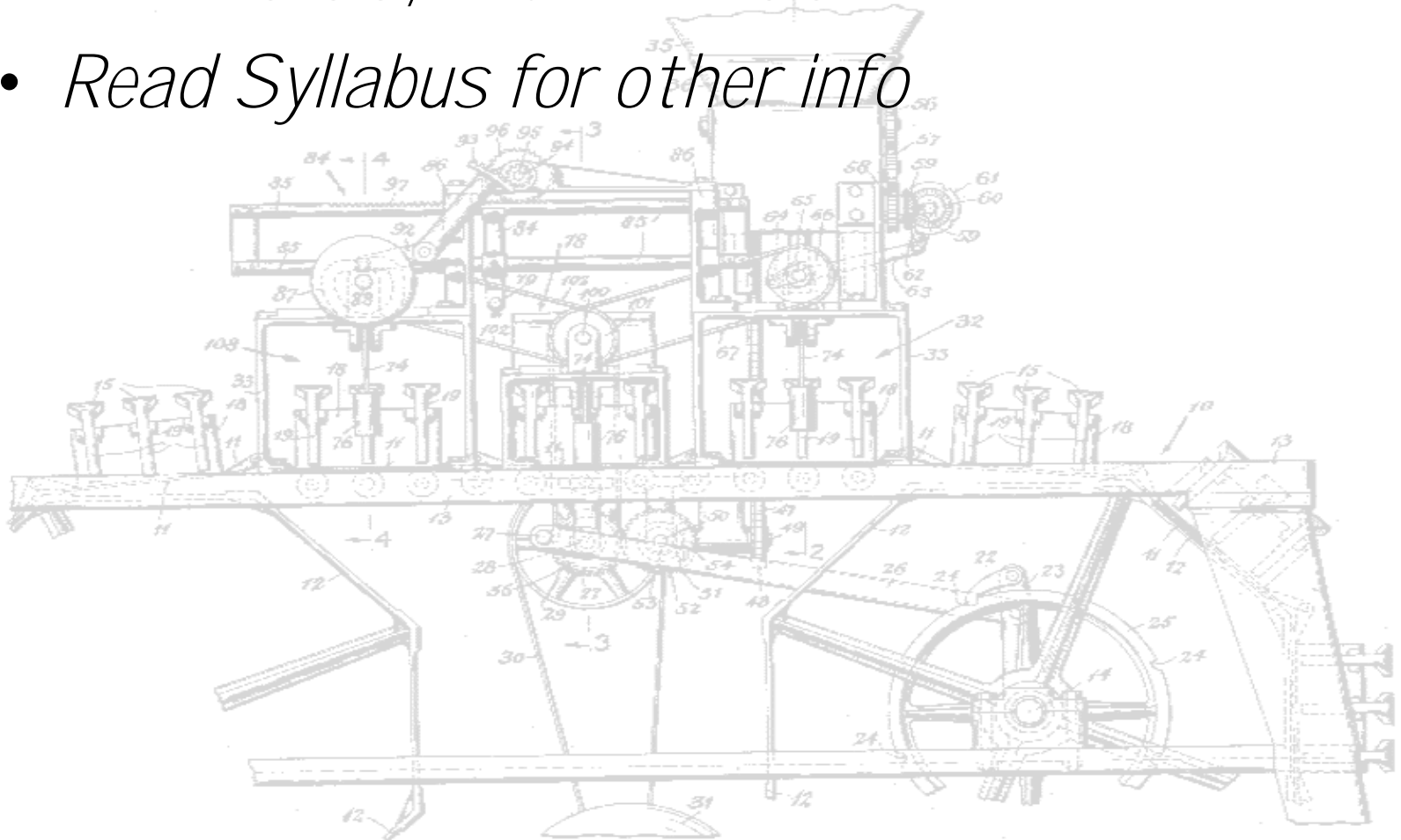

ENGR480 Manufacturing Systems

Spring 2006



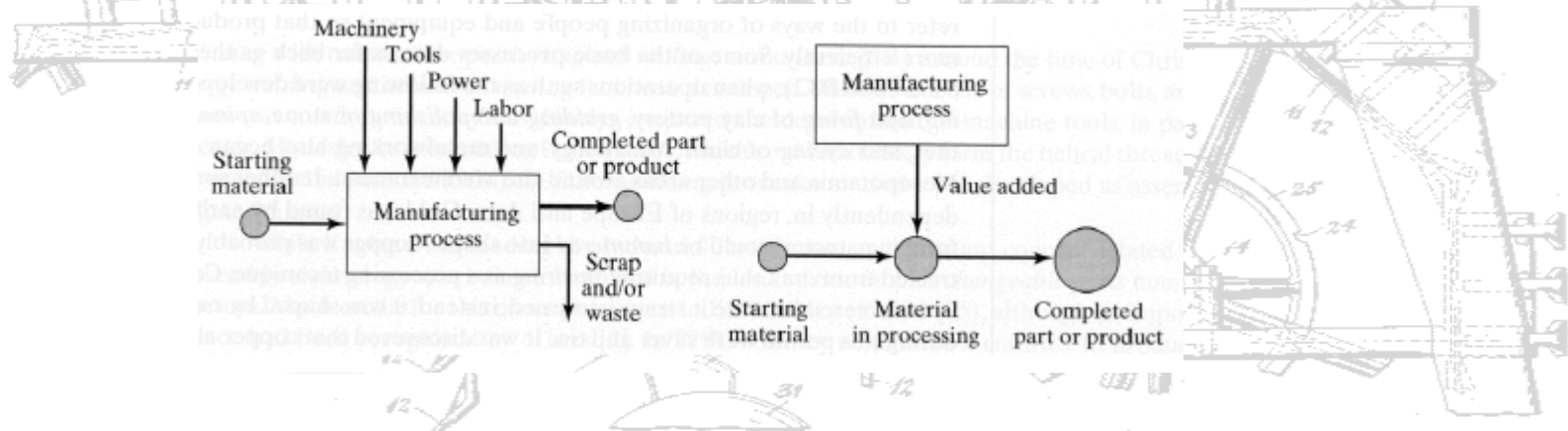
ENGR480 Manufacturing Systems

- *MWF 10:00, Lab Tue 2:00*
- *Read Syllabus for other info*



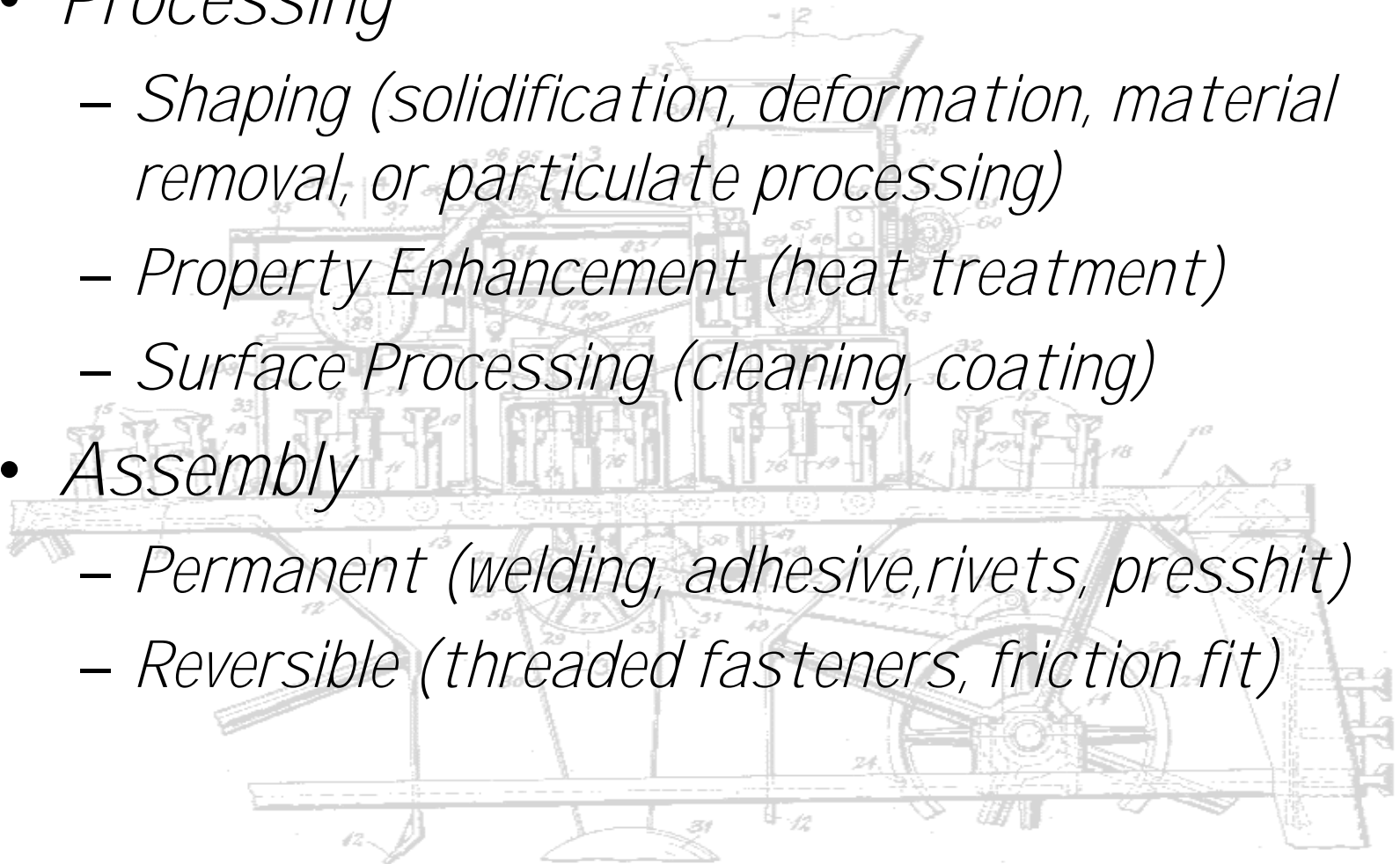
What is Manufacturing?

- *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)*



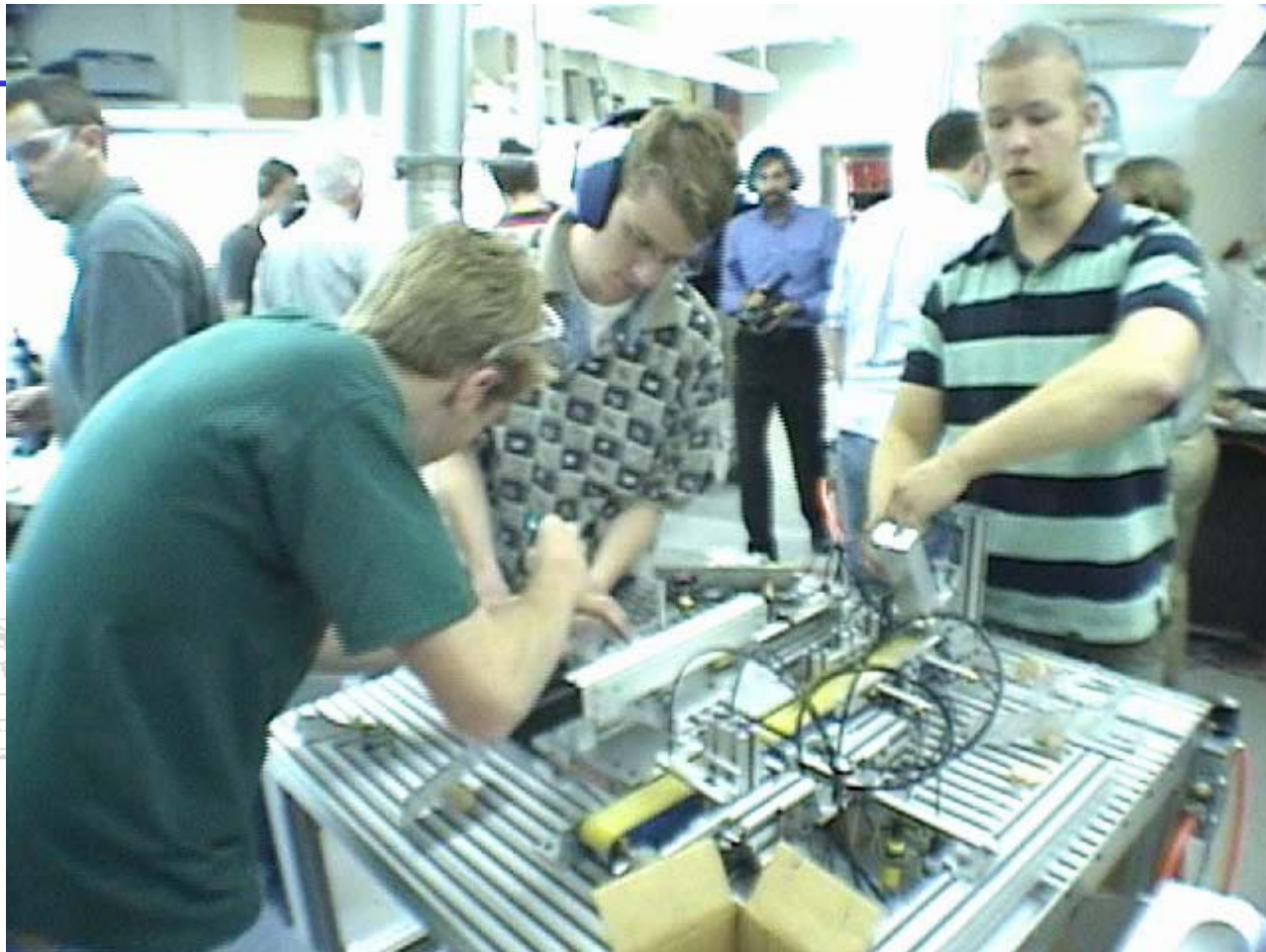
Short History of Manufacturing

- *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*
- *1965: Toyota Production System, single-piece flow*
- *2000: Virtual corporations, global manufacturing*

Our Manufacturing Company

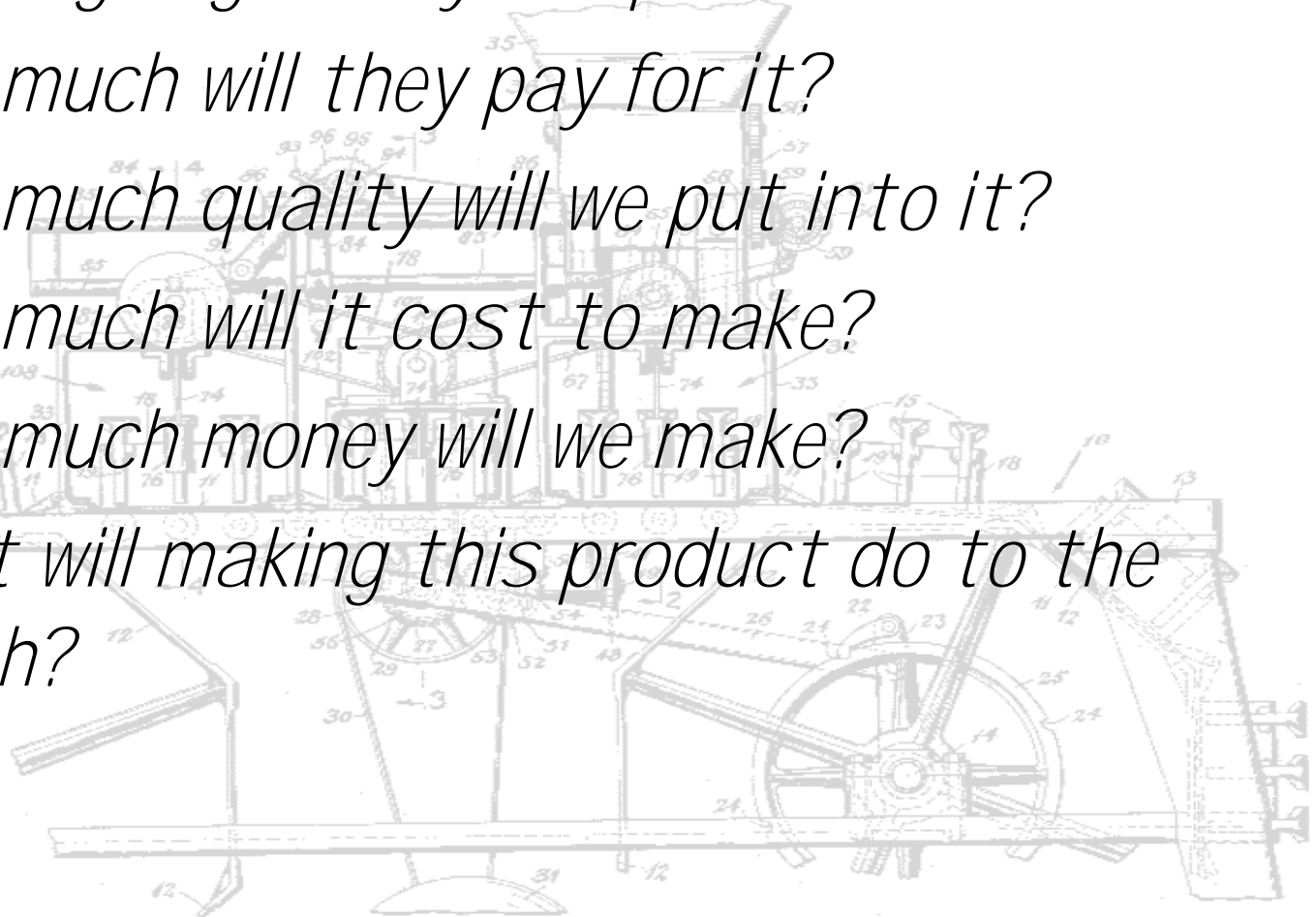
- *You thought this was a class - it's really a manufacturing company*
(we'll call it Puzzazzle Inc)
- *Our products are six-piece wooden puzzles*





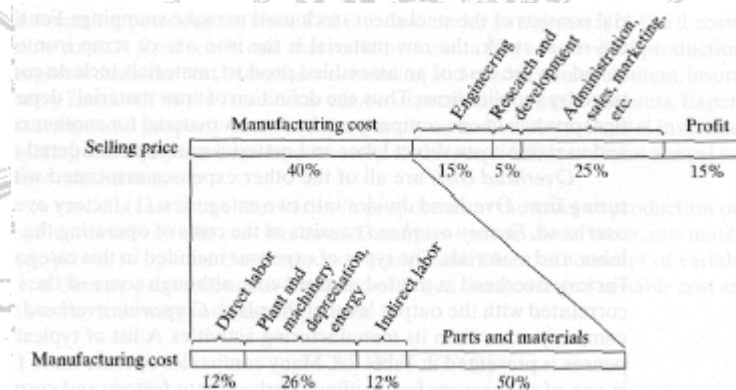
Some Questions a Manufacturer Needs Answered

- *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?*



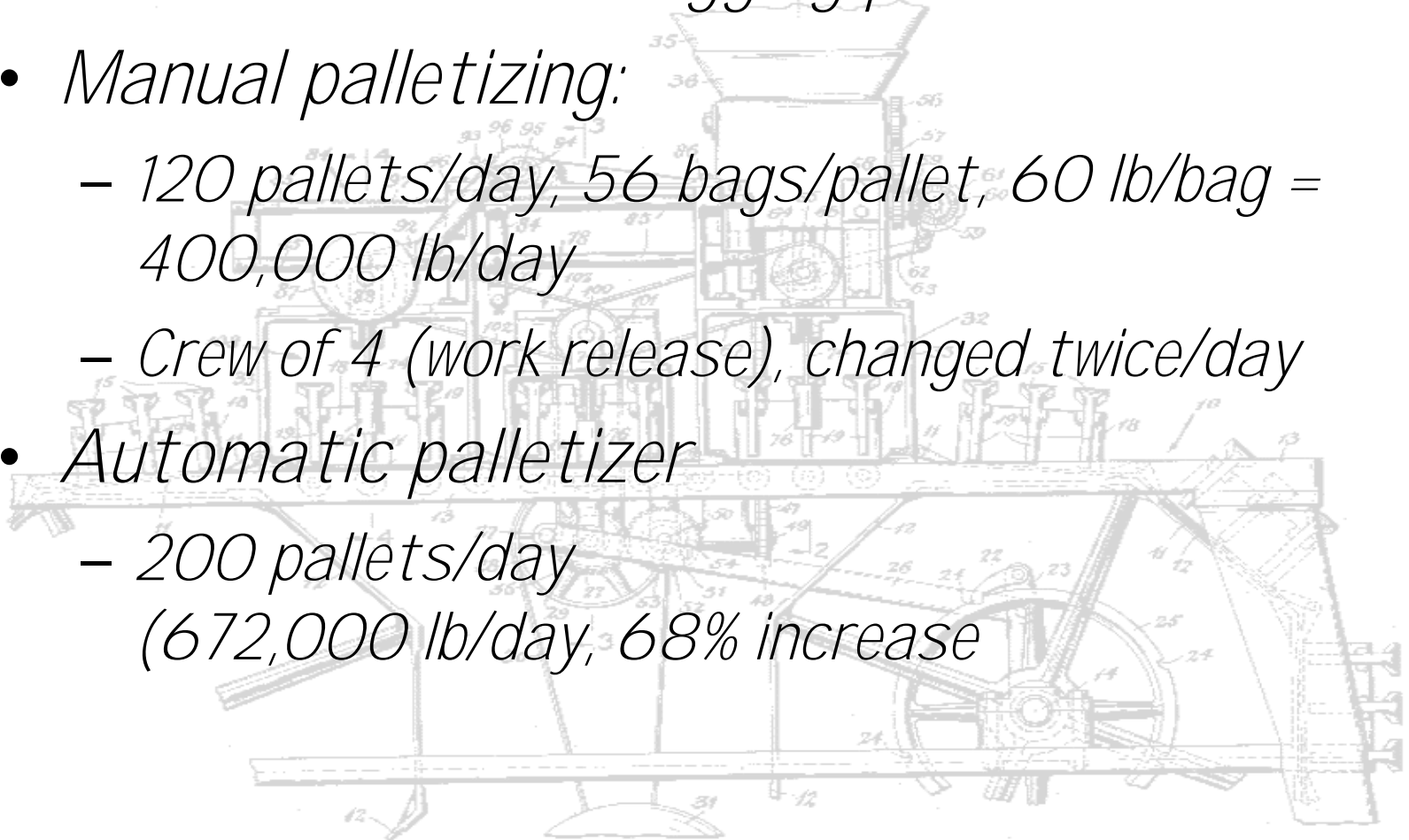
The Next Questions

- *Will we make 1 or 1,000,000 units?*
- *Should this product be durable or disposable?*
- *What will be our production schedule?*
- *How long can development take?*
- *How much should we invest in production efficiency for this product?*



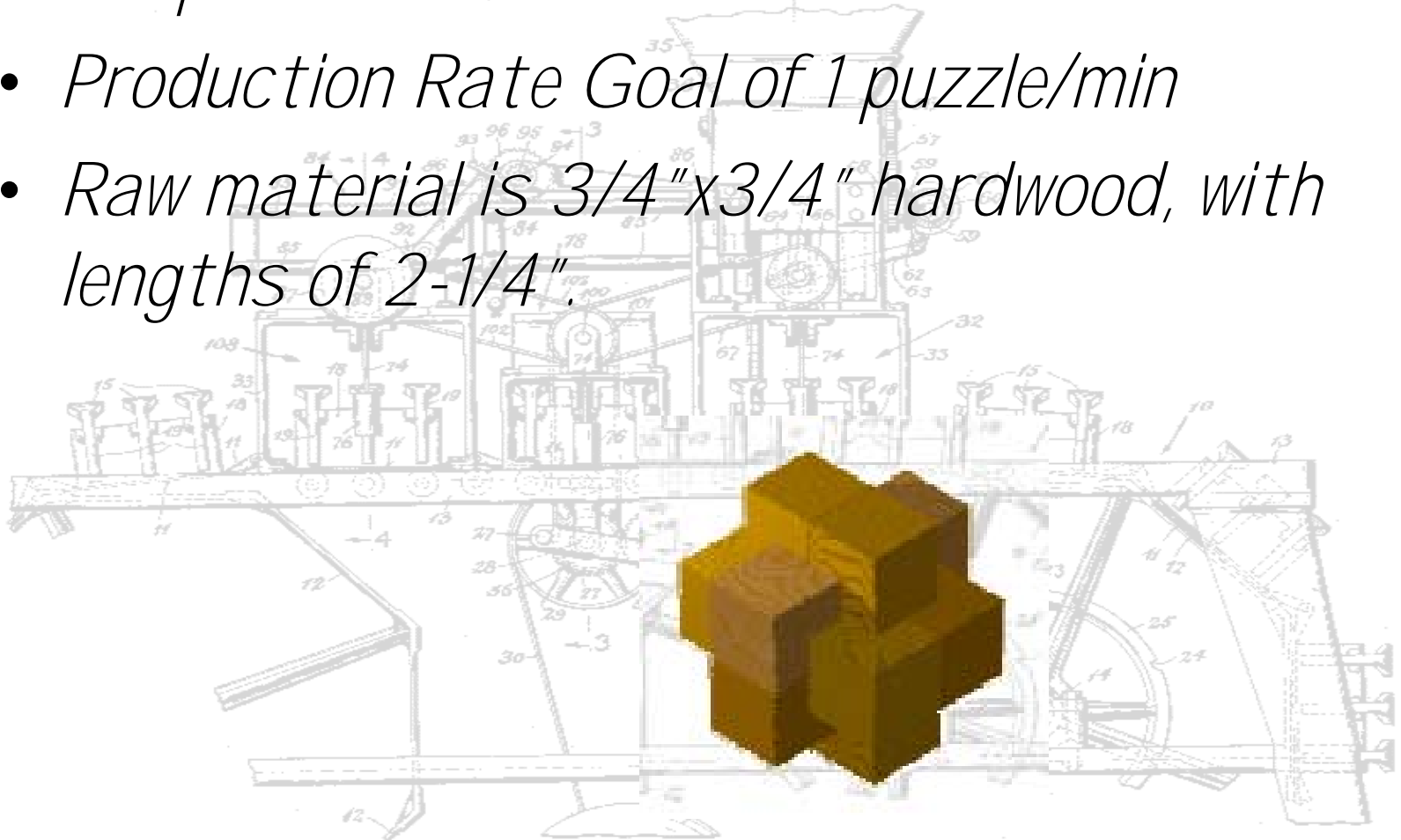
Case History: Forge Industrial

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



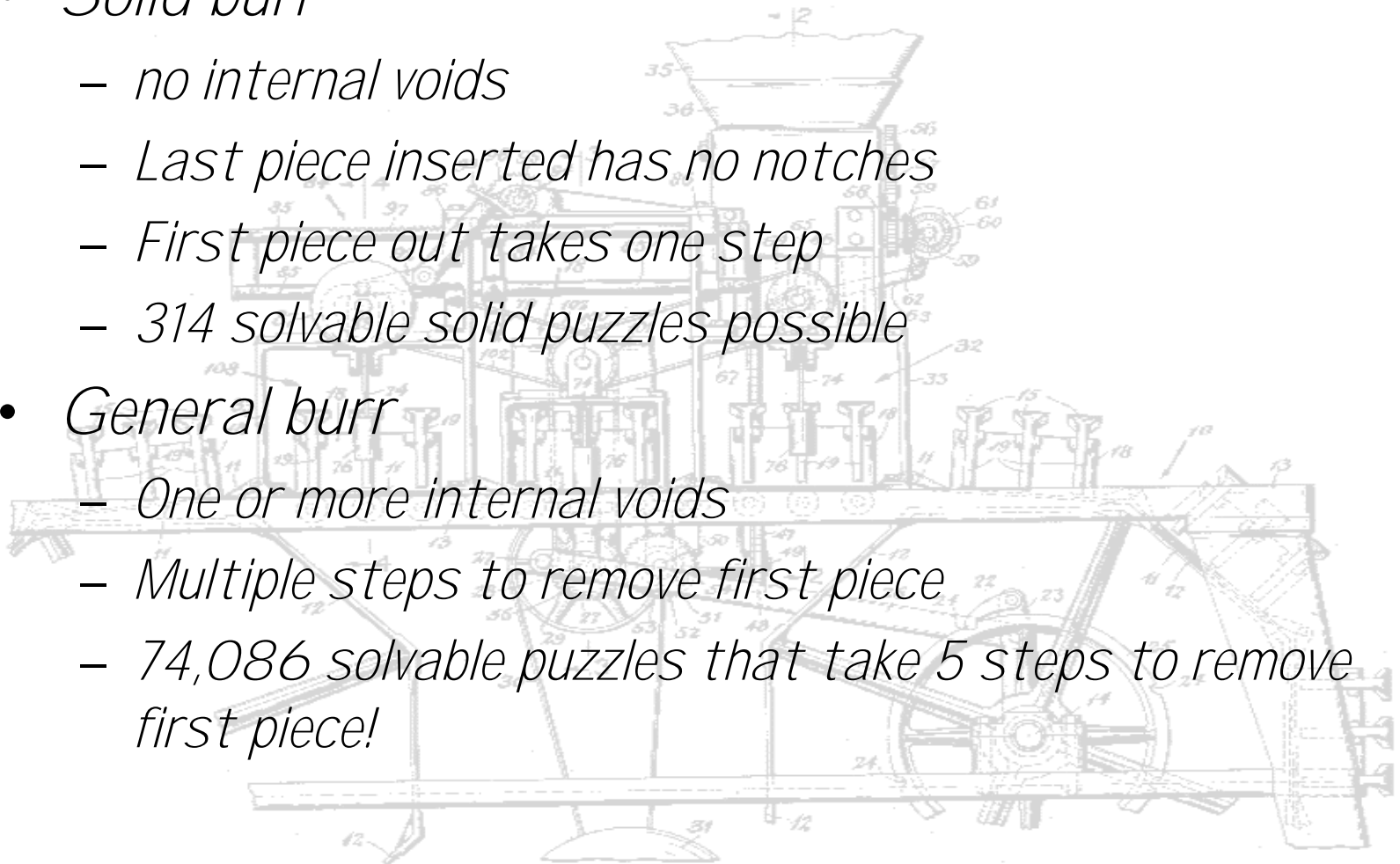
Our Product

- *Six-piece Wooden "Burr" Puzzles*
- *Production Rate Goal of 1 puzzle/min*
- *Raw material is 3/4"x3/4" hardwood, with lengths of 2-1/4".*



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*
 - *74,086 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 all possible solid burrs*
- *IBM Research - Burr Puzzles site:*
<http://www.research.ibm.com/BurrPuzzles>