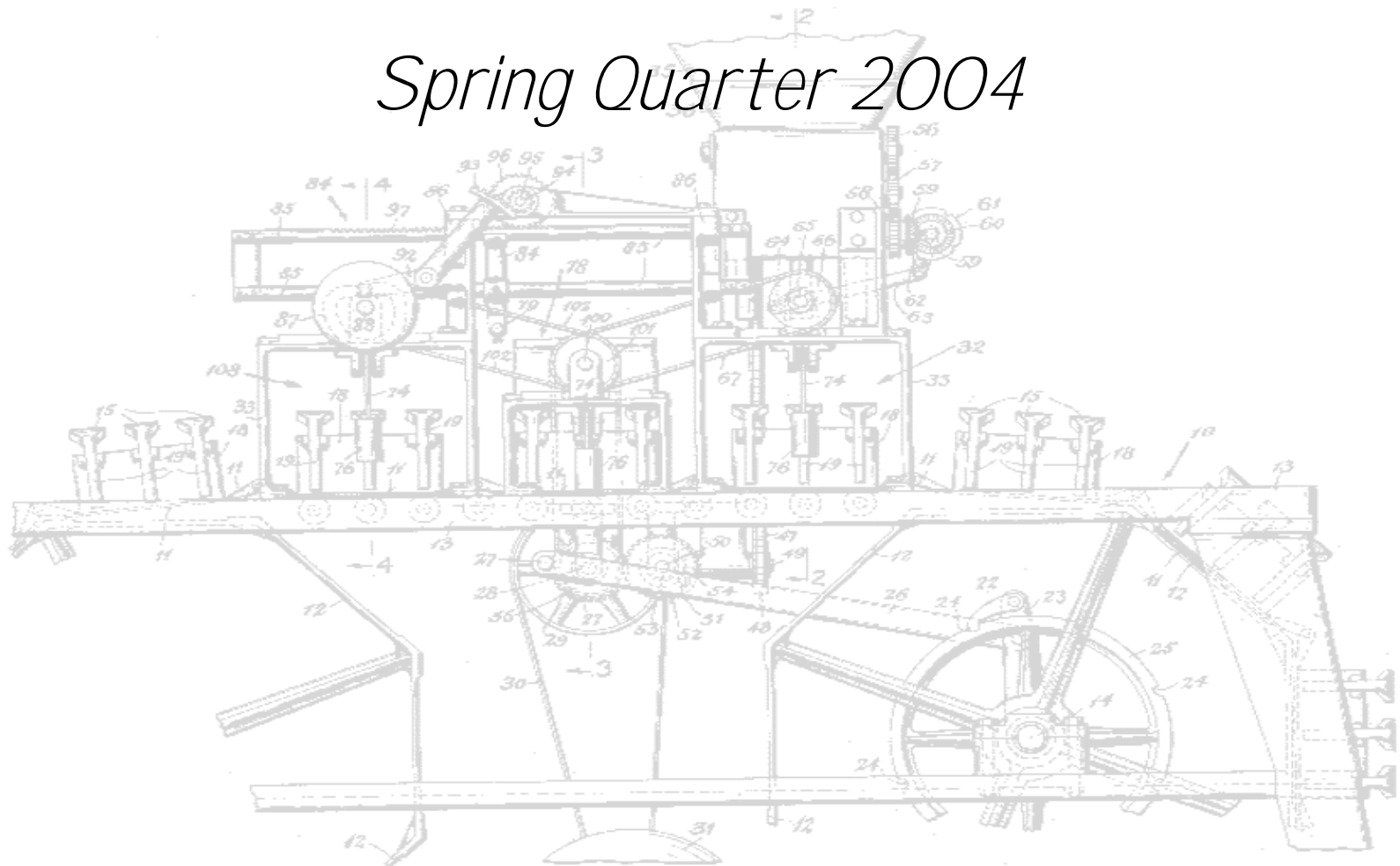


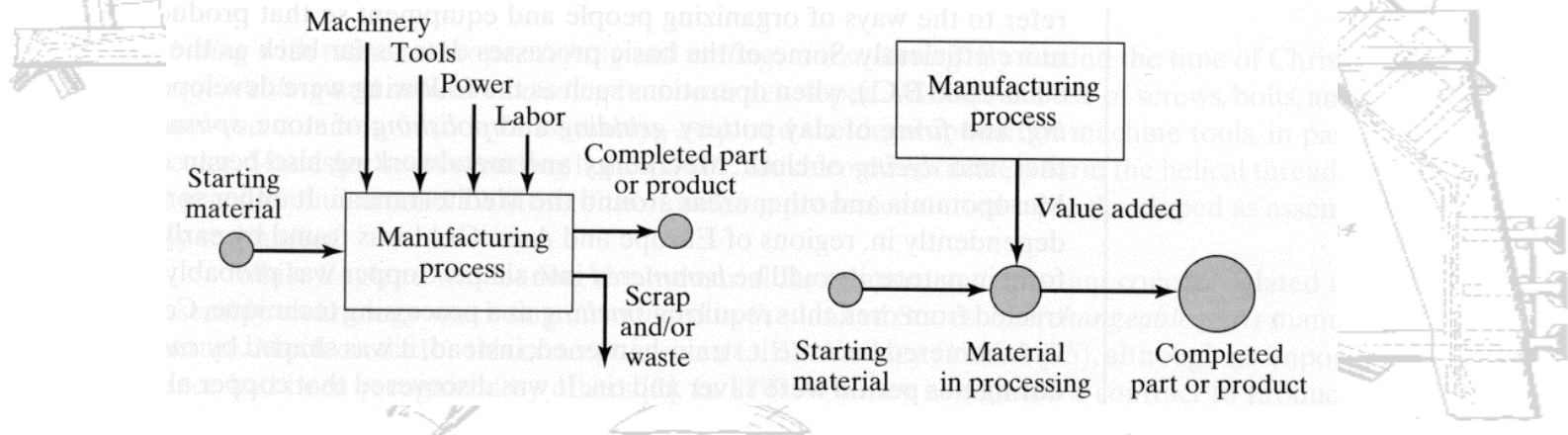
ENGR480 MANUFACTURING SYSTEMS

Spring Quarter 2004



WHAT IS MANUFACTURING?

- *Man-u-fac-ture: To make or process a raw material into a finished product, esp. by means of a large-scale industrial operation.*
- *From Latin manu + factus: by hand, to make*



MANUFACTURING OPERATIONS

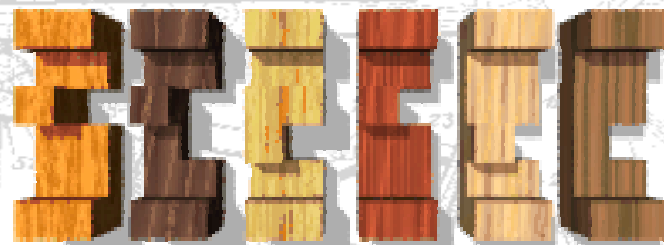
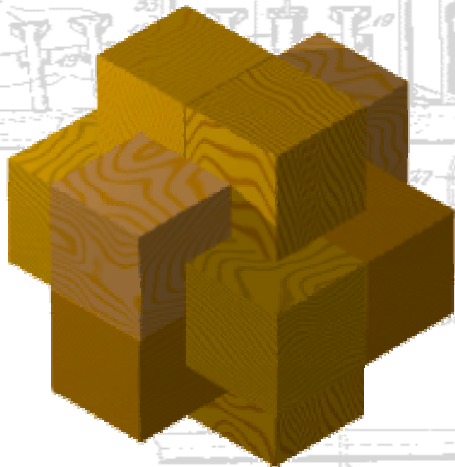
- *Processing*
 - *Shaping (solidification, deformation, material removal, or particulate processing)*
 - *Property Enhancement (heat treatment)*
 - *Surface Processing (cleaning, coating)*
- *Assembly*
 - *Permanent (welding, adhesive, rivets, press fit)*
 - *Reversible (threaded fasteners, friction fit)*

SHORT HISTORY OF MANUFACTURING

- *3000BC: Egyptian and Korean sand casting*
- *1000BC: Iron age began*
- *26BC: Egyptian lathe turning*
- *1770AD: Steam engine, industrial revolution*
- *1801: Interchangeable parts*
- *1911: F.W.Taylor's "Principles of Scientific Management", Henry Ford's mass production*
- *1980's: Concurrent engineering and TQM*
- *2000: Virtual corporations & global commerce*

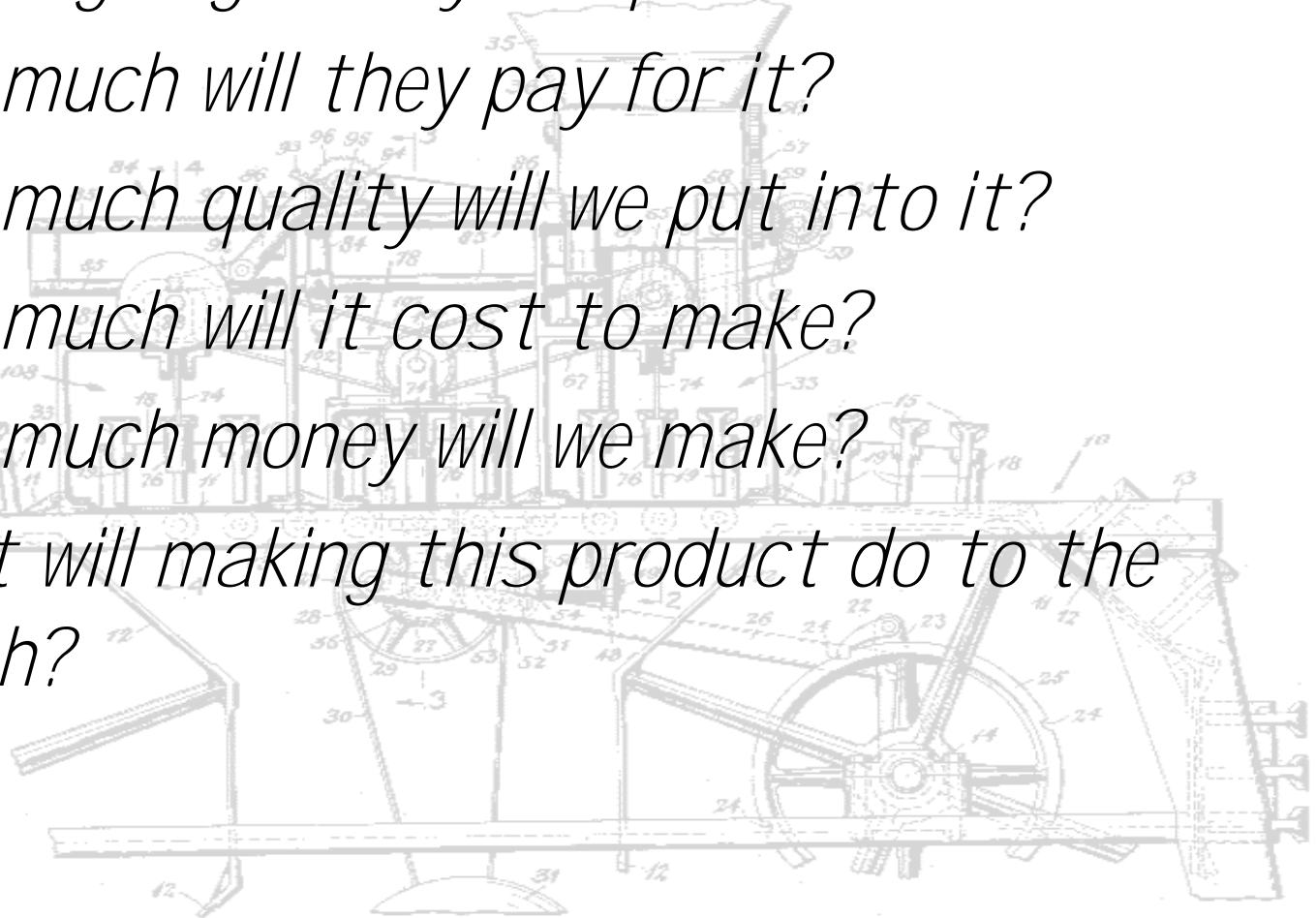
OUR MANUFACTURING COMPANY

- *You thought this was a class – it is really a manufacturing company*
(we'll call it *Puzzazzle Inc*)
- *Our products are six-piece wooden puzzles*



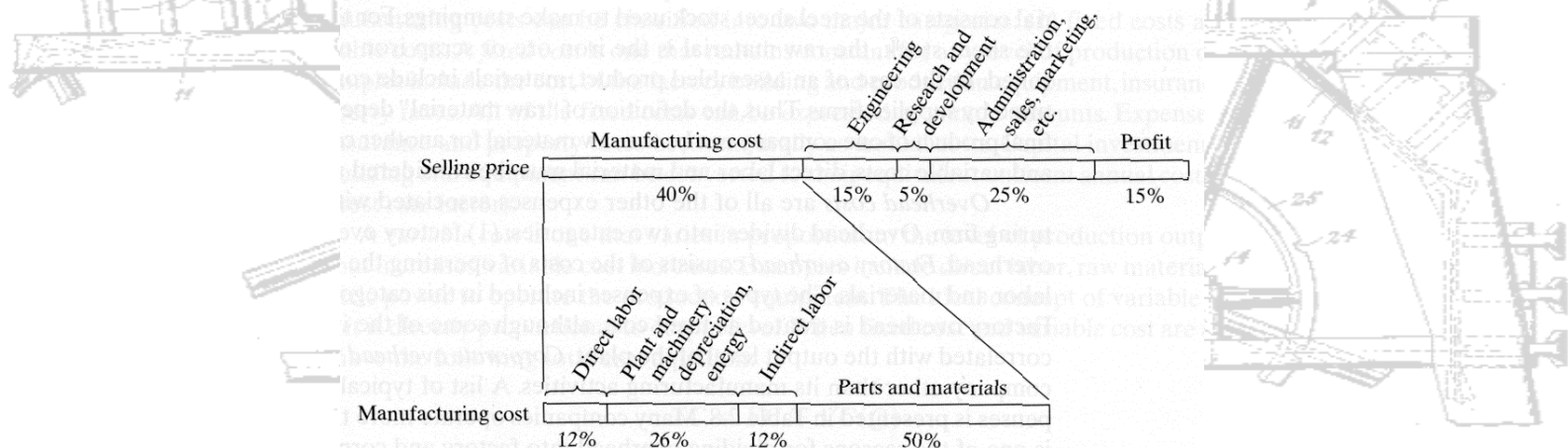
SOME QUESTIONS A MFG'R NEEDS ANSWERED

- *Who is going to buy our product?*
- *How much will they pay for it?*
- *How much quality will we put into it?*
- *How much will it cost to make?*
- *How much money will we make?*
- *What will making this product do to the Earth?*



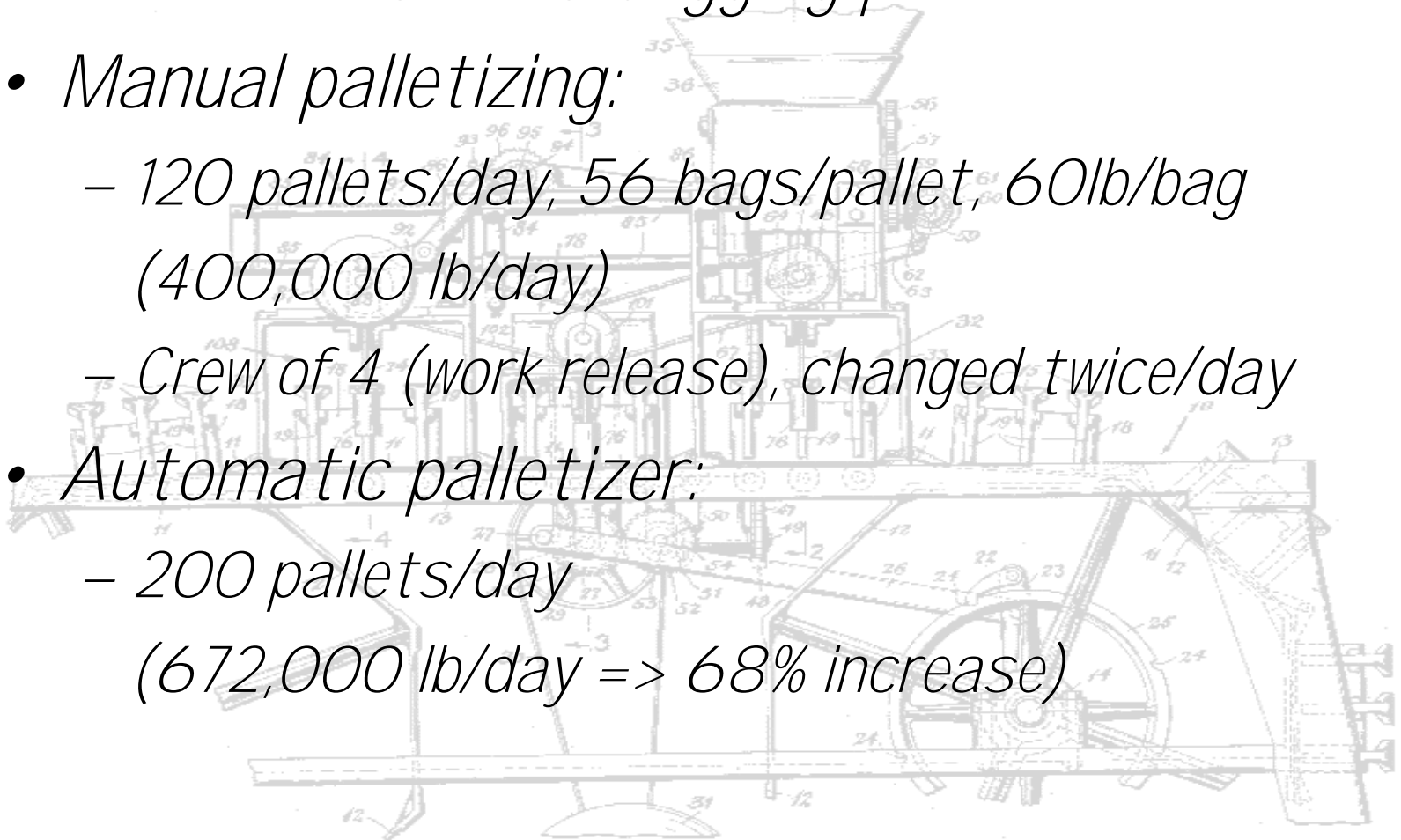
THE NEXT QUESTIONS

- *Will we make 1 or 1,000,000 units?*
- *Is this a “consumable” or a major asset?*
- *How long a development time can we afford?*
- *How much should we invest in production efficiency for this product?*



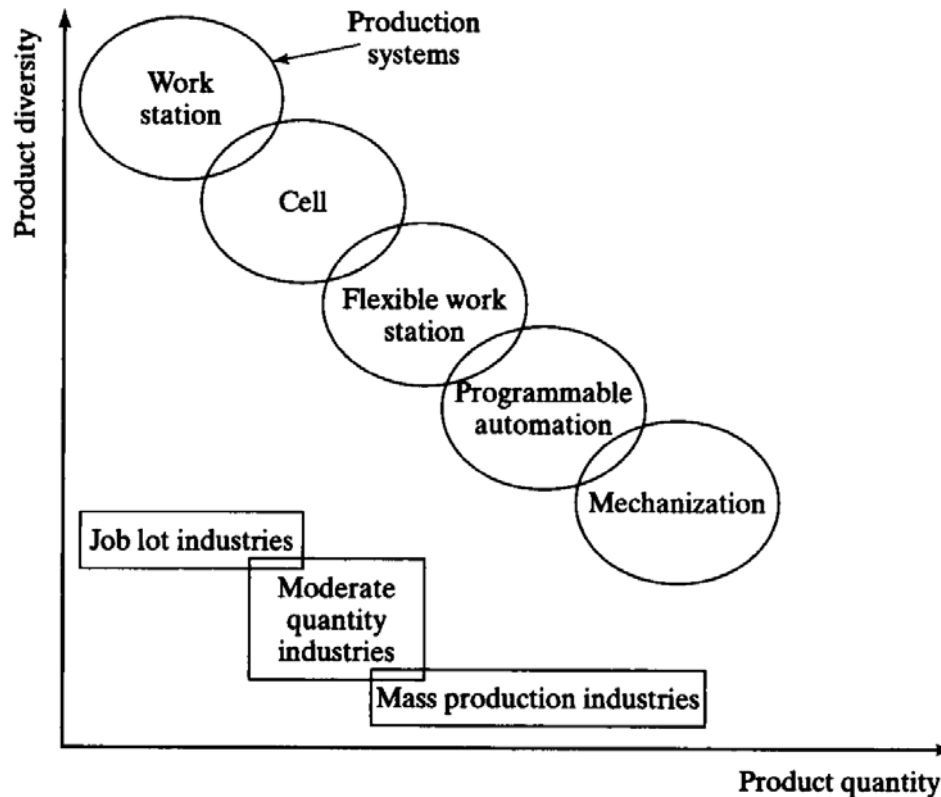
CASE HISTORY: FORGE INDUSTRIAL

- *Cement and sand bagging plant*
- *Manual palletizing:*
 - *120 pallets/day, 56 bags/pallet, 60lb/bag
(400,000 lb/day)*
 - *Crew of 4 (work release), changed twice/day*
- *Automatic palletizer:*
 - *200 pallets/day
(672,000 lb/day => 68% increase)*



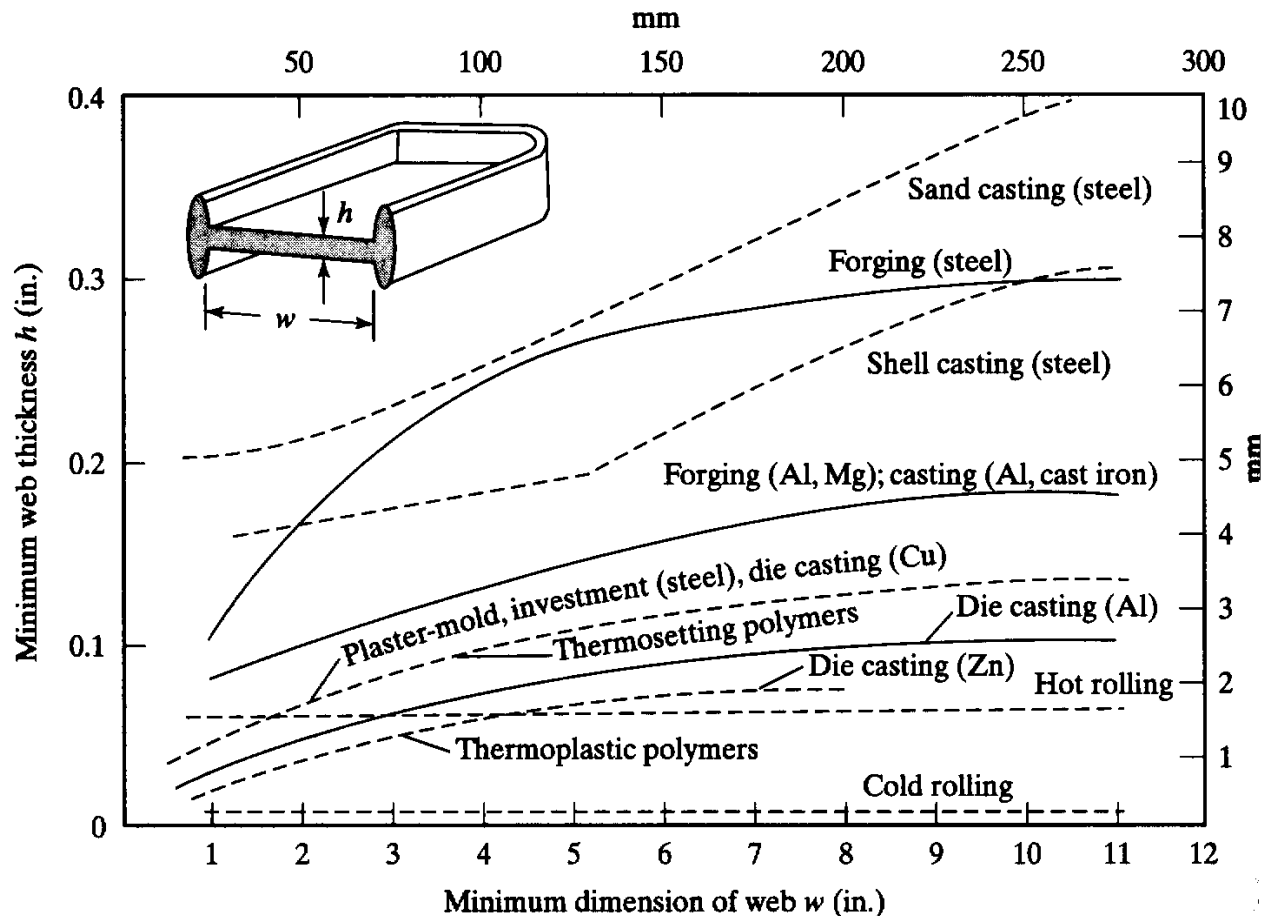
ANALYZING THE PRODUCT

- What is the required production rate?*



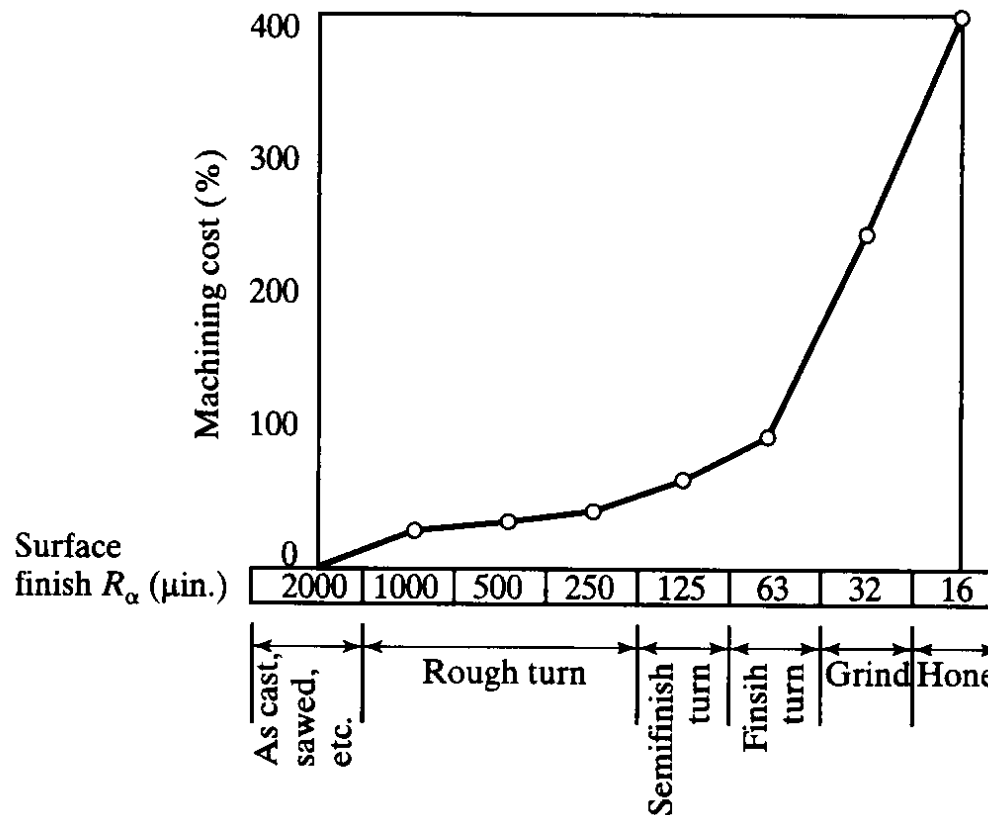
ANALYZING THE PRODUCT

- What are the materials and dimensions?*

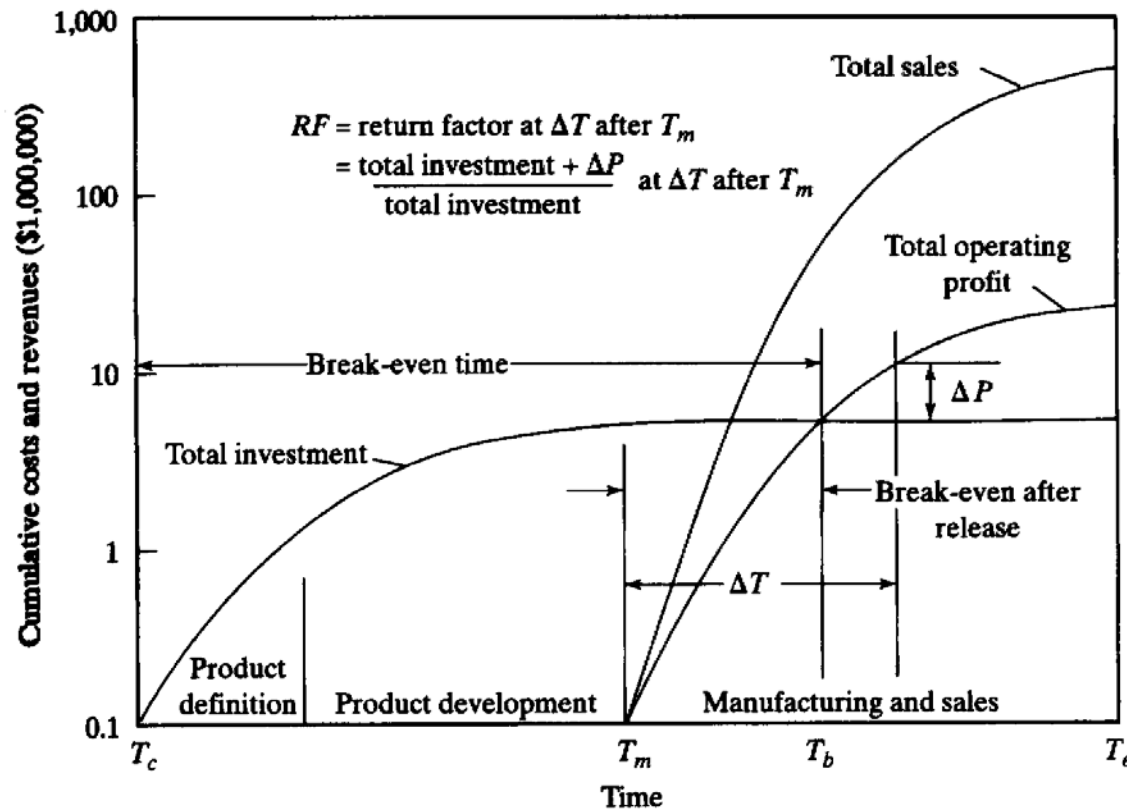


ANALYZING THE PRODUCT

- What are the required tolerances?*

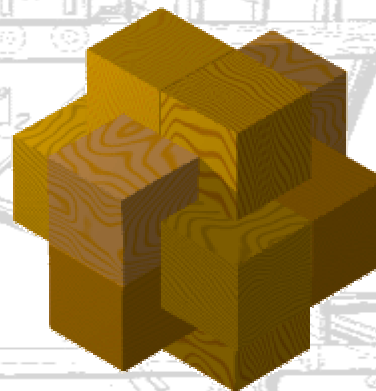


PROFIT POTENTIAL



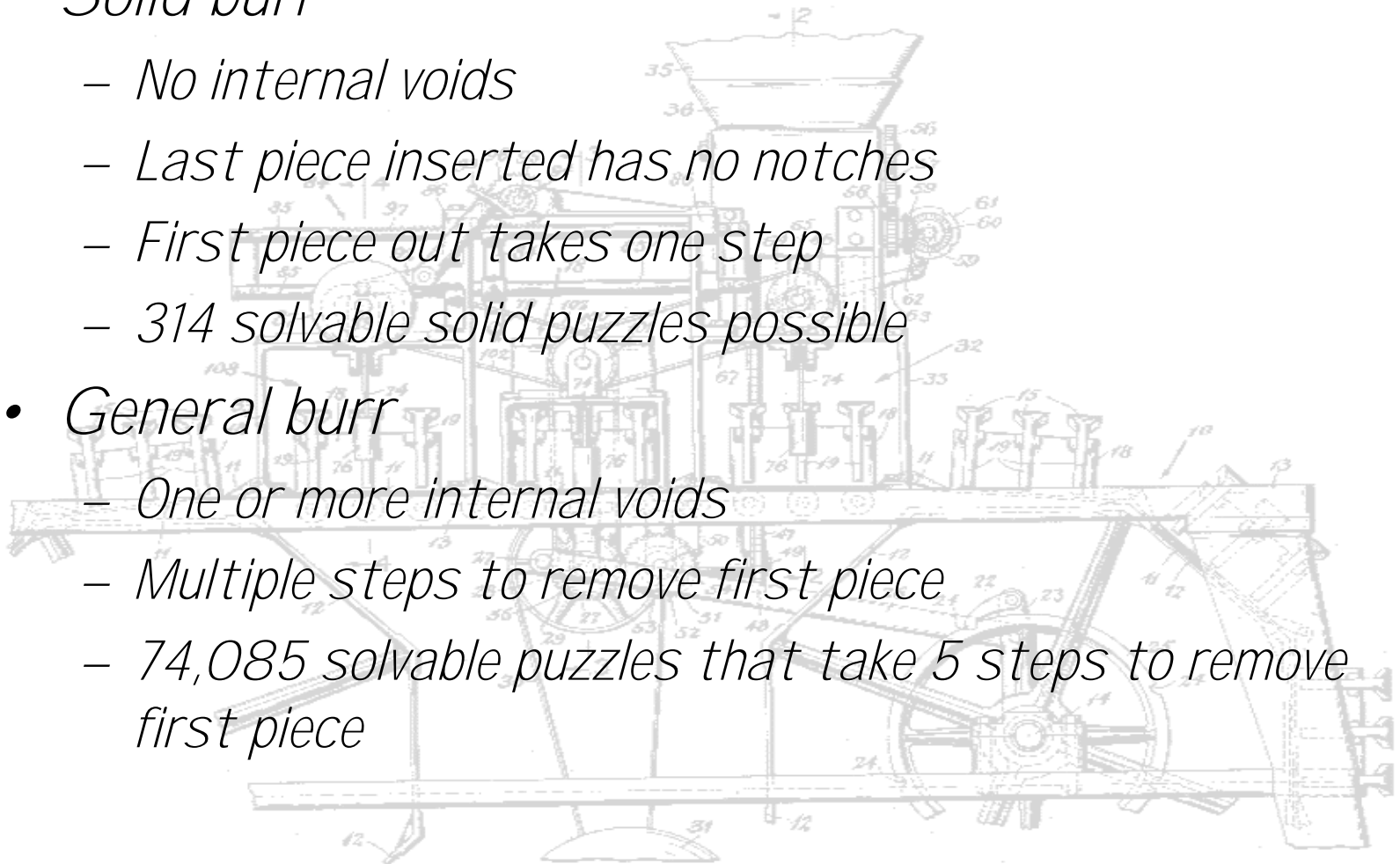
OUR PRODUCT

- *Six-piece Wooden "Burr" Puzzle*
- *Production Rate of One Puzzle/minute (batches of fifteen puzzles)*
- *Raw material is 3/4"x3/4" hardwood strips, lengths of 2.25"*

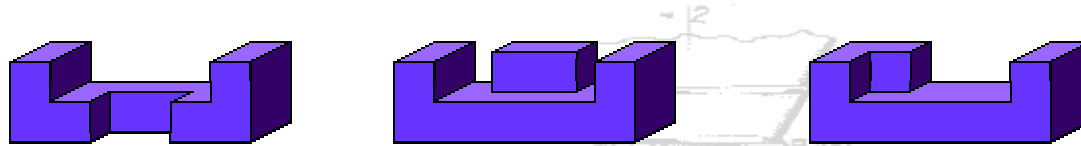


SOLID AND GENERAL BURRS

- *Solid burr*
 - *No internal voids*
 - *Last piece inserted has no notches*
 - *First piece out takes one step*
 - *314 solvable solid puzzles possible*
- *General burr*
 - *One or more internal voids*
 - *Multiple steps to remove first piece*
 - *74,085 solvable puzzles that take 5 steps to remove first piece*



NOTCHABLE, MACHINABLE, AND GENERAL PIECES



- *We only need to produce notchable pieces*
- *There are 59 notchable pieces, of which 25 are needed to make solid burrs.*
- *IBM Research – Buzz Puzzles site:*

<http://www.research.ibm.com/BurrPuzzles/>

