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View Point

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Global Engineering: the new imperative for the aerospace industry

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Executive Summary

The Aerospace industry is interestingly poised, as demand is primed to outstrip supply. Efforts to increase supply must contend with higher development costs and increased time to market, caused at least in part by a paucity of engineering skills.

In response, the industry is looking to build a business model that can easily scale up and down in response to the variability and cyclicality in demand. Global product development is a key element of such a flexible, scalable model that offers benefits such as increased speed to market, lower costs and enhanced flexibility. The devil, as always, lies in the detail. The key to successfully implementing a robust global product development capability lies in taking a modular approach to conceptualizing, building and managing a global model for Engineering.

Dec2005

The old order makes way for the new

The aerospace industry appears to be on the upswing after a protracted downturn. Demand is now strong and outstrips supply, with orders in 2005 expected to be twice as large as last year's levels. All indicators point toward this secular trend continuing until 2008. All major segments – large commercial aircraft manufacturers, regional jet manufacturers, and business aircraft manufacturers – are expected to benefit.

However, it is no longer business as usual. Several mega-trends are forcing the industry to look at new ways to make itself more responsive to the market:

- Lighter, more fuel-efficient aircraft are de rigueur, placing extraordinary demands on new product development
- The increased pressure on new product development diverts resources from sustenance programs, leading to significant backlog in processing engineering changes in areas like design for manufacture
- With the bulk of the new demand emanating from emerging markets, smaller airlines, which are highly price-conscious, have more bargaining power than ever before. Consequently, aerospace manufacturers are forced to explore every possible avenue to meet specifications, trim costs and reduce delivery times

In such an environment, success will surely come to those manufacturers that move quickly to adapt their business model to leverage the associated opportunities.

Global Engineering holds the key to success

The engineering function is uniquely placed to significantly impact the odds of success. It plays a key role in determining the Aerospace organization's performance on every critical metric – be it time to market, cost or flexibility.

Yet, in their current form, aerospace engineering business models tend to be constraining due to certain fundamental issues (see Table 1). However, as explained in Table 1, these issues can be effectively tackled by the globally sourced engineering model. Though global sourcing is not new to aerospace organizations, it is yet to be leveraged effectively by the majority. In contrast, over 80% of Fortune 500 companies are already successfully leveraging the capabilities of offshore service providers. Global sourcing of services has thus matured in the past 20+ years and is today a mainstream strategy for multiple industries. It is in this context that applying the paradigm of global sourcing to engineering becomes attractive.

The table illustrates how a global sourcing model addresses each fundamental issue faced by the traditional engineering model.

Traditional Engineering Model	Globally Sourced Engineering Model
Lacks proper balance - Creates resource constraints for either new product development (NPD) or product sustenance	**Balances** resource deployment across NPD and product sustenance
Suboptimal cost efficiencies - Does not leverage skilled, affordable engineering resources in countries like India	**Reduces costs** by leveraging the high quality, low-cost resources based out of emerging economies
Excessive dependency on a single talent pool - Runs the risk of in-house talent pool contraction	**De-risks** dependence on soon-to-retire in-house resource pool
Sub-optimal geographical spread - Being NA and EU-centric, it is not designed to adequately address demand from emerging markets	**Optimizes** reach into the emerging markets from the standpoint of product development for these markets
Lack of flexibility - Industry cycles lead to extreme expansions and contractions in the workforce	**Enables** the business owners with the required flexibility to painlessly modulate the team size

Table 1: A comparative of business models

A number of organizations have tried to transition to the new engineering model. However, many of these initiatives have failed to deliver in the absence of adequate structures and processes. Given that the nature of change being proposed is huge and that the current business model has existed for a few decades, it is important to adopt a structured approach to drive the change. This methodology would:

- Demystify the process of identifying the processes that can be globally sourced
- Identify the sources who provide the most optimal value proposition
- Manage the new globalized engineering environment through a time-bound initiative

This methodology must therefore cover three critical aspects (Figure 1).

Figure 1: Critical aspects to be considered

Infosys' modular sourcing framework for Global Engineering

Drawing on our experience in providing engineering services to Aerospace and other manufacturing companies, we have developed a comprehensive sourcing framework. It comprises a structured approach to assess and address each of the three critical aspects (Figure 1). This framework de-risks the global sourcing process while accelerating the inflow of benefits in a predictable, time-bound manner.

Overview

The sourcing framework provides assistance to Product Development and Sustenance managers in:

- Outsourcing engineering processes that create alignment between corporate priorities and engineering priorities
- Structuring engineering programs and processes in a well-defined modular fashion that allows for flexibility and reduction of risks
- Determining optimal sourcing strategies and resource utilization models (in-house, engineering service vendors, contractors) and locations (on site, off-site, offshore)
- Acting on a global level using global delivery to ensure predictability of cost, quality, and risk to meet business objectives
- Establishing appropriate processes and leveraging suitable tools to ensure seamless global product development and sustenance while ensuring IP protection

How does Modularization ensure effective globalization?

Modularization translates to defining parameters on which the engineering "black box" can be exploded into discrete "modules". This approach allows for each module to be examined for its amenability toward global sourcing and decisions to be taken based on the potential benefit. This helps address nuances of sourcing objectives to a suitably granular level. An example of a module could be the stress analysis process for a specific part of Single Aisle aircraft being designed by a business unit focused on corporate jets.

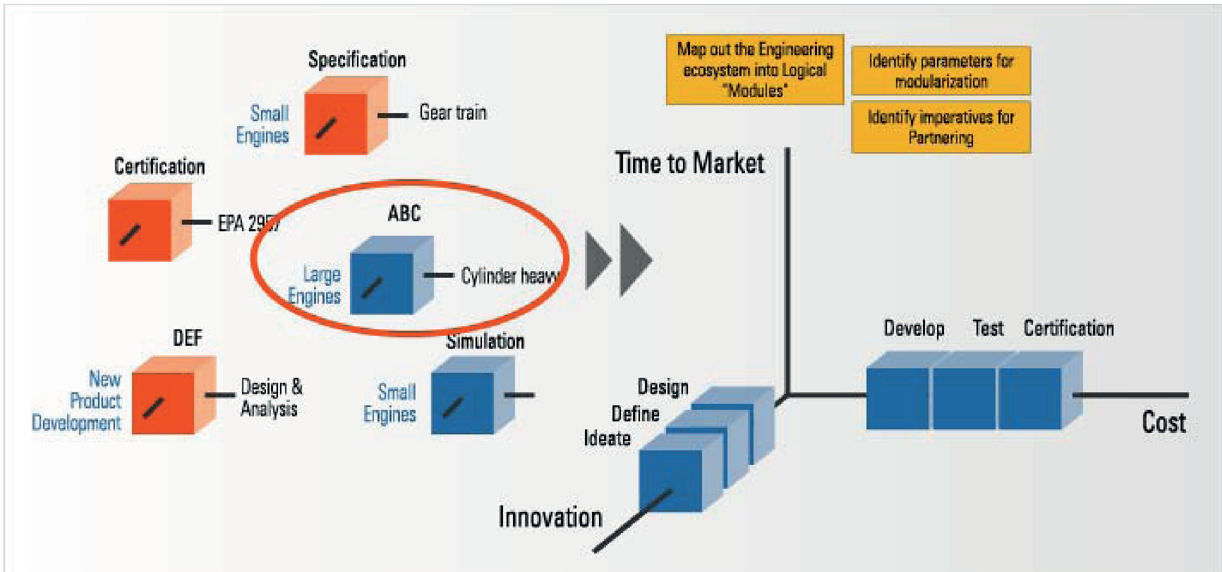

Figure 2: An example of modules being mapped to sourcing imperatives

Modules are typically defined on the dimensions of product category, process step and the component class undergoing design. Product categories can differ on the front of sourcing ability.

Products that require highly intensive final customer interaction may have certain processes that are difficult to source globally. Process steps differ on global 'sourceability' based on aspects like degree of digitization, standardization, etc. Finally, the components themselves may differ on this front. However, all of these dimensions would not be applicable in all of the cases.

Each module can be associated with a unique set of objectives/imperatives for global sourcing. These objectives may encompass aspects like cost, innovation, or time to market. They can later (in the "who" and "where" stages) be run against alternative sourcing options to assess which option is most appropriate from the perspectives of fit versus risk.

Whom should we source from and where?

Once the global engineering sourcing objectives have been defined, they must be mapped to the sourcing options (Table 2).

Offshore engineering service provider like Infosys
Offshore captive unit
Dedicated captive design center for a specific class of components

Table 2: Some examples of global sourcing options

Each option would have a unique set of fit-and- risk ratings for a given module. The modules that have least risk and highest fit would be short-listed for global sourcing.

Each would then be mapped to global sourcing options using the sourcing objectives to identify the optimal source.

Fit drivers	Wt.	Score for the module
Digitization	0.25	1 |___|___|___|___| 5
Customer interaction	0.10	1 |___|___|___|___| 5
Repetitiveness	0.25	1 |___|___|___|___| 5
Size	0.30	1 |___|___|___|___| 5
Infrastructure	0.10	1 |___|___|___|___| 5
Consolidated	1.00	1 |___|___|___|___| 5

Figure 3: Sample fit drivers

The sourcing option that results in the highest benefit with respect to sourcing objectives should typically be selected for that module. However, interdependencies between modules should be checked so that highly interdependent modules are not outsourced to different sources.

How should we outsource?

The best-laid plans are only as good as their execution. "How" represents the execution facets of Infosys' outsourcing framework.

Global product development is very different from the traditional product development model in terms of:

- Operational complexity (multiple partners, multi-geography teams)
- Communication requirements (time-zone and cultural differences)
- Information security (intellectual property concerns, defense data)
- Connectivity across various locations

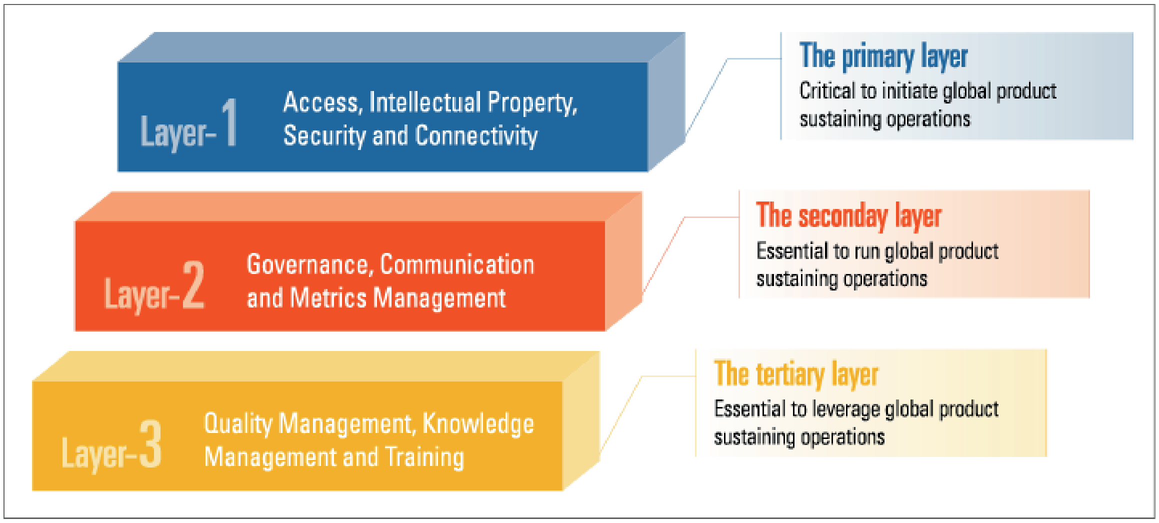

Figure 4: The Infosys layered framework to address the "How" of global engineering sourcing

These differences and associated challenges need to be overcome in a methodical, prioritized way. The Infosys framework uses a 3-tiered approach that helps creation, sustenance and growth of the global product development sourcing model.

Tier-1 : Access, Intellectual Property, Security and Connectivity

Access: Engineers typically access a variety of engineering and support applications like CAx systems, Product Data Management systems, Engineering Calculation tools, etc. The Infosys framework comprehensively addresses the issue of access by:

a. Assessing access requirements comprehensively
b. Determining software licenses required for onsite/offshore access
c. Identifying and resolving web-accessibility issues with software vendor! engineering IT
d. Establishing mechanisms to check-out/check-in data for applications that cannot be shared with the global development center

Intellectual Property (IP): As engineering continues to offer a key competitive advantage in the Aerospace industry, it is imperative that adequate mechanisms for IP protection be put into place while considering Global Sourcing.

Clients must consider IP risks from three primary angles:

- Potential leakage of IP through an existing project team member
- Potential leakage of IP when a resource resigns (employee attrition/ turnover): This presents the highest IP risk as there is minimal influence on the knowledge that the employee carries in the form of experience.
- Potential leakage of IP when the resource rolls off the client's project team and joins a competitor's project team: Such a risk is reduced if there is a significant time interval between the two projects.

Having worked for multiple clients who compete in the market, Infosys has developed mature IP protection mechanisms. These include:

- Ensuring that Non-Disclosure Agreements are signed by each individual working on the client engagement.
- Physical and information security mechanisms: Physical security involves restricted access to facilities and locations. Client confidential information is shared with employees on a need-to-know basis (information security aspects are covered in detail in the section below).
- A comprehensive set of policies to enhance employee retention by addressing the root causes. Infosys has achieved this by creating and fostering a highly professional culture that fosters learning and growth. Our attrition rates (around 10%) are half of the Indian offshore services industry.
- A comprehensive planned employee rotation policy for key customers. This ensures that core resources are put on a cool-off period after they roll off the client's project team. During this period they are not staffed on a competitor's project team. The cool-off period is defined jointly by Infosys and the client based on IP sensitivity specific to the project.

Security: A number of Aerospace organizations cater to both civil and defense segments. This introduces aspects of information security and regulations like ITAR (International Traffic in Arms Regulation). The Infosys framework consists of the following steps to specifically address defense information-related security requirements:

a. Identify data that is considered as defense-related and as dual use
b. Assess mechanisms currently available to partition the engineering data
c. Enhance engineering data partition mechanisms, where required
d. Establish mechanisms for manual data filtering where automation is not possible or where there is a need for a person to take a decision
e. Obtain export licenses from the government, where required

Broadly, the Infosys framework covers a 4-step methodology to address security aspects (Figure 5).

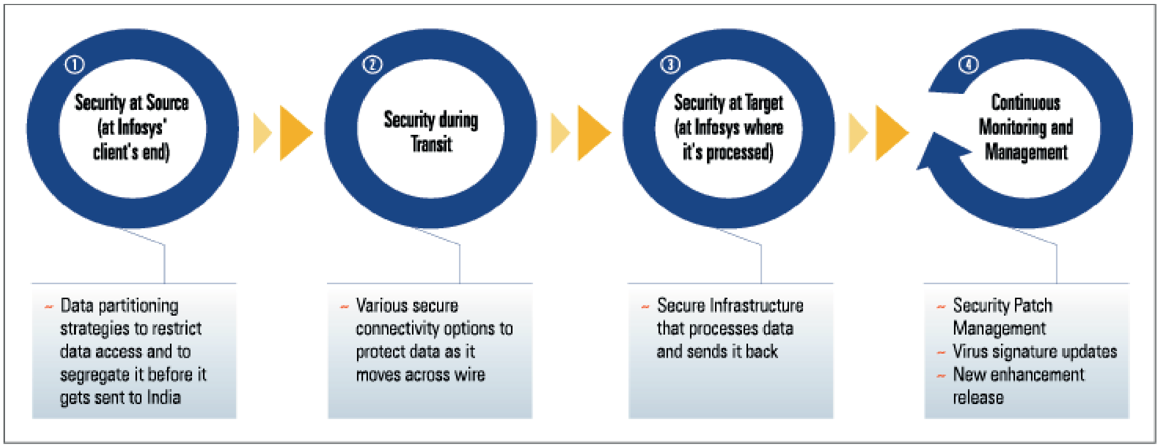

Figure 5: The Infosys framework covers a 4-step methodology to address security aspects

Connectivity: Transitioning from a primarily local to a significantly global operation opens a new frontier. Connectivity is the basic telecommunication infrastructure between various product development locations. This infrastructure is required to support engineering data transmission as well as access to systems from an offshore location. The Infosys framework incorporates three key aspects of connectivity:

a. Assess robustness requirements: If the global operations are highly time-critical the connectivity should be robust enough to minimize productivity losses due to connectivity breakdown
b. Assess bandwidth needs: This is driven by the quantum of engineering data to be transferred between locations and whether it needs to be transferred on a real-time basis.
c. Assess cost: This would primarily be driven by the robustness of infrastructure and by the required bandwidth.

Tier-2: Governance, Communication and Metrics Management

Governance: Operating on a global scale requires the institutionalization of additional governance mechanisms. These mechanisms must be developed to cater to global product development-specific requirements. Based on our experience, we recommend a three-layered governance framework. The key benefit of this approach is clarity in roles and responsibilities. This in turn ensures that project level focus enables engagement level objectives.

The *first layer*, the Joint Steering Committee, would set strategic direction, relationship objectives, provide guidance, and develop a relationship scorecard. It would typically hold quarterly reviews.

The *second layer*, the Program Management Office (PMO), would be focused on identifying new initiatives, tracking action plans, monitoring all programs, prioritizing key activities and reviewing metrics. It would typically hold monthly reviews.

The *third layer* comprises project team managers focused on managing project execution , conducting design reviews, reporting status, and managing communication.

Communication: The global product development process calls for a frequent and informal engineer–to-engineer communication. Additionally, there is a need for significant, structured communication mechanisms at the project and program levels. The communication framework hence needs to accommodate both informal and formal communication needs.

The communication plan section of the Infosys framework comprises the following key aspects:

- Definition and formats of artifacts like process forms, design review logs, metrics analysis reports that would be used for structured communications
- Definition of mechanisms (like in-person meetings, teleconferences) and their frequencies
- Definition of tools that would be used for communication

Metrics Management: The need for a structured metrics management process cannot be over-emphasized in the globalized product development environment. Metrics are only as good as the underlying data that feeds them. Quite often , the current state engineering processes do not have adequate clean data capture mechanisms. The Infosys framework has the following phased approach toward metrics management:

- Definition phase
- Readiness and data gathering phase
- Baselining phase
- Ongoing measurement and control phase

Tier-3: Quality Management, Knowledge Management and Training

Quality Management: It is imperative that each team member has equal understanding of the quality requirements. Developing, publishing and maintaining a quality plan is therefore essential. Infosys recommends that the quality plan includes aspects such as:

- Review and audit mechanisms and plans
- Problem reporting and corrective action processes
- Data exchange methods
- Design data-receiving inspection
- Engineers' computing hardware and software
- Quality records

Knowledge Management and Training: The resource model would lead to the dual need for one set of resources with in-depth skills in a specific domain and another with good understanding of one domain and a workable level of skills in an additional domain. The training framework must therefore be structured such that training needs are identified, training plans established, training is executed and its efficacy measured. The Infosys framework includes training of resources on:

- The client's product development processes and standards
- Domain-specific product development methods, manuals
- Engineering tools

How fast can a company implement Global Sourcing initiatives in a planned manner?

Infosys has put together a structured methodology that includes the following phases:

While Global Sourcing has established itself as a strategic option that is being increasingly leveraged by A&D organizations across the globe, the speed of implementation is driven by an organization's ability to absorb change. Companies have unique adoption curves that could be significantly enhanced through partnerships based on understanding the need to appreciate cultural change management while planning Global Sourcing.

Phase I	High-level assessment of corporate and business objectives toward global engineering sourcing	A four-hour workshop followed by a two-hour meeting
Phase II	Broad assessment of business unit level context to assess the impact of product lines, customers, resource requirements etc on engineering	One-day meeting at Business Unit location
Phase III	Detailed business unit level global engineering sourcing workshop that will go into module level details	Two to four weeks at each Business Unit location

Table 3: Typical phases and timelines for taking Global Sourcing forward

Which areas in aerospace engineering are the most amenable to global sourcing?

Typically, the most stable processes are the most amenable to global sourcing. In the high level example provided in Figure 6, Business Jets is a category that is often not connected to regulations like ITAR. For a specific organization, the detailed design process for aero-structures could be a well-documented, well-digitized, relatively stable process requiring lower levels of customer interaction.

Such a process is more amenable to global sourcing than, say, a process like the definition of military aircraft landing gear. While these are generic, high-level examples, the amenability to global sourcing differs radically from organization to organization. Infosys has developed a robust set of global sourcing assessment tools that can be leveraged for a comprehensive global sourcing analysis of engineering processes.

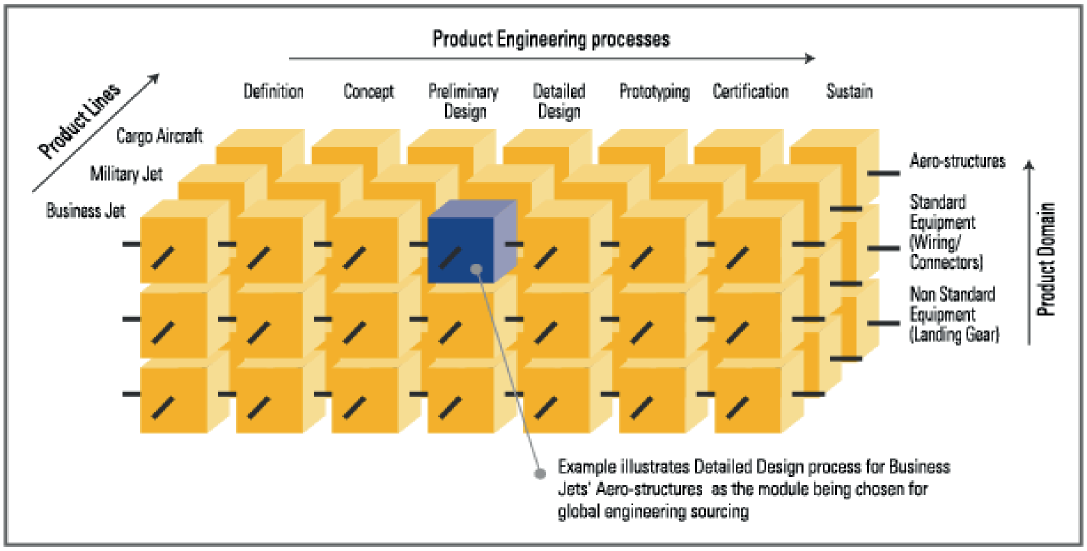

Figure 6: An example of a Globally 'Sourceable' module

Conclusion

All indicators of the Aerospace industry point toward significant global sourcing. A structured, well thought-out approach will help cut through the complexity and the flux that typically accompany a major global initiative. Infosys' Modular Global Engineering Sourcing approach helps Aerospace organizations manage risk and minimize time to market. Adopting this approach will enable aerospace and defense companies to achieve their global engineering sourcing objectives effectively.

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