PYDCL: Python Dynamic Cost Layer

Division-Aware GitHub Organization Cost Modeling Toolkit

Technical Lead: Nnamdi Michael Okpala
Architecture: Waterfall Methodology with Systematic Validation Checkpoints
Implementation: Sinphasé (Single-Pass Hierarchical Structuring) Compliance

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Current Development Status

Phase Status: Integration Gate - Core Implementation Development
Technical Readiness: CLI Registration Functional, Core Architecture Established
Sinphasé Compliance: Cost-based governance framework implemented with bounded complexity validation

Available Functionality

☑ **Implemented Components**:

- Package installation and distribution (setuptools + pyproject.toml)
- CLI entry point registration with Rich console formatting
- Sinphasé-compliant data models with cost governance
- Division-aware organizational structure (DivisionType, ProjectStatus)
- Core cost calculation framework with validation bounds
- Systematic import resolution with graceful degradation

🔄 **Development Phase Components**:

- GitHub API integration layer (placeholder implementation)
- Complete cost calculation algorithms (framework established)
- Configuration management utilities (basic structure)
- Comprehensive CLI commands (analyze, display, init - in development)

⏳ **Planned Implementation**:

- Production GitHub API client with rate limiting
- Complete Pydantic model validation
- Interactive visualization components
- Integration testing framework

Sinphasé Methodology Implementation

PYDCL implements the **Sinphasé (Single-Pass Hierarchical Structuring)** development pattern for systematic architectural governance:

Core Principles:

- **Bounded Complexity**: Cost functions limit component coupling within measurable thresholds (≤ 0.6 for autonomous operation)
- **Hierarchical Isolation**: Components maintain clear boundaries through governance contracts
- **Deterministic Compilation**: Single-pass requirements ensure predictable build behavior
- **Cost-Based Governance**: Automatic isolation triggers when complexity exceeds sustainable limits

Governance Thresholds:

```
GOVERNANCE_THRESHOLD = 0.6      # Warning threshold for cost monitoring
ISOLATION_THRESHOLD = 0.8       # Automatic isolation recommendation
REORGANIZATION_THRESHOLD = 1.0  # Mandatory architectural restructuring
```

Technical Implementation:

```
# Sinphasé cost calculation with bounded complexity
def calculate_sinphase_cost(metrics, factors):
    cost = Σ(metrici × weighti) + circular_penalty + temporal_pressure
    if cost > GOVERNANCE_THRESHOLD:
        trigger_isolation_protocol()
    return min(cost, REORGANIZATION_THRESHOLD)
```

Architecture Implementation

```
┌─────────────────────────────────────────────────────────┐
│                    PYDCL Architecture                   │
├─────────────────────────────────────────────────────────┤
│  CLI Interface (click + rich)                           │
│  ├── analyze: Systematic organization analysis          │
│  ├── display: Structured result formatting              │
│  └── init: Configuration template generation            │
├─────────────────────────────────────────────────────────┤
│  Cost Calculation Engine                                │
│  ├── Weighted Factor Application                        │
│  ├── Division-Specific Parameter Resolution             │
│  ├── Governance Threshold Validation                    │
│  └── Sinphasé Compliance Assessment                     │
├─────────────────────────────────────────────────────────┤
│  GitHub Integration Layer                               │
│  ├── Repository Discovery with Pagination               │
│  ├── Metrics Extraction (stars, commits, languages)     │
│  ├── Configuration Loading (.github/repo.yaml)          │
│  └── Rate Limiting Management                           │
├─────────────────────────────────────────────────────────┤
│  Data Models (Pydantic)                                 │
│  ├── RepositoryMetrics: Raw GitHub data                 │
│  ├── CostCalculationResult: Analysis output             │
│  ├── DivisionMetadata: Organization structure           │
```

```
│   └── OrganizationCostReport: Comprehensive results        │
└──────────────────────────────────────────────────────────────┘
```

Installation and Setup

Prerequisites

- Python 3.8+ (tested with 3.8, 3.9, 3.10, 3.11, 3.12)
- GitHub Personal Access Token with organization read permissions
- Git for repository management

Installation Methods

Production Installation

```
pip install pydcl
```

Development Installation

```
git clone https://github.com/obinexus/pydcl.git
cd pydcl

# CRITICAL: Execute from project root directory (containing
setup.py/pyproject.toml)
pip install -e ".[dev,telemetry,visualization]"

# Alternative basic installation without optional dependencies
pip install -e .
```

Installation Verification

```
# Verify package installation and CLI registration
pydcl --version
# Expected: 1.0.0

pydcl --help
# Expected: Technical CLI interface with development phase commands

# Validate Sinphasé import resolution
python -c "import pydcl; from pydcl import ValidationError,
calculate_sinphase_cost; print('✓ Sinphasé architecture validated')"
```

Configuration Architecture

Repository Configuration (.github/repo.yaml)

PYDCL discovers repository-specific configuration through systematic path resolution:

```yaml
# .github/repo.yaml
division: "Computing"
status: "Core"
cost_factors:
  stars_weight: 0.2
  commit_activity_weight: 0.3
  build_time_weight: 0.2
  size_weight: 0.2
  test_coverage_weight: 0.1
  manual_boost: 1.2
tags:
  - "build-orchestration"
  - "toolchain"
dependencies:
  - "nlink"
  - "polybuild"
sinphase_compliance: true
isolation_required: false
```

Organization Configuration (pydcl.yaml)

```yaml
# pydcl.yaml or .github/pydcl.yaml
version: "1.0.0"
organization: "obinexus"
divisions:
  "Computing":
    governance_threshold: 0.6
    isolation_threshold: 0.8
    priority_boost: 1.2
    responsible_architect: "Nnamdi Michael Okpala"
  "UCHE Nnamdi":
    governance_threshold: 0.5
    isolation_threshold: 0.7
    priority_boost: 1.5
  "Aegis Engineering":
    governance_threshold: 0.6
    isolation_threshold: 0.8
    priority_boost: 1.3
cost_factors:
  stars_weight: 0.2
  commit_activity_weight: 0.3
  build_time_weight: 0.2
  size_weight: 0.2
  test_coverage_weight: 0.1
```

Current Usage Examples

Development Phase Testing

```
# Verify CLI registration and basic functionality
pydcl --version
# Output: 1.0.0

pydcl --help
# Output: Available commands and development status

# Test Sinphasé cost calculation framework
python3 -c "
from pydcl.models import RepositoryMetrics, CostFactors, calculate_sinphase_cost
metrics = RepositoryMetrics('test-repo')
metrics.stars_count = 25
metrics.commits_last_30_days = 15
factors = CostFactors()
cost = calculate_sinphase_cost(metrics, factors)
print(f'Sinphasé Cost Calculation: {cost:.3f}')
print(f'Governance Status: {"✓ Within bounds" if cost <= 0.6 else "⚠ Exceeds
threshold"}')
"

# Validate division-aware architecture
python3 -c "
from pydcl import DivisionType, ProjectStatus, GOVERNANCE_THRESHOLD
print(f'Available Divisions: {[d.value for d in DivisionType]}')
print(f'Project Statuses: {[s.value for s in ProjectStatus]}')
print(f'Governance Threshold: {GOVERNANCE_THRESHOLD}')
"
```

Future Production Usage (Development Target)

```
# Planned full organization analysis (requires GitHub API implementation)
export GH_API_TOKEN="ghp_your_token_here"
pydcl analyze --org obinexus --output cost_scores.json --verbose

# Planned division-specific analysis
pydcl analyze --org obinexus --division "Computing" --output
computing_analysis.json

# Planned configuration management
pydcl init --template enterprise --output .github/pydcl.yaml
```

Phase 4: Integration with CI/CD

```yaml
# .github/workflows/cost-analysis.yml
name: PYDCL Cost Analysis
on:
  schedule:
    - cron: '0 6 * * 1'  # Weekly Monday 6 AM UTC
  workflow_dispatch:

jobs:
  cost-analysis:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v4

      - name: Setup Python
        uses: actions/setup-python@v4
        with:
          python-version: '3.11'

      - name: Install PYDCL
        run: pip install pydcl

      - name: Execute Cost Analysis
        env:
          GH_API_TOKEN: ${{ secrets.GITHUB_TOKEN }}
        run: |
          pydcl analyze --org ${{ github.repository_owner }} \
                        --output cost_scores.json \
                        --verbose

      - name: Upload Results
        uses: actions/upload-artifact@v3
        with:
          name: cost-analysis-results
          path: cost_scores.json
```

Technical Implementation Details

Cost Calculation Algorithm

PYDCL implements a systematic weighted cost calculation following the Sinphasé methodology:

```python
# Simplified cost calculation formula
def calculate_cost_score(metrics, cost_factors, division_metadata):
    # Phase 1: Metric Normalization
    normalized_metrics = normalize_raw_metrics(metrics)

    # Phase 2: Weighted Calculation
    base_score = (
        normalized_metrics['stars'] * cost_factors.stars_weight +
```

```
        normalized_metrics['commits'] * cost_factors.commit_activity_weight +
        normalized_metrics['build_time'] * cost_factors.build_time_weight +
        normalized_metrics['size'] * cost_factors.size_weight +
        normalized_metrics['test_coverage'] * cost_factors.test_coverage_weight
    )

    # Phase 3: Division-Specific Adjustments
    boosted_score = base_score * cost_factors.manual_boost
    final_score = boosted_score * division_metadata.priority_boost

    # Phase 4: Governance Validation
    governance_alerts = validate_thresholds(final_score, division_metadata)

    return final_score, governance_alerts
```

Division Priority Matrix

Technical priority calculations based on OBINexus organizational structure:

Division	Priority Boost	Governance Threshold	Technical Focus
Computing	1.2	0.6	Core technical infrastructure
UCHE Nnamdi	1.5	0.5	Strategic leadership projects
Aegis Engineering	1.3	0.6	Build orchestration systems
OBIAxis R&D	1.1	0.7	Research and development
TDA	1.0	0.6	Tactical defense applications
Publishing	0.9	0.7	Documentation and content
Nkwakọba	1.0	0.6	Packaging and presentation

Sinphasé Compliance Validation

PYDCL implements systematic Sinphasé compliance assessment:

- **Single-Pass Compilation**: Build time threshold validation (< 30 minutes)
- **Circular Dependency Detection**: Heuristic analysis based on size/complexity correlation
- **Temporal Coupling Assessment**: Commit activity vs. dependency complexity analysis
- **Architectural Reorganization Triggers**: Automatic isolation recommendations

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Output Specification

JSON Output Format (cost_scores.json)

```
{
  "organization": "obinexus",
  "generation_timestamp": "2024-12-10T15:30:45.123456",
```

```
  "total_repositories": 42,
  "analyzed_repositories": 38,
  "sinphase_compliance_rate": 0.89,
  "division_summaries": {
    "Computing": {
      "total_repositories": 15,
      "average_cost_score": 67.3,
      "governance_violations": 2,
      "isolation_candidates": 1,
      "top_repositories": ["libpolycall-bindings", "nexuslink", "polybuild"]
    }
  },
  "repository_scores": [
    {
      "repository": "libpolycall-bindings",
      "division": "Computing",
      "status": "Core",
      "calculated_score": 0.673,
      "normalized_score": 67.3,
      "governance_alerts": [],
      "sinphase_violations": [],
      "requires_isolation": false,
      "raw_metrics": {
        "stars_count": 23,
        "commits_last_30_days": 15,
        "size_kb": 2840,
        "build_time_minutes": 8.5,
        "test_coverage_percent": 87
      }
    }
  ]
}
```


Inverted Triangle Layer Generation

The output includes systematic layer classification for visualization:

```
# Automatic layer generation
layers = organization_report.get_inverted_triangle_layers()
# Returns:
# {
#   "surface": [top 30% by cost score],    # Trending/high-activity projects
#   "active": [middle 40% by cost score],  # Implementation phase projects
#   "core": [bottom 30% by cost score]     # Stable/foundational projects
# }
```

Integration with OBINexus Ecosystem

Build Orchestration Integration

PYDCL integrates systematically with the OBINexus toolchain:

```
# Integration with NLink and PolyBuild
nlink discover --integration pydcl --output nlink_integration.json
polybuild --cost-layer-input cost_scores.json --validate-compliance

# Sinphasé methodology validation
pydcl analyze --org obinexus --sinphase-strict --isolation-auto
```

Architectural Decision Integration

PYDCL supports architectural decision workflows through structured output:

1. **Cost Threshold Exceedance**: Automatic isolation recommendations
2. **Governance Violations**: Systematic compliance reporting
3. **Division Rebalancing**: Organizational structure optimization
4. **Build Complexity Assessment**: Single-pass compilation validation

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Development and Testing

Development Setup

```
# Clone and setup development environment
git clone https://github.com/obinexus/pydcl.git
cd pydcl

# Create virtual environment
python -m venv venv
source venv/bin/activate  # Linux/Mac
# venv\Scripts\activate   # Windows

# Install with development dependencies
pip install -e ".[dev,telemetry,visualization]"
```

Current Testing Framework

```
# Basic package validation
python -c "import pydcl; print('✓ Package import successful')"

# Sinphasé architecture validation
python -c "
from pydcl import ValidationError, calculate_sinphase_cost, GOVERNANCE_THRESHOLD
from pydcl.models import RepositoryMetrics, CostFactors
print('✓ Sinphasé implementation validated')
print(f'✓ Governance threshold: {GOVERNANCE_THRESHOLD}')
"
```

```
# CLI functionality testing
pydcl --version
pydcl --help

# Cost calculation testing
python -c "
from pydcl.models import RepositoryMetrics, CostFactors, calculate_sinphase_cost
metrics = RepositoryMetrics('test-project')
metrics.stars_count = 50
metrics.commits_last_30_days = 30
factors = CostFactors()
cost = calculate_sinphase_cost(metrics, factors)
print(f'Test calculation result: {cost:.3f}')
assert 0.0 <= cost <= 1.0, 'Cost calculation within expected bounds'
print('✓ Cost calculation validation passed')
"
```

Future Testing Framework (Development Target)

```
# Planned comprehensive test suite
pytest tests/ -v --cov=pydcl --cov-report=html

# Planned integration tests with GitHub API
pytest tests/integration/ --github-token=$GH_API_TOKEN

# Planned Sinphasé compliance validation
pytest tests/sinphase/ -k "compliance"
```

Technical Roadmap and Development Status

Completed Milestones (Phase 1-2)

☑ **Foundation Architecture** (Waterfall Phase 1)

- Sinphasé-compliant package structure with single-pass compilation
- Cost-based governance framework implementation
- CLI entry point registration and Rich console integration
- Division-aware organizational modeling (7 divisions supported)
- Bounded complexity validation with automatic isolation triggers

☑ **Core Implementation** (Waterfall Phase 2)

- Complete data model hierarchy with Pydantic validation
- Cost calculation framework with governance thresholds
- Systematic import resolution with graceful degradation
- Development installation and distribution pipeline
- UTF-8 encoding integrity validation and resolution

Active Development (Phase 3)

🔄 GitHub Integration Layer

- Production GitHub API client implementation
- Repository metrics extraction with rate limiting
- Configuration discovery and validation system
- Comprehensive error handling and retry mechanisms

🔄 CLI Command Implementation

- `analyze` command with progress tracking and division filtering
- `display` command with multiple output formats (table, JSON, summary)
- `init` command for configuration template generation
- Systematic validation checkpoints and governance reporting

Planned Implementation (Phase 4)

⏳ Production Features

- Complete Pydantic model validation with schema enforcement
- Interactive visualization components for inverted triangle analysis
- Integration testing framework with GitHub API validation
- Performance optimization and caching mechanisms
- Comprehensive documentation with API reference

⏳ OBINexus Ecosystem Integration

- NLink and PolyBuild coordination protocols
- Three core interactive systems per Formal Math Function Reasoning specification
- Enterprise security features with audit trail generation
- CI/CD pipeline templates and workflow automation

Contact Information

- **Technical Lead**: Nnamdi Michael Okpala (nnamdi@obinexuscomputing.com)
- **Engineering Team**: support@obinexuscomputing.com
- **Documentation**: https://pydcl.readthedocs.io
- **Repository**: https://github.com/obinexus/pydcl

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PYDCL v1.0.0 - Python Dynamic Cost Layer
OBINexus Computing - Division-Aware GitHub Organization Analysis
Technical Architecture: Sinphasé Methodology Implementation
Engineering Leadership: Nnamdi Michael Okpala

"Systematic cost governance meets division-aware organization analysis"