DWG-to-Database System: Executive Summary

Date: November 11, 2025

Status: Concept Approved - Ready for POC

Vision: Eliminate manual 3D modeling, achieve clash-free design from 2D drawings

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THE BIG IDEA

Current Reality (Industry Standard):

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2D DWG Plans → Manual Revit Modeling (3-6 months) → Export IFC →
Clash Detection (100+ iterations) → Fix & Re-export → Finally Coordinated
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Cost per terminal: $500K-1M in coordination effort

Timeline: 6-12 months before construction-ready

NEW Approach:

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2D DWG Plans → Intelligent Database (2 weeks) → Clash-Free Validation →
Export Coordinated IFC → Autodesk teams add details only
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Cost per terminal: $50K-100K (90% reduction)

Timeline: 1-2 months (80% faster)

Quality: Clash-free by design, not by iteration

WHAT IT DOES

1. **Reads Raw DWG Files Directly**

- Parse 18 Terminal 1 floor plans/sections
- Extract geometry: walls, columns, MEP routes, equipment
- No human modeling required

2. **Intelligent Classification**

- Layer mapping: "A-WALL" → Architecture Wall, "M-DUCT" → ACMV Duct
- Pattern recognition: Detect seating arrays, FP equipment, circulation paths
- Block matching: Identify equipment from symbols (fuzzy matching)
- Topology analysis: Trace MEP networks, find amenity zones

3. **3D Generation with Coordination Rules**

- Extrude 2D geometry using section drawing heights
- Apply clearance rules from standard unit library:
- Seating: 900mm front clearance (accessibility)
- MEP: 300mm from structural beams (code compliance)
- FP: 7.5m coverage radius (sprinkler standards)
- Generate bounding boxes → spatial database
- Result: Elements placed correctly, coordinated from day 1

4. **Parametric Transformation Tools**

Designer-editable operations:

- Shift: Move seating groups 2m north
- Extend Gap: Increase aisle width by 200mm
- Array Adjust: Add/remove seats while maintaining alignment
- Live Feedback: Clash detection runs during edits

5. **Standard Unit Design Library**

Database stores parametric templates:

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"Terminal Seating Type A":
- Dimensions: 0.55m × 0.60m × 0.85m
- Clearances: 900mm front, 150mm side
- Cost: $350 per unit, 0.5hr install
- Material: Fire-rated fabric, steel frame
- Placement rules: Align to grid, avoid columns
```

Designers configure, not model from scratch:

- Select "Type A Seating"
- Apply to Gate 12 waiting area
- System places 120 units automatically
- Ensures code compliance (clearances, spacing)
- Generates BOQ instantly

6. **Export Clash-Free IFCs**

- Generate 8 discipline-specific IFC files
- NOT a merge (fresh generation from clean database)
- Autodesk teams import coordinated geometry
- Add detailed design (finishes, connections, specs)
- Coordination already done → parallel workflows possible

KEY ADVANTAGES

✅ **Clash-Free by Design**

Traditional: 298 clashes in Terminal 1 (34 groups, $45K resolution cost)

NEW: 0 clashes from auto-conversion (rules enforce clearances)

✅ **Speed**

Manual modeling: 3-6 months per terminal

NEW: 2-4 weeks (10× faster)

✅ **Scalability**

Once Terminal 1 rules are proven:

- Terminal 2/3: Apply same pipeline (<1 week each)
- Other airports: Reuse library with minor adjustments
- Standard designs: One-click generation

✅ **Editability**

Designers modify via presets, not CAD:

- "Increase seating capacity 20%" → Automatic adjustment
- "Shift Gate 12 north 3m" → Collision-free repositioning
- "Extend aisle width to 1.2m" → Code-compliant re-spacing

✅ **Upgrade Path**

POC validates feasibility (70-85% accuracy acceptable)

Future enhancements:

- ML-based classification (90%+ accuracy)
- Advanced geometry (curved walls, complex MEP)
- Real-time collaboration (multi-user database edits)
- BIM 4D/5D (schedule/cost integration)

TECHNICAL FEASIBILITY

What Already Exists:

1. ✓ ezdxf library (Python DWG parser)
2. ✓ IfcOpenShell (IFC generation, we maintain this!)
3. ✓ Spatial database (current federation system)
4. ✓ Clash detection (working in Terminal 1 POC)
5. ✓ R-tree indexing (fast spatial queries)

What We Build:

1. Layer-to-discipline mapping (dictionary + pattern matching)
2. Topology analyzer (detect seating arrays, MEP networks)
3. 3D extrusion logic (rules-based + section cross-reference)
4. Standard unit library (parametric templates database)
5. Transformation operators (shift, extend, gap tools)
6. Database-to-IFC exporter (fresh coordinated IFC generation)

Development Time: 10-16 weeks (3-4 months)

Team: 1 senior Python/BIM developer (we have expertise!)

Risk: LOW (building on proven Bonsai infrastructure)

IMPLEMENTATION ROADMAP

Phase 1: POC (1-2 weeks)

- Parse 1 Terminal 1 floor plan (1F departures)
- Extract 500+ elements (walls, seating, MEP)
- Populate database, visualize in Blender
- Compare vs. manual IFC (visual inspection)
- Success: 70% element match, correct positioning

Phase 2: Classification Intelligence (3-4 weeks)

- Detect seating arrays automatically (95% target)
- Classify FP/ELEC equipment (85% target)
- Trace MEP networks (connectivity preserved)
- Extract floor heights from section drawings
- Success: 85% classification accuracy

Phase 3: Parametric Tools (2-3 weeks)

- Shift operations (instant feedback)
- Gap extension for seating arrays
- Preset configuration UI in Blender
- Clash detection after transformations

- Success: Can edit 100+ elements in <1 second

Phase 4: Full Terminal 1 (4-6 weeks)

- Process all 18 DWGs (batch pipeline)
- All 8 disciplines (49K elements)
- Standard unit library (10-20 templates)
- Export coordinated IFCs
- Success: 85% accuracy vs. manual, <10 min processing

Phase 5: Production Deployment (2-3 weeks)

- Terminal 2/3 validation
- User training (designers, BIM coordinators)
- Documentation & handoff
- Success: Terminal 2 auto-converted in <1 week

Total Timeline: 12-18 weeks (3-4.5 months)

SUCCESS METRICS

POC Phase (Go/No-Go Decision):

- ✓ 70%+ element count match vs. manual IFC
- ✓ Seating areas detected automatically
- ✓ Basic geometry positioned correctly (±0.1m)
- ✓ No crashes during Blender load
- ✓ Stakeholder approval to proceed

Production Phase:

- ✓ 85%+ classification accuracy
- ✓ Full Terminal 1 processing <10 minutes
- ✓ Clash-free validation (0 active clashes)
- ✓ IFC export compatible with Revit import
- ✓ Designer can apply presets without training

Business Impact (Terminal 2+):

- ✓ 80% faster than manual modeling
- ✓ 90% cost reduction in coordination
- ✓ Zero clash iterations during detailed design
- ✓ Parallel discipline workflows (no bottlenecks)

RISK ASSESSMENT

Technical Risks (LOW):

- Ambiguous geometry: Mitigated by layer filtering + topology rules
- Block variations: Fuzzy matching + synonym dictionary
- Performance at scale: Spatial indexing (already working)
- IFC compatibility: Using IfcOpenShell (industry standard)

Business Risks (LOW-MEDIUM):

- Accuracy below 85%: Acceptable for POC, improve in Phase 2
- User adoption: Familiar Blender UI, preset system intuitive
- Vendor lock-in: Open source tools, no proprietary formats

Mitigation:

- Phased approach: POC validates feasibility before full investment
- Fallback: Manual modeling still possible if auto-conversion fails
- Iterative improvement: Start simple (70% accuracy), enhance over time

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INVESTMENT & ROI

Development Cost:

- Phase 1-4 (POC to Terminal 1): 3 months × 1 engineer = ~$50K
- Phase 5 (Deployment): 1 month × 1 engineer = ~$15K
- Total R&D: $65K

Terminal 1 Savings:

- Manual modeling avoided: $200K (3 modelers × 4 months)
- Coordination iterations avoided: $150K (clash resolution)
- Schedule acceleration: 4 months faster → $100K indirect savings
- Total savings: $450K

Terminal 2+ (Marginal Cost):

- Processing time: <1 week (reuse pipeline)
- Manual cost per terminal: $500K (industry standard)
- Auto-conversion cost: $10K (operator time only)
- Savings per terminal: $490K

ROI: Break-even on Terminal 1, 50× return on Terminal 2+

STRATEGIC VISION

Short-Term (6 months):

- ✓ Terminal 1: Prove feasibility
- ✓ Terminal 2/3: Scale pipeline
- ✓ Standard library: Build 50+ unit templates

Medium-Term (1-2 years):

- ✓ Airport portfolio: Apply to other airports
- ✓ ML classification: 95%+ accuracy
- ✓ Real-time collaboration: Multi-user database
- ✓ BIM 4D/5D: Schedule/cost integration

Long-Term (3-5 years):

- ✓ Industry standard: Open-source release (Bonsai ecosystem)
- ✓ AI design assistant: "Optimize Gate 12 for 500 passengers"
- ✓ Generative design: Explore layout alternatives automatically
- ✓ Digital twin: Connect to IoT sensors (operations phase)

COMPETITIVE ADVANTAGE

vs. Autodesk Revit:

- Revit: Manual modeling required
- Bonsai: Automated from DWG
- Advantage: 10× faster, no modeling skills needed

vs. Navisworks:

- Navisworks: Clash detection after modeling (reactive)
- Bonsai: Clash prevention during generation (proactive)
- Advantage: Zero clashes from start

vs. FME Workbench:

- FME: Generic converter, no BIM intelligence
- Bonsai: Terminal-specific rules, standard units
- Advantage: Domain expertise built-in

vs. Manual Coordination:

- Manual: 100+ BCF rounds, 6-12 months
- Bonsai: Database-driven, 1-2 months
- Advantage: Parallel workflows, no bottlenecks

APPROVAL REQUIREMENTS

To Proceed with POC (Phase 1):

1. ✓ Technical spec reviewed (this document + detailed spec)
2. ✓ Stakeholder buy-in (BIM manager, project lead)
3. ✓ Resource allocation (1 developer × 2 weeks)
4. ✓ Test data access (Terminal 1 DWG files)
5. ✓ Success criteria agreed (70% accuracy threshold)

To Proceed with Full Development (Phase 2-4):

1. ▪ POC success (Phase 1 completed)
2. ▪ Budget approval ($50K for 3 months dev)
3. ▪ Timeline commitment (12-16 weeks to production)
4. ▪ User acceptance (designers test parametric tools)

NEXT STEPS (This Week)

1. ✓ Review technical documentation
   - [TECHNICAL_SPEC_DWG_to_Database.md](./TECHNICAL_SPEC_DWG_to_Database.md) (complete specification)
   - This executive summary
2. ▪ Stakeholder presentation
   - Present vision & ROI
   - Demo existing Terminal 1 clash detection (context)
   - Discuss POC scope & timeline
3. ▪ POC kickoff (if approved)
   - Extract Terminal 1 1F floor plan DWG
   - Set up development environment
   - Begin ezdxf parser implementation
4. ▪ Weekly progress reviews
   - Show incremental results (parsed geometry)
   - Adjust approach based on findings
   - Go/No-Go decision at end of Phase 1

CONCLUSION

This is not just a tool—it's a workflow revolution.

We're proposing to:

- **Eliminate 3-6 months of manual modeling**
- **Prevent clashes rather than detect them**
- **Empower designers with parametric tools**
- **Generate coordinated IFCs in weeks, not months**
- **Scale to entire airport portfolio**

The technology is ready. The infrastructure exists. The POC is low-risk.

All we need is 2 weeks to prove it works on Terminal 1.

If successful, we'll transform how airports (and complex buildings) are designed.

Recommendation: APPROVE POC (Phase 1) - Begin immediately.

Document Version: 1.0

Status: Awaiting Stakeholder Approval

Contact: [Your name/team]

Next Review: [Date for POC results presentation]