CS 5331-003: Special Problems in Computer Science: Embedded Systems

Instructor: Dr. Morshed, Associate Professor

Assignment-1: Product Market

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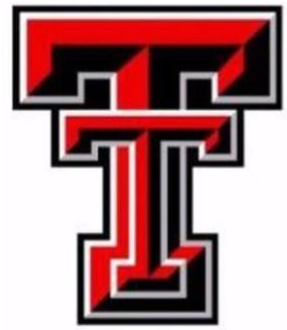

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Problem 1 (40%)

For an embedded system product with a market life of 60 months, compare the revenues for an on-time product and a delayed by 10 months product. Assume the revenue peak is $100K. Use the triangular approximation model for the market window. Also, determine the percentage loss of revenue for the delayed product.

Solution:

Given values,

Market Life, T = 60 months

Revenue Peak, P = $100K

Delayed Time, D = 10 months

Revenue for the on-time product:

R = ½ * P * T

R = ½ * 100000 * 60

= 3000000

= 3000K

Revenue for the delayed product:

R = P/T * (T/2 - D) * (T - D)

R = (100000/60) * (60/2 - 10) * (60 - 10)

= (1000000/60) * 20 * 50

= 1666666.667

= 1666.67K

Percentage of Revenue Loss:

%RL = (3TD – 2D^2/T^2) * 100%

%RL = ((3 * 60 * 10) – (2 * 100) / (60 * 60)) * 100

= 400/9

= 44.44%

Problem 2 (60%)

For an embedded system product, the NRE cost, and unit cost are the following for the four technologies:

Technology	NRE expense	Unit cost
Semi-custom VLSI	**$200,000**	**$5**
ASIC	**$50,000**	**$10**
Programmable FPGA	**$15,000**	**$20**
Microcontroller	**$10,000**	**$15**

Solution:

a) Calculate total per-product cost for production volumes of 100, 1k, 10k, and 100k units.

i. 100 Units:

- Semi-Custom VLSI:

  Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

  PPC = ($200000 / 100) + $5
  = $2005

- ASIC:

  Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

  PPC = ($50000 / 100) + $10
  = $510

- Programmable FPGA:

  Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

  PPC = ($15000 / 100) + $20
  = $170

- Microcontroller:

  Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

  PPC = ($10000 / 100) + $15
  = $115

ii. 1K Units:

- Semi-Custom VLSI:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($200000 / 1000) + $5
= $205

- ASIC:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($50000 / 1000) + $10
= $60

- Programmable FPGA:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($15000 / 1000) + $20
= $35

- Microcontroller:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($10000 / 1000) + $15
= $25

iii. 10K Units:

- Semi-Custom VLSI:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($200000 / 10000) + $5
= $25

- ASIC:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($50000 / 10000) + $10
= $15

- Programmable FPGA:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($15000 / 10000) + $20
= $21.5

- Microcontroller:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($10000 / 10000) + $15
= $16

iv. 100K Units:

- Semi-Custom VLSI:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($200000 / 100) + $5
= $7

- ASIC:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($50000 / 100000) + $10
= $10.5

- Programmable FPGA:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

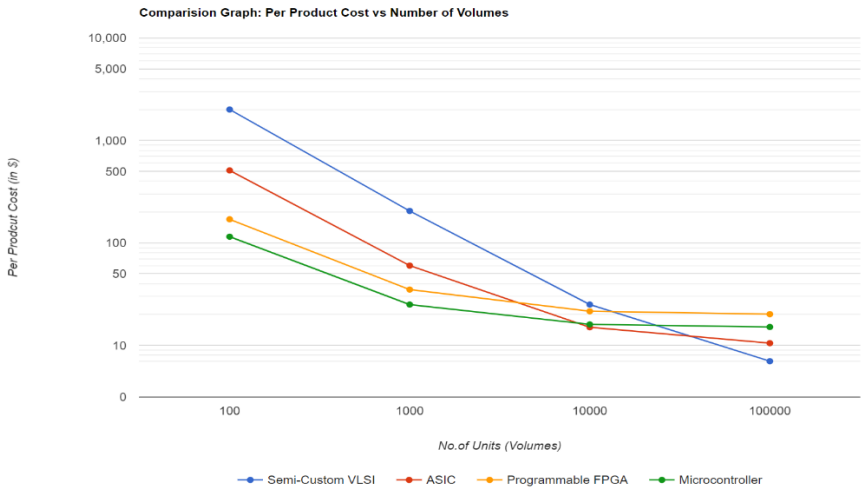
PPC = ($15000 / 100000) + $20
= $20.15

- Microcontroller:

Per-Product Cost = (NRE Cost / Number of units) + Unit Cost

PPC = ($10000 / 100000) + $15
= $15.1

b) Plot these data from (a) in a single graph with log-scale for per-product cost against product volume, and draw fitted lines for each technology. Then, determine the best choice of technologies for these production volumes (100, 1k, 10k, and 100k units) to achieve the lowest per-product cost.



From the above graph, the best choice of technologies for these production volumes (100, 1k, 10k, and 100k units) to achieve the lowest per-product cost:

1. For 100 Units: Microcontroller
2. For 1K Units: Microcontroller
3. For 10K Units: ASIC
4. For 100K Units: Semi-Custom VLSI

c) From the plot in the (b), estimate the range of production volumes for which each of these technologies is financially optimal.

The difference between the two values for a range of each technology and where the value is low provides us with the financially optimal range.

- Semi-Custom VLSI:
  - 100 – 1000 Units:
    Difference = $2005 – $205 = $1800
  - 1000 – 10000 Units:
    Difference = $205 - $25 = $180
  - 10000 – 100000 Units:
    Difference = $25 - $7 = $18 (Financially Optimal)

- ASIC:
  - 100 – 1000 Units:

Difference = $510 – $60 = $450

- 1000 – 10000 Units:
  Difference = $60 - $15 = $45
- 10000 – 100000 Units:
  Difference = $15 - $10.5 = $4.5 (Financially Optimal)

- Programmable FPGA:
  - 100 – 1000 Units:
    Difference = $170 – $35 = $135
  - 1000 – 10000 Units:
    Difference = $35 - $21.5 = $35
  - 10000 – 100000 Units:
    Difference = $21.5 - $20.15 = $1.35 (Financially Optimal)

- Microcontroller:
  - 100 – 1000 Units:
    Difference = $115 – $25 = $90
  - 1000 – 10000 Units:
    Difference = $25 - $16 = $9
  - 10000 – 100000 Units:
    Difference = $16 - $15.1 = $0.9 (Financially Optimal)

(OR)

For the range of "10K – 100K" units, all the technologies have the lowest per-product cost at 1,00,000 units (100K units).

So, '10K – 100K' provides us with the financially optimal range for all the technologies.