



The Boeing 787 Dreamliner: *More Than an Airplane*

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*787 Dimensional
Management*

21 April, 2005



Dimensional Management

787 – A New Paradigm

DREAMLINER



Cultural Changes



Infrastructure



Processes and Tools

787 DREAMLINER

Dimensional Management Definition

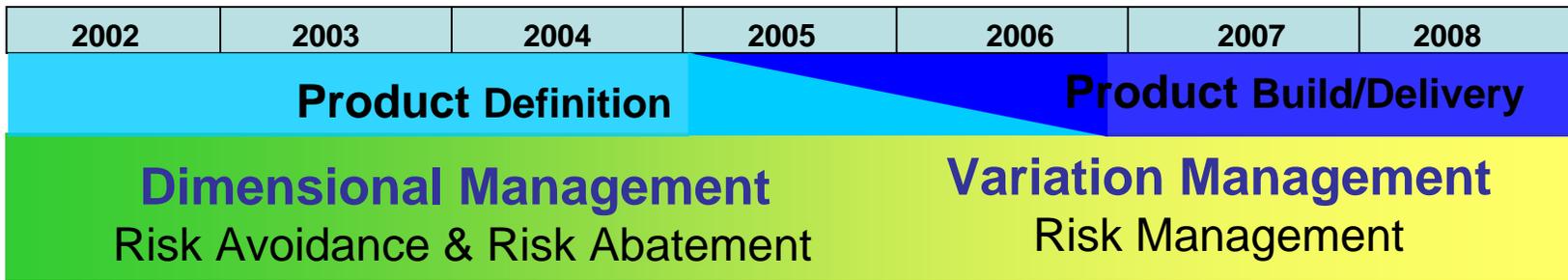
Dimensional Management – a disciplined approach to understanding the probability/costs of, and appropriate responses to, geometric variation of parts and assemblies. It is a “Product Definition Phase” effort.



Dimensional Management

Product Definition Phase

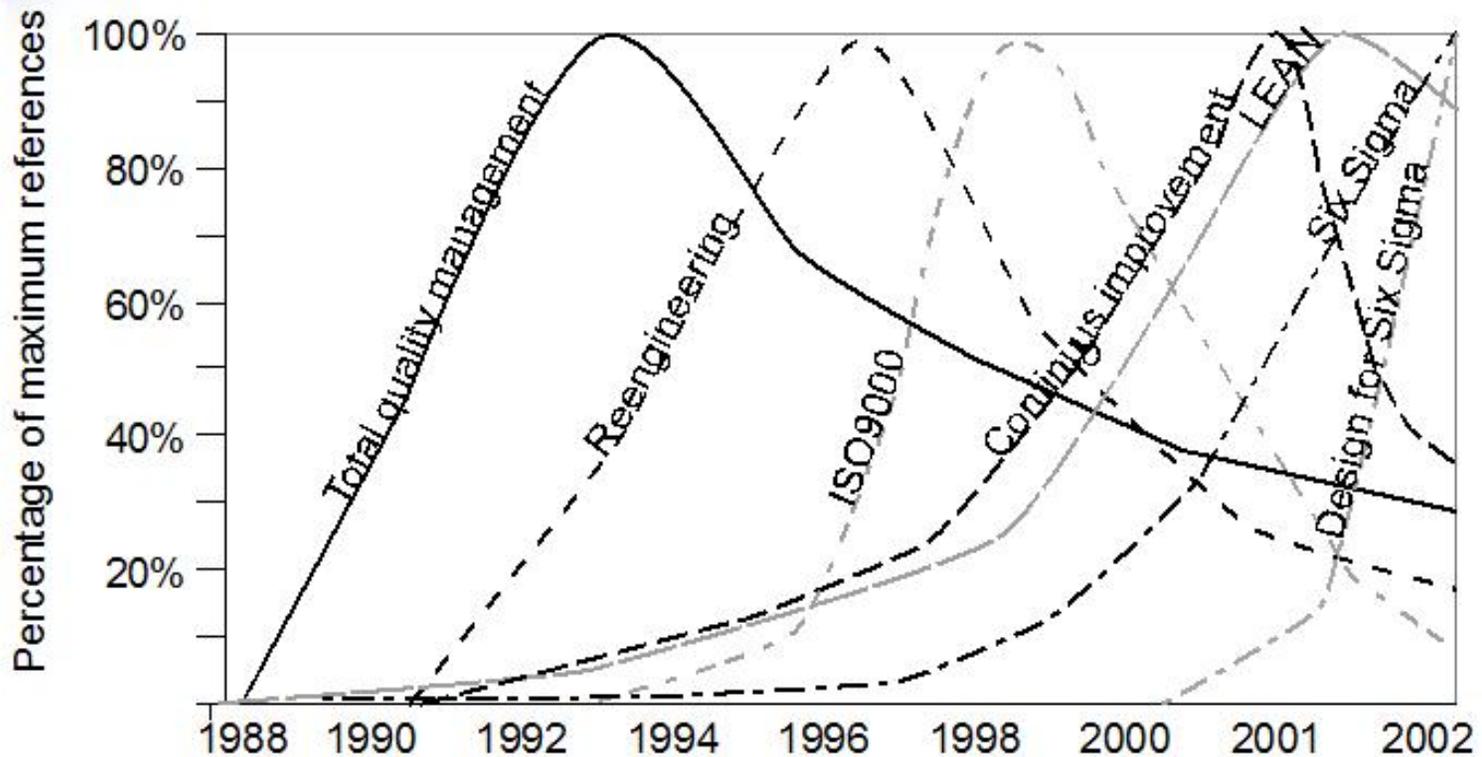
787 Development Schedule



Variation Risk Management

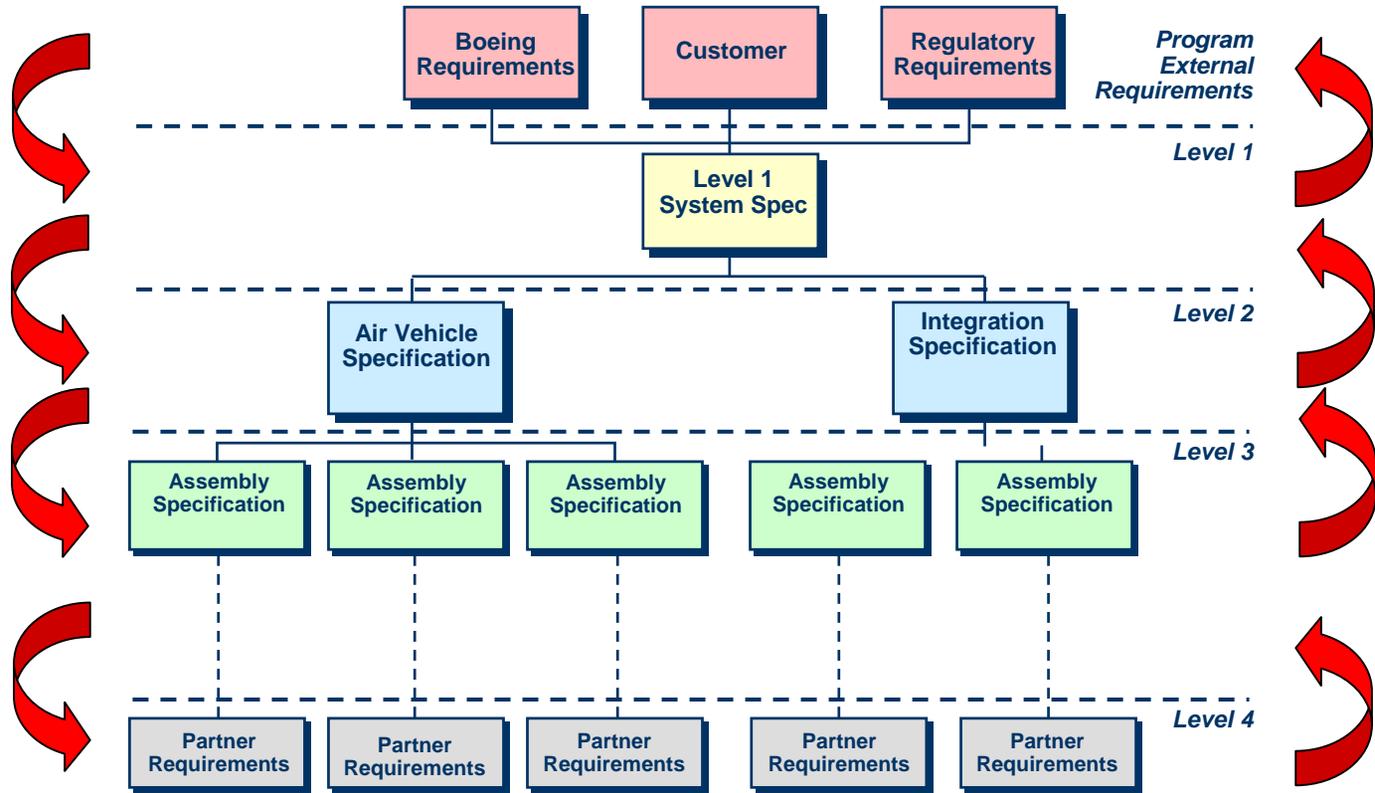
Dimensional Management Culture

This graph was generated by counting the number of times articles in the general press contained references to a given method.



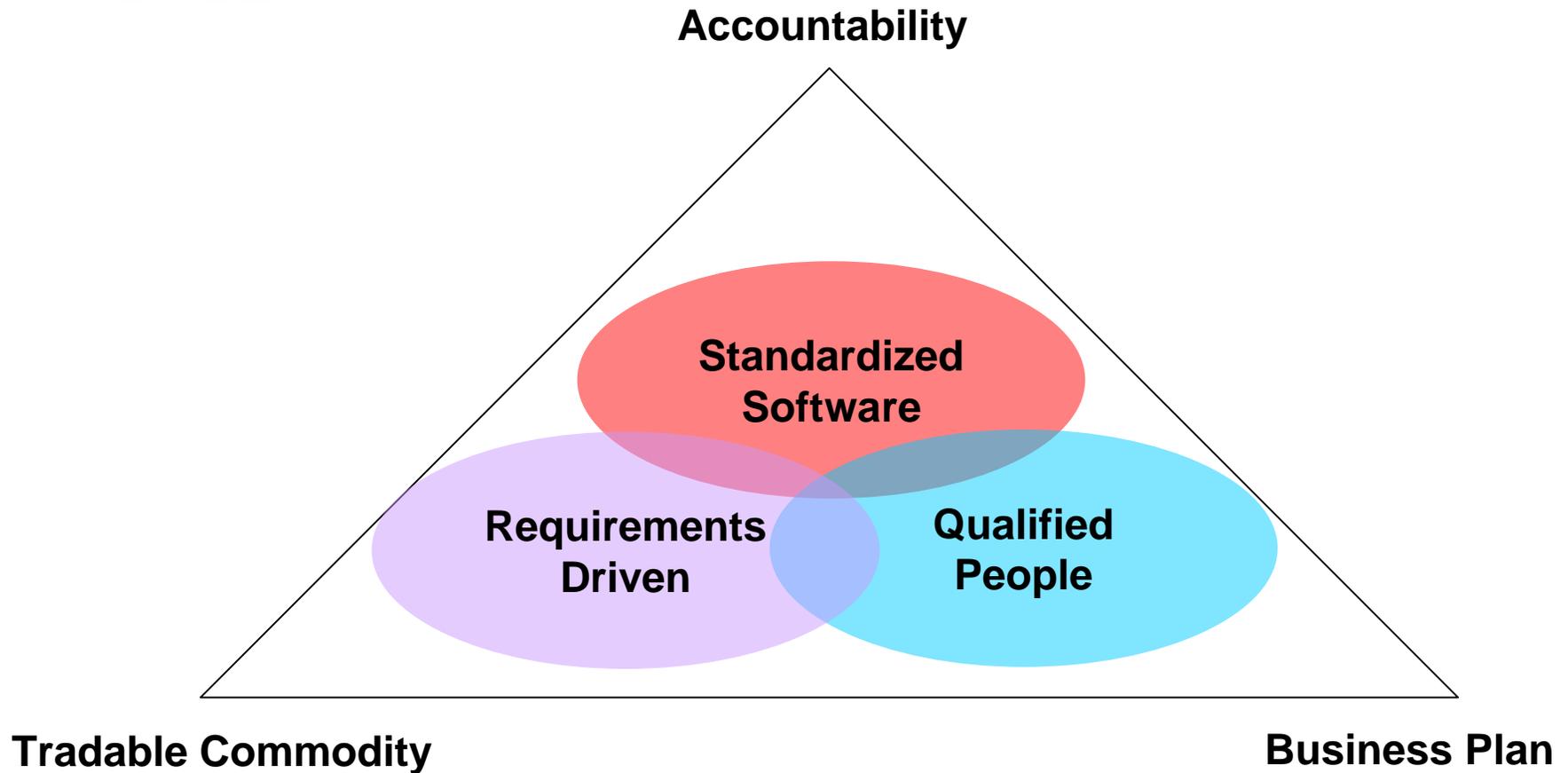


Dimensional Management Requirements Driven





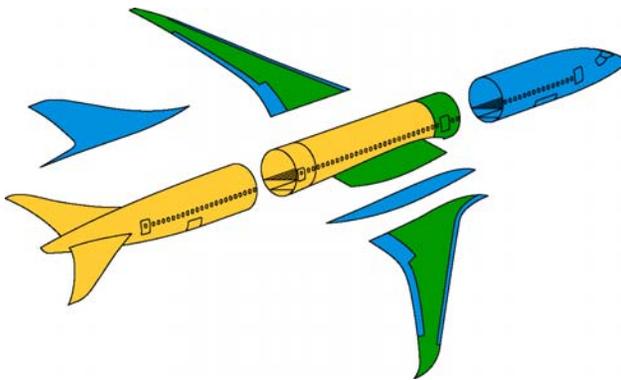
Dimensional Management Infrastructure





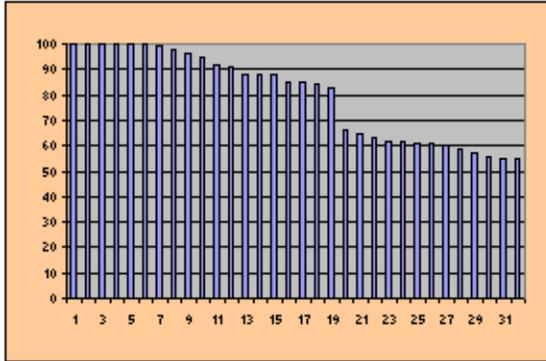
Dimensional Management Processes and Tools

- Dimensional Management Activities
- Dimensional Management Documentation
- CATIA Integrated DM Tool





Dimensional Management Critical Few



Compiled Variation Analysis Working Together Agreements

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
...

Identified Focus Areas on the 787 Program

- Integrations have been identified that are considered risky enough to warrant in-depth variation analysis studies.

Responsibility

- Philosophy – only through analysis, compromise, and value sharing can the whole production system be optimized for sensitivity to variation.

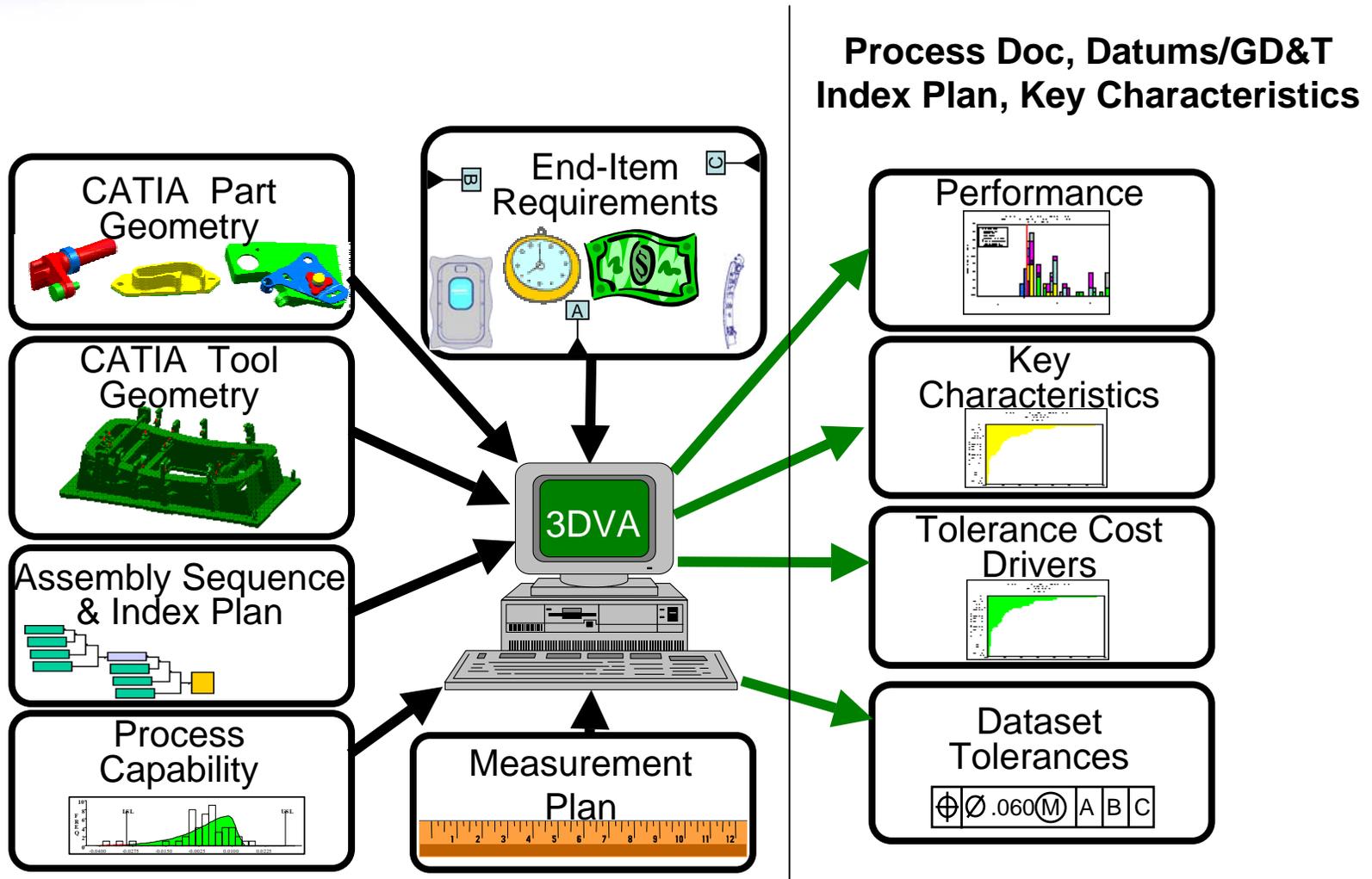
- Expectation – the product definition must reflect important Dimensional Management information (features, indexes, datums, tolerances, important measures)

Concurrent Product Definition

- Functional* – Initial airplane tolerance allocation
- Physical* – Baseline indexing plans assessed
- Build* – Variation analysis cycles complete

Dimensional Management

Build Plan Analysis





Dimensional Management

Concurrent Product Definition

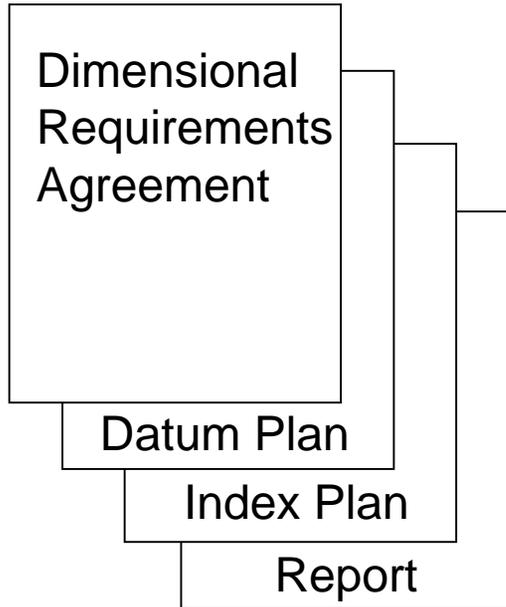
<p>You must consider this</p>   <p>If you are creating this</p>	<p>Requirements</p>	<p>Geometry (Joints and Features)</p>	<p>Assembly Methods</p>	<p>Assembly Sequence</p>	<p>Measurements</p>
<p>Geometry (Joints and Features)</p>	<p>Product definition must meet dimensionally sensitive requirements in addition to stress, fatigue, etc.</p>		<p>Datums are based on assembly methods. Tooling indexes match part datums. Product definition must not over constrain part.</p>	<p>Product definition must consider whether indexing features will be available when defining datums.</p>	<p>Applied GD&T must be measurable. KC's are identified and maintained.</p>
<p>Assembly methods</p>	<p>Care must be taken not to optimize to one requirement at the expense of other requirements.</p>	<p>Assembly method must not over constrain parts.</p>		<p>Assembly method must consider the availability of features based on assembly sequence.</p>	<p>Assembly method is used to create component validation method.</p>
<p>Assembly sequence</p>		<p>Assembly sequence may change assembly method that would change part datums. Determines which joints will absorb variation.</p>	<p>The assembly sequence must consider the datums derived from assembly methods.</p>		<p>Consider in-process measurement requirements.</p>
<p>Measurements</p>	<p>Measurements must completely, consistently, and accurately validate requirements.</p>	<p>Measurements use critical features defined in data set. Can the product be measured (sight lines, access, capability)?</p>	<p>Some measurements are created based on reference frames derived from the assembly method.</p>	<p>Assembly sequence determines the availability of part features for measurements.</p>	



Dimensional Management Documentation and Processes

Documentation

- Identify Responsibility
- Agreement on Baseline
- Details for Variation Analysis
- Document Results



787

Dimensional Management Documentation

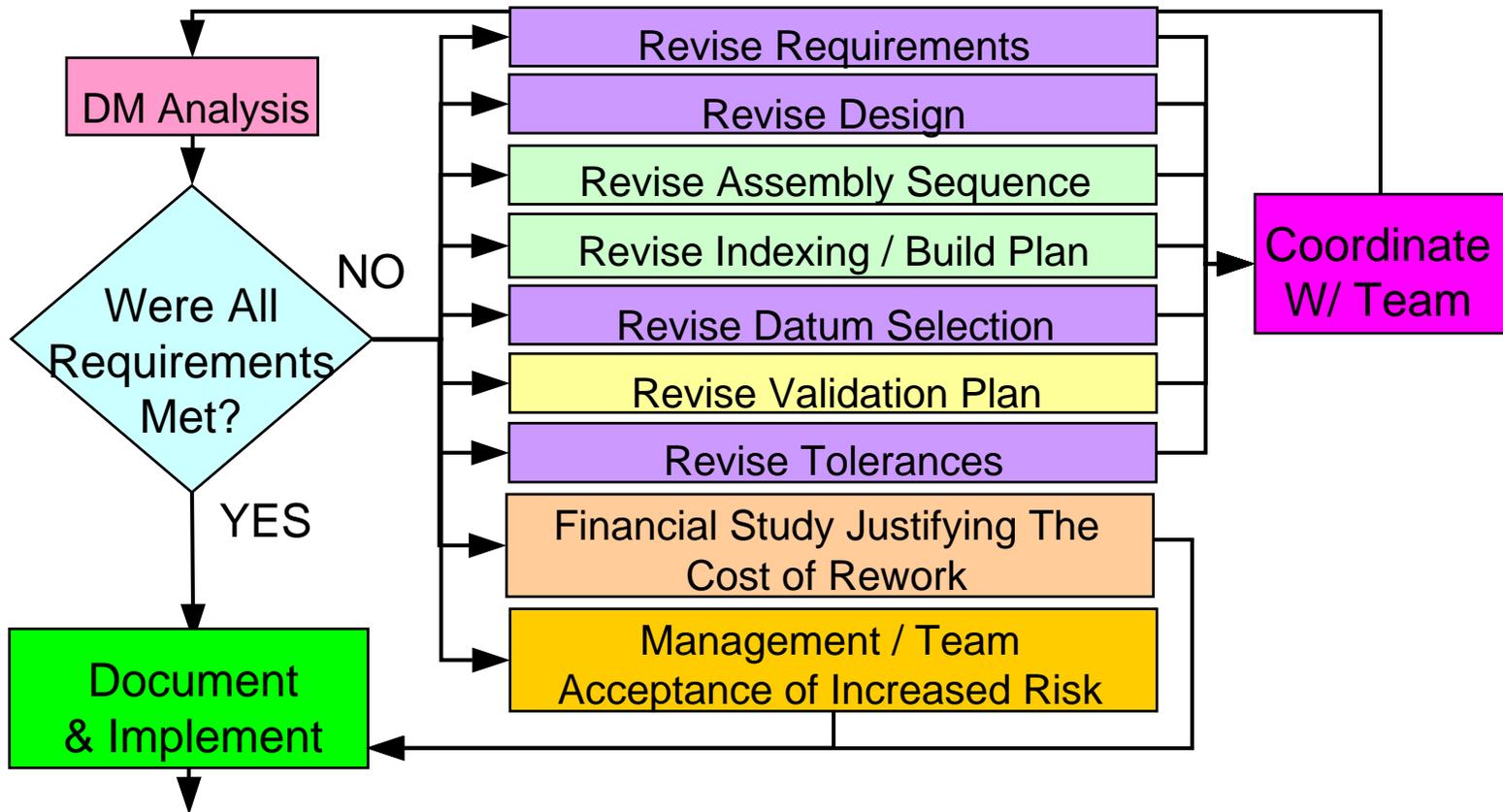
DREAMLINER

- **Index Plan** A detailed technical description of how multiple parts' or multiple assemblies' features are physically “locked” to each other as they are joined.
- **Datum Plan** –Summary of datums and datum reference frames for a given assembly or integration.
- **Variation Analysis Report** – Summary of analysis inputs / outputs and conclusions.
- **Dimensional Requirements Agreement** –Serves as a common location for agreements made during design development. These items includes requirements, tolerances, measurements and components.



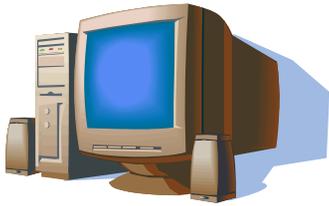
Dimensional Management Iterative Process

How Does DM Work? - Analysis Process





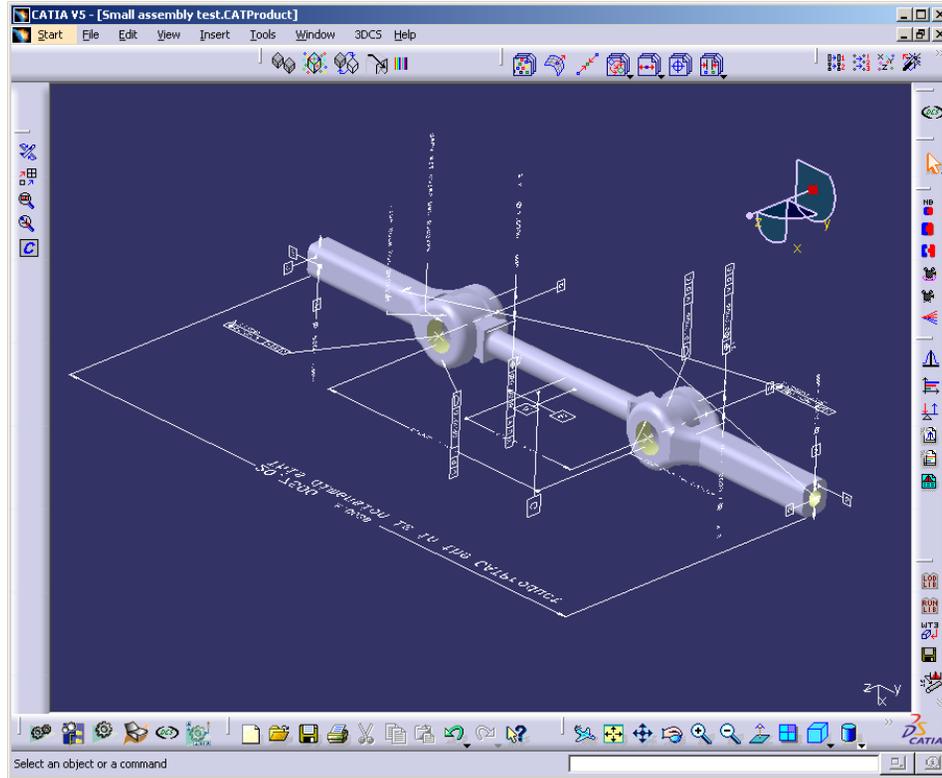
Dimensional Management CAD Integrated Environment



Single CAD



Authority Data



PDM Storage



Common Interface

Questions

