Multi-Tiered
Simulation Data & Process Management

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With SPECIAL thanks to:
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Jim Martin / Jotne EPM Technology
Karlheinz Peters / intrinSIM
Joe Walsh / intrinSIM

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August 19, 2013

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

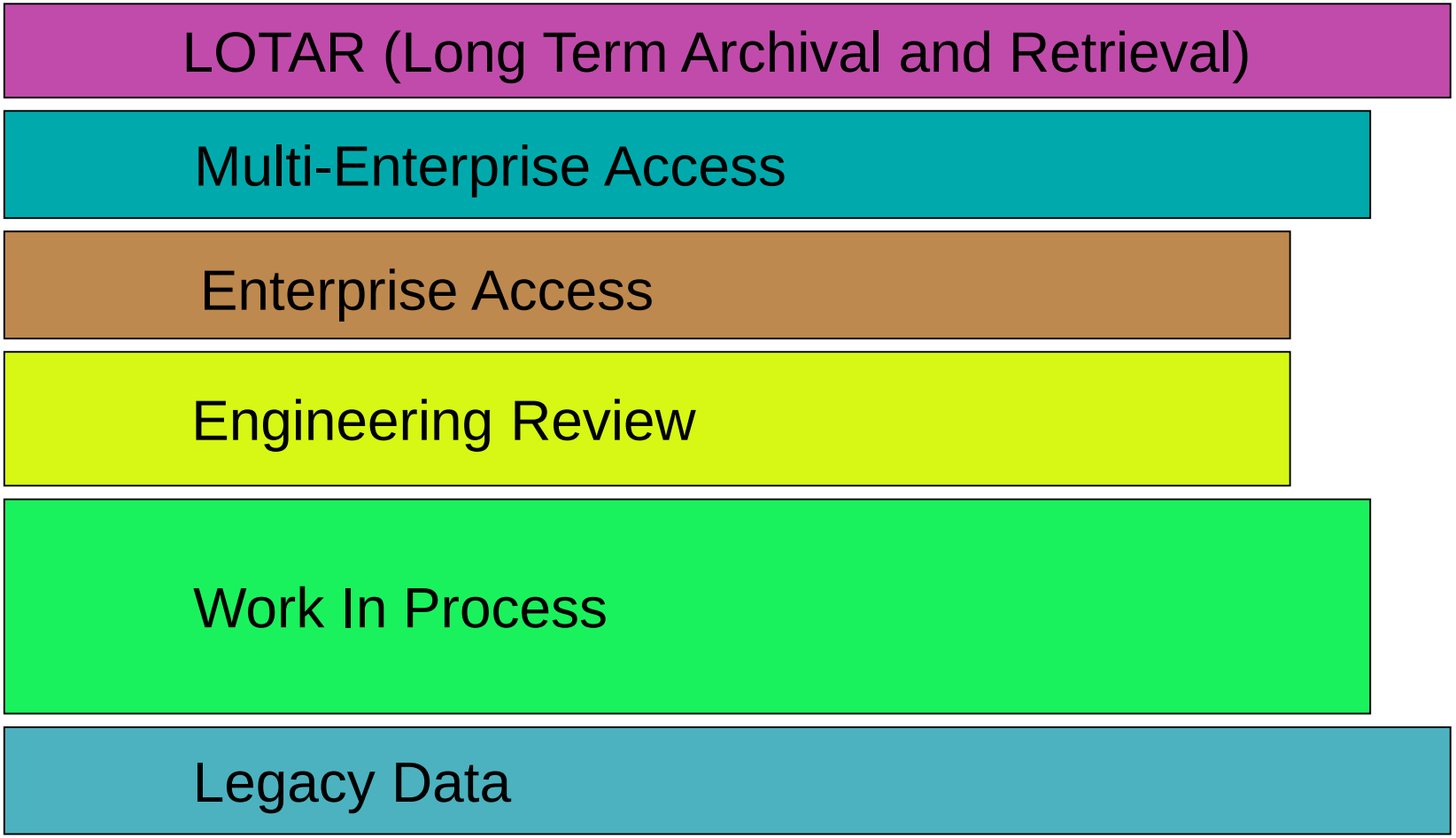
- Simulation data comes from multiple sources and work flows (ad-hoc work needs to be considered)
- Legacy data must be accommodated
- Context related information required for meaningful use of data
- Data access requirements
  - Project and process context
  - Consumer of data
  - IP issues
- Comprehensive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

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



SD&PM Usage Tiers

Legacy Data

- Simple approach (e.g., smart shared drives)
- Re-running solutions to capture data is not (usually) a viable approach
  - Would have to be planned in advance
- 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

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SD&PM Usage Tiers

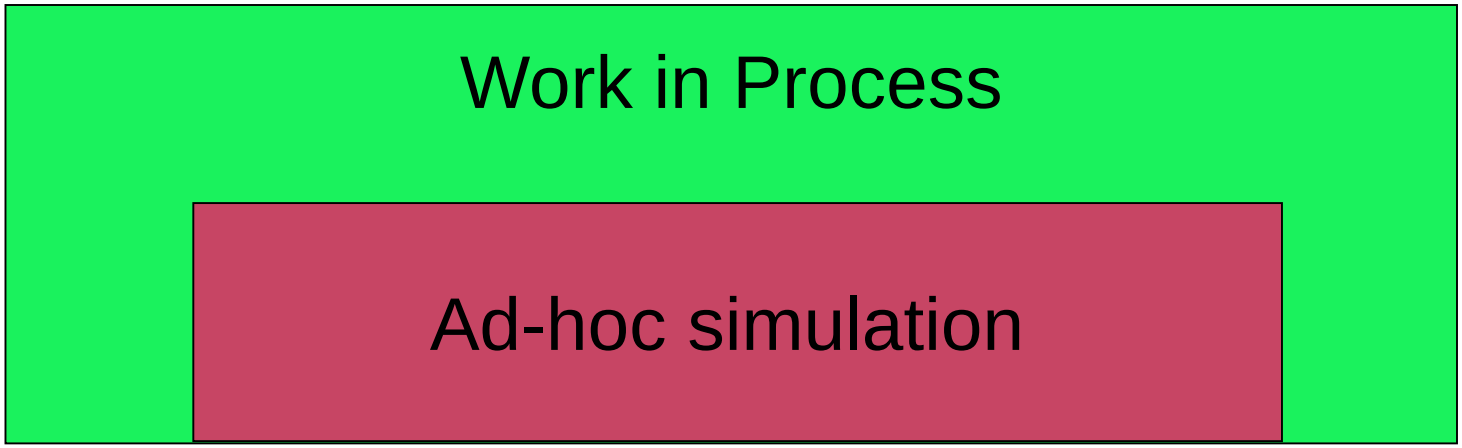
Work In Process

- 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

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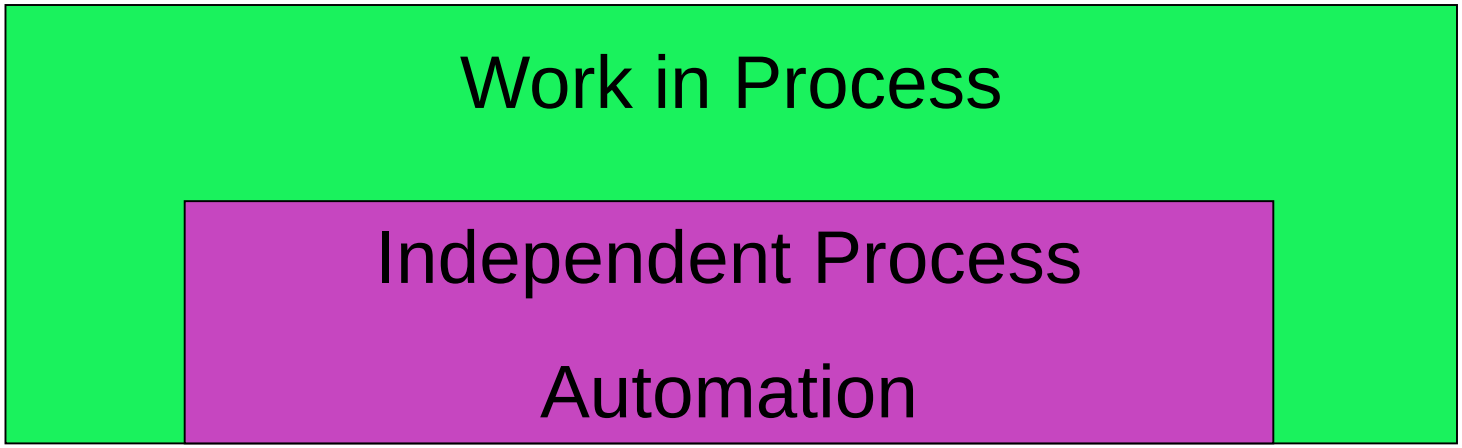
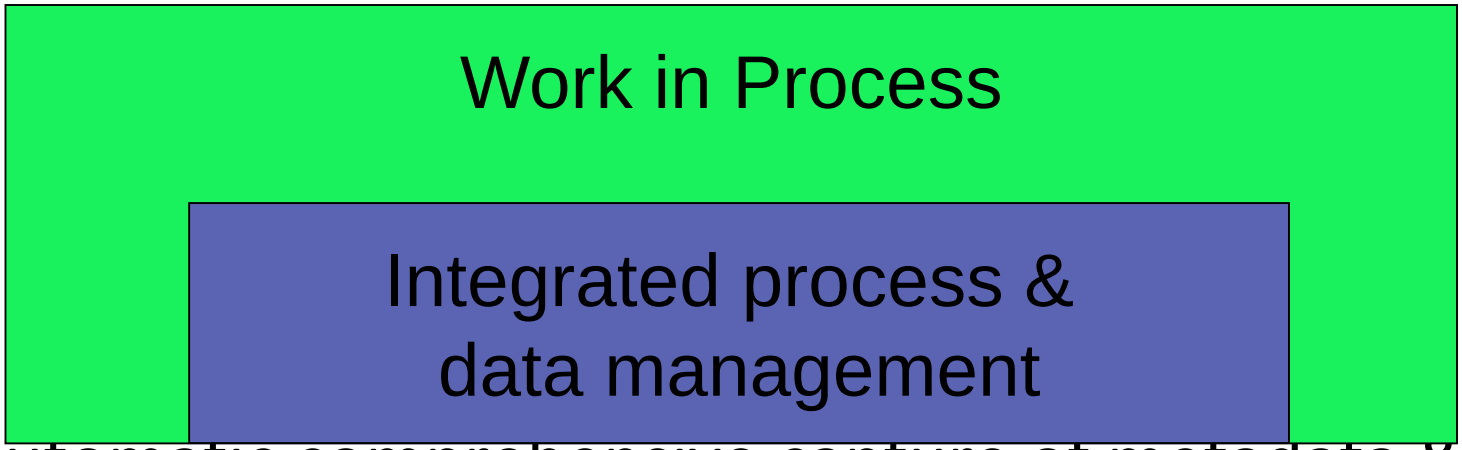
SD&PM Usage Tiers - Work in Process



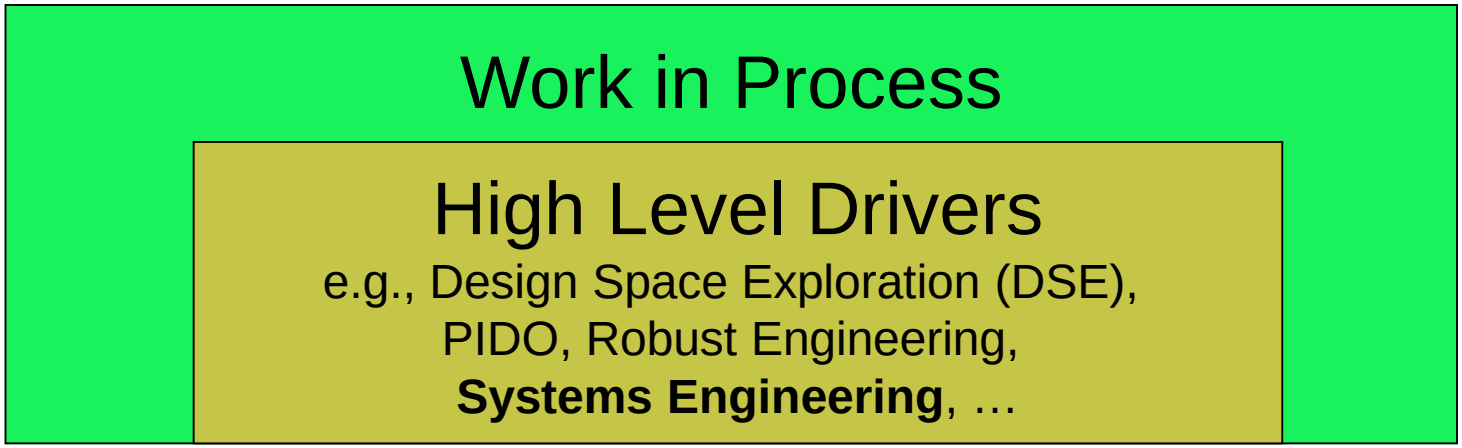
- Includes “homegrown” and commercial process automation tools
- To manage the data there is a need to integrate process automation tools and SDM environment
  - **Rewriting all processes is not viable**
- Other needs similar to ad-hoc simulations

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

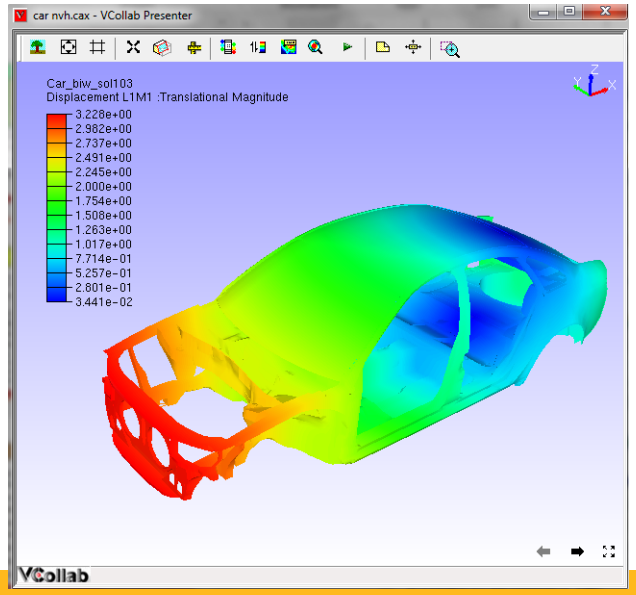


- Complex systems and processes that spawn simulations
- Needs integration with SDM environment
- Pass data, context and metadata to SDM and back

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
- Only a subset of the data required at Engineering Review tier
- Reduced data set for integration into product lifecycle management solution
- Simple access and multiple views into data
- Lightweight visualization
- Used by: **Enterprise beyond Design 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

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SD&PM Usage Tiers

LOTAR

- **Standards based** *representation* 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
  - May be required at intervals when infrastructure upgrades occur
- Needs lightweight visualization
- Used by: Organizations with long term retention requirements

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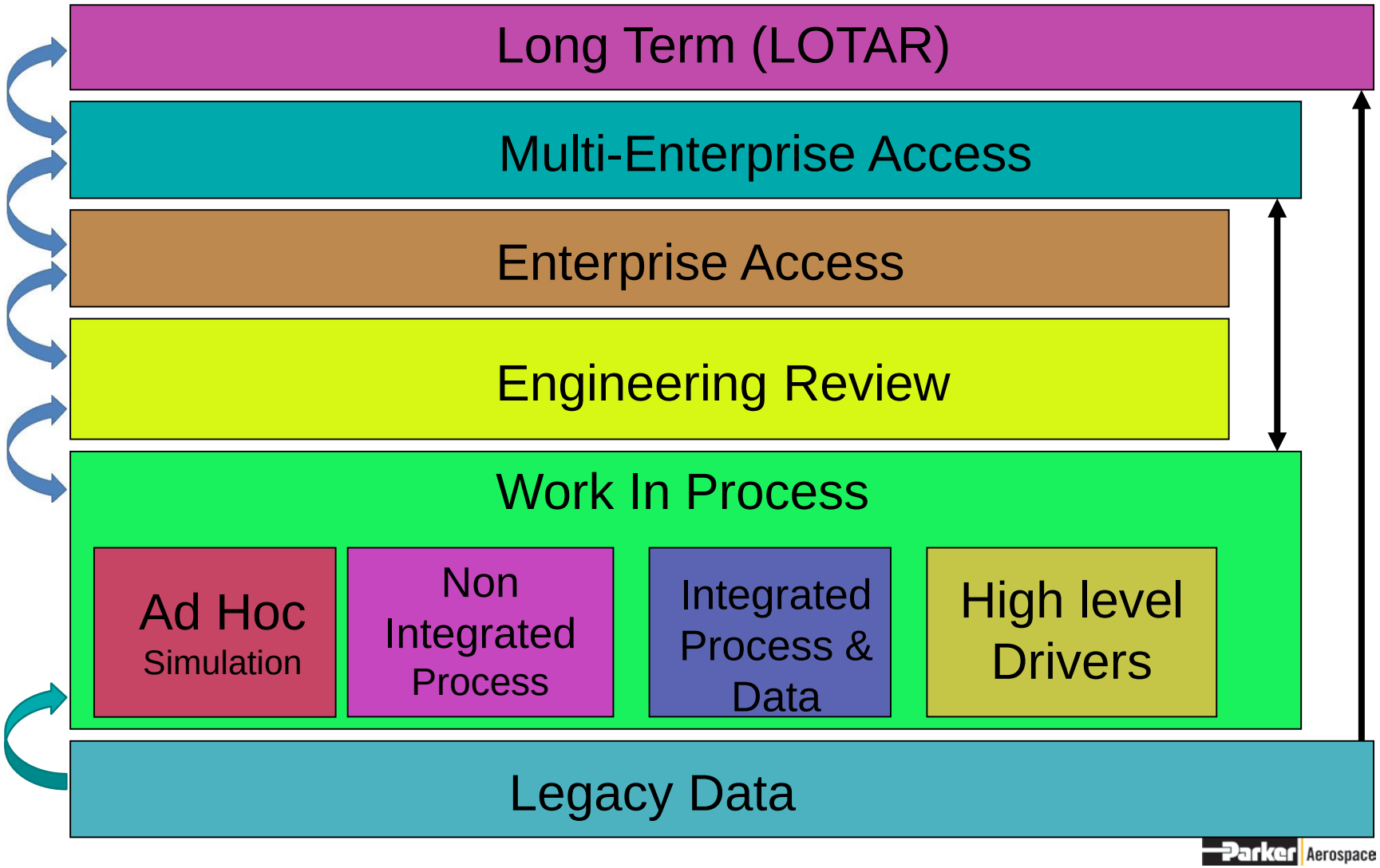
SD&PM Usage Tiers

Communication Between Tiers



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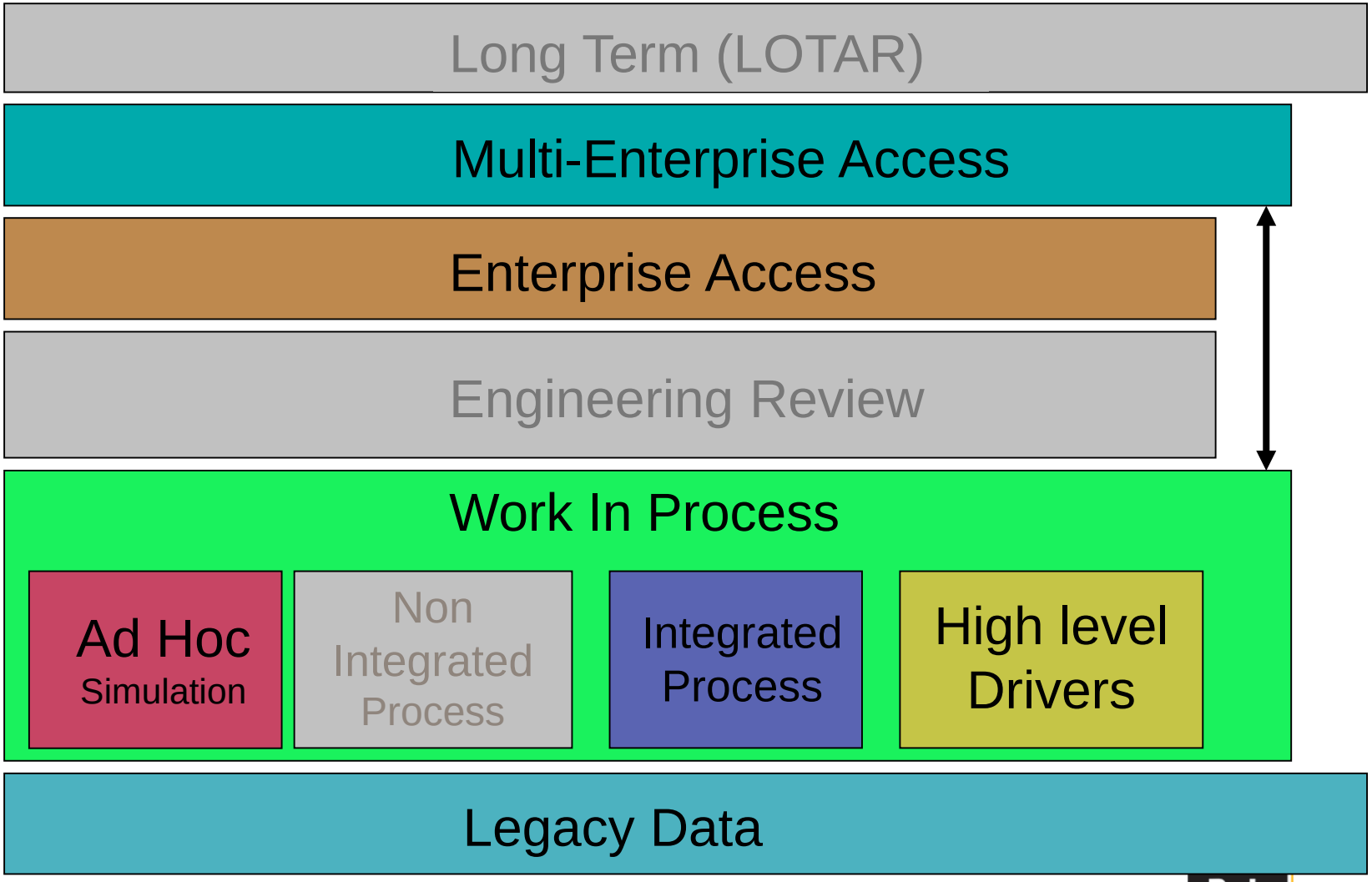
Deploying Broad Scale SD&PM

- 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



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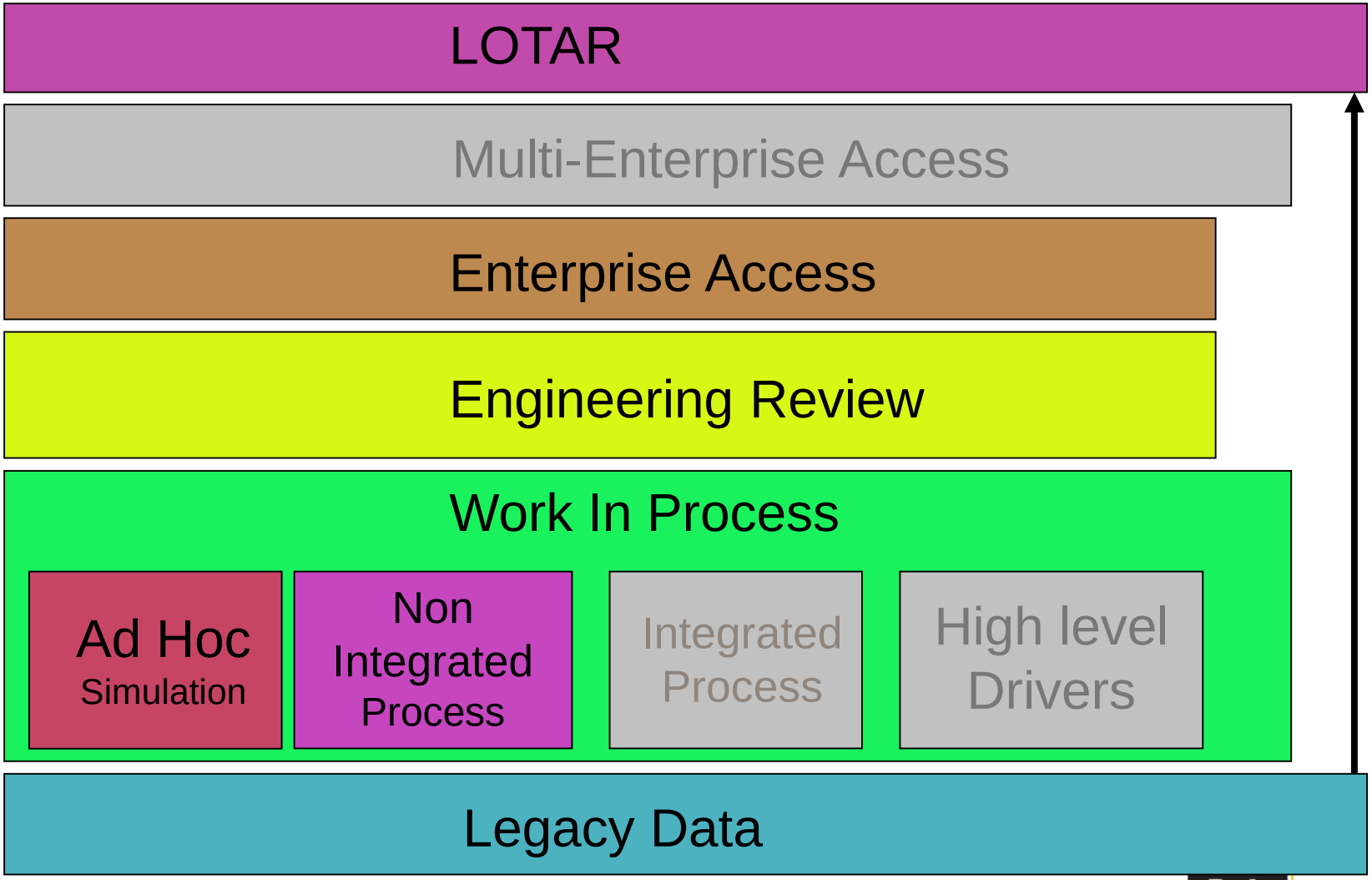
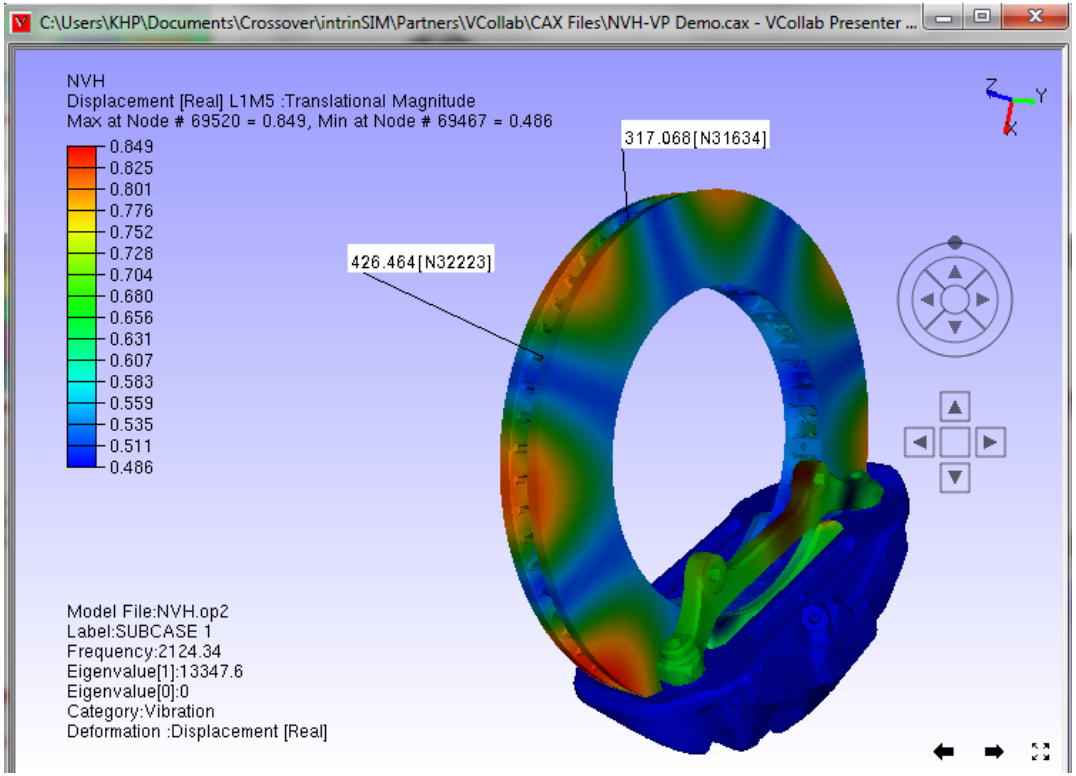
Which Aspects Are Important
Company “2” Example



Priorities and Phases

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



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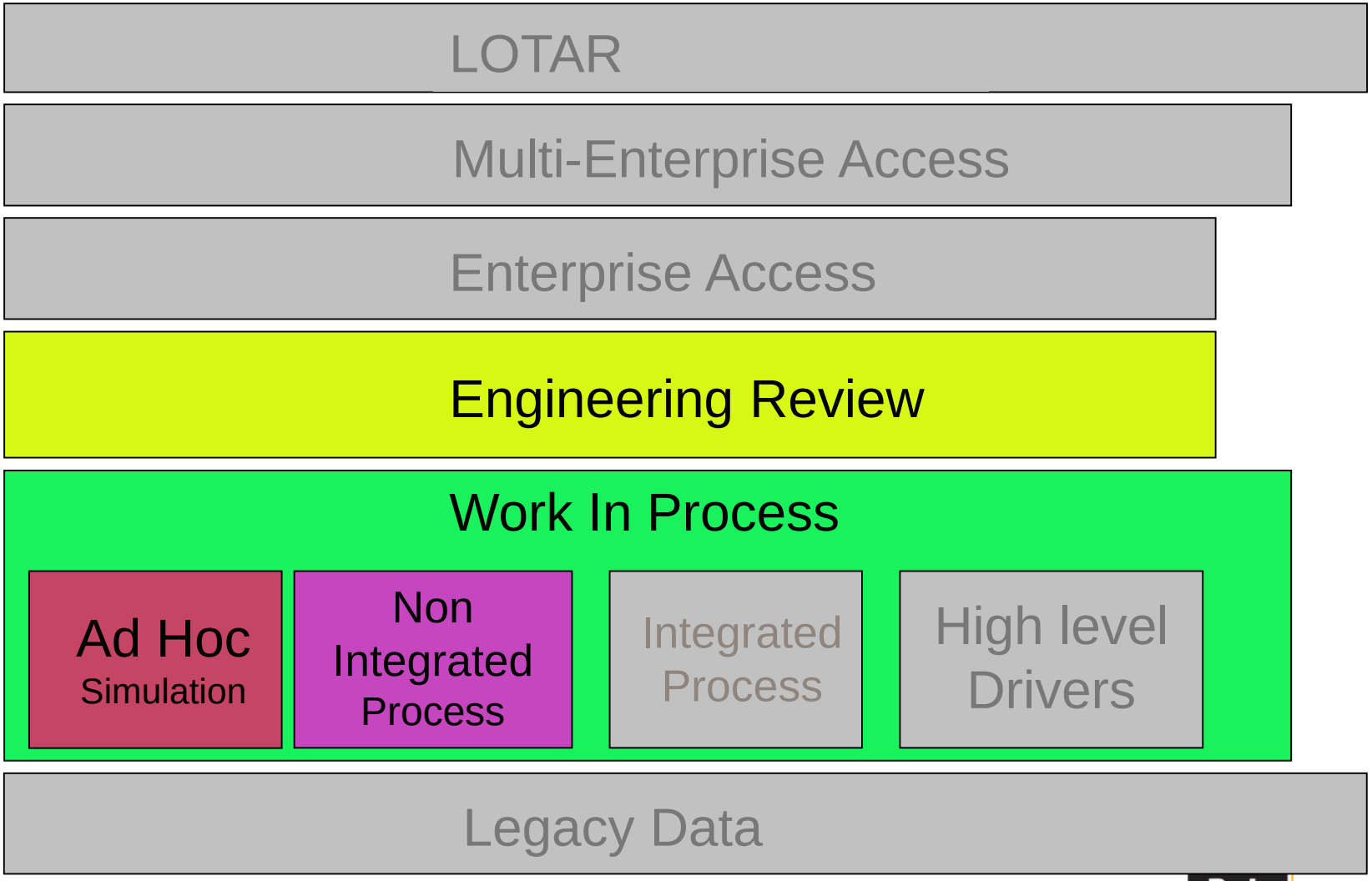
Which Aspects Are Important
Company 2 - Phase 1



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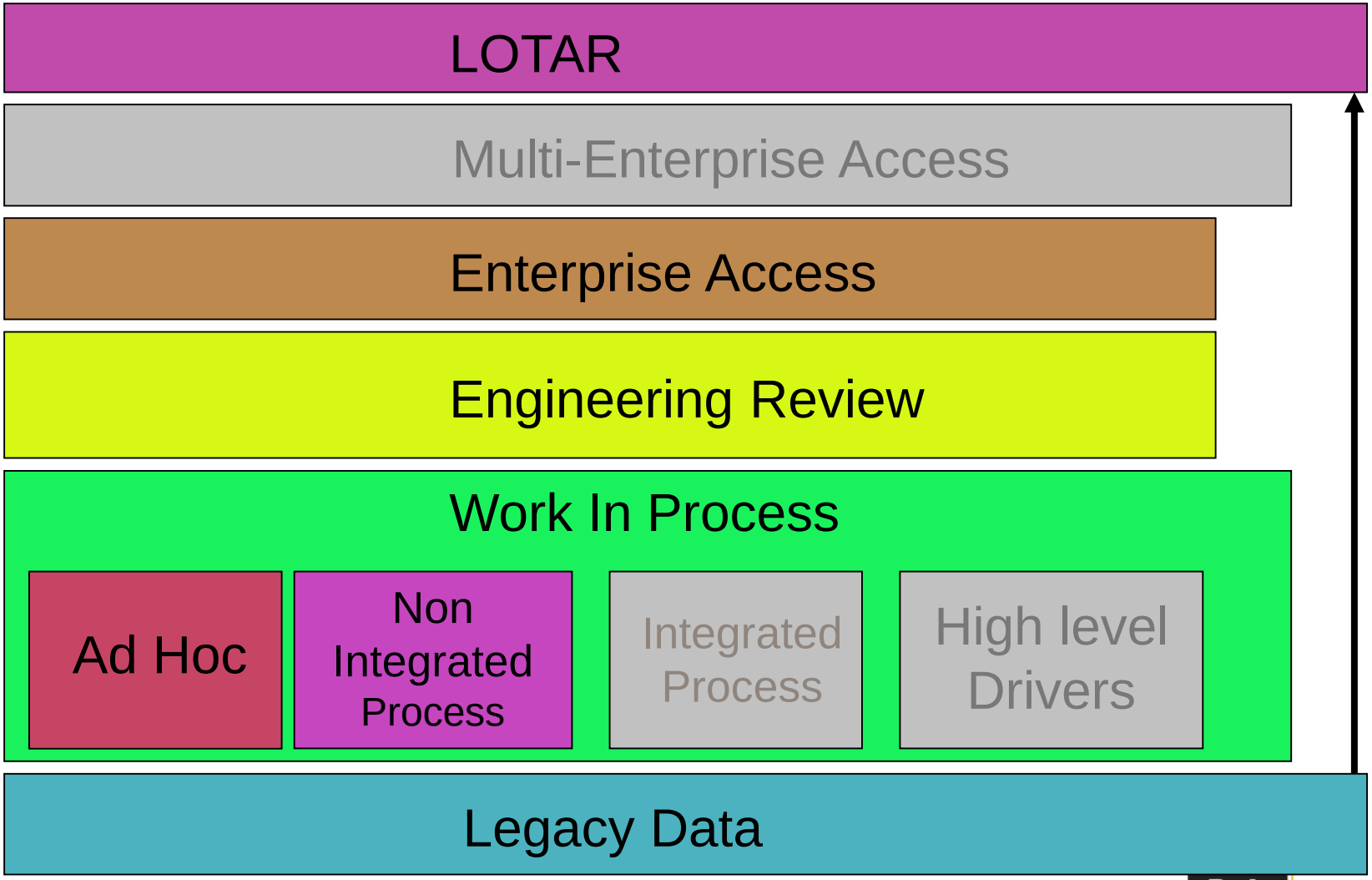
Which Aspects Are Important
Company 2 - Phase 2



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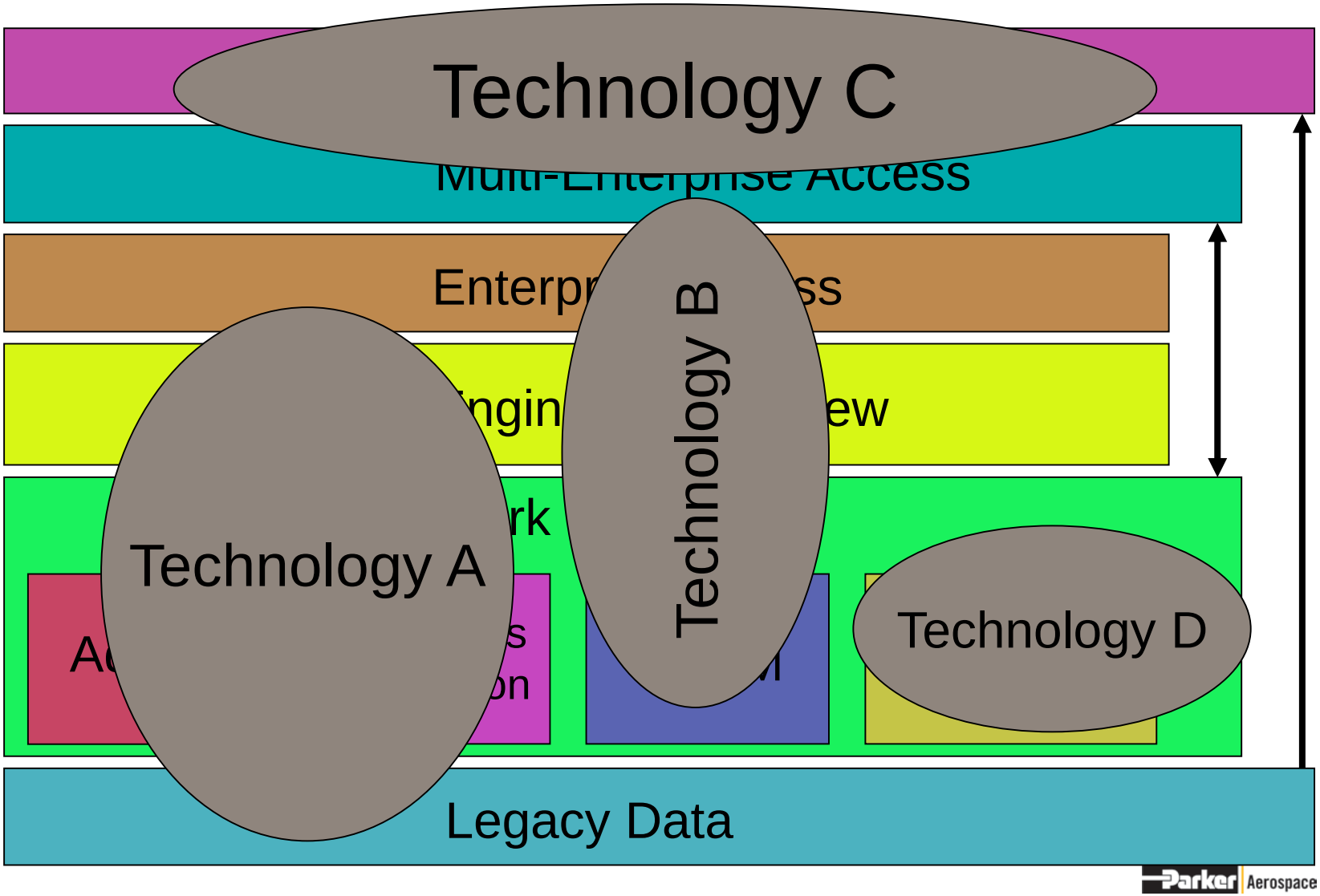
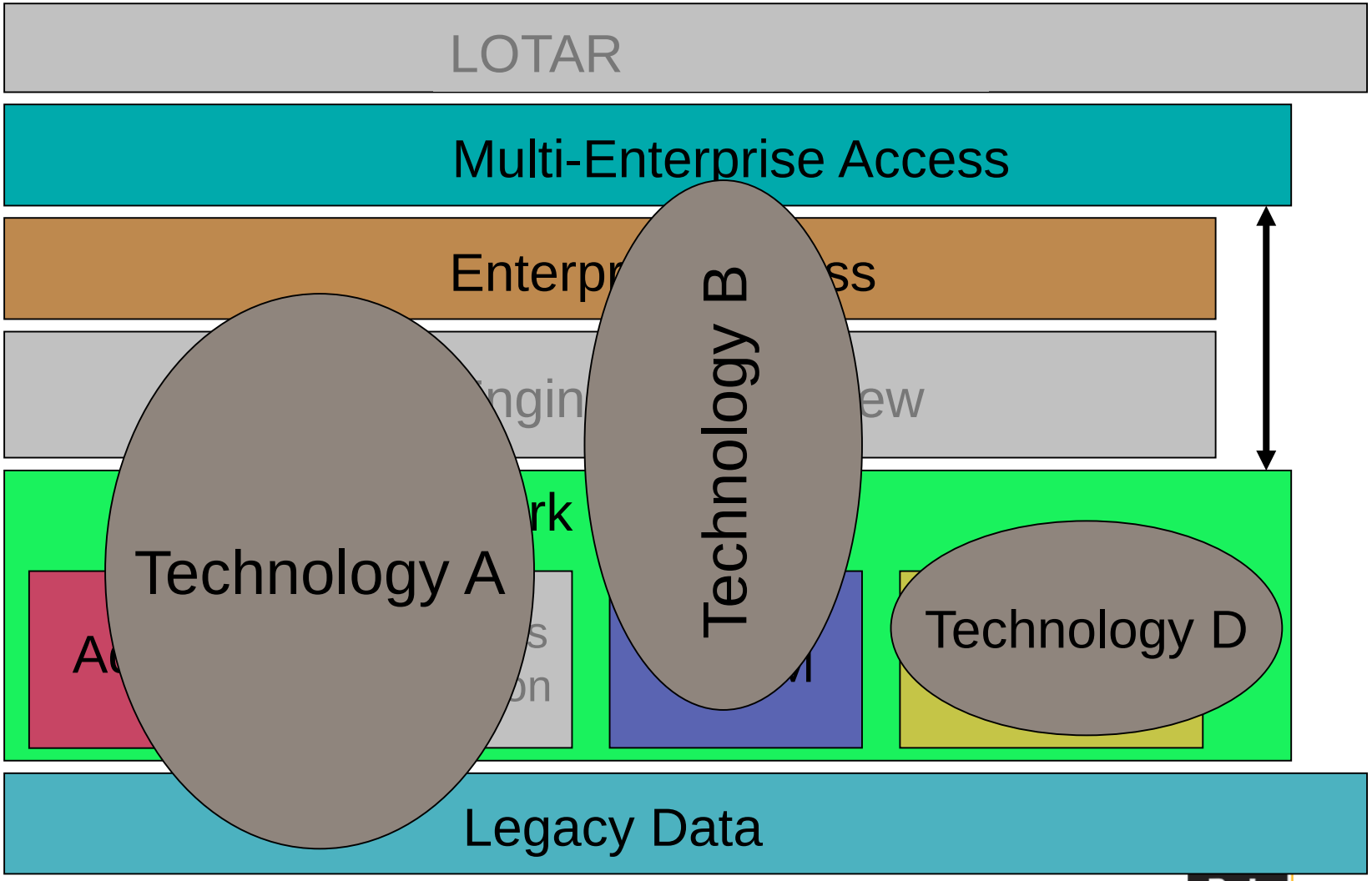
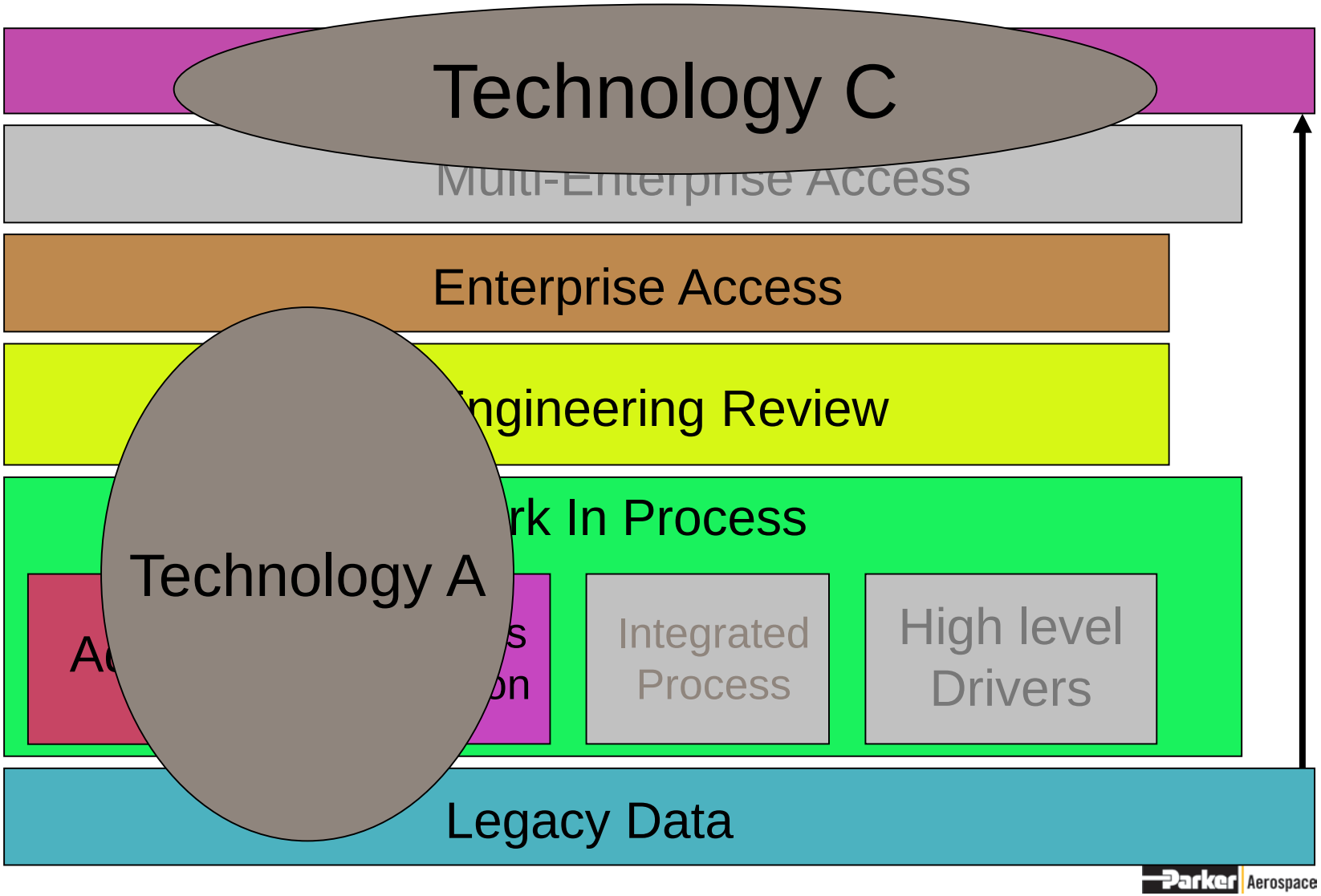
SD&PM Technology Map



Company 1 Example - Solution Map



Company 2 Example - Solution Map



Deployment Recommendations

- Focus on your requirements
  - Don't be afraid of a multi-technology (multi-vendor) solution
- Interoperability is available in many forms
  - Tight integrations
  - Intermediate software
  - Data exchange using standards
  - Dropbox type of approach with smart data
- Different SD&PM solutions offer dissimilar approaches
  - Varying advantages and disadvantages
- SD&PM offerings are usually developed for a specific application ***and usage tier***
  - even when the supplier does not say they did
  - **No single SD&PM technology covers all usage tiers well**

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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More on LOTAR

EDITORIAL OPINIONS – PURELY MY OWN!

One customer – LOTAR means ALL DATA (input, raw results, post-processed results, reports) for program life

Program life – 30-50 years

But – what about infrastructure (hardware upgrades, OS upgrades and patches, DB upgrades or replacements, AV signature patches, application improvements, new versions, network changes…)?

More on LOTAR

Raw data – 5 (small) to 500 (large) TB per program

RAW Cost PER YEAR in 2013 dollars = $3,879/TB [1]

Service = 1 FTE/180 TB ($500/TB/year)[2]

Controllers, OS, software, backups, migrations = $13,275/TB/year [3]

Per year storage = $17,654/year/TB

30 years at 3% inflation and constant cost = **$1,991,316 PER TB**

1 – Gartner “IT Key metrics 2013”

2 – Gartner “IT Key metrics 2013” plus FTE salary + benefits of $90,000/year

3 – “ITCalc.com” – Network Appliance storage calculation cost

More on LOTAR

Costs to rerun versus retain raw data:

Engineer = $150,000

Server = $150,000

Software licenses = $250,000

Total = $550,000 – **One time (per analysis execution set)**

More on LOTAR

Storage costs = $10,000,000-100,000,000 (approximately) over life of program (5-50TB* $2M/TB)

Simulation costs = $550,000 (approximately) at qualification, and if re-run in future

Current programs at tier-one – 150 (MY company)

Number of occurrences of re-analysis in last 33 years (my history at my company) – 10

Cost to store raw data = $10M-100M * 150 = $1.5B-15 BILLION

Cost to rerun analysis = $5,500,000 (over last 33 years)

Cost to MAINTAIN execution environment over 50 years = ???

Minimum savings – 1,500,000,000 – 5,500,000 = $1,494,500,000

Savings by managing only input, high precision reduced data (used for visualization and LOTAR), and reports = $1.5B-15B

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Conclusions

- 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
  - Capture and management of SD&PM data required from a LOTAR perspective at a vastly reduced cost compared to ‘saving it all’!

thank you
рахмат
danke
謝謝
ngiyabonga
teşekkür ederim
Баярлалаа
mersi
kia ora
barka
welalin
tack
spas
mahalo
tapadh leat
спасибо
faafetai lava
vinaka
спасибі
blagodaram
dank je
misaotra
matondo
paldies
grazzi
gracias
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dankie
nanni
nandri
dhanyavad
mauruuru
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ευχαριστώ
diolch
dhanyavadagalu
shukriya
mercé
мерси
তোমাকে ধন্যবাদ
감사합니다
xièxie
merci

Questions?

I may have answers, but if not, I know who to ask!

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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