

# nwC2013

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Simulation Process & Data Management

## Multi-Tiered Simulation Data & Process Management

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# Multi-Tiered Simulation Data & Process Management

- Technology to support SD&PM has been available for several years
- Deployment of SD&PM has been limited to a relatively small number of companies for **focused** activities
- Wide ranging deployment of SD&PM for the full spectrum of simulation usage continues to be an elusive goal
- Is there an approach that can make wide scale deployment of SD&PM viable?



# Terminology Used

- Tool Categories
  - Simulation Data Management (SDM)
  - Simulation Process Management (SPM)
  - Simulation Process & Data Management (SPDM)
  
- User Objectives
  - Simulation Data & Process Management (SD&PM)
    - Management of simulation data and simulation processes for all modes of activity and tools for simulation



# SD&PM Challenges

- Simulation data comes from multiple sources and work flows (ad-hoc work needs to be considered)
- Legacy data must be accommodated
- Context related information required for meaningful use of data
- Data access requirements
  - Project and process context
  - Consumer of data
  - Intellectual Property (IP) issues
- Comprehensive information sharing
- Long term archival of product and process data





# Options for Deployment of SD&PM

- Option 1 – tool based approach
  - Results in limited scope and coverage based on selected tool capabilities
- Option 2 – multi-tiered usage approach
  - Clear definition and understanding of access requirements as well as data and process state requirements based on usage



# SD&PM Usage Tiers

LOTAR (Long Term Archival and Retrieval)

Multi-Enterprise Access

Enterprise Access

Engineering Review

Work In Process

Legacy Data



# SD&PM Usage Tiers

## Legacy Data

- Simple approach ( e.g., smart shared drives)
- Re-running solutions to capture data is not a viable approach
- Metadata extraction
- Capabilities to add context data
- Automatic visualization of data
- Used by:
  - Selected data (decreasing amounts) used by all potential participants including LOTAR
  - All data used by work groups that created the data



# SD&PM Usage Tiers

## Work In Process

- Multiple sources of how data can be created each with their own set of requirements and issues
- Used by: work groups that create the data

## Work In Process Options

Ad-hoc  
Simulation

Independent  
Process  
Automation  
Tools

Integrated  
Process & Data  
Automation

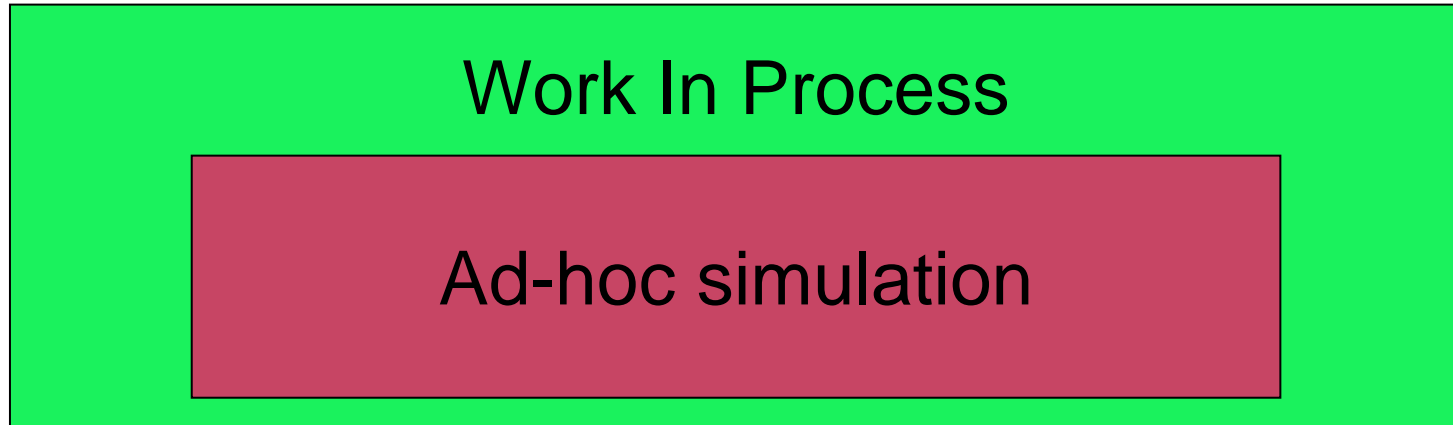
High Level  
Drivers





# SD&PM Usage Tiers

## Work in Process

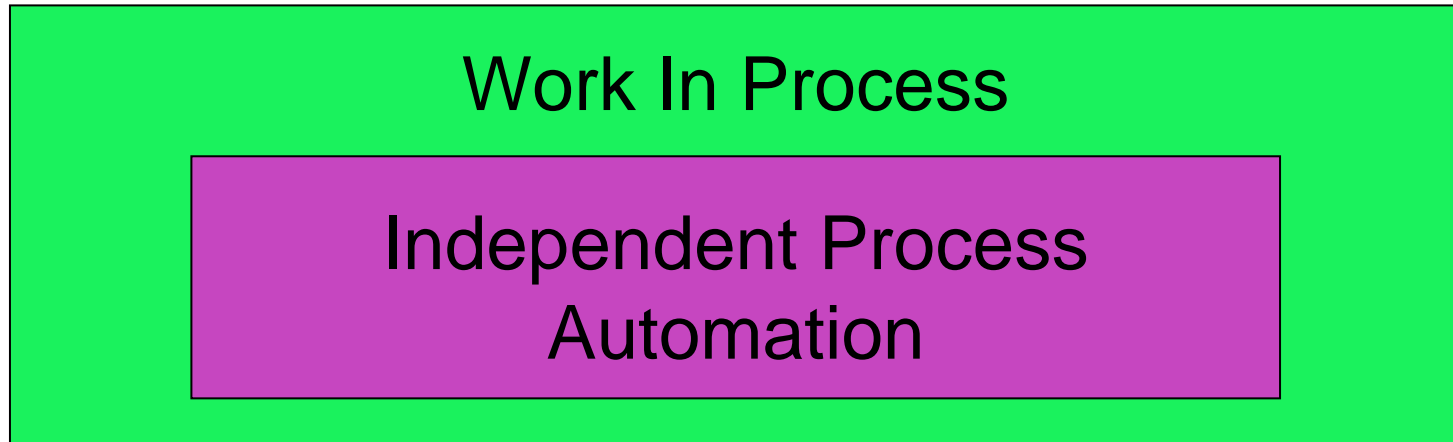


- Non-automatic execution of solvers, job submissions, simulation reports & early methods development
  - Accounts for significant % of simulation runs
- SDM environment needs to be simple and straightforward
  - User specific access rights desirable
  - Easy metadata extraction preferred
- Needs lightweight visualization with ability to explore data



# SD&PM Usage Tiers

## Work in Process

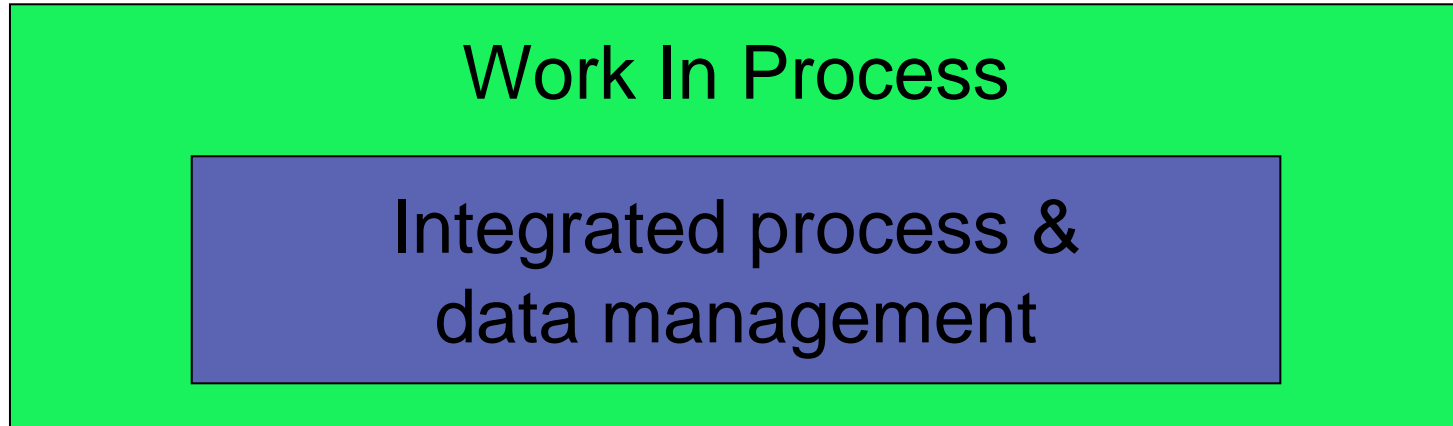


- Includes “homegrown” and commercial process automation tools
- To manage the data there is a need to integrate process automation tools and SDM environment
  - **Rewriting all processes is not viable**
- Other needs similar to ad-hoc simulations



# SD&PM Usage Tiers

## Work in Process



- Automatic comprehensive capture of metadata & context
  - Requires processes to be implemented in an integrated system
- Lightweight visualization required with ability to explore data
- May be too inflexible for efficient ad-hoc simulations



# SD&PM Usage Tiers

## Work in Process

### Work In Process

#### High Level Drivers

e.g., Design Space Exploration (DSE), PIDO, Robust Engineering, Systems Engineering, ...

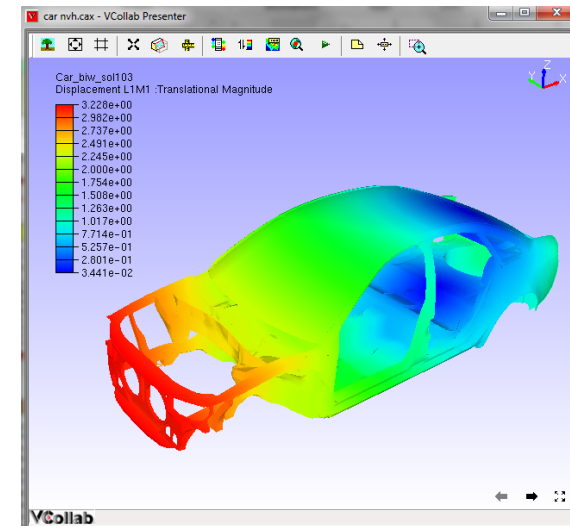
- Complex systems and processes that spawn simulations
- Needs integration with SDM environment
- Pass data, context and metadata to SDM and back



# SD&PM Usage Tiers

## Engineering Review

- Access to data and pedigree to support communication and decision making
- May be summary of different aspects at product development stages
- Typically a subset of the data from the Work In Process tier
- Lightweight visualization
- Simple access and multiple views into data
- Approvals & issues management
- Used by:
  - Project/product teams
  - Engineering departments
  - Program organization





# SD&PM Usage Tiers

## Enterprise Access

- Access to data and pedigree to document decisions made
- Only a subset of the data required at Engineering Review tier
- Reduced data set for integration into product lifecycle data
- Simple access and multiple views into data
- Lightweight visualization
- Used by: **Enterprise beyond Engineering**



# SD&PM Usage Tiers

## Multi-Enterprise Access

- Data representation and access controls for IP protection
- Supports supply chain and multi-enterprise collaboration
- May need access to Work-in-Process tier
- Only a subset of the data from the Engineering Review & Work-in-Process tiers
- Lightweight visualization
- Used by: Organizations sharing design and simulation data



# SD&PM Usage Tiers

## LOTAR

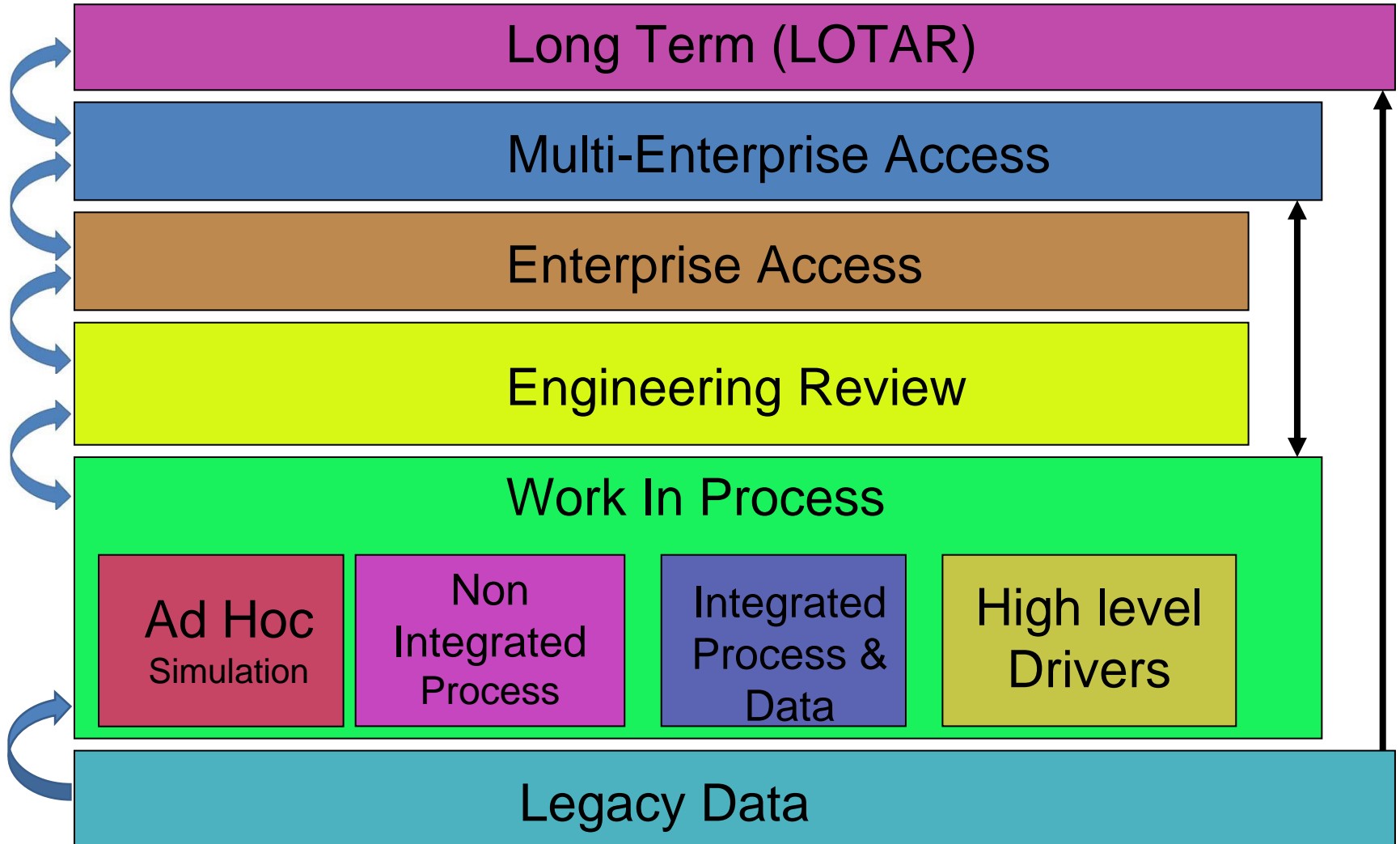
- Standards based representation (e.g. STEP AP 209) to ensure data retrieval throughout the full retention period
- Only a subset of the data from the Engineering Review & Work-in-Process tiers
- Verification and validation at both archival and retrieval
- Needs lightweight visualization
- Used by: Organizations with long term retention requirements





# SD&PM Usage Tiers

## Communication Between Tiers



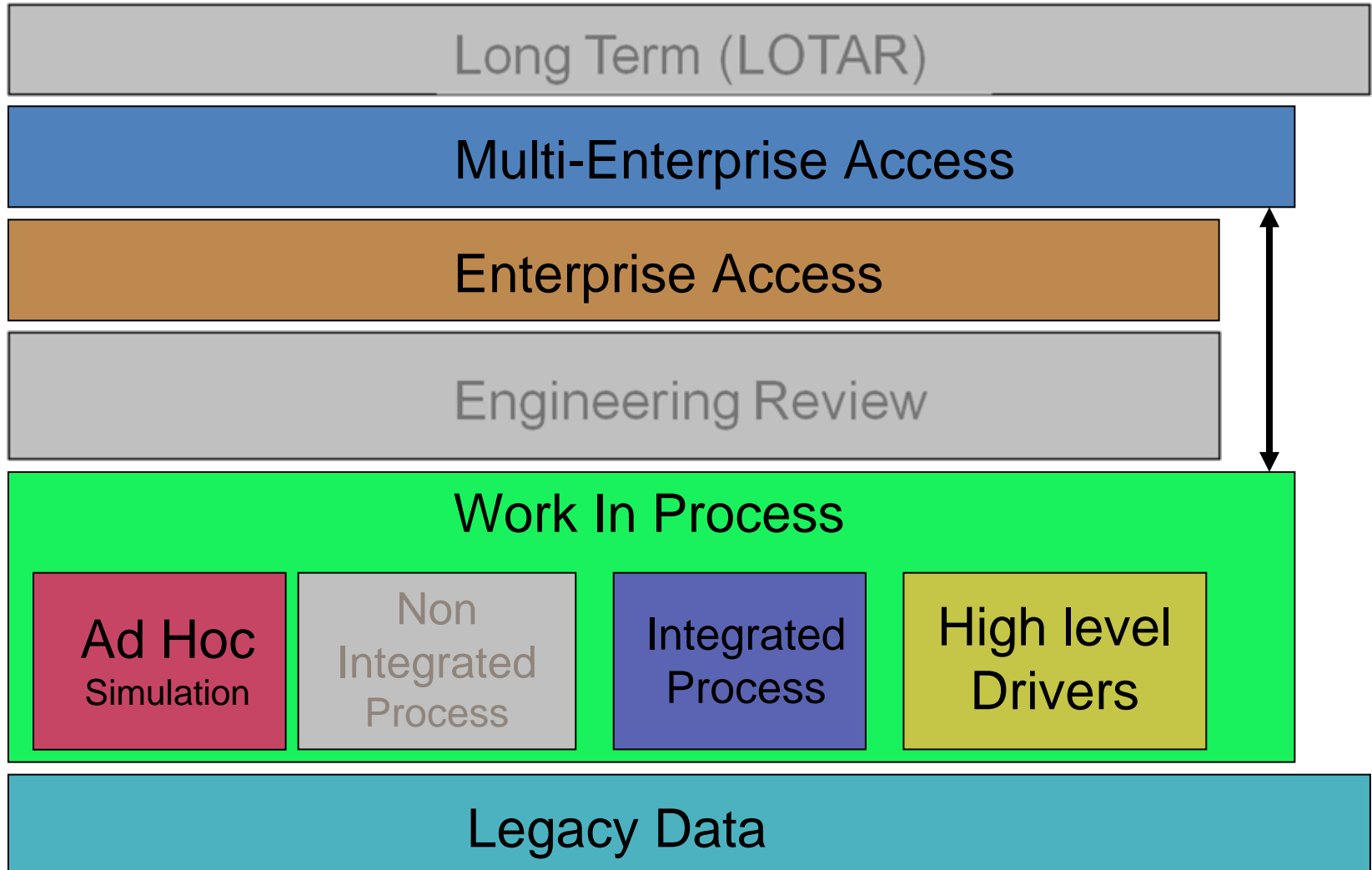


# Deploying Broad Scale SD&PM

- A multi-tiered approach allows a pragmatic methodology for wide scale SD&PM deployment
  - Define what aspects are important for your organization
  - Define a phased approach
  - Review options based on your needs
    - **Be wary of any option that claims to meet requirements for all tiers**
  - Implement your preferred options

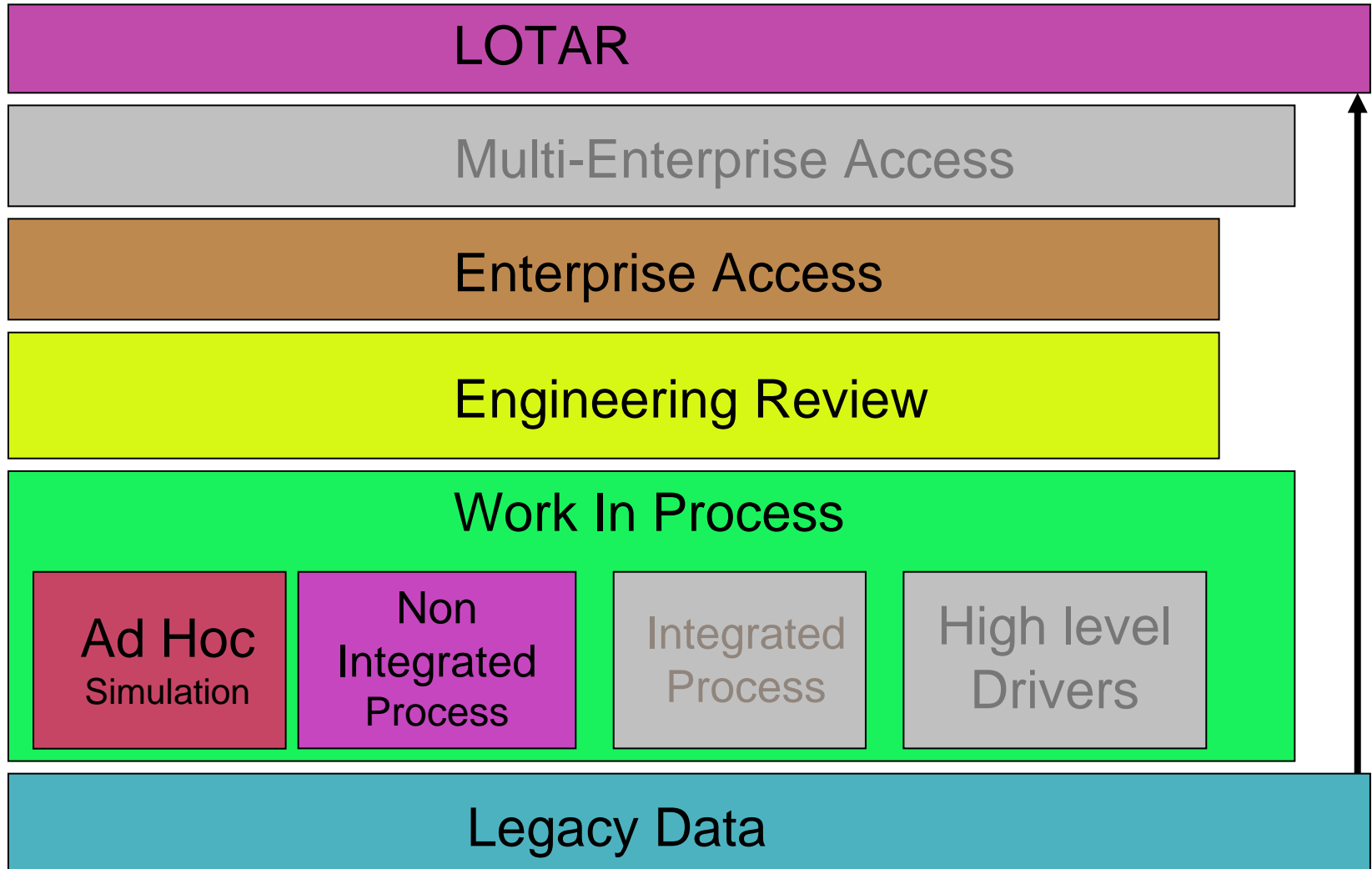


# Which Aspects Are Important Company 1 Example





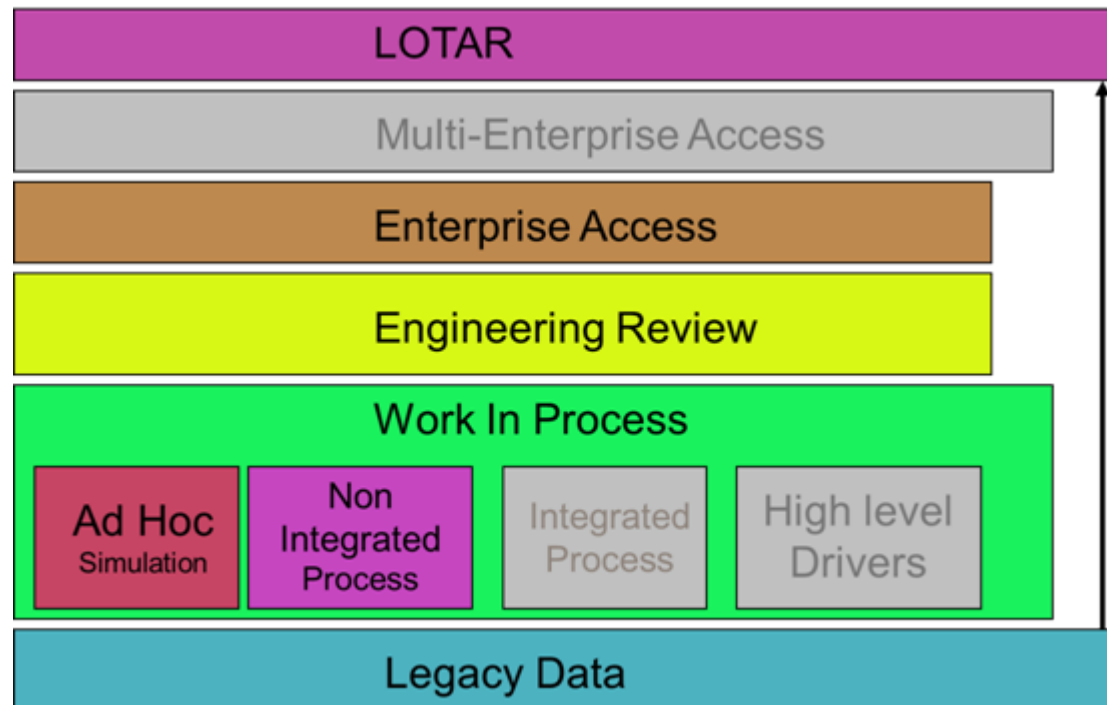
# Which Aspects Are Important Company 2 Example





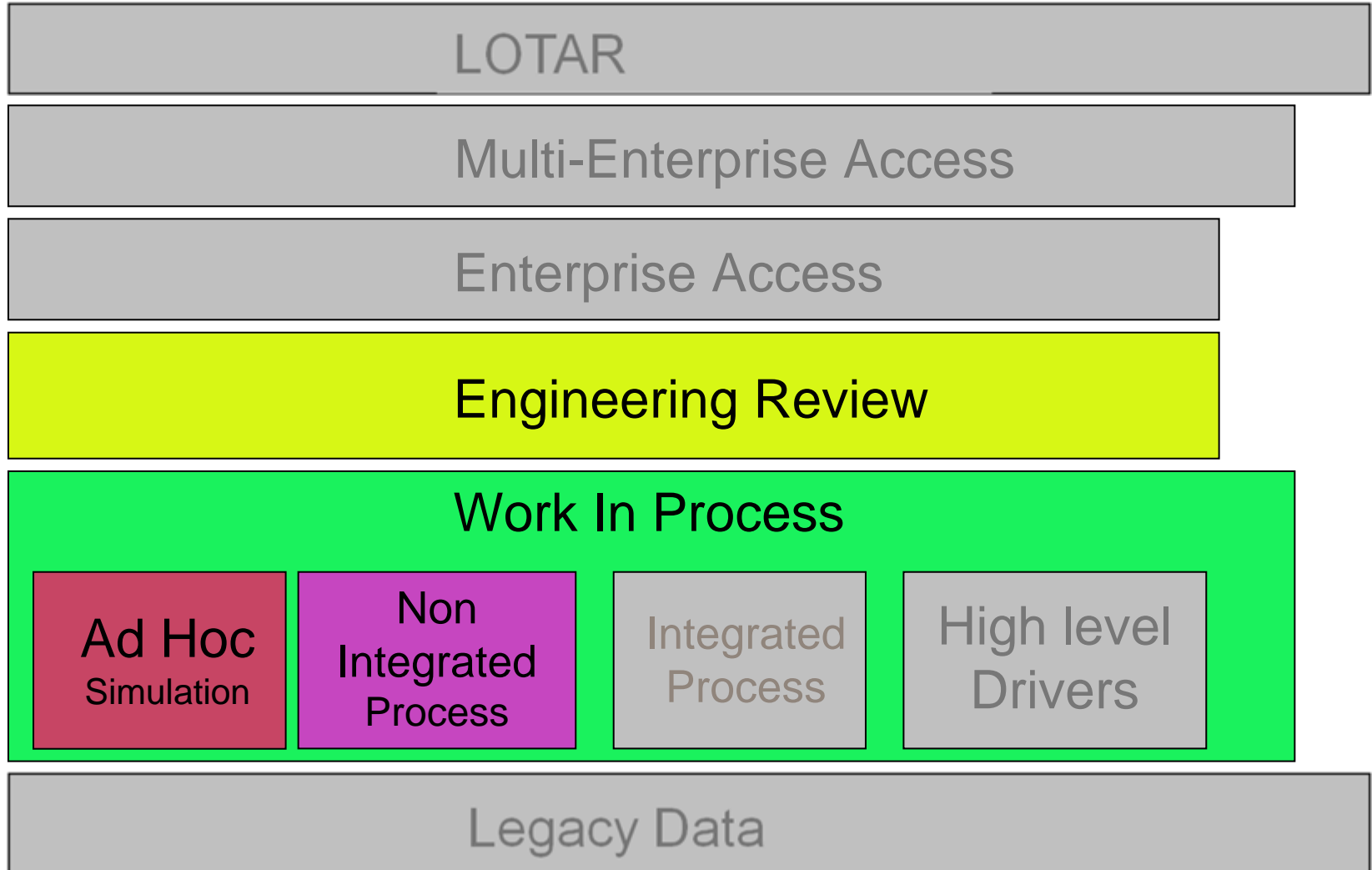
# Priorities and Phases

- Let's take a look at Company 2 in a sample 2 phase approach
  - Realistic implementations may need more than 2 phases



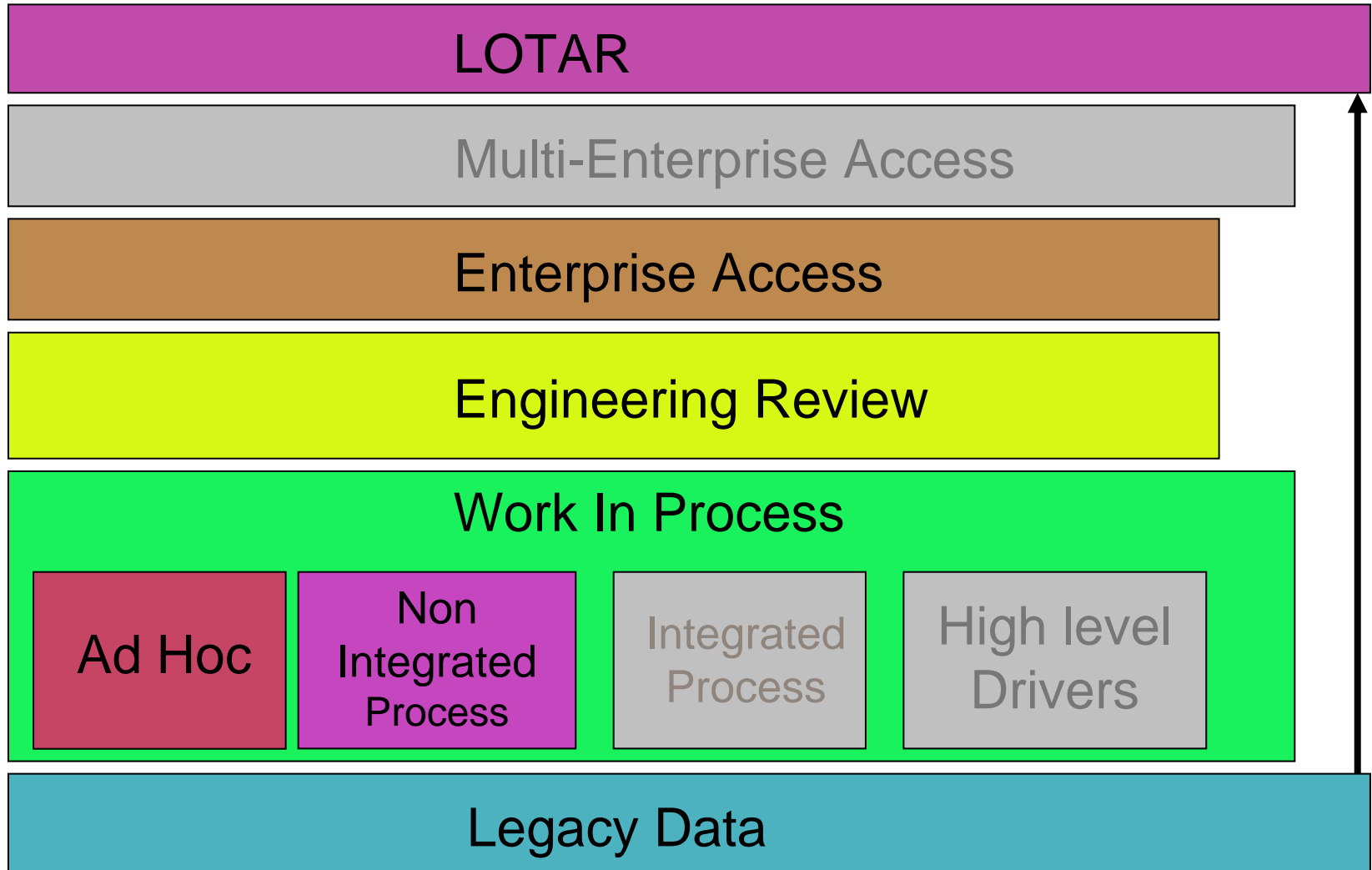


# Which Aspects Are Important Company 2 - Phase 1





# Which Aspects Are Important Company 2 - Phase 2





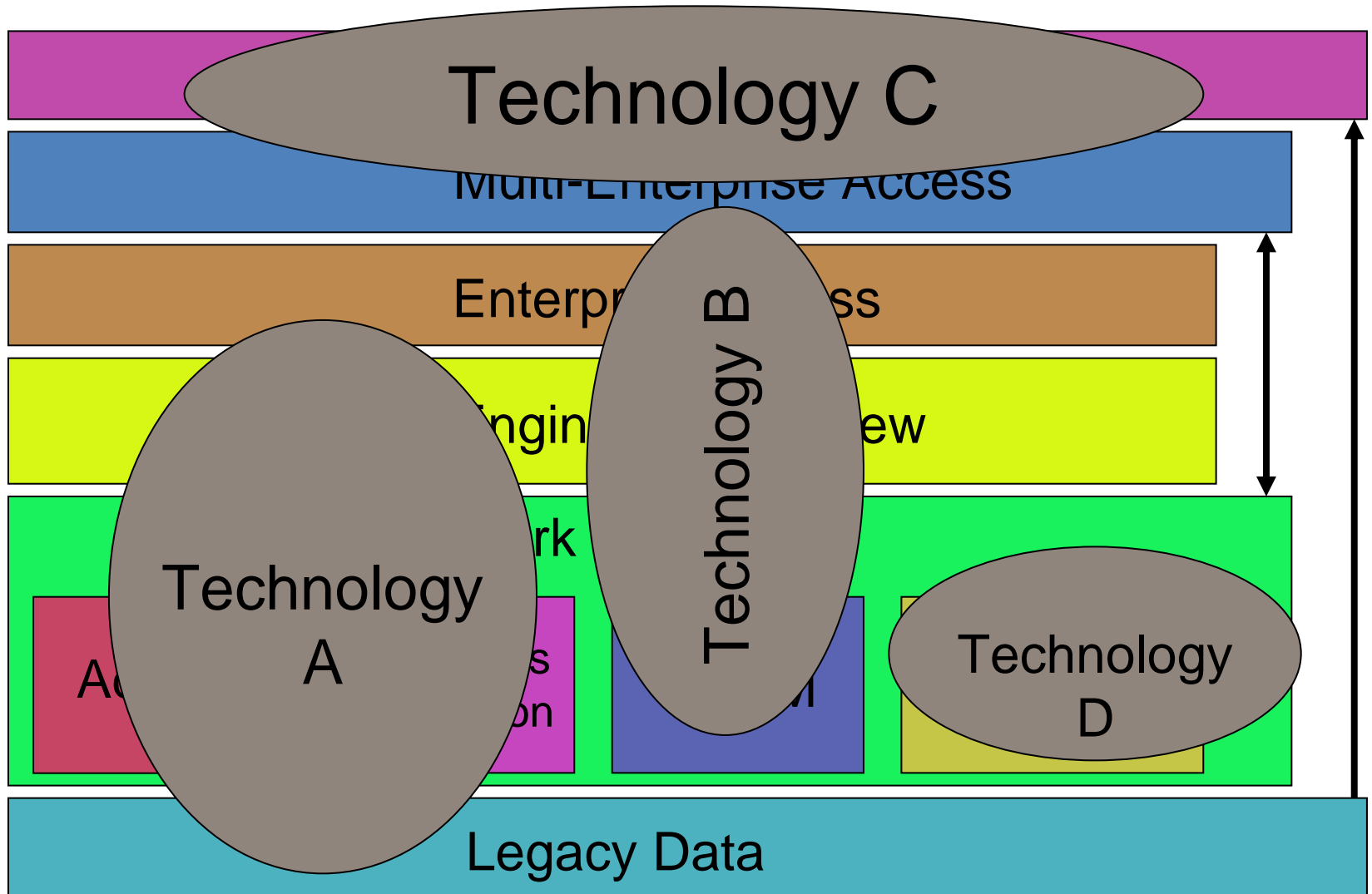
# Deployment Recommendations

- Focus on your requirements - Don't be afraid of a multi-technology solution
  - Interoperability is available in many forms
    - Tight integrations between technologies
    - Intermediate software to connect both sides via API access
    - Data exchange using standards
    - Dropbox type of approach with smart data
      - XML or similar with context, relationships and metadata
- Different SD&PM solutions offer dissimilar approaches with distinctly varying advantages and disadvantages
- SD&PM offerings are usually developed for a specific application and usage tier
  - **No single SD&PM technology covers all usage tiers well**



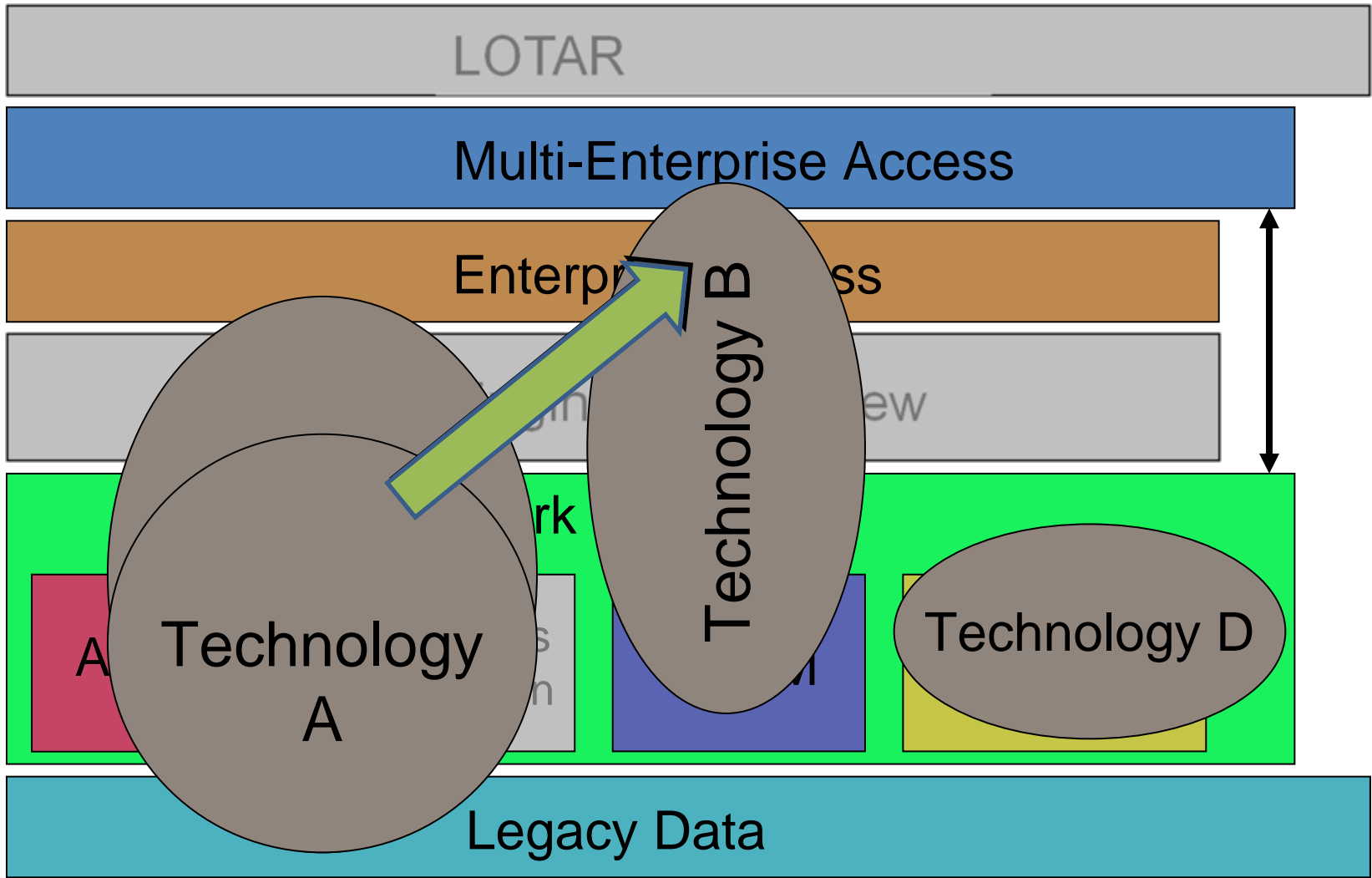


# SD&PM Technology Map



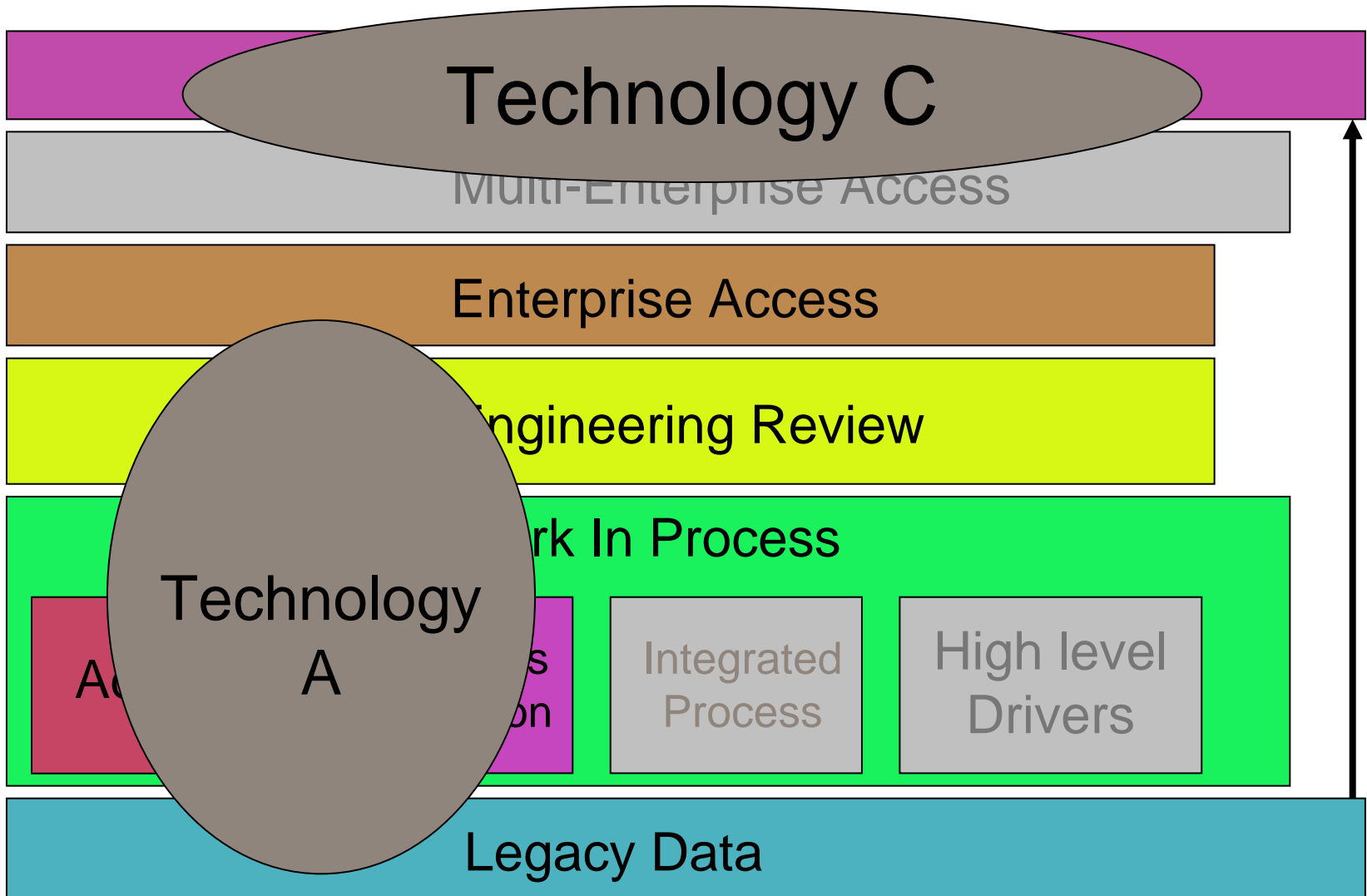


# Company 1 Example - Solution Map





# Company 2 Example - Solution Map





# Conclusions

- A multi-tiered approach provides a pragmatic guideline to wide scale SD&PM implementation
  - Opportunity for deployment of SD&PM beyond a relatively small number of companies and beyond focused activities
- A multi-tiered SD&PM approach allows for:
  - Capture of SD&PM requirements
  - Technology solution mapping to meet the SD&PM requirements
  - Phased implementation to meet the SD&PM requirements

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Thank You for Your Attention!

Questions?



# For More Information

- LOTAR: <http://www.long-term-archiving-and-retrieval.org/>
- NAFEMS: SDMWG: <http://www.nafems.org/tech/SDMWG/>
- AP209: <http://www.iso.org>