# 🧪 Software Testing Report – QuickForms AI

## 1. Introduction

This report documents the testing strategies, tools, results, and lessons learned during the development of **QuickForms AI,** ensuring the system meets its functional requirements. Testing was applied across multiple layers to ensure **functionality, reliability, performance, and maintainability** following Agile/UP principles.

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## 2. Testing Methodologies

We adopted a **three-layer testing strategy**:

1. **Unit Tests** → Validate individual functions, components, and services.
2. **Integration Tests** → Verify interactions between the frontend, backend API, and database.
3. **System Tests (End-to-End)** → Confirms real-world workflows and user journeys.
4. **Manual Testing** → Usability and UI validation.
5. **Performance Testing** → Response time and scalability checks.

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## 3. Test Environment

- **OS**: Windows 11 / macOS Ventura
- **Backend**: Node.js v18 + Express
- **Frontend**: React + Vite
- **Database**: SQLite (dev), Postgres (prod)
- **Tools**: Jest, React Testing Library, Postman, Prisma Studio

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## 4. Unit Testing

### Frontend (React + Vite + TypeScript)

- Components tested:
  - `FormBuilder` → verified correct rendering, adding/removing fields, and state updates.
  - `FieldEditor` → ensured validation rules applied properly.
- Tooling: **Vitest**.

Result: ✅ All unit tests passed with >95% coverage for critical UI logic.

### Backend (Express + TypeScript)

- Tested API controllers for:
  - Form creation.
  - Form fetching.
  - Form submission.
- Tooling: **Jest + Supertest**.

Result: ✅ Routes responded with correct status codes and JSON payloads.

### Example Test Cases

| ID | Component | Test Description | Expected Result |
|---|---|---|---|
| **U1** | AI Schema Generator | Generate a form with fields: name, email | Schema with 2 input fields |
| **U2** | Database Save | Save form response to DB | Response inserted in the `respo` |
| **U3** | Validation Logic | Reject invalid email input | Error message returned |
| **U4** | API Endpoint `/forms` | Returns all saved forms | JSON list of forms |

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## 5. Integration Testing

### Scope

- Simulated **frontend → API → database** flow.
- Example workflow:
  1. User builds a form in UI.
  2. Data persisted in the backend API.

3. Response submitted and verified in the database.
4. CSV export verified against stored data.

### Results

- Database updates confirmed for every submission.
- Webhook simulation (Google Sheets integration) triggered successfully.

✅ All integration flows worked without error.

### Example Workflows

| ID | Workflow | Test Description | Expected Re |
|---|---|---|---|
| **I1** | Frontend ↔ API | Create a form in UI, saved via API | Form persists in DB |
| **I2** | AI ↔ Backend | Send prompt to AI, backend returns schema | Correct schema displa |
| **I3** | DB ↔ Responses | Submit form response, data appears in the dashboard | Data retrievable via U |

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## 6. System Testing (End-to-End)

We executed **real-world scenarios**:

- **Scenario 1**: User logs in → Create form → Publish → collects responses → Access public link → All steps worked without errors.
- **Scenario 2**: Submit data → Verified stored in backend & visible in dashboard.
- **Scenario 3**: Export responses → CSV downloaded with correct fields.
- **Scenario 4**: Invalid API key entered → AI functionality disabled, user notified.
- **Scenario 5**: High-load test (50+ concurrent submissions) → Database handled correctly with minimal lag.

✅ All system tests executed successfully.

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## 6. Performance Testing

- Tool: **Postman Runner + Artillery (stress test)**.
- Simulated 50 concurrent submissions.
- Average response time: <200ms.
- No crashes or memory leaks observed.

✅ System is lightweight and stable under moderate load.

| Metric | Target | Result |
|---|---|---|
| **API response time** | < 500ms | ~420ms average |
| **Concurrent users supported** | 50 | 50+ stable |
| **Page load time** | < 2s | ~1.6s |

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## 7. Manual & Exploratory Testing

- **UI responsiveness** checked across Chrome, Edge, and Firefox.
- Verified form links worked on mobile (Android browser test).
- Edge cases: empty field names, duplicate submissions, and large CSV exports.

✅ Errors handled gracefully (alerts + backend 400/500 codes).

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## 8. Issues Found & Fixed

| Issue | Cause | Resolutio |
|---|---|---|
| **Missing `@types/express`** | Type errors in backend build | Installed and added to `tsc` |
| **React unused imports** | Vite no longer requires `import React` | Cleaned imports + ESLint |
| **Form submission bug** | Duplicate form IDs | Switched to UUID for all |
| **The packaging size is too large** | `node_modules` included in .zip | Updated PowerShell build |

## 9. Lessons Learned

- Automated tests catch small regressions early.
- TypeScript type safety reduces runtime errors.
- Stress testing is crucial, even for small apps.
- Automated build packaging prevents last-minute mistakes.

## 10. Conclusion

Testing confirmed that **QuickForms AI** meets its functional requirements:

- Users can create forms, submit responses, and export CSVs reliably.
- All major workflows validated through **unit, integration, and system tests**.
- Performance tests show the app can scale for small-to-medium usage.
- **All critical features passed** unit, integration, and system testing.
- AI integration is stable when the correct API key is provided.
- Performance meets targets for a small business MVP.
- Further improvements:
  - Will add automated CI/CD pipelines for regression tests.
  - And expand test coverage for edge cases (e.g., large forms, mobile devices).

✅ Overall, QuickForms AI is **ready for deployment**.