Presentation Outline

Introduction

Trends in the Automotive sector

Overview of the GPD landscape

Typical challenges to enabling GPD

Keys to enabling GPD

Examples – A deeper look at
- Defining a Modular / Platform Architecture
- Distributed Design Collaboration
- Managing Supplier Improvement

Summary

Q&A
PDSEC: Global product and system realization

Introduction

About PTC

Recognized Global Leader in PLM and ECM

- 3,751 PTC employees in more than 30 countries
- 40,000+ worldwide customers
- Deep partnerships with leading partners, academia, and industry
- $721M in FY 2005

About Me

- Lead the NA Product Development Consulting Team
- World-Class Services: 100% focused on realized value
- Experience with dozens of Global PLM implementations involving extended supply chains
- BS in Aerospace Engineering, U.S. Military Academy at West Point
- MBA, Auburn University

… and…

Aerospace/Defense

High Tech/Electronics

Industrial Equipment

Life Sciences

Publishing

Financial Services

Government

Retail

Footwear & Apparel

Automotive

Audi

BMW

Harley-Davidson

Polaris

INFINITI

TOYOTA

Volkswagen

TRW
Introduction: PTC Product Development Consulting

Improving Product Development

Proprietary high-impact methodologies for improving product development practices

Product Development Consulting
Intense focus on achieving operational impact

Insight into next-generation product development value, challenges, and trends

Operational Impact

Methodologies
Insight
Expertise

Committed to attaining realized value for customers

Core product and industry expertise combined with global presence and knowledge of best practices
PDSEC: Global product and system realization

Presentation Outline

Introduction

Trends in the Automotive sector

- 10 key product development insights
- The Automotive Industry Pressures
- Drivers of Success in Automotive GPD

Overview of the GPD landscape

Typical challenges to enabling GPD

Keys to enabling GPD

Examples – A deeper look

Summary

Q&A
Study of Global Automotive Trends

Automotive and industrial equipment study overview

- Conducted by PTC and RWTH Aachen University in Germany
- Participants: 40% Europe, 55% US, and 5% Asia
- Separate Automotive and Industrial Equipment analysis
- 76 Automotive and 129 Industrial Equipment (205 Total)
- Primarily Tier 1 and Tier 2 Suppliers

Research structured around four areas of investigation

- Market and Financial Performance
- Product Development Strategy
- Product Development Trends and Performance
- Product Development Capabilities
Automotive Study Findings (10 key product development insights)

1. Clear divide between leaders and laggards
2. Optimistic outlook. Increased revenue & R&D spending
3. New Product Revenue linked to financial success
4. Increasing Complexity within the Value Chain
5. Lifecycle Stage Determines Product Development Priorities
6. High spend R&D return. **7X** return on 20% R&D spend
7. Fewer, more innovative projects (**4X** R&D spend)
8. Platform and Product Focus Wins
9. Change Management Matters
10. Leaders drive 3 times more revenue from services

Automotive Benchmark findings: http://www.ptc.com/solutions/industry/automotive/index.htm
### Automotive Findings: Success Factors of the Leaders

**High performance goes along with...**

<table>
<thead>
<tr>
<th>Early Stage of Lifecycle</th>
<th>Mature Stage of Lifecycle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus for innovativeness</strong></td>
<td><strong>Broad range for special needs</strong></td>
</tr>
<tr>
<td><strong>Iterations for innovativeness</strong></td>
<td><strong>First time right for efficiency</strong></td>
</tr>
<tr>
<td><strong>Change flexibility and predictability</strong></td>
<td><strong>Change flexibility and predictability</strong></td>
</tr>
<tr>
<td><strong>Ability to collaborate across the enterprise</strong></td>
<td><strong>Ability to collaborate across the enterprise</strong></td>
</tr>
</tbody>
</table>

**Automotive Benchmark findings:** [http://www.ptc.com/solutions/industry/automotive/index.htm](http://www.ptc.com/solutions/industry/automotive/index.htm)
The Automotive Industry Pressures

**Market Demands**

- Increased Performance Pressures
- Increase Economic Pressures
- Market structure
- Product Complexity

**Operational Demands**

- Improved Efficiency
- Global Operations
- Improved Collaboration
- Modularity and Platforming

*Center for Automotive Research (CAR) Study*: http://www.ptc.com/solutions/industry/automotive/index.htm
Drivers of Success in Automotive GPD

We know **WHAT** to do..

- Key drivers of success and business value in the future
  - Effective portfolio and platform planning / management
  - Improved discipline in product development processes
  - Improving Design for Manufacturability, Reliability, and Durability
  - Better use of virtual tools
  - Outsourcing more to global suppliers

But...we are just beginning learn **HOW** to be effective in GPD

- It’s hard! Many operational challenges
- In a very dynamic environment
Presentation Outline

Introduction

Trends in Automotive Sector

Overview of the GPD Landscape
- Next Generation Product Development
- GPD Operating Scenarios
- Effects of Alliance Relationships
- The GPD Lifecycle
- Challenges in enabling GPD

Keys to Enabling GPD

Examples – A deeper look

Summary

Q&A
Next Generation Product Development

Product development is moving aggressively towards a new global paradigm that mandates flexibility and effective information management.

Carries strategic importance to business
Makes otherwise transparent execution challenges visible
Forces a holistic planning view (people, process, and technology enablers)
Requires identifying what’s important in context with global relationships
Drives a focus on the creation and management of information
Companies Use Different Models For Global Product Development

7 GPD Operating Scenarios

1. Outsourcing task
2. Outsourcing function
3. Collaborating with design partners in JV
4. Coordinating captive distributed R&D centers
5. Outsourcing module development
6. Participating in a complex program as a Tier 1 Supplier
7. Managing a complex program as an OEM

Number of dependencies to manage

Total development value

Least Complex GPD

Most Complex GPD

Managing a complex program as an OEM
Participating in a complex program as a Tier 1 Supplier
Coordinating captive distributed R&D centers
Outsourcing module development
Outsourcing function
Outsourcing task

1 10s 100s 1000s
GPD Presents a Spectrum of Alliance Relationship Possibilities

The Nature of Alliance Relationships Introduces Strategic Considerations

- **Duration of Commitment**
  - Long
  - Short

- **Extent of Joint Decision Making**
  - None
  - Extensive

- **Market Exchange**
  - Competitive suppliers
  - Preferred suppliers
  - One-off arms’ length purchase
  - Licensing
  - Outsourcing agreements

- **Alliances/Strategic Partnerships**
  - Co-development
  - Co-production
  - Co-marketing
  - Joint Ventures
  - Minority investments
  - Global Technology Centers
  - Mergers and Acquisitions
  - Global

- **Internal**
  - Co-development
  - Co-production
  - Co-marketing
  - Joint Ventures
  - Minority investments
  - Global Technology Centers
  - Mergers and Acquisitions
The GPD Lifecycle

Many Companies are Feeling the Pain of Distributed Development

- Visibility to issues occurs in Ramp-up (too late)
- Getting to mainstream is 2-5 years (too long)

Globalizing Product Development

Phases of Global Product Development

- **GPD Planning** (~30%)
- **GPD Pilot** (<5%)
- **GPD Ramp-Up**
- **GPD Going Mainstream**

Time

- **0-18 months**
- **3-6 months**
- **18-36 months**
- **? years**
Typical Challenges to Enabling GPD

Typical challenges are common across industries:

1. Collaboration
2. Management Control
3. Engineering Productivity
4. IP Protection
5. Innovation and Quality
6. Institutional Learning & Knowledge Management
7. Managing Organizational Change

Source: research from AT Kearney, Deloitte, The Economist, Duke University & PTC experience with customers
Presentation Outline

Introduction
Trends in Automotive Sector
Overview of the GPD Landscape

Keys to Enabling GPD
- Align the distributed enterprise
- Get the Working Practices Right

Examples – A deeper look

Summary
Q&A

We know WHAT the problems are, but HOW do we solve them?
Align the Distributed Enterprise

**Business drivers and corporate objectives**

Clear, high level view of future state

**Process and practices that change to support business objectives**

**GPD CHALLENGES**

**Process**

**Technology**

**Strategy**

**Operating Model**

**Adoption**

Activities that increase organizational ability to benefit from change

Technical infrastructure that enables and supports the change
PDSEC: Global product and system realization

Align Strategy, Operating Model, Process, and Technology

Establish the framework to manage the execution of the project and commit to it

- What is important?
- What to measure?
- What to improve?
- What are the benefits?
- What is the path?
- How did we do?

Value Realization Approach

Operational Practice - Plan and Execute to Realize Value
PDSEC: Global product and system realization

Get the Discipline and Details of PD Working Practices Right

**Process Levels**

- **High Level Processes**: Management perspective of process structure
- **Practices**: The day-to-day work of the practitioner
- **Methods**: The specifics of tool usage

**Strategy**

**Operating Model**

**Process**

**Technology**

**Examples:**
- Platform Design
- Distributed Team Collaboration
- Virtual Prototyping
Multiple Processes and Practices Span the Product Development Lifecycle

Today's Focus

Product Development Consulting Areas of Application

- Modular Product Architecture Design
- Digital Design and Verification
- Requirements Management
- Eng. Change Mgmt.
- Robust Design
- Distributed Design Collaboration
- Partner Program Management
- Supplier Integration
Defining the Details of Working Practices

Working Practices

- The day-to-day work of practitioners involved in Product Development
- Harmonizes all aspects of people, process, and technology enablers
- Requires detail definition and disciplined enforcement
- Analogous to working practices of lean manufacturing

Examples – A deeper look

- Defining a Modular / Platform Architecture
- Distributed Design Collaboration
- Managing Supplier Improvement
Align Product Architecture To Enable Business Strategies

MPA Addresses Business Problems Throughout Product Lifecycle

- What’s most important?
- Where to start?

Balancing product variety requirements against development costs
Managing complexity and increasing standardization & re-use
Rationalizing procurement operations & leveraging outsourcing opportunities
Optimizing assembly sequence and processes & minimizing inventory costs
Minimizing maintenance and servicing costs & enabling on-going revenue streams

Modular Product Architecture
Managing the interface is the key to managing the product architecture

**Interface Characteristics**

- “F”: Fixed essential connection
- “T”: Transfer force, load, torque, pressure
- “W”: Water
- “O”: Oil
- “C”: Signals, data
- “U”: User interaction,

![Modular Product Diagram](image)
Modular Product Architecture Approach Summary

Conceptual Design  System Design  Detail Design  Release to Mfg

Product Architecture Implementation

Architecture Definition  Architecture Realization  Architecture Deployment

Architecture Requirements  Architecture Plan  Module Development

Functional Decomposition  System Management  Architecture Management

Module Clustering  Module Management  Change

Interface Identification  Interface Management  Configuration Mgmt
PDSEC: Global product and system realization

MPA is a Critical Working Practice in System Level Design

HIGH LEVEL PROCESS

|----------|---------------------|--------------|--------------|----------------|

Defined: System Design

- How to decide what’s in a module
- How to define important interfaces

PRACTICE GAP

- How to manage interfaces
- How to manage complexity
- How to identify who’s involved
- Etc...

Defined: Top-Down Design

METHODS
Defining the Details of Working Practices

Examples

- Defining a Modular / Platform Architecture
- Distributed Design Collaboration
- Managing Supplier Improvement
Enabling Distributed Design Collaboration

**Collaboration**

- Not a process, but an enabler (working practice) touching all processes
- Demands alignment of people, process, and technology enablers

**Typical Challenges**

- Unclear Strategy / Operating Model
- Poorly structured Collaboration Interfaces
- Inadequate Supporting Infrastructure
- Negative Personal Dynamics/Culture

**Dynamic Alliance Relationships**

- **Arms Length**
  - (low risk/complexity)
  - Supplier → OEM

- **Strategic Relationship**
  - (high risk/complexity)
  - Complicated By Dynamic Alliance Relationships

- **OEM**
  - Supplier
**PDSEC: Global product and system realization**

### An Illustration Of Complexity

<table>
<thead>
<tr>
<th>Product</th>
<th>OEM</th>
<th>Alliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Sheet</td>
<td>Marketing</td>
<td>Discrete Support Services</td>
</tr>
<tr>
<td>Requirements</td>
<td>Project Manager</td>
<td>Offshore Virtual Prototyping</td>
</tr>
<tr>
<td>Software Code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viewable</td>
<td>Engineering</td>
<td></td>
</tr>
<tr>
<td>CAD Model</td>
<td></td>
<td></td>
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<tr>
<td>Test Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End-to-End Design Project**

- **Marketing**
- **Procurement**
- **Program Manager**
- **Onshore Engineering**
- **Onsite Coordinator**

**Complex Engineering Change**

- **Engineering Europe**
- **Engineering North America**
- **Drafter**
- **Program Manager**
- **Project Manager**
- **Technical Expert**
Enabling Distributed Design Collaboration – A Framework

• Aligns roadmap to strategic objectives
• Identifies key interfaces to resolve pain points
• Aligns people, process, technology

1. Roadmap for Evolution

2. Collaborating Communities

3. Process Structure

4. Clearly-Defined Interfaces

5. Vehicles of Collaboration

6. Enabling Technology
PDSEC: Global product and system realization

Addressing the Key Practices Gap

<table>
<thead>
<tr>
<th>HIGH LEVEL PROCESS</th>
</tr>
</thead>
</table>

**PRACTICE GAP**

**Defined: Detail Design**

What are the key interfaces in the design process for distributed R&D centers?

What should be the vehicles of collaboration at these interfaces?

What IP should be exchanged and what needs to be protected?

How do I ensure designs are adequate and on track ahead of the gate?

**Defined: Drafting**

**METHODS**

2. Collaborating Communities

3. Process Structure

4. Clearly-Defined Interfaces

5. Vehicles of Collaboration

6. Enabling Technology
Collaboration Practices are Critical to Enabling All Virtual Processes

Develop Interface Standards for the Global Team
- Coordinate with plan with the deliverable
- Connect People to Process
- Connect People to Technology

**Virtual Design Review**

<table>
<thead>
<tr>
<th>Roles and RACI</th>
<th>EFL</th>
<th>BPL</th>
<th>Purchasing</th>
<th>Project Leader</th>
<th>Supplier</th>
<th>Cust</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/R</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

**Information Flow**

- BPL
- Purch
- PL
- Supp
- Cust

**Deliverables**
- Technical Documents
- Designs

**Vehicle of Collaboration**

**Asynchronous – Not Live**
- E-mail
- Central Repository
- Discussion Forum
- Subscription

**Synchronous – Real time**
- Phone
- In Person Meeting
- Peer-to-Peer Design Session
- Virtual Meeting
Defining the Details of Working Practices

Examples

- Defining a Modular / Platform Architecture
- Distributed Design Collaboration
- Managing Supplier Improvement
Supplier Integration: Certification Approach

Manage the improvement program to increase maturity

- Align the stakeholders to certification program objectives and business drivers
- Identify measures and assess current performance levels
- Identify priority improvement opportunities
- Evolve the program with changing business dynamics
## Establish and Manage the Program with a Maturity Ladder

<table>
<thead>
<tr>
<th>Relationship Maturity</th>
<th>Organization</th>
<th>Process</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Co-Dependency</strong></td>
<td>Integral</td>
<td>Optimizing</td>
<td>Federated</td>
</tr>
<tr>
<td>✓ Bi-directional change authority</td>
<td>✓ Extended decision structure horizontal &amp; vert alignment</td>
<td>✓ Continuous improvement of processes / WP</td>
<td>✓ Auto synch of data / processes throughout the enterprise</td>
</tr>
<tr>
<td>✓ Comprehensive Agreement. Joint responsibility for performance</td>
<td>✓ Joint readiness plans institutionalized and applied in new areas</td>
<td>✓ Continuous improvement of processes / WP aligned with project measures</td>
<td>✓ Seamless associatively and state control among footprint components</td>
</tr>
<tr>
<td><strong>Preferred</strong></td>
<td>Application</td>
<td>Managed</td>
<td>Integrated</td>
</tr>
<tr>
<td>✓ Joint planning</td>
<td>✓ Well-defined decision structure – Corporate based</td>
<td>✓ Proactive Org-based</td>
<td>✓ Access to systems across the enterprise</td>
</tr>
<tr>
<td>✓ Preferred agreement. Joint developed risk / reward model assessed over life of relationship</td>
<td>✓ Joint readiness plans aligned with work activity</td>
<td>✓ Process effectiveness measures aligned with project business needs</td>
<td>✓ Integral / integrated footprint components w/i corp walls</td>
</tr>
<tr>
<td><strong>Approved</strong></td>
<td>Awareness</td>
<td>Repeatable</td>
<td>Synchronized</td>
</tr>
<tr>
<td>✓ Performance measures shared</td>
<td>✓ Decision structure vertically defined. Adhoc among individuals x-enterprise</td>
<td>✓ Process / WP defined but not followed</td>
<td>✓ Manual synchronization / data re-work among disparate systems</td>
</tr>
<tr>
<td>✓ Basic Agreement, structured consideration business parameters (Risk/Volume, etc)</td>
<td>✓ Acknowledged readiness gaps without CA plan</td>
<td>✓ Process / WP defined within corporate / functional boundaries</td>
<td>✓ Manual integration / rework among footprint components</td>
</tr>
<tr>
<td><strong>Arms-Length</strong></td>
<td>Absent</td>
<td>Adhoc</td>
<td>Disconnected</td>
</tr>
<tr>
<td>✓ Adhoc planning with independent performance measures</td>
<td>✓ No decision and working structure defined</td>
<td>✓ Process / WP not defined – individual effort based</td>
<td>✓ Disconnected systems - unsupportive of distributed operations</td>
</tr>
<tr>
<td>✓ Basic PO - Low business volume, No risk / reward</td>
<td>✓ Readiness / need not considered</td>
<td>✓ Process / WP not defined – individual effort based</td>
<td>✓ Lack of standardization / interoperability of tools within footprint components</td>
</tr>
</tbody>
</table>

### Level 0 - Arms-Length
- Planning/Ops
- Agreement
- Governance
- Adoption
- Support
- Product Dev
- Architecture (3Is)
- Footprint (5Cs)

### Level 1 - Approved
- Planning/Ops
- Agreement
- Governance
- Adoption
- Support
- Product Dev
- Architecture (3Is)
- Footprint (5Cs)

### Level 2 - Preferred
- Planning/Ops
- Agreement
- Governance
- Adoption
- Support
- Product Dev
- Architecture (3Is)
- Footprint (5Cs)

### Level 3 - Co-Dependency
- Planning/Ops
- Agreement
- Governance
- Adoption
- Support
- Product Dev
- Architecture (3Is)
- Footprint (5Cs)
Assess How To Evolve The Supplier Development Program

Assess Validity of Targets

Assess performance levels

Reward top performers

Evolve Supplier Development Program to achieve business objectives

Performance Measures

<table>
<thead>
<tr>
<th>Area</th>
<th>Balanced Scorecard Metrics</th>
<th>Supplier A</th>
<th>Benchmark Best in Class (BIC)</th>
<th>Supplier B</th>
<th>Supplier C</th>
<th>Value from achieving BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial</strong></td>
<td></td>
<td>$5M</td>
<td>$7.6M</td>
<td>$5M</td>
<td>$7.6M</td>
<td>3-5% Increase in Revenue</td>
</tr>
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<td>Financial</td>
<td></td>
<td>$5M</td>
<td>$7.6M</td>
<td>$5M</td>
<td>$7.6M</td>
<td>3-5% Increase in Revenue</td>
</tr>
<tr>
<td>Business Process</td>
<td></td>
<td>$5M</td>
<td>$7.6M</td>
<td>$5M</td>
<td>$7.6M</td>
<td>3-5% Increase in Revenue</td>
</tr>
<tr>
<td>Customer and Innovation</td>
<td></td>
<td>$5M</td>
<td>$7.6M</td>
<td>$5M</td>
<td>$7.6M</td>
<td>3-5% Increase in Revenue</td>
</tr>
<tr>
<td>Organization and Learning</td>
<td></td>
<td>$5M</td>
<td>$7.6M</td>
<td>$5M</td>
<td>$7.6M</td>
<td>3-5% Increase in Revenue</td>
</tr>
</tbody>
</table>

What performance Requirements support business objectives?

Value Mapping

<table>
<thead>
<tr>
<th>Supplier Maturity</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship Maturity</td>
<td></td>
<td></td>
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<tr>
<td>Organization</td>
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<tr>
<td>Process</td>
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</tr>
<tr>
<td>Technology</td>
<td></td>
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</tbody>
</table>

Where would improvement programs provide the most value?

What level of performance is needed at each maturity level?
Certification Aligned with Agreements and Improvement Initiatives

Supplier Development Framework

Supplier Agreements
- New Supplier
- Approval Process
- Preferred Supplier
- Preferred Supplier Assessment
- Comprehensive Supplier Agreement

Supplier Certification Program
- Define the Certification Program
- Launch the Certification Program
- Manage the Certification Program
- Evolve the Certification Program

Increasing Supplier Status
- Non-Approved (Potential Supplier)
- Approved Supplier
- Preferred Supplier
- Preferred Supplier Assessment

Increasing Supplier Maturity
- Supplier Certification Program
- Supplier Certification Program
- Supplier Certification Program

Improving Supplier Performance
- Organization
  - Governance
  - Perf Metrics
- Process Alignment
  - Working Practice
  - Process Interface

Technology
- Interfaces & Standardization

Adoption and Training
We’re Making Good Progress in Addressing GPD Challenges

<table>
<thead>
<tr>
<th>PDC Practices</th>
<th>Collaboration</th>
<th>IP Protection</th>
<th>Institutional Learning &amp; Knowledge Management</th>
<th>Engineering Productivity</th>
<th>Innovation &amp; Quality</th>
<th>Managing Organizational Change</th>
<th>Management Control</th>
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</thead>
<tbody>
<tr>
<td>1 Modular Product Architecture Design</td>
<td>X</td>
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<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>2 Requirements Management</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3 Digital Design &amp; Verification</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4 Change Management</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5 Robust Design</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>6 Partner Program Management</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7 Distributed Design Collaboration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8 Supplier Integration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Summary

Global product development is a clear mandate of future success

Enabling GPD is challenging - universally

Prioritize and align the global team

Getting the working practices right is the key

Select and manage digital interfaces

We are making great progress in removing the barriers