Distributed product development

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best practice brief

Today's highly competitive global economy makes distributed product development a necessity for many companies. The ability to effectively perform one or more development processes across multiple geographic locations is crucial for implementing a successful distributed initiative. Today's PLM technologies allow distributed operations to function as a single corporate entity through the use of global collaboration, enterprise data management and process automation capabilities.

Distributed product development

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Overview of distributed product development

Agile product makers in key industries, including aerospace and automotive companies, increasingly leverage both internal and external resources across a globally distributed supply chain to perform the design, engineering and manufacturing functions associated with product development. While the benefits of a more distributed development process are varied, today's highly competitive global economy makes a distributed approach to new product development a necessity rather than a just an option.

The following best practice brief describes *whether* and *when* to implement a distributed product development strategy. Other Siemens PLM Software briefs provide detailed information about how to execute these strategies through the use of concurrent design and engineering management.

Defining distributed product development. Distributed product development has become the business initiative of choice for implementing a distributed approach to product realization. According to the Aberdeen Group's *Global Product Design Benchmark Report*[1], today's products are increasingly brought to market by cross-enterprise teams that span multiple geographic borders.

When product innovation is executed by distributed design networks, additional communications, collaboration and control challenges impact an already complex operational effort. This observation is bolstered by recent finding published in the Aberdeen Group's *New Product Development Value Research Series*, which indicates that approximately 66 percent of the manufacturers in its studies ranked collaboration capabilities "very highly" as a factor in improving product revenue.

With this in mind, the major tenets of distributed product development are defined by the Product and Development Management Association (PDMA) as follows:

> ***Distributed product development:*** *The separation and optimization of activities performed during a single product development process (i.e., product ideation, development and launch) across multiple geographic locations. These locations may be within a single corporate entity, within subsidiaries or involve the use of third parties.*[2]

At the crux of today's initiatives, companies implement best practice solutions for assembling a value chain comprised of the best and/or most appropriate people for performing every product development function. However, the best resources are not always available in geographically adjacent locales. In addition, global competition requires many companies to reduce their development expenditures by selecting best-cost alternatives.

Fortunately, today's product lifecycle management (PLM) technology enables companies to establish truly viable distributed product development initiatives through the use of highly secure global collaboration, enterprise data management and process automation capabilities.

In brief:

Many product makers have decided to leverage both internal and external resources in a globally distributed supply chain to perform the design, engineering and manufacturing functions associated with product development.

Their goal is to assemble a value chain that is comprised of the best and/or most cost effective people capable of performing every product development function. Today's PLM capabilities make this challenging business initiative truly viable.

Distributed product development's business value. PDMA cites several examples that nicely illustrate the business effectiveness of distributed product development.

A semiconductor company saved nearly 60 percent on its design costs by locating its design and layout engineering resources in India.

A major automotive manufacturer recognizes that it can save millions of dollars by leveraging the R&D investments of its suppliers.

China's new technology entrants are closing functionality gaps with their competitors by leveraging original design manufacturers (ODMs) and design talent in Taiwan.

The Joint Strike Fighter program represents a highly publicized example of distributed product development that brings an extremely large value chain together. The F-35 Joint Strike Fighter (JSF) is being built by a Lockheed Martin-led coalition of leading military aircraft manufacturers and suppliers. This worldwide coalition is expected to work as a single contiguous enterprise.

The coalition's primary partners – Lockheed Martin, Northrop Grumman and BAE Systems – are supported by up to 1,000 suppliers. Taken together, the coalition spans more than 30 countries, 130 sites, 17 time zones and approximately 6,500 designers and engineers. In this environment, the coalition's ability to manage multiple design data formats is crucial – as is Lockheed Martin's ability to coordinate the operational efforts of organizations that employ dissimilar development tools.

Beyond this, Lockheed Martin needs to ensure that the intellectual property rights of each coalition member are respected and that the program fulfills its ITAR compliance requirements. These responsibilities are further complicated by expectations that the program will achieve unprecedented cycle-time reductions in both design and manufacturing. Lockheed Martin leverages distributed product development techniques to meet these program goals. To date, it has seen a comparative cycle time reduction of 35 percent, which represents billions of dollars in savings. Lockheed Martin anticipates that manufacturing time will be cut by up to 66 percent with huge reductions in tooling.

Today's companies need to establish a strategy for current and short-term projects, as well as to ensure their competitiveness on a long-term basis. While many companies already distribute key business functions around the globe, they lack actionable mechanisms and everyday experience that is essential for maximizing the value of these resource pools in a manageable way.

In brief:

Distributed product development enables companies to lower their development costs, access more specialized skill sets, shorten the development cycle, mitigate financial risk and improve their ability to deliver localized product content.

The Joint Strike Fighter program illustrates how an extremely large value chain can deliver highly ambitious business objectives by taking advantage of the latest techniques and tools associated with distributed product development.

Stakeholders in distributed product development initiatives. Because distributed product development applies to processes across the entire product development lifecycle, it affects virtually everyone in today's extended enterprises. Most companies that offer global products already distribute their service, sales and zone-marketing functions. The use of distribution techniques continues to expand as companies increasingly locate their design, engineering and manufacturing teams wherever this expertise is resident.

Essentially, distributed product development is based on the premise that a resource is a resource – and product success depends on the ability to identify the best fit for each crucial product development function. However, distributed product development raises unique management issues. Considerations that were taken for granted in co-located organizations have to be articulated, communicated and carefully monitored. Business and technical alignment can never be assumed. Program and project managers need to be cognizant of time zone difference. The activities of product development's various participants need to be synchronized.

In essence, the ability to determine when and how to look across product development's distributed landscape makes the difference between business success and marketplace failure.

In brief:

Program executives, program managers and team leaders are crucial stakeholders with key responsibilities for making distributed product development successful. These responsibilities need to be seriously addressed given the unique management issues that arise in executing this kind of complex initiative.

Crucial stakeholders

Stakeholder	Role
Executive program management	Must provide executive buy-in with respect to the costs, risks and ultimate business value of distributing a new development project; required in order to secure the project's budget and resources
Program management	Must determine whether a distributed strategy is appropriate for the project in question and be ready to commit the management effort needed to return the project's associated benefits
Team leaders	Need to consider and account for potential distributed product development challenges, including time zone differences and asynchronous collaboration requirements

Challenges

It is easy to say "the best team for handling this job is in the XYZ division in Japan." It is much harder to meet the challenges associated with actually implementing that decision. With this in mind, PDMA's research identifies a common set of apparent risks.[3]

In brief:

Distributed product development requires companies to understand and resolve a variety of key business challenges. Projects that implement one or more distributed processes can fail to meet user community expectations, deviate from their initial specifications and jeopardize the company's future mission-critical capabilities if they are not properly planned and executed.

To mitigate these risks, the project's implementation team needs to make careful make/license/buy decisions, avoid organizational fragmentation, honor third-party contracts and respect the intellectual property interests of all participating organizations.

Failing to meet initial expectations. Inefficiencies in the distributed process often cause organizations to miss their deadlines or exceed their budgeted expenditures. Distributed projects do not benefit from the personal contact that characterizes the daily interaction of most co-located teams. Distributed team members miss out on the hallway conversations, water-cooler discussions and spur-of-the-moment meetings that quickly arise when people see each other daily. As a result, distributed teams must anticipate the following warning signs:

- Misunderstandings exacerbated by non-intersecting workdays
- Long gaps between formal meetings
- "Us-versus-them" mentality arising from the absence of personal contact
- Surprise discoveries that only materialize during formal checkpoints

Deviating from original specifications. Dysfunctions in a distributed development organization often cause product specifications to vary from the project's originally understood market and customer requirements. Significant problems typically arise during the evolution of the development cycle when individual groups make design changes without the knowledge of the project's other stakeholders.

For example, the fuel economy of an automobile is directly related to the weight of the combined vehicle. Design changes that impact the vehicle's weight need to be communicated to all project teams to ensure that the car's miles per gallon (MPG) rating is preserved without risk to the target buyer segment.

Jeopardizing future capabilities. When sourcing decisions are made with a myopic view, a company's organizational capabilities can be placed at risk. While some short term decisions appear to be easy at first glance, the decision to distribute specific development processes to third parties or keep them in-house can be crucial. These decisions can risk:

- Loss of key design skills essential for marketplace competitiveness
- Loss of intellectual property rights that determine competitive positioning
- Weakened customer and supplier negotiating power if mission-critical development functions are shifted to third parties

To mitigate these risks, distributed teams must recognize the following dangers:

- Lack of a systematic process for reviewing make/license/buy decisions
- Excessive organizational fragmentation with no critical mass at any one location
- Absence of guidelines and visibility into third-party contracts
- Failure to communicate intellectual property protections and confidentiality rules to third-party suppliers

Understanding whether and where distributed product development makes sense. Distributed product development is not an initiative that every company should adopt. While distributed teams and processes can help companies shore up individual areas of weakness, it is *not* a replacement for a weak overall product development process. It is a challenging strategy that provides reward only if companies are willing to invest in the tools and devote the management attention required for successful implementation.

Equally important, distributed product development is only a good fit for companies, products and industries that are well suited for distributed operation. As the accompanying table indicates, PDMA has developed an approach that companies can use to evaluate the suitability of distributed product development for their own business-specific purposes.

In brief:

Distributed product development is not a replacement for an otherwise weak overall development process. Distributed product development is not a good fit for every company. It only makes sense if the adopting company's products, operations and industry attributes fit the distributed business model.

Evaluating the suitability of distributed product development[4]

Attribute	Conditions where distributed product development fits
Product attributes	
Product modularity	If the product being developed is very modular, if each of its components can be defined discretely and if component development can be parallelized.
Advanced specification	If the product's technical requirements and component interfaces are self evident and are not evolutionary in design.
Sequence of development	If the product development sequence does not need to be linear.
Labor intensity	If labor is a high component in the overall R&D effort and if the assets and tools required by the product's developers are small and easily movable.
Product usage	If the end product is a component used by an OEM in its products and if the end product is readily interchangeable with other OEM assets.
Company attributes	
Skills and capabilities	If the company evaluating the initiative has a resource gap in key capability areas vital to its success, if the company is unable to find the talent it needs within a satisfactory timeline or if the required talent is accessible from third parties or geographies where the company has no current operations

Attribute	Conditions where distributed product development fits
Culture	If the company's cross-functional teams are frequently assembled, operational and then disbanded and if the company wants to make a strong push for best-in-class solutions (regardless whether they are developed in-house or externally)
Systems and infrastructure	If the company has widely used systems in place that it can leverage to share, collaborate and manage its development processes.
Industry attributes	
Innovation pool	If the company operates in an industry where there is a vibrant community of innovation and associated capital support, if significant product development projects have emerged from this pool in the past and if the pool provides an enticing option for employing the industry's most skilled professionals.
Center of excellence	If the company has no presence in established centers of excellence or if emerging centers of excellence provide an opportunity for the company to influence the centers' future direction
Innovation as a primary value driver	If innovation is more highly valued than efficient integration or economic efficiency.
Relative R&D spend	If R&D is number 1 or number 2 as the industry's expense category and if a marginal improvement in R&D spend can produce a disproportionate improvement in net income – thereby creating a competitive advantage.

In brief:

Companies are suitable candidates for distribute product development initiatives if:

- Their products are modular, their product specifications are clearly defined, the product development process is linear, labor costs are high and the product's components are readily interchangeable.
- Resource gaps exist in the current value chain, cross-functional teams are frequently assembled and disassembled, and a collaborative infrastructure is in place to manage the development process
- Innovation communities are highly valued, centers of excellence can be quickly leveraged, innovation drives executive decision makers and R&D spending is a major line item that differentiates industry competitors.

How to implement successful distributed product development initiatives. PDMA identifies ten key factors that significantly influence a company's ability to implement a successful distributed product development strategy.[5] By carefully considering these factors and evaluating them in terms of a company's business-specific profile, decision makers can reduce their implementation risks.

Ten steps for implementing a distributed product development strategy

Major phase	Step
Identifying opportunities	*Step 1.* Selectively adopt best practices by limiting their deployment to suitable projects (defined by the table on page 5). Establish realistic objectives aligned with the best practices described on page 8.
	Step 2. Identify locations and resources best suited for performing specific product development functions. Survey the resource landscape with an eye toward meeting both immediate needs and long-term business requirements.
	Step 3. Keep strategic R&D capabilities in house.
Organizing the implementation team	*Step 4.* Establish an authority model to resolve project differences, including a "prime" group responsible for defining the design effort. Implement a systematic process for resolving conflicts and issues before initiating the project. Avoid distributing authority too evenly. Foster move-forward decision-making by populating the authority model with single or odd-numbers of decision makers.
	Step 5. Design a sufficient number of interface points into the implementation process. Schedule formal progress reviews and define the responsibilities and expectations of individual participants. Ensure that numerous interim interactions and one-on-one discussions take place between formal review meetings.
	Step 6. Over-invest in up-front design specifications as much possible. Avoid vague specifications, especially those applying to third-party suppliers. Ensure that the implementation is managed in accordance with its original specifications – and that specification changes are only executed after their implications and alternatives have been explicitly reviewed.
Executing the initiative	*Step 7.* Make certain that the project's development teams (including third-party suppliers) normalize their choice of collaborative design tools so that a standard set of tools is employed across the project's entire lifecycle. Provide adequate training before the project begins.
	Step 8. Rigorously apply a stage gate methodology with predefined stages and advancement criteria for the overall project and all of its subcomponent levels.
	Step 9. Deploy strong management controls to ensure on-time completion by all participating teams. Leverage contractual incentives and penalties to motivate the behavior of third-party suppliers.
	Step 10. Ensure cross-organization visibility by monitoring the activities of all interdependent activities. Focus on information flow between project participants – as well as overall product flow.

In brief:

PDMA identifies ten factors that influence successful distributed product development deployment. Companies start their implementation process by identifying and defining where the initiative should be adopted, how product development's functions should be distributed and what strategic functionality should be kept in house.

During next major phase, companies organize the project's implementation teams by establishing clear lines of authority, ensuring sufficient project reviews, and investing in up-front design specification.

During the last major stage, the project's development teams execute the initiative by normalizing the solution's collaborative design tools, applying the stage gate methodology, instituting strict management controls and ensuring cross-organization visibility.

Best practice benefits. PDMA outlines the benefits that companies can expect to achieve when adopting today's best practices for distributed product development.[6]

Benefits derived from distributed product development's best practices

Benefit	Best practice
Lower development costs	*Outsourced factory functionality.* Capitalize on lower costs while retaining comparable performance
	Efficient labor. Transfer functional activities to locations where efficiency and/or productivity can be gained by specialization or critical scale
	Automated processes. Transfer process-related activities to locations having sufficient scale to justify investment
	Rationalized R&D processes. Source non-strategic R&D functions to third-party suppliers
Access to specialized skills	*Specialized talent.* Fill resource gaps critical to marketplace success
	Global ecosystem. Leverage core competencies of migrating ecosystem comprised of connected internal and external resources
Faster development cycles	*Parallel efforts.* Segment development tasks individually but run them in parallel processes
	Intellectual property re-use. Build new products by re-using components, standards, reference designs and third-party products
Mitigated financial risk	*Sharable development costs.* Jointly develop large projects
	Sharable launch costs. Transfer launch activities to larger or more specialized groups
Improved localization	*Tailored products.* Localize products by developing them closer to their respective end market
	Local purchasing. Invest in local markets to overcome purchasing or channel barriers

In brief:

Each best practice delivers appropriate benefits that companies should monitor to ensure that their distributed solution provides the business results they can reasonably expect.

Key Siemens solution capabilities

A robust portfolio of PLM capabilities. Siemens' scalable PLM solutions are ideal for distributing product development activities among globally dispersed teams. Teamcenter® software provides an open PLM foundation that enables designers and engineers using NX™ software or virtually any product development system to work in a multi-CAD environment. Tecnomatix® software provides an open manufacturing backbone that enables companies to connect and synchronize their product development processes with their manufacturing processes. Siemens' industry-leading collaboration capabilities facilitate a Global Innovation Network where information can be shared and knowledge can be validated among widely dispersed team members, partners and suppliers.

To facilitate project collaboration on a global basis, NX enables design teams to perform all product development activities – from initial concept layout to manufacturing – in a concurrent and distributed manner. These stages include, but are not limited to, the design of detailed components and assemblies, simulation and analysis and manufacturing tool path preparation – all performed in a single unified development environment. NX solutions enable teams to synchronize product data and process knowledge across the supply chain and leverage it in a structured collaborative environment that facilitates engineering process management.

Teamcenter complements NX and Tecnomatix by enabling companies to manage the *entire* product lifecycle from concept ideation to end-of-life disposition. Its capabilities directly address potential inefficiencies in distributed processes by providing global teams with visibility into the project's entire range of product and process information through a secured data repository. Teamcenter ensures that entitled team members have access to the project's most up-to-date decision making and design definitions. In addition, Teamcenter's collaboration community provides a combination of synchronous tools (i.e., application sharing and virtual conferencing) and asynchronous tools (i.e., information workflow and routing capabilities) that teams can use to move projects forward while providing authorized participants with the data they need to make informed product decisions.

The risk associated with specification deviation is mitigated by Teamcenter's requirements management capabilities. Teamcenter enables teams to manage the project's collected requirements by tying these requirements to specific design elements and management constraints. Requirement changes are communicated through formal workflow processes that automatically notify stakeholders when issues need to be decided, approvals have been made or changes in direction need to be executed.

In brief:

Siemens solutions enable companies to implement distributed product development processes in real-world settings. Siemens solutions are especially adept at facilitating global collaboration and enabling companies to manage their entire product lifecycle. The risk associated with specification deviation is mitigated by Siemens' requirements management capabilities and the ability to manage evolving project requirements. Equally important, Siemens provides built-in security protections to safeguard the intellectual property interests of all value chain participants.

Teamcenter also address the difficulties that distributed teams face in reviewing each other's individual progress and assessing overall project results on an integrated basis. Teamcenter's visualization capabilities provide all project participants with a common 3D viewing environment they can use to validate form, fit and function (e.g., through measurements and representative cross-sections). This environment enables teams to collaboratively capture issues in real-time (within the context of the product design) and route these issues to appropriate members for immediate resolution.

Teamcenter's built-in security protects the intellectual property rights of every project participant – including third-party suppliers. Team members who do not wish to share fully detailed CAD data can leverage the JT format – Siemens' open CAD-neutral 3D visualization and interoperability format. JT is ideal for distributed teams that use different design systems but have to collaborate to validate their integrated design and digital manufacturing processes.

Siemens capabilities for managing distributed product development. Teamcenter enables project teams to establish a management environment well suited to the unique challenges of distributed product development. Teamcenter's world-class configuration management functionality supports product modularity by enabling teams to divide their projects into manageable resources (e.g., tasks, design definitions, processes) that can be easily re-used by other programs with full confidence that these usages can be consistently defined and managed.

NX digital product development solutions work in concert with the managed environment that companies establish using Teamcenter. Teamcenter-managed requirements are integral to the product definition's design intent – enabling product developers to ensure design integrity from concept design to actual release. NX' intimate relationship with Teamcenter makes it easy for development teams to gain visibility into design knowledge and logic, as well as to re-use components. In addition, Teamcenter is able to tightly manage product structures and bills of materials along with their related revisions, options and variants.

At the end of the day, a company's largest cost center – and that of its supply chain – is its manufacturing operations. Siemens' digital manufacturing solutions provide a combination of open software and manufacturing methods capable of transforming today's production processes and business-related initiatives. Tecnomatix provides a suite of solutions that links all manufacturing disciplines including manufacturing process design, process simulation/engineering and production management. By bringing product, process, resource and plant information together in a single environment, Tecnomatix' digital manufacturing solutions enable companies to maximize the efficiency of their production operations while optimizing their product design investments and supply chain relationships.

In brief:

Specific Siemens solutions address specific initiative issues. Teamcenter's configuration management capabilities support product modularity by enabling development teams to divide their projects into manageable resources.

NX enables design teams to perform all product development activities – from initial concept to manufacturing engineering – in a concurrent and distributed manner.

Tecnomatix links all manufacturing disciplines into the distributed product development process. It also integrates with Teamcenter and NX to bring all of the value chain's product, process, resource and plant information into a single environment – where it can be shared and easily exchanged.

The proliferation of design technologies among the product development community is one of the largest challenges that companies face when they try to distribute design functions among third-party vendors. Siemens leads the PLM industry in providing collaboration tools to distributed project teams. These collaboration tools are especially valuable because they enable team members to work in concert even when they employ different design tools. Siemens' JT format provides a common language for 3D collaboration that everyone in a distributed team can use to review and interact with design information regardless of their development orientation. Teamcenter's visualization capabilities leverage this format to ensure that all stakeholders can view and interact with 3D data in an unambiguous manner.

Best-practice support. Siemens' digital product development, digital manufacturing and digital lifecycle management solutions support key best practices as indicated by the accompanying table.

Siemens support for distributed product development's best practices

Best practice/business imperative	Siemens support
Lean development and manufacturing: to facilitate more innovation	Siemens' digital product development, digital manufacturing and digital lifecycle management capabilities enable companies to standardize and automate processes throughout the entire product lifecycle. This enables companies to bring their product development and manufacturing communities together to stimulate more innovation. Siemens solutions are especially adept at leveraging knowledge across a distributed enterprise so that development and manufacturing functionality can be located where efficiency, excellence and/or productivity advantages can maximized.
Access to specialized skills: to optimize enterprise resources	Siemens digital lifecycle management tools enable internal and external participants to work in a single, seamless project team. These tools allow teams to gather their members without regard to physical location and enable them to share and exchange product-related information while protecting the intellectual property interests of all autonomous parties.

In brief:

Siemens' solutions support all of the best practices required for effective distributed product development, including practices associated with:

- Lean development and manufacturing
- Specialized skill access
- Fast development cycles
- Mitigated financial risk
- Improved localization

Best practice/business imperative	Siemens support
Faster development cycles: to accelerate time to market	All Siemens applications enable project teams to implement concurrent development methodologies to speed time to market. Siemens' digital lifecycle management solutions accelerate process times by facilitating the use of parallel workflow processes. This enables team members to synchronize their work tasks, quickly locate and re-use previously validated design definitions and workflow processes – without affecting the usage and effectivity of those original components.
Mitigated financial risk: to ensure compliance	Siemens' digital product development, digital manufacturing and digital lifecycle management tools enable disparate teams to jointly and concurrently develop projects that meet customer requirements and comply with regulatory restrictions. Siemens' digital lifecycle management solutions include multi-site capabilities that allow independent teams to work with synchronized product and process data on a flexible basis – thereby allowing companies communicate and manage change across a distributed value chain while maintaining a digital trail that mitigates the risk of non-compliance.
Improved localization: to facilitate effective globalization	Siemens' digital lifecycle management solutions support the creation and management of multiple product configurations for individual market segments, including support for localized product variations and strategic sourcing arrangements where local suppliers provide final components to meet local market requirements.

Next steps

Siemens PLM Software offers the world's most comprehensive solutions for facilitating a common, standardized approach to distributed product development. The entire Siemens portfolio can be deployed throughout an organization to ensure that all stakeholders are working with the most up-do-date information regardless of their geographic, organizational or technological boundaries.

To learn more about Siemens' global product development capabilities from an executive perspective, see Siemens' brief on *Powering Global Development* at: http://www.ugs.com/products/teamcenter/gpd.shtlml

To learn more about Siemens' product lifecycle management solutions, visit: http://www.plm.automation.siemens.com/en_us/products/

In brief:

Siemens solutions facilitate a standardized, best practice approach to distributed product development that ensures the effective operation of design, engineering and manufacturing functions distributed across multiple geographic, organizational and technological borders.

Footnotes

[1] *The Global Product Design Benchmark Report*, Aberdeen Group, December, 2005.

[2] *The PDMA Handbook of New Product Development*, Kenneth B. Kahn, George Castellion, Abbie Griffin, 2005.

[3] Ibid.

[4] Ibid.

[5] Ibid.

[6] Ibid.

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 5.5 million licensed seats and 51,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software's open enterprise solutions enable a world where organizations and their partners collaborate through Global Innovation Networks to deliver world-class products and services. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

SIEMENS

Division headquarters

United States
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
972 987 3000
Fax 972 987 3398

Regions

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
800 498 5351
Fax 972 987 3398

Europe
Norwich House Knoll Road
Camberley, Surrey
GU15 3SY
United Kingdom
44 (0) 1276 702000
Fax 44 (0) 1276 705150

Asia-Pacific
Suites 6804-8, 68/F Central Plaza
18 Harbour Road, Wan Chai
Hong Kong
852 2230 3333
Fax 852 2230 3210

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