBD                   |
| FR-052         | V&S §2.1           | TBD                   |
| FR-053         | GoBD               | TBD                   |
| FR-054         | V&S §2.1           | TBD                   |
| FR-055         | V&S §2.1           | TBD                   |
| FR-056         | V&S §2.1           | TBD                   |
| FR-057         | V&S §2.1           | TBD                   |
| FR-058         | §14 UStG           | TBD                   |
| FR-059         | §14 UStG           | TBD                   |
| FR-060         | V&S §2.1           | TBD                   |
| FR-061         | V&S §2.1           | TBD                   |
| FR-062         | V&S §2.1           | Deferred (v0.2)       |
| IR-001         | ADR 0001           | TBD                   |
| IR-002         | V&S §1.3 BO-5      | TBD                   |
| IR-003         | V&S §3.2           | TBD                   |
| IR-004         | V&S §3.2           | TBD                   |
| IR-005         | ADR 0001           | TBD                   |
| IR-006         | ADR 0001           | TBD                   |
| IR-007         | ADR 0001           | TBD                   |
| IR-008         | V&S §2.2           | Deferred (v0.3)       |
| IR-010         | ADR (forthcoming)  | TBD                   |
| IR-011         | Security practice  | TBD                   |
| NFR-001        | Performance target | TBD                   |
| NFR-002        | Performance target | TBD                   |
| NFR-003        | Performance target | TBD                   |
| NFR-004        | Performance target | TBD                   |
| NFR-005        | V&S §1.6 R-3       | TBD                   |
| NFR-006        | Quality target     | TBD                   |

| Requirement ID | Source                 | Implementation Status |
|----------------|------------------------|-----------------------|
| NFR-007        | V&S §3.2               | TBD                   |
| NFR-008        | V&S §2.1               | TBD                   |
| NFR-009        | OWASP                  | TBD                   |
| NFR-010        | FR-006                 | TBD                   |
| NFR-011        | FR-005                 | TBD                   |
| NFR-012        | IR-011                 | TBD                   |
| NFR-013        | GDPR                   | TBD                   |
| NFR-014        | OWASP                  | TBD                   |
| NFR-015        | OWASP, FR-050          | TBD                   |
| NFR-016        | OWASP                  | TBD                   |
| NFR-017        | Security practice      | TBD                   |
| NFR-018        | Security practice      | TBD                   |
| NFR-019        | IR-002                 | TBD                   |
| NFR-020        | IR-003                 | TBD                   |
| NFR-021        | V&S §2.1               | TBD                   |
| NFR-022        | IR-004                 | TBD                   |
| NFR-023        | NFR-019                | TBD                   |
| NFR-024        | NFR-019                | TBD                   |
| NFR-025        | V&S §1.5               | TBD                   |
| NFR-026        | NFR-025                | TBD                   |
| NFR-027        | V&S §1.5               | TBD                   |
| NFR-028        | V&S §1.6               | TBD                   |
| NFR-029        | IR-008                 | Deferred (v0.3)       |
| NFR-030        | V&S §1.5               | TBD                   |
| NFR-031        | Quality goal           | TBD                   |
| NFR-032        | Quality goal           | TBD                   |
| NFR-033        | ADR 0002               | TBD                   |
| NFR-034        | arc42 §9               | TBD                   |
| NFR-035        | IR-010                 | TBD                   |
| NFR-036        | ADR 0001               | TBD                   |
| NFR-037        | Quality goal           | TBD                   |
| NFR-038        | IR-005                 | TBD                   |
| NFR-039        | IR-005                 | TBD                   |
| NFR-040        | V&S §3.2               | TBD                   |
| NFR-041        | Wachstumschancengesetz | TBD                   |
| NFR-042        | ADR (forthcoming)      | TBD                   |
| NFR-043        | ZUGFeRD 2.1            | TBD                   |
| NFR-044        | FR-043                 | TBD                   |
| NFR-045        | GoBD                   | TBD                   |

## C Revision History

| Version | Date       | Author     | Change           |
|---------|------------|------------|------------------|
| 1.0     | 2026-05-27 | Z. A. Raja | Initial release. |