The engineer’s impact on product cost and success in business

Helping increase your capabilities
I don’t give presentations to large audiences and this is a new experience to me

As long as we are here, use the time wisely and ask questions
Areias Background

- Founded 1999 and located in Scotts Valley, CA
  - Started with $2,000.00 in my garage
- Due to a strong relationship with our customers, we have experienced excellent sales growth in the last few years
- Contract design and manufacturing for the following industries:
  - Capital Equipment
  - Instrumentation
  - Industrial Electronics
  - Medical Electronics
My background

- Born and raised in Brazil
- Came to US in 1986 on a surf trip
- Graduated from Cal-Poly SLO with a BS in Aero in 1993
- Attended MSME program as SJSU until 1999
- Married, 2 children
- Still surf a bunch
I’m here to discuss

- How an engineer helps reduce product costs.
- How one figures out what it will cost to take a product from prototype into production.
- How to manage these costs so that you can make a profit as a business.
Costing a product

- Product costs are based on:
  - Total cost
    - Parts cost
      - Purchased parts
      - In-house manufactured parts
    - Labor cost
      - Labor time
      - Labor rate
      - Test
    - Overhead
      - Accounting
      - Purchasing
      - Inventory
      - Quality Control
      - Sales
    - Other
      - Software
      - Equipment
      - Furniture
      - Furniture
      - Sales
    - Engineering cost
      - Design time
      - Design rate
    - Regulatory cost
      - Prototypes
      - Regulatory body fees
    - Raw materials cost
      - Burden
      - Labor cost
      - Equipment cost
    - Burden
    - Labor cost
    - Equipment cost
Costing a product

- Engineer’s influence on costs
  - Specifying easy to obtain parts
  - Designing easy to manufacture parts
  - Becoming efficient at software
Engineer’s influence on costs

- Specifying easy to obtain parts
Engineer’s influence on costs

- Specifying easy to obtain parts, cont.
  - Purchased parts: if easier to find, they should be cheaper.
  - Burden: if parts are easier to find, they will be easier to buy, which will reduce the cost of bringing them in.
  - Accounting: the more suppliers accounting has to deal with the more expensive it is to manufacture the product.
    - If a part is easier to find, the more likely that a current supplier will have it.
Engineer’s influence on costs

- Specifying easy to obtain parts, cont.
  - Purchasing: same as accounting.
  - Inventory: if multiple suppliers have the part, there isn’t a need to maintain minimum inventory, which in turn reduces cash outflow.
  - Prototypes: same as purchased parts
  - Regulatory body fees: if the part is easily available, it is likely that the regulatory body has already tested it thus reducing the project time.

- UL
- CE
- FDA
- FCC
Engineer’s influence on costs

- Designing easy to manufacture parts

Diagram showing cost breakdown:
- Total cost
  - Parts cost
    - Purchased parts
    - Burden
    - In-house manufactured parts
  - Labor cost
    - Labor time
    - Labor rate
    - Test
  - Overhead
    - Accounting
    - Purchasing
    - Inventory
    - Quality Control
    - Sales
  - Other
    - Software
    - Equipment
    - Furniture
    - Test
  - Engineering cost
    - Design time
    - Design rate
  - Regulatory cost
    - Prototypes
    - Regulatory body fees

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Engineer’s influence on costs

- Designing easy to manufacture parts, cont.
  - Labor Cost: if it is easier to manufacture it should take less labor, thus reducing labor costs.
  - Equipment cost: if easier to manufacture, it is likely it will take simpler equipment.
  - Inventory: if easier to manufacture, there less likely it is that minimum inventory will be needed, thus reducing cash outflow.
Engineer’s influence on costs

- Designing easy to manufacture parts, cont.
  - Prototypes: a combination of labor cost and equipment cost.
  - Regulatory body fees: the regulatory body members are also engineers.
    - The simpler the part, the easier it is for them to understand, thus the shorter the project time.
Engineer’s influence on costs

- Becoming efficient at software

![Cost Breakdown Diagram](image-url)

- Total cost
  - Parts cost
    - Purchased parts
    - Burden
    - In-house manufactured parts
  - Labor cost
    - Labor time
    - Labor rate
    - Test
  - Overhead
    - Accounting
    - Purchasing
    - Inventory
    - Quality Control
    - Sales
  - Other
    - Engineering cost
      - Software
      - Equipment
      - Furniture
      - Design time
      - Design rate
    - Regulatory cost
      - Prototypes
      - Regulatory body fees

Helping increase your capabilities
Engineer’s influence on costs

- Becoming efficient at software, cont.
  - Labor time: an assembler needs properly written assembly instructions. The expectation is that every detail is shown on the print.
  - Design time: the more efficient one is at software, the shorter the design time.
  - Prototype: with proper software usage, one can send files to prototyping without having to detail prints.
Engineer’s influence on costs

- Becoming efficient at software, cont. (side note)
  As and Engineer/CEO I regularly use the following

  - Solidworks
    - Solid modeling
  - Autocad
    - Work instructions
    - Wiring diagrams
  - Word
    - Proposals
    - Documents
  - Excel
    - Cost analysis
    - Company performance

  - MRP software
    - Material requirement planning (BOM)
  - Access databases
    - Generate simple database
  - Crystal reports
    - Write my own reports to extract data from database
  - OrCad schematic software
  - PowerPoint
    - Presentation
Prototype cost

Design cost
- Software
- Design time
- Design rate
- Furniture
- Equipment

Purchased parts
- Part cost
- Purchasing
- Shipping
- Accounting
- Inventory
- Excess inventory

Manufactured parts
- Documenting cost
- Raw materials cost
- Tooling cost
- Quality Control
- Purchasing
- Shipping
- Accounting
- Inventory
- Excess inventory

Assembly
- Assembly time
- Tools
- Furniture
- Equipment

Purchased parts
- Purchasing
- Shipping
- Accounting
- Excess inventory

Manufactured parts
- Tooling cost
- Quality Control
- Purchasing
- Shipping
- Accounting
- Inventory
- Excess inventory

Assembly
- Tools
- Furniture
- Equipment

Prototype cost

Areias Systems, Inc.
Electro-Mechanical Design, Prototyping, and Manufacturing

Helping increase your capabilities
Prototype cost

The are a couple of ways to generate a prototype (not limited to)

- Have an idea, build a company and then build a prototype.
  - Expensive and more likely to fail
  - Depending on complexity of product it is the only way to do

- Have an idea, build a prototype and then build a company.
  - Takes a different kind of person
    - Long work hours
    - Risky
    - No deep pockets (usually)
  - Limited complexity
  - Idea person usually moves on from product design to company management
Moving to production

(this is when things get complicated)

Types of Products

- Consumer product
  - UL
  - CE
  - Radio Frequency?
    - FCC
  - Medical?
    - FDA
      - Class I
      - Class II
      - Class III

- Semiconductor equipment
  - UL
  - CE

- Industrial equipment
  - UL
  - CE

- Automotive components
  - UL
  - CE

- Military components
  - UL
  - CE
Engineering concerns when moving to production

- Consumer product
  - All consumer products need to be tested by the proper testing agency prior to sale.
  - Once the product is approved, there is a need to find:
    - Manufacturer
      - In-house
        - Need to develop infrastructure
      - Outsource
        - Whole
        - Sub-assemblies
    - Outsource overseas (volume dependent)
      - Whole
      - Sub-assemblies
- Marketing
- Distribution channels
Engineering concerns when moving to production

- Good communication skills

- Good documentation generation skills
  - Complete Bill of Materials (BOM)
  - Understandable drawings
  - Understandable assembly instructions

- Good problem handling and solving skills
  - Parts out of tolerance
  - Parts not available and need to find a replacement
  - Poor craftsmanship
  - Assembly times
“Engineering” is not only design it is

Project starts

Determine customer requirements

Determine product requirements

Determine regulatory requirements

Concept design (at least 2)

Design review

Is customer satisfied?

Yes

No

Design

Design review

Is customer satisfied?

Yes

No

Start Prototyping

Create Bill of Materials

"Buy" off the shelf parts

Order the parts

"Buy" custom parts

Generate documentation

Order the parts

"Make" parts

Generate documentation

Order raw material

Support vendor

Support manufacturing

Receive

Assemble prototype

Did it work?

Yes

Design review

Is customer satisfied?

Yes

No

Work with regulatory agency

Did it pass?

Yes

Generate Documentation package

Support New Product Introduction group

Support Purchasing

Support Manufacturing

Product
“Engineering” is not only design it is… and I love it!