Growth Opportunities in the Aerospace Manufacturing Market
Strategies and Tactics such as 3D Printing and Internet of Things to Accelerate Margin Growth in a Transforming Space
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Executive Dashboard
Purpose of this Experiential Study

- The primary objective of this experiential study is to uncover **Your Company’s Growth Zone** in the Aerospace Manufacturing Market.

- Your company’s Growth Zone represents opportunities that have been validated and optimized, based on your internal objectives and capabilities weighed against growth opportunities in the Aerospace Manufacturing Market.

- An integral part of achieving this goal is engaging with Frost & Sullivan to develop your company’s **Growth Opportunities Matrix** at the end of this study.

Source: Frost & Sullivan
5-step Process to Transformational Growth

**Scope of this Study**

- Deep Analysis of the Market
- Predicting the Future of the Market
- Determination of Opportunity Universe
- Strategic Options Framework

**Customized Solutions for Your Company**

- Prioritization of Growth Opportunities
- Translation into Cogent Strategies
- Planning and Implementation
- Monitoring and Optimization

*Source: Frost & Sullivan*
Strategic Imperatives for Aerospace Manufacturers

- Reduce costs by shared digital design between manufacturers and suppliers
- Reduce production costs through new manufacturing processes
- Manage production scheduling and carry cost versus just-in-time issues
- Reduce costs by improved automation of processes
- Improve integration of logistics services into manufacturing workflow

Source: Frost & Sullivan
Growth Environment—Market Overview
Landscape of Collaboration Tools

Tools Evolve with More Extended Features, Tighter Integrations, and Richer Analytics

Communications Centric
- Automated Scheduling
- Cloud Storage
- Enterprise ERP Platforms
- Audio, Web, Video Conferencing
- Enterprise Social Platforms
- Team Collaboration Tools
- File Sharing/Collaboration

Real-time Centric

Non Real-time Centric

Source: Frost & Sullivan
# Aerospace Manufacturing Landscape

## Regional Focus

<table>
<thead>
<tr>
<th>Region</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>Aerospace is a global business. There is no aircraft in current production that has content exclusively from the OEM’s region.</td>
</tr>
<tr>
<td>North America</td>
<td>North America produces the greatest number of aircraft of any region. It also has the greatest number of suppliers of any region.</td>
</tr>
<tr>
<td>Europe</td>
<td>Europe produces the second largest number of aircraft and has the second greatest number of component providers.</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>Asia-Pacific will soon become a major production region with the emergence of COMAC and Mitsubishi as regional OEMs.</td>
</tr>
<tr>
<td>Latin America</td>
<td>Latin America’s role in aerospace is tied to the fortunes of Embraer. While Embraer uses components from many North American and European suppliers, it also has a significant number of local suppliers.</td>
</tr>
</tbody>
</table>

Source: Frost & Sullivan
Market Definitions

Aerospace Design Processes:
- The electronic processes necessary to coordinate the design process between offices within a company and between the aerospace manufacturer and the various industry suppliers.
- Includes design software, mutual data storage, bills of material software, and design services.
- Excludes salaries, travel costs, and routine in-house administrative costs.

Aerospace Manufacturing Automation:
- The use of electronic data and automated manufacturing to minimize costs, enhance conformity, and allow improved ease of manufacturing in small lots.
- Includes automated tooling, additive manufacturing, flexible manufacturing, and outsourced services.

Aerospace Manufacturing Scheduling:
- The use of shared schedules and production information to assure supplier.
- Includes scheduling software, shared mutual data storage, and production information software.

Aerospace Manufacturing Logistics Services:
- The use of electronic coordination of logistics services to minimize costs and assure timely support.
- Includes automated notification software, packaging design, and related services.

Source: Frost & Sullivan
### Issues and Problems by Manufacturing Area

<table>
<thead>
<tr>
<th>Common Issues</th>
<th>Aerospace Design Processes</th>
<th>Aerospace Manufacturing Automation</th>
<th>Aerospace Manufacturing Scheduling</th>
<th>Aerospace Manufacturing Logistics Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Off-the-shelf parts interfaced into designs</td>
<td>• Prototyping</td>
<td>• OEM/Supplier co-scheduling</td>
<td>• Raw material lead time and stockage versus pricing</td>
<td></td>
</tr>
<tr>
<td>• Interface engineering</td>
<td>• CNC modeling</td>
<td>• Schedule sharing</td>
<td>• Pick and pull operations</td>
<td></td>
</tr>
<tr>
<td>• Envelope engineering</td>
<td>• Casting and forging forms</td>
<td>• Lot timing</td>
<td>• Stacking locations versus transit time</td>
<td></td>
</tr>
<tr>
<td>• Cooperative design</td>
<td>• Additive manufacturing approvals</td>
<td>• Build-up and tear-down delays</td>
<td>• Custom shipping containers</td>
<td></td>
</tr>
<tr>
<td>• Common design software</td>
<td>• Programming for multi-axis systems</td>
<td>• OEM unit delivery and rate notification</td>
<td>• Just-in-time packing and shipping</td>
<td></td>
</tr>
<tr>
<td>• Shared models</td>
<td>• Minimal flexible manufacturing</td>
<td>• Shipping delay timing</td>
<td>• Parts classifications</td>
<td></td>
</tr>
<tr>
<td>• Shared data storage</td>
<td>• Small lot manufacturing</td>
<td>• Production commitment dates</td>
<td>• Customs classifications</td>
<td></td>
</tr>
<tr>
<td>• Automatic versioning</td>
<td>• Automated pricing</td>
<td>• Rate changes driving price and cost implications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Firewalls</td>
<td>• Redesign complexity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• “What if” versions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Traditional interface engineering can fail</td>
<td>• Time delays and poor conformity on prototypes and forms</td>
<td>• Traditionally OEM driven scheduling</td>
<td>• Expedited delivery costs</td>
<td></td>
</tr>
<tr>
<td>• More suppliers are being given partial design authority</td>
<td>• Long tool setup times</td>
<td>• OEM hides delays</td>
<td>• Custom shipping containers</td>
<td></td>
</tr>
<tr>
<td>• Conversion from engineering to manufacturing</td>
<td>• Cost of product to product line changes</td>
<td>• OEM schedules often do not accommodate supplier retooling time</td>
<td>• Non-AOG part logistics management</td>
<td></td>
</tr>
<tr>
<td>• Traditional interface engineering can fail</td>
<td>• Training for multiple product lines</td>
<td>• Better commitment date management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• More suppliers are being given partial design authority</td>
<td></td>
<td></td>
<td></td>
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<td>• Conversion from engineering to manufacturing</td>
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</table>

Key: CNC—Computer Numerical Control; AOG—Aircraft on Ground

Source: Frost & Sullivan
# Total Aerospace Manufacturing Market: Key Market Drivers and Restraints, Global, 2017–2025

## Market Drivers
- Aircraft orders and delivery rates
- Model upgrades continuing to refresh fleets
- New technology available for manufacturing
- New IoT cost reduction opportunities
- Better software integration for situational awareness

## Market Restraints
- New manufacturers using traditional construction
- Convincing airworthiness authorities of new methods
- A large body of legacy software used
- Difficulty in attaching hard ROI to some services
- A conservative industry

### Impact:
- **H** High
- **M** Medium
- **L** Low

### Table

<table>
<thead>
<tr>
<th>Drivers and Restraints</th>
<th>1–2 Years</th>
<th>3–4 Years</th>
<th>5–9 Years</th>
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<tbody>
<tr>
<td>Aircraft orders and delivery rates</td>
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<tr>
<td>Model upgrades continuing to refresh fleets</td>
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<td>H</td>
<td>H</td>
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<tr>
<td>New technology available for manufacturing</td>
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<td>H</td>
<td>H</td>
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<tr>
<td>New IoT cost reduction opportunities</td>
<td>M</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Better software integration for situational awareness</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>New manufacturers using traditional construction</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Convincing airworthiness authorities of new methods</td>
<td>H</td>
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<td>H</td>
</tr>
<tr>
<td>A large body of legacy software used</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Difficulty in attaching hard ROI to some services</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>A conservative industry</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

IoT—Internet of Things; ROI—Return on Investment

Note: Drivers and Restraints are ranked in order of impact

Source: Frost & Sullivan
Market Forecast
Revenue Forecast—Total Aerospace Manufacturing Market

Key Takeaway: Revenue share of savings will grow to $2.82 billion by 2020.

Total Aerospace Manufacturing Market: Revenue Forecast, Global, 2016–2020
CAGR: 65.8%

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue ($ Million)</th>
<th>Aerospace Manufacturing Logistics Services</th>
<th>Aerospace Manufacturing Scheduling</th>
<th>Aerospace Manufacturing Automation</th>
<th>Aerospace Design Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>14.3</td>
<td>34.4</td>
<td>286.5</td>
<td>38.3</td>
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<tr>
<td>2017</td>
<td>99.7</td>
<td>49.7</td>
<td>570.3</td>
<td>82.1</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>192.5</td>
<td>88.1</td>
<td>853.7</td>
<td>145.2</td>
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<tr>
<td>2019</td>
<td>292.2</td>
<td>158.0</td>
<td>1,227.2</td>
<td>299.6</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>497.3</td>
<td>293.7</td>
<td>1,697.9</td>
<td>333.4</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>CAGR: 142.7%</td>
<td>CAGR: 70.9%</td>
<td>CAGR: 56.0%</td>
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</tbody>
</table>

Note: All figures are rounded. The base year is 2016. Source: Frost & Sullivan
Visioning Scenarios
Macro-to-Micro Visioning

Assessing the impact of global Mega Trends, disruptive technologies, and new business models on the future of the aerospace manufacturing market

- Industry Mega Trends
- Manpower Trends
- Economic and Regional Trends
- New Business Models
- Disruptive Technologies
- Competitive Landscape Trends

Macro-to-Micro Implications

Visioning Scenarios for the Aerospace Manufacturing Market

Source: Frost & Sullivan
Mergers and acquisitions have depleted the pool of small competitors.

New technology has introduced innovative firms from other industries.

At the Tier I level, 2 to 3 firms dominate in each product segment.

The use of international suppliers is increasingly important to OEMs.

A conservative industry, but digitally knowledgeable companies are enhancing their market share.

Source: Frost & Sullivan
Trends/Factors Impacting the Aerospace Manufacturing Market (continued)

3D printing is making an impact, but approvals from authorities are slow.

Lean/ Kanban/Six Sigma are making an impact, but must fit within the production conformity and manufacturing authorization structures.

Automation of processes has scale challenges in size and numbers.

Digitalization of design and production is accelerating.

Data flow-through into logistics and aftermarket may be crucial.

Source: Frost & Sullivan
Trends/Factors Impacting the Aerospace Manufacturing Market (continued)

- Additive manufacturing may reduce the need for prototyping houses.
- Production facility design firms may solve more problems than OEMs.
- On-shoring to automated suppliers can reduce costs.
- Selection of technical standard order parts assures availability and price.
- Integrators act as designers.

Source: Frost & Sullivan
Trends/Factors Impacting the Aerospace Manufacturing Market (continued)

- Fewer programs exist for suppliers than 15 years ago, and that will continue.
- OEM competition is driving reduced margins for everyone.
- New OEMs are entering the market, but with Western components, for now.
- Military spending is reduced with fewer military programs.
- Civil production remains at record levels with little growth opportunity.

Source: Frost & Sullivan
Trends/Factors Impacting the Aerospace Manufacturing Market (continued)

- Experienced personnel is lacking in aerospace manufacturing.
- Cost of skilled personnel is creating reduced margins.
- Frequent massive layoffs are driving workers from the industry.
- Spool-up times are long for training and QA when restarting production.
- Complex certifications are required for some key personnel.

Source: Frost & Sullivan
Global economic conditions are spotty with few signs of growth.

Business aircraft sales into China have not been good.

China wants to contribute manufacturers or suppliers, but IP protection is poor.

Shipping costs are increasing and may make on-shoring more attractive.

Exchange rates have fluctuated significantly.

Source: Frost & Sullivan
Top Predictions for the Aerospace Manufacturing Market

1. Additive manufacturing will become the normal method for highly complex shapes.

2. Automated tooling will replace the current labor-intensive tool designs.

3. New scheduling software will have apps that control logistics movement and manufacturing.

4. Multi-access cloud storage will be the coordinating element between OEMs and suppliers.

5. Conformity will be enhanced by the use of tablets for checklists and in-process imaging.

6. Specialty design firms will experience market growth as solutions improve manufacturing margin.

Source: Frost & Sullivan
Growth Pipeline

- Growth Environment
- Visioning Scenarios
- Growth Pipeline
- Growth Strategy
- Growth Implementation
Frost & Sullivan has identified 24 levers for margin growth in this market. These represent specific focus areas or strategic business initiatives that can be tailored and leveraged to drive growth for your company in this market.

<table>
<thead>
<tr>
<th>Vision and Strategy</th>
<th>Brand and Demand</th>
<th>Technology and IP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Re-visioning</td>
<td>Brand Margin Recognition</td>
<td>Disruptive Technologies</td>
</tr>
<tr>
<td>IIOT Applications</td>
<td>Value Proposition</td>
<td>Technology Convergence</td>
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<tr>
<td>Disruptive Applications</td>
<td>Process Differentiation</td>
<td>Cloud</td>
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<tr>
<td>Business Models</td>
<td>Thought Leadership</td>
<td>Software Interfaces</td>
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<tr>
<td>Distributed Engineering</td>
<td>Co-Development</td>
<td>Outsourcing</td>
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<tr>
<td>Distributed Manufacturing</td>
<td>Quick Turnaround</td>
<td>New Process Development</td>
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<td>Value-add Services</td>
<td>Multiregional</td>
<td>Technology Sourcing</td>
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<tr>
<td>On-shoring</td>
<td></td>
<td>IP Monetization</td>
</tr>
<tr>
<td>Global Partnerships</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IIOT—Industrial Internet of Things
Source: Frost & Sullivan
Vision and Strategy: Growth Opportunities
# Growth Opportunity 1—Shared Digital Design

## Context and Opportunity

- Arial 13
- Currently, engineering is an OEM responsibility.
- Easy inclusion of TSO items are made through interface drawings.
- Custom assemblies and components are an OEM IP.
- OEM and supplier software are often different.
- Translation software is needed for CNC machine instructions.
- Coordination is more difficult when multiple international partners are involved.

## Call to Action

- Agree on co-design and unique designs versus TSO designs.
- Use common software with common references from OEM.
- Agree on IP/aftermarket.
- Use envelope versus interface engineering.
- In-process QA and agreements are needed on design parameters.
- Agree on standards set and basis for materials.

### Applicable Segments
- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

### Applicable Regions
- North America
- Europe, Middle East, and Africa (EMEA)
- Asia-Pacific
- Latin America

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TSO—Technical Standard Order

Source: Frost & Sullivan
Growth Opportunity 2—Design to Prototype

Context and Opportunity

- Arial 13
- Current prototyping uses production specifications and drawings as the basis.
- Prototyping houses add casting or forging details for casting channels and related forging detail.
- Ideally, when the prototype passes inspection and testing, the casting or forging model will become the production model.
- Some component manufacturers create their own prototypes to save cost.

Call to Action

- Engage a prototyping firm, since it will have the experience, software, and tools to minimize cost.
- Deal with a prototyping firm that has the same design software as the OEM or component manufacturer.
- Plan to have the prototyping firm provide the investment casting models and forging dies.
- IP belongs to the designer. For the component it is the manufacturer and for the prototyping tooling it belongs to the prototyper.

Source: Frost & Sullivan
# Growth Opportunity 3—Design to Manufacture

## Context and Opportunity

- Arial 13
- The OEM’s designers are focused only on the end item and not the component and sub-assemblies.
- The OEM’s designers use designs for sub-assemblies and components with which they are familiar.
- They also assume manufacturing methodologies will be used with which they are familiar.
- Designs seldom account for difficulty in set up or the challenges of small lot manufacturing.

## Call to Action

- By co-engineering the components, the manufacturer’s design engineers will work with the company’s manufacturing engineers to design the product.
- Consider the best use of additive manufacturing for highly complex shapes and to reduce assembly parts count.
- Co-engineering allows the component manufacturer to optimize the product for OEM use and the supplier’s capability.

### Table: Applicable Segments and Regions

<table>
<thead>
<tr>
<th>Applicable Segments</th>
<th>Aerospace Design Processes</th>
<th>Aerospace Manufacturing Automation</th>
<th>Aerospace Manufacturing Scheduling</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Applicable Regions</td>
<td>North America</td>
<td>EMEA</td>
<td>Asia-Pacific</td>
<td>Latin America</td>
</tr>
</tbody>
</table>

Source: Frost & Sullivan
### Growth Opportunity 4—Automate the Manufacture

#### Applicable Segments
- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

#### Applicable Regions
- North America
- EMEA
- Asia-Pacific
- Latin America

#### Context and Opportunity
- Arial 13
- Aerospace is one of the last bastions of hand work.
- Setting up automated tooling for small production runs has been too time and labor intensive.
- Traditional construction methods are not well suited to automation based on inaccessible areas and requirements for conformity.
- The airworthiness authorities are only comfortable with traditional manufacturing methods and materials for flight-critical parts.

#### Call to Action
- Automate to minimize hand work, reduce defects, and reduce costs.
- New tooling and jigs can convert from one product to another largely on their own, with minimal human interaction.
- If manufacturing is accounted for in the design, minimal hand work and minimal rework would be required.
- Manufacturers should include the airworthiness authorities in validation of new materials and processes.

Source: Frost & Sullivan
Growth Opportunity 5—Shared Scheduling

Context and Opportunity

- Arial 13
- Schedules are too frequently fictional documents which are seldom shared.
- Scheduling lead times are often unrealistic and result in delayed product deliveries.
- Schedules are generally OEM-driven and changed only when the OEM realizes that the previous version is unattainable.
- Offshore manufacturing demands even greater lead time for both materials and finished products.

Call to Action

- Shared scheduling software with action triggers can provide better visibility into the required timelines.
- Automatic ordering messages and POs can be by scheduling software which provide for material ordering, production schedules, and shipping.
- If costs are reduced by shared scheduling, on-shoring can reduce transportation delays and costs.
- By using single portal cloud schedulers with schedule change pushouts to the OEMs and suppliers, sharing is possible.

Applicable Segments

- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

Applicable Regions

- North America
- EMEA
- Asia-Pacific
- Latin America

Source: Frost & Sullivan
Brand and Demand—Growth Opportunities

- Growth Environment
- Visioning Scenarios
- Growth Pipeline
- Growth Strategy
- Growth Implementation
Growth Opportunity 6—Shared Product Development

**Context and Opportunity**

- Aerospace sales are revenue-centric with OEM pressures to reduce supplier’s expected margin.
- Component manufacturers are known more for their reliability than for their manufacturing expertise.
- Product development is often the outcome of an industry need, but only one company’s effort.
- Design and development lead times are very long and often do not optimize the product for either the end user or the manufacturer.

**Call to Action**

- While topline revenues have the attention of Wall Street, improved margins are the best goals.
- Many component manufacturers have used military R&D funding for product improvements, but now IR&D is needed and is best done as co-development with a customer.
- Suppliers should pitch their on-time delivery and quick response times along with price and quality.
- The sooner that the supplier is involved in the development, the better the optimization.

Source: Frost & Sullivan
Growth Opportunity 7—Become Known for Reliable Delivery

Context and Opportunity

- Arial 13
- Aerospace is a low volume, high mix market. Accommodating that lack of scale is difficult.
- Production ramp-up time is a major factor in on-time delivery.
- Packing and shipping can be the difference between on-time and late delivery.
- Shipping becomes a more critical item under global supply chain.
- On-hand material is costly.
- Shelf stock of completed items is even more costly.

Call to Action

- Low volume and high mix drives many small material purchases and timely automated ordering.
- Packing and shipping of finished product can be optimized by product-unique, reusable containers and shipper notifications.
- Automated completion of shipping manifests, customs documentation, and product certifications makes global production more feasible.
- Automatic setup of tooling and jigs for the next product run can greatly aid timeliness of production.

Applicable Segments

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Applicable Regions

- Aerospace Design
- Processes
- Manufacturing
- Automation
- Manufacturing
- Scheduling
- Logistics
- Services

Brand Margin Recognition

Value Proposition

Process Differentiation

Thought Leadership

Co-development

Quick Turnaround

Multiregional

Source: Frost & Sullivan
Technology—Growth Opportunities

- Growth Environment
- Visioning Scenarios
- Growth Pipeline
- Growth Strategy
- Growth Implementation
Growth Opportunity 8—One Model

Applicable Segments

- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

Applicable Regions

- North America
- EMEA
- Asia-Pacific
- Latin America

Context and Opportunity

- Arial 13
- The official version of the design exists on the OEM’s servers with limited access by suppliers.
- The transfer of models from one format to another invariably results in loss of detail and geometric variations.
- These aspects often result in interface engineering, which is modeling only the contact points between the OEM’s model and the supplier’s model.
- Translated models tend to be slow and cumbersome.

Call to Action

- The OEMs model should be available to all on the cloud.
- The access should be through a single login point, but all should be able to access the entire model.
- Versioning control must be automatic with changes highlighted to all within the model space.
- Firewalls are needed to protect everyone’s IP.
- All who are given model access must use the same software, but runtime versions are not useful.

Source: Frost & Sullivan
### Growth Opportunity 9—Sharing the Schedule

#### Context and Opportunity
- Arial 13
- OEMs are often reluctant to change schedules.
- Decisions on schedule changes are often made at the top and at the last moment.
- Suppliers are seldom given heads up on potential schedule changes.
- Canned OEM leadtimes are used for supplier delivery dates and are usually those in the basic contract.
- Changes often result in poor planning, delays, and extra cost.

#### Call to Action
- The cloud is the best location for the schedule, and it should be a master schedule.
- While the master schedule does not preclude child schedules, it should reflect all the planning constraints from subordinate schedules.
- The master schedule should push out notifications that drive automatic manufacturing schedules as well as shipping information and paperwork.

### Applicable Segments
- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

### Applicable Regions
- North America
- EMEA
- Asia-Pacific
- Latin America

### Disruptive Technologies

### Technology Convergence

### Cloud

### Software Interfaces

### Outsourcing

### New Process Development

### Technology Sourcing

### IP Monetization

Source: Frost & Sullivan
Growth Opportunity 10—Professional Prototyping

<table>
<thead>
<tr>
<th>Applicable Segments</th>
<th>Aerospace Design Processes</th>
<th>Aerospace Manufacturing Automation</th>
<th>Aerospace Manufacturing Scheduling</th>
<th>Aerospace Manufacturing Logistics Services</th>
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</thead>
<tbody>
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<td>Applicable Regions</td>
<td>North America</td>
<td>EMEA</td>
<td>Asia-Pacific</td>
<td>Latin America</td>
</tr>
</tbody>
</table>

**Context and Opportunity**

- Arial 13
- Some companies make their own prototypes, even though they actually prototype infrequently.
- Prototyping technology has changed significantly over the last ten years, but few companies have invested in the new technology.
- Successful prototypes are often used to create models for investment castings or forging tools rather than creating those from digital models.
- Certification is generally done using production items in place of prototypes.

**Call to Action**

- Professional prototyping companies have improved technologies for creation of prototypes.
- Whenever possible prototypes and the production products should be created from the same models using the same software.
- Some prototyping companies will also create investment casting molds and forging tools.
- For prototypes created by additive manufacturing, it may be possible to certify on the prototype.

Source: Frost & Sullivan
# Growth Opportunity 11—Automated Jigs and Tools

**Applicable Segments**
- Aerospace Design Processes
- Aerospace Manufacturing Automation
- Aerospace Manufacturing Scheduling
- Aerospace Manufacturing Logistics Services

**Applicable Regions**
- North America
- EMEA
- Asia-Pacific
- Latin America

## Context and Opportunity

- Arial 13
- Aerospace tools and jigs have traditionally been single purpose, handmade devices.
- The time required to set up and tear down jigs can be substantial, which can result in extensive down time for the entire production effort.
- Aerospace manufacturing is invariably done in small production runs with jig changes.
- Manufacturers must decide between the cost of line setup, inventory costs, and customer requirements.

## Call to Action

- Specialty tooling companies can make jigs and tools for each product type from digital data.
- Some firms can make single jigs and tools that can transform themselves when it is time to change production line from one product to another.
- Some types of additive manufacturing require very few tools and can adaptively change to accommodate new products.

Source: Frost & Sullivan
Growth Opportunity 12—Additive Manufacturing

**Applicable Segments**

<table>
<thead>
<tr>
<th>Aerospace Design Processes</th>
<th>Aerospace Manufacturing Automation</th>
<th>Aerospace Manufacturing Scheduling</th>
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<tbody>
<tr>
<td>North America</td>
<td>EMEA</td>
<td>Asia-Pacific</td>
<td>Latin America</td>
</tr>
</tbody>
</table>

**Context and Opportunity**

- Arial 13
- Many types of aerospace manufacturing required massive machines to bend and shear sheet metal.
- Other types of aerospace manufacturing requires casting, molding, or forging to produce near final form products.
- Some other types require extensive machining from billets or primitive forms to complete the final product.
- All of these processes are very labor and material intensive.

**Call to Action**

- Additive manufacturing is well suited to the forming of complex shapes with little loss of material.
- The products of additive manufacturing can be produced in near final form.
- Setup and tear down time is minimal supporting the manufacture of single or small lots with ease.
- Additive manufacturing requires minimal adaptation from the manufacturer's model.

Source: Frost & Sullivan
Growth Opportunities Matrix

- Growth Environment
- Visioning Scenarios
- Growth Pipeline
- Growth Strategy
- Growth Implementation
Identifying Your Company’s Growth Zone

- Your company’s **Growth Zone** represents opportunities that have been validated and optimized, based on your internal objectives and capabilities weighed against opportunities in the marketplace.

- The objective of the **Growth Opportunities Matrix** is to identify your company’s Growth Zone in the Aerospace Manufacturing Market.

- The **Growth Opportunities Matrix** also identifies major threats to your business if you don’t respond quickly and adequately to external opportunities.

- The following slides are an example using several Tier I and II suppliers.

Source: Frost & Sullivan
# Growth Opportunities 1–12—Vision and Strategy

Rate Relevance vs. Internal Capabilities for Company X

<table>
<thead>
<tr>
<th>No.</th>
<th>Growth Opportunity</th>
<th>Relevance to Your Objectives</th>
<th>Current Internal Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Shared Digital Design</td>
<td>Medium</td>
<td>Moderate</td>
</tr>
<tr>
<td>2.</td>
<td>Design to Prototype</td>
<td>Medium</td>
<td>Moderate</td>
</tr>
<tr>
<td>3.</td>
<td>Design to Manufacture</td>
<td>Medium</td>
<td>Strong</td>
</tr>
<tr>
<td>4.</td>
<td>Automate Manufacture</td>
<td>Medium</td>
<td>Moderate</td>
</tr>
<tr>
<td>5.</td>
<td>Shared Scheduling</td>
<td>High</td>
<td>Weak</td>
</tr>
<tr>
<td>6.</td>
<td>Shared Product Development</td>
<td>Medium</td>
<td>Moderate</td>
</tr>
<tr>
<td>7.</td>
<td>Known for Reliable Delivery</td>
<td>High</td>
<td>Strong</td>
</tr>
<tr>
<td>8.</td>
<td>One Model</td>
<td>Medium</td>
<td>Strong</td>
</tr>
<tr>
<td>9.</td>
<td>Sharing the Schedule</td>
<td>High</td>
<td>Weak</td>
</tr>
<tr>
<td>10.</td>
<td>Professional Prototyping</td>
<td>Low</td>
<td>Weak</td>
</tr>
<tr>
<td>11.</td>
<td>Automated Jigs and Tools</td>
<td>Medium</td>
<td>Weak</td>
</tr>
<tr>
<td>12.</td>
<td>Additive Manufacturing</td>
<td>Medium</td>
<td>Weak</td>
</tr>
</tbody>
</table>

Source: Frost & Sullivan
Growth Opportunities Matrix
Develop this Matrix for Your Company

High
Threat / Weakness
GO: 5, 9
Develop
GO: 11, 12
Low
Weak
GO: 10
Medium
GO:
Develop
GO: 12
Growth Zone
GO:
Augment
GO: 1, 2, 4, 6
GO: 7
Leverage
GO: 3, 8
Strong
Leverage
GO:
Relevance to Your Objectives
Internal Capabilities

Source: Frost & Sullivan
Growth Strategy and Implementation

- Growth Environment
- Visioning Scenarios
- Growth Pipeline
- Growth Strategy
- Growth Implementation
# Growth Strategies for Your Company


## Growth Opportunity 7
- Company X has been known for reliable delivery for many years:
  - In upcoming bid to Boeing, highlight that reliability in the proposal and financials.
  - Create a media campaign that quantifies that reliability to the industry.
  - Make that a central point to COMAC.
  - It could result in an additional platform win.

## Growth Opportunity 8
- Company X has traditionally insisted on its design model’s use with suppliers:
  - Models are available via FTP site.
  - Suppliers can request changes, but cannot mark up company model.
  - Design change cycle could be cut in half by shared design access/versioning.

## Growth Opportunity 3
- Company X has an excellent history of designing products for manufacture:
  - Maintain that ability to design products to be easily manufactured.
  - Look to new technologies for improved manufacturing of complex products.
  - Do not rely on current skills exclusively.
  - Expect 1–2% improvement per product line.

## Growth Opportunity 5
- Company X does not allow supplier input into the scheduling process:
  - It does not share scheduling with its customers or suppliers.
  - Schedule issues are not resolved by coordinated scheduling.
  - Shared schedule software is available.
  - This has saved a 3-week delay for some.

Source: Frost & Sullivan
Growth Strategies for Your Company (continued)


<table>
<thead>
<tr>
<th>Growth Opportunity 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X shares schedules with its suppliers on a push-out basis:</td>
</tr>
<tr>
<td>o It should try to coordinate schedules, its customers, and its suppliers.</td>
</tr>
<tr>
<td>o Schedule changes are often delayed and occasionally missed.</td>
</tr>
<tr>
<td>o Shared schedule software is available.</td>
</tr>
<tr>
<td>o A Tier I claims $650K savings one year.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Growth Opportunity 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X uses Catia V5 for its design activities:</td>
</tr>
<tr>
<td>o Its primary customers use Catia, prompting Company X to use it.</td>
</tr>
<tr>
<td>o Approximately 35% of its suppliers can use Catia models.</td>
</tr>
<tr>
<td>o Cooperatively design in Catia.</td>
</tr>
<tr>
<td>o This could save 3-4 weeks of design effort.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Growth Opportunity 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X does design for manufacturing and to a lesser degree for prototyping:</td>
</tr>
<tr>
<td>o When performing in-house prototyping the design supports the activity.</td>
</tr>
<tr>
<td>o There is less attention to the challenges of prototyping for contracted prototypes.</td>
</tr>
<tr>
<td>o Prototyping should be central to design.</td>
</tr>
<tr>
<td>o This could cut prototyping costs by 20%.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Growth Opportunity 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X has a good capability to automate its manufacturing:</td>
</tr>
<tr>
<td>o Its automation uses industry standard automation techniques and machines.</td>
</tr>
<tr>
<td>o It does not design for automation.</td>
</tr>
<tr>
<td>o It is risk averse when considering the use of newer automation.</td>
</tr>
<tr>
<td>o Selected products could save 55% on labor.</td>
</tr>
</tbody>
</table>

Source: Frost & Sullivan

Growth Strategies for Your Company (continued)

Growth Opportunity 6

- Company X shares designs with some of its suppliers and one client:
  - Many of its products are TSO items, and it is reluctant to share TSO IP with others.
  - By limiting information it increases the costs of production.
  - Protection of IP is important, but it drives a 30% increase in production man hours.

Growth Opportunity 11

- Company X has a large collection of jigs and tools for products:
  - Finding the proper jig, tearing down the old line, aligning the new jigs, and starting production is time consuming.
  - Jigs are hand built and hand aligned.
  - Product line changes are frequent.
  - Costs 400 man-days per year.

Growth Opportunity 12

- Company X has looked at additive manufacturing, but has not adopted it:
  - It believes that its product mix is not well suited to additive manufacturing.
  - It prefers to have other companies try new technology.
  - It is missing opportunities.
  - It could save 15% on selected products.

Growth Opportunity 10

- Company X believes that its in-house prototyping capability is good enough:
  - Its current prototyping shop is composed of individuals near retirement.
  - The technology of the prototyping shop supports only traditional manufacture.
  - It is missing opportunities.
  - Outsourcing saved a company 22%.

Source: Frost & Sullivan
Prioritized Opportunities through Implementation

Prioritized Growth Opportunities

1. GO 7
2. GO 3
3. GO 8
4. GO 5
5. GO 9
6. GO 1
7. GO 2
8. GO 4
9. GO 6
10. GO 11
11. GO 12
12. GO 10

Internal Capabilities
- Executive Champion
- Budget / Funding
- Product Development
- Marketing
- Sales
- Support

Prioritized Opportunities

1. GO 7
2. GO 3
3. GO 8
4. GO 5
5. GO 9
6. GO 1
7. GO 2
8. GO 4
9. GO 6
10. GO 11
11. GO 12
12. GO 10

Actionable Strategies

Gap Analysis

Recommended Strategic Options

Quick Wins

Long Term

Business Case Development

Implementation Options
Benefits Statement
Feasibility Analysis
Risk Assessment
Impact Analysis
Executive Approval
Stakeholder Alignment

Implementation

Plan
Develop
Roll Out
Support

Sustainable Profitable Growth

Source: Frost & Sullivan
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