Industrial involvement in planning for X-FEL (TESLA)

- **Contracts to industry for costing of components**
  - <u>Planning, layout & operation of fabrication facilities for major linac components ("study by industry")</u>
  - Prototype development
- **Cooperation with industry**
  - Feedback from fabrication of TTF components
  - Proposals for cost saving in fabrication
  - Engage new companies in TESLA technology
  - Implementation of EDMS system

Contracts to industry for evaluation of fabrication ("industrial study")

- **Analyze present production of TTF components**
  - Describe present fabrication process
  - Determine cost drivers, critical procedures
  - Define core technology, outsourcing possibility

- **Implementation of mass production methods**
  - Evaluate investment of machinery, tooling, roboting
  - Cost optimize flow of fabrication
  - Describe layout for "core tech" factory

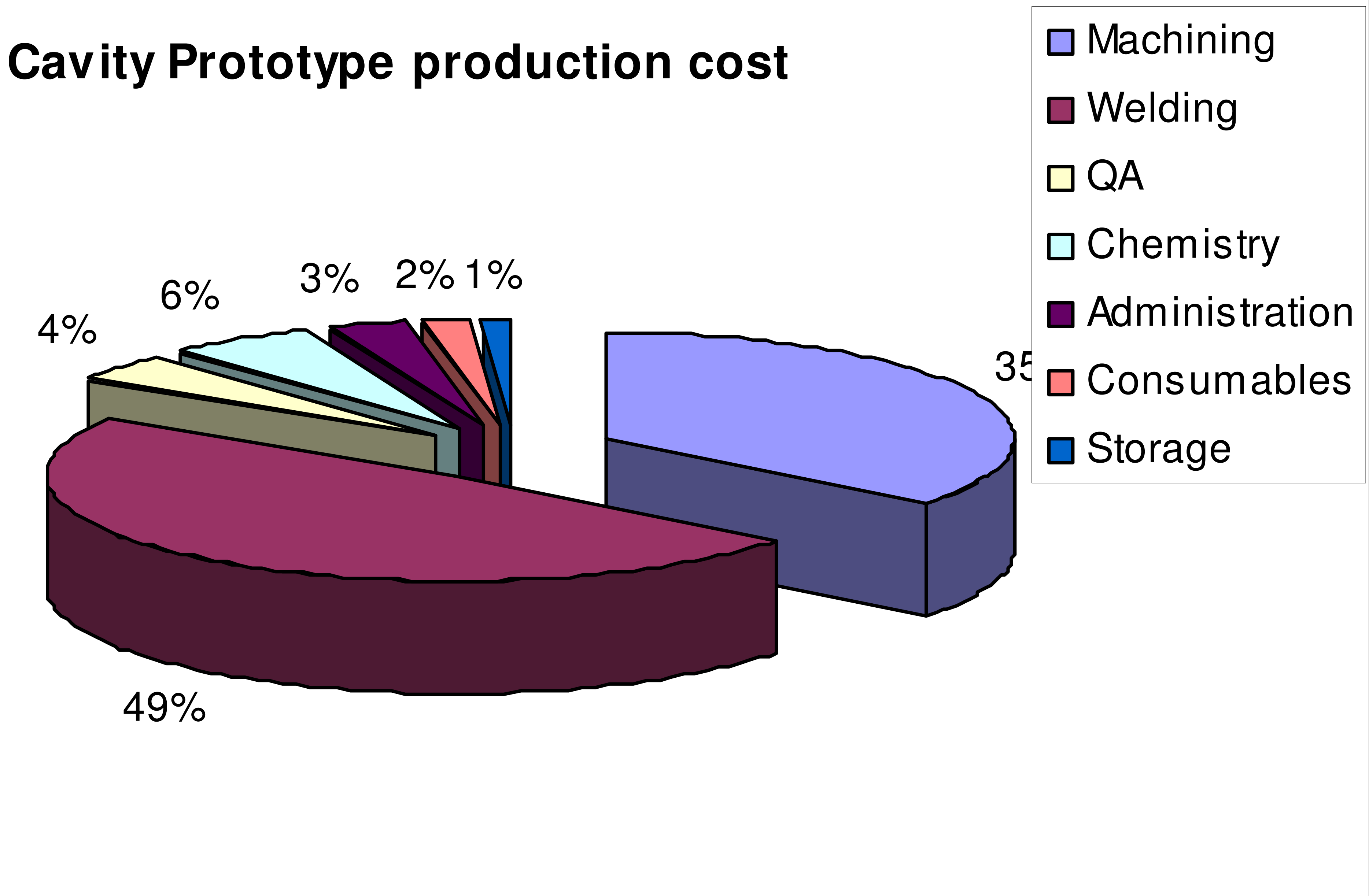
Contracts to industry in cost evaluation, (“industrial study”),cont.

- **Complete planning of new “core tech” factory**
  - Determine costs for buildings, investment, man power, ramp up & production & ramp down, overhead, consumables, QC,…
  - Get bits for outsourced parts
  - Sum up total cost of component fabrication

Industrial evaluations

- **Cavity fabrication (welding) for TESLA**
  - Noell (Dornier- Astrium),
- **Cavity preparation and module assembly**
  - Noell,
  - ACCEL
- **Niobium production for TESLA**
  - Noell (W.C.Heraeus)
  - H.C.Stark (under test sheets production)

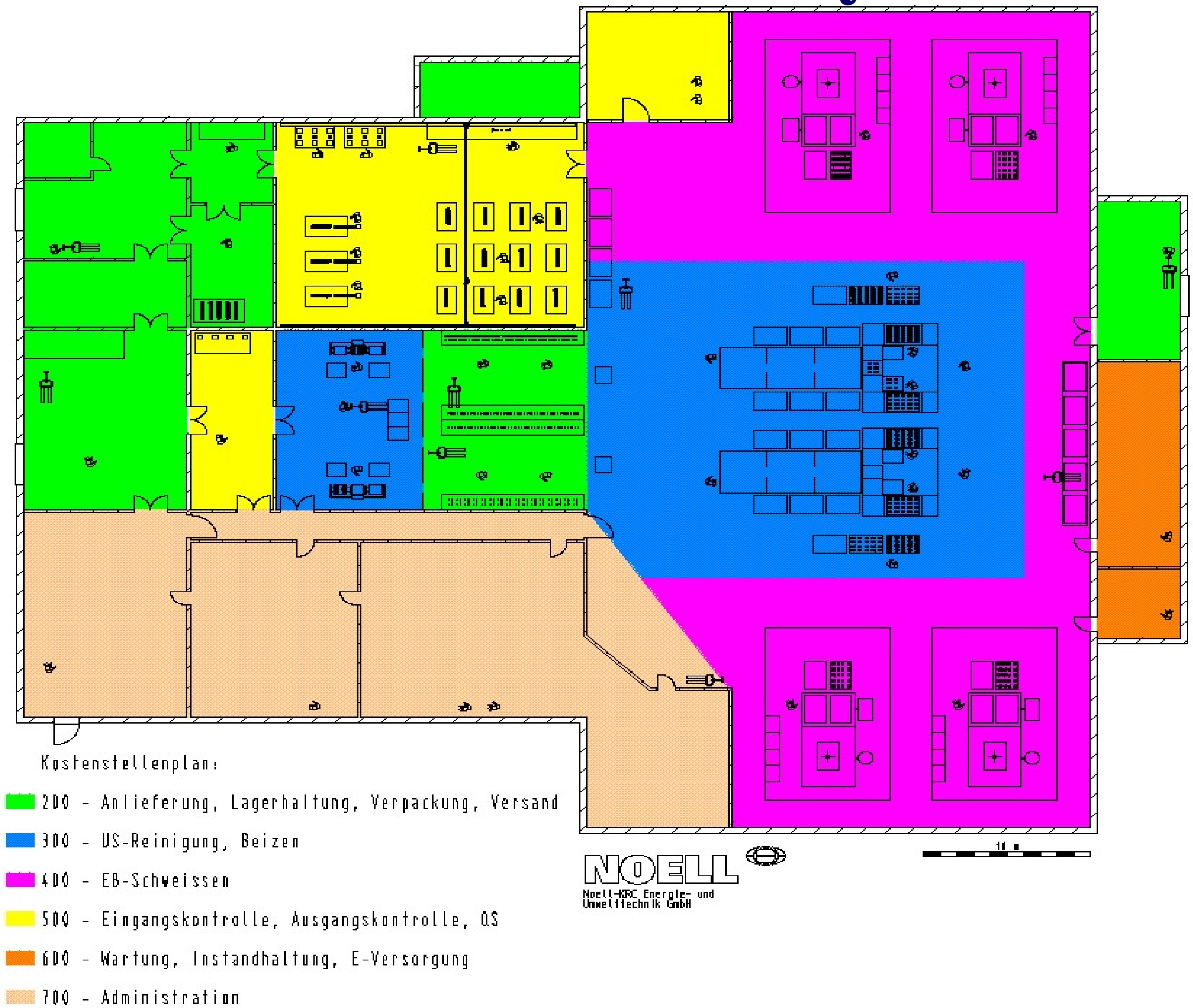
Standard Cavity Production, welding

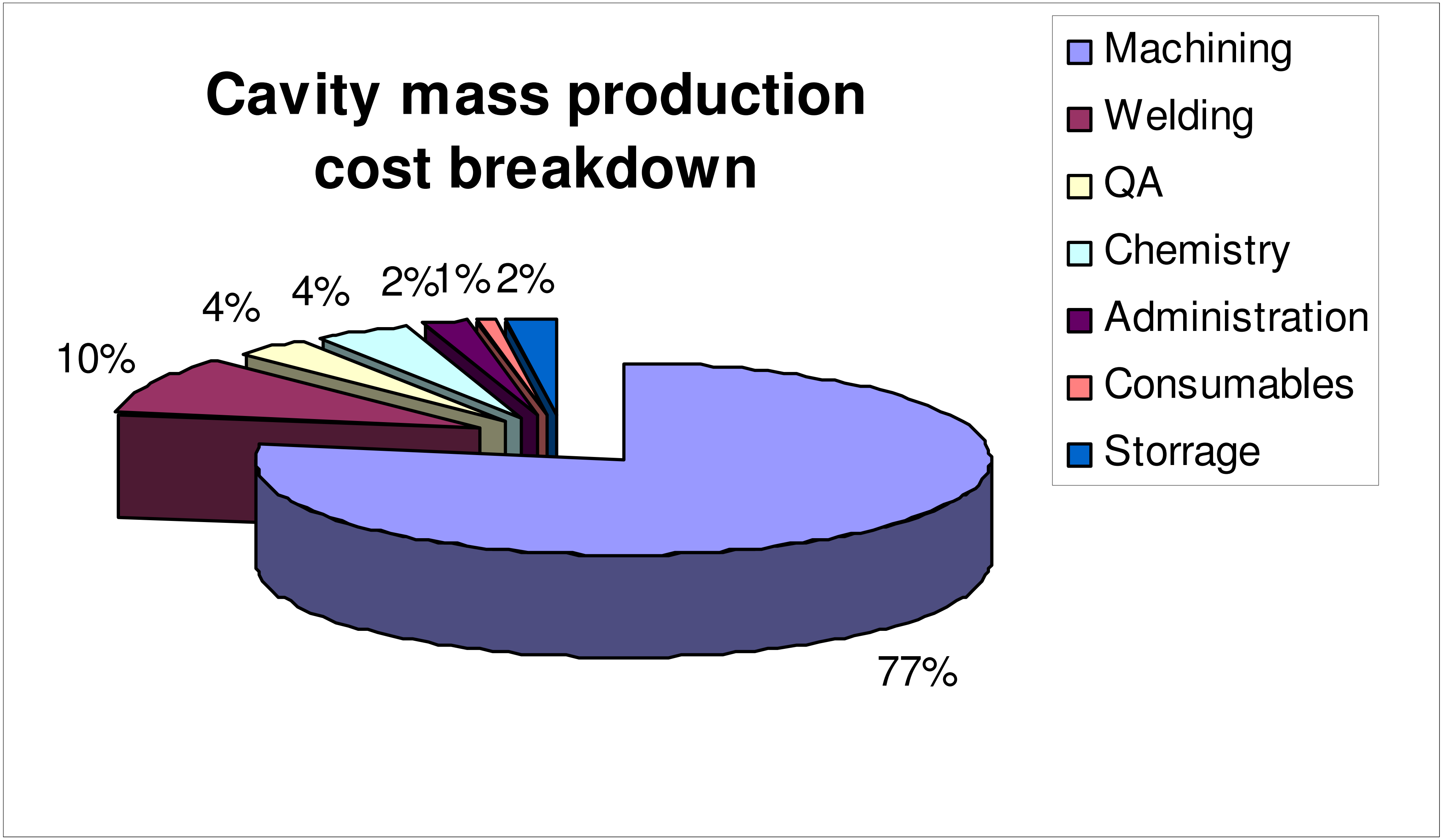

Cavity Prototype production cost
Machining
Welding
QA
Chemistry
Administration
Consumables
Storage
4%
6%
3%
2%
1%
35
49%

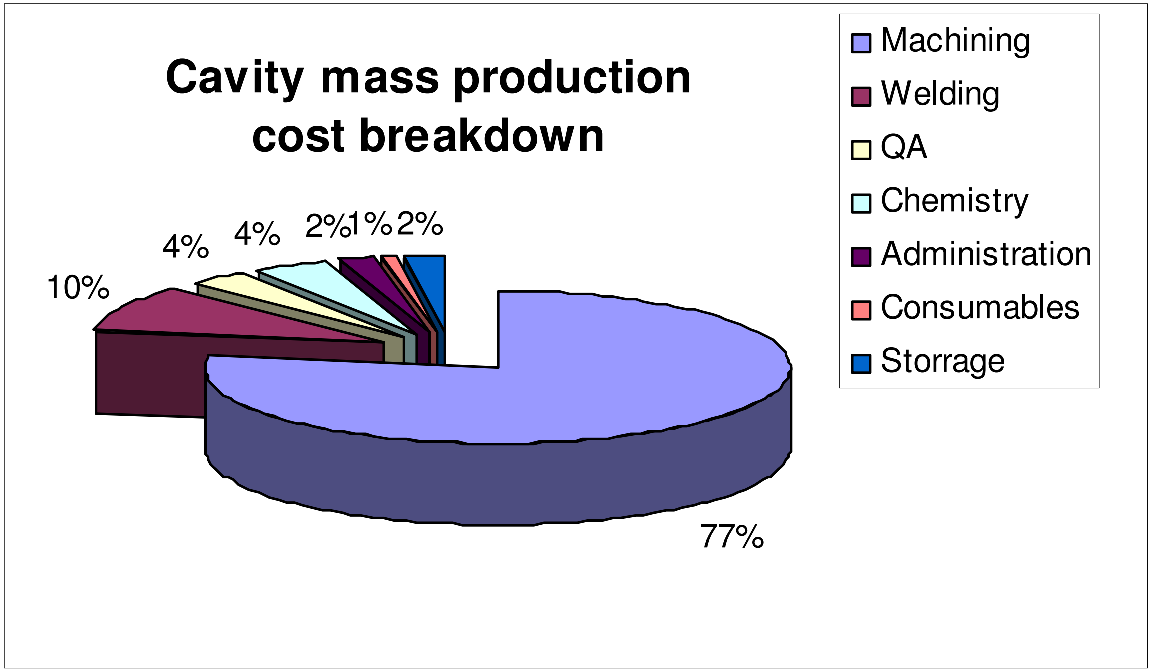
Reduction of fabrication cost

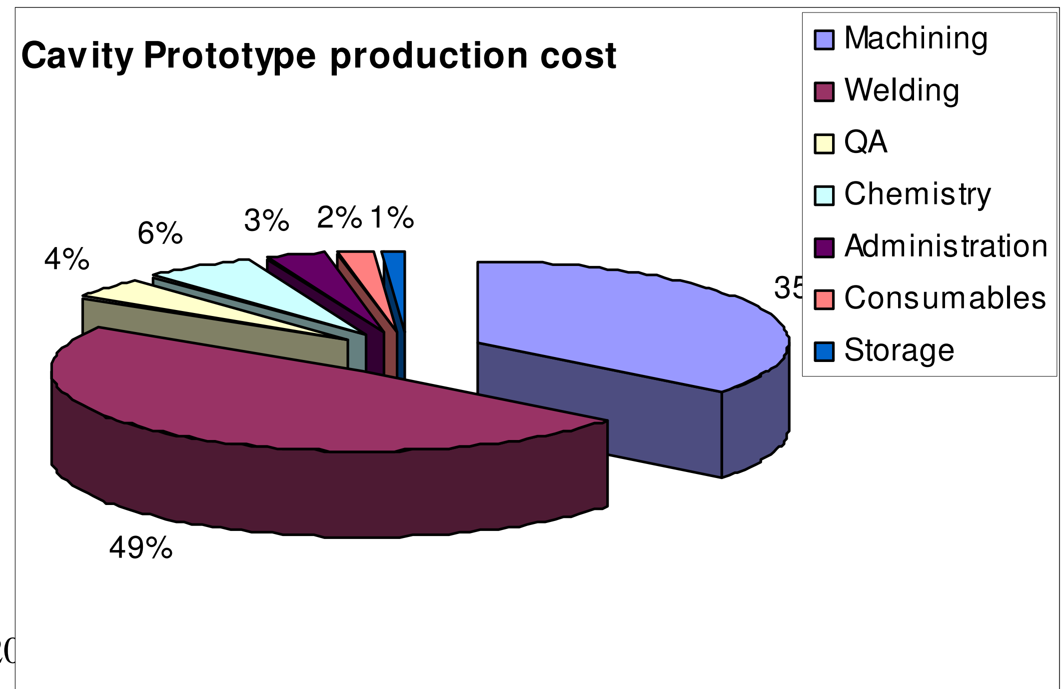
- **3 chamber welding machine:**
  - Pump down and cool down in separate chamber
  - Welding in middle chamber
- Tooling for welding many parts in one cycle
- **Outsource machining of parts**

Production facility




Cavity mass production
cost breakdown
10%
4%
4%
2%
1%
2%
77%
Machining
Welding
QA
Chemistry
Administration
Consumables
Storrage


Cavity mass production cost breakdown
10%
4%
4%
2%
1%
2%
77%
Machining
Welding
QA
Chemistry
Administration
Consumables
Storrage


Cavity Prototype production cost
4%
6%
3%
2%
1%
49%
Machining
Welding
QA
Chemistry
Administration
Consumables
Storage

Cavity preparation, Cryostat and Assembly

- X-FEL cryo-modules are based on the 12 m TTF modules
- Two industrial investigations
  - Cavity preparation and module assembly by
    - Babcock Noell Nuclear
  - Vacuum vessel and cold mass by
    - ZANON

Cavity Preparation; String and Module Assembly

Cavity preparation, Cryostat and Assembly, cont.

- Major cost drivers are
  - Cavity heat treatment (1400°C) :
    investment and operation costs
  - Module assembly:
    man power

→ New study under preparation to optimize the cryostat assembly procedure

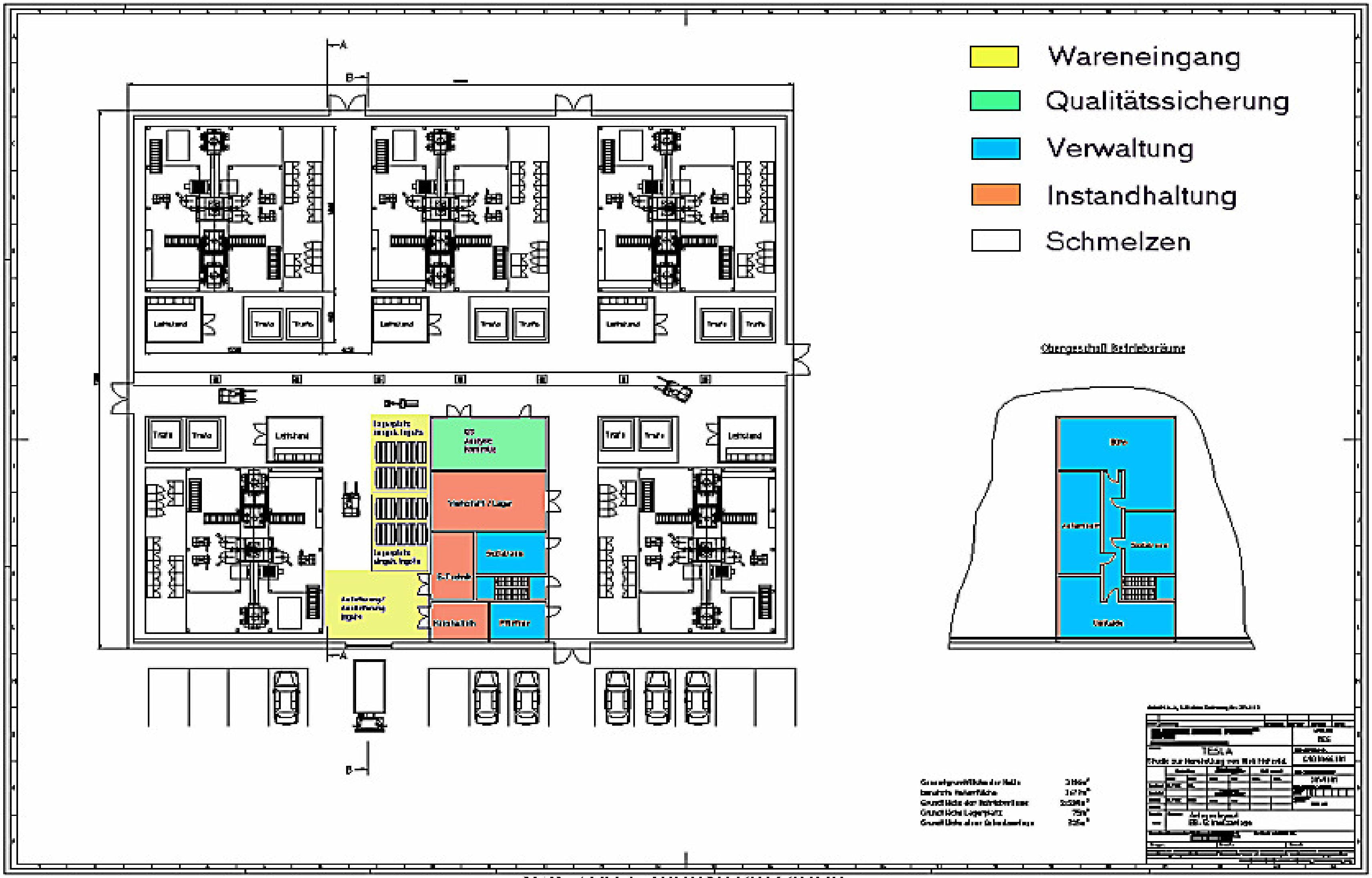
Niobium for ILC (TESLA)

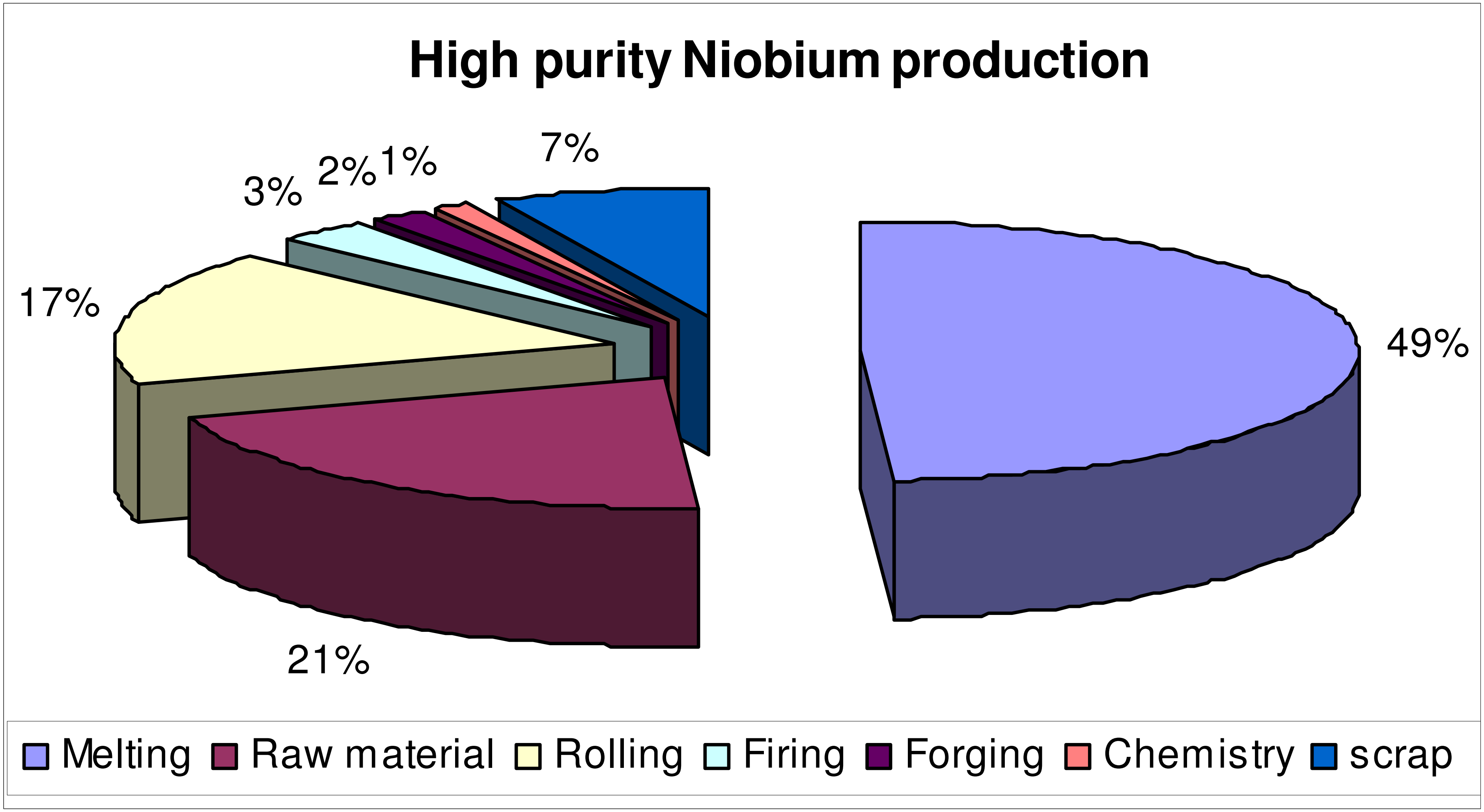
- Production of 500 tons of high purity Niobium (RRR300) in 3 years
  - Total World production of Nb is about 40.000tons
  - But critical step for high purity Niobium is high vacuum electron beam melting
  - Only one company (Wah Chang) has melting capacity for total demand, two other (Tokyo Denkai, Heraeus) can make 30 %

Niobium for TESLA, cont.

- Offer for large quantity of Niobium for TESLA showed only moderate mass production saving. Why??
- High quality of Niobium is crucial for TESLA cavities
  - In depth understanding of production is desirable
- ==> Planning, layout & operation of a new fabrication facility
  - Defined all process parameters
  - Planning for a new melting company
  - Total cost evaluation

Produktionsanlage zum Umschmelzen




High purity Niobium production
7%
3%
2%
1%
17%
49%
21%
Melting
Raw material
Rolling
Firing
Forging
Chemistry
scrap

Conclusion of Nb production evaluation

- **Overall financial effort is 88% of TDR costs**
- **Costs are dominated by melting investment, longer production time could lower the costs**