Manufacturing and Assembly Variation

- Engineering design of an assembly
 - Nominal design
 - Variation design
 - Process design

Nominal Design

- Determination of ideal locations and orientations of parts
- Defines mutual positioning constraints



Variation Design

- Determination of allowable variation in location and orientation
- How much variation in each constraint can be tolerated and still achieve the key characteristics?



Process Design

- Determination of fabrication and assembly processes that will contribute no more than the tolerable variation
- May require loosening allowable variation if no economical process exists



Variation Risk Management (VRM)

- Nominal Design, Variation Design, Process Design together make Variation Risk Management
- Very hard for many products

Example - Car Doors



Car Door Example





Car Doors - Mounting



Car Doors - Mounting



Mathematical Modeling of Assembly

 Coordinate frames – each part has a base HAMMER HANDLE coordinate frame "Z" DIRECTIO Relationships between TOP VIEW parts are expressed as ANVI 4x4 matrix transforms HAMME HANDLE "Y" DIRECTION STAPL CARRIER SIDE VIEW BASE "X" DIRECTION

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