

School of Mechanical Engineering

Course Code : BTME3056

Course Name: Product Design

UNIT 6

Product Development Economics

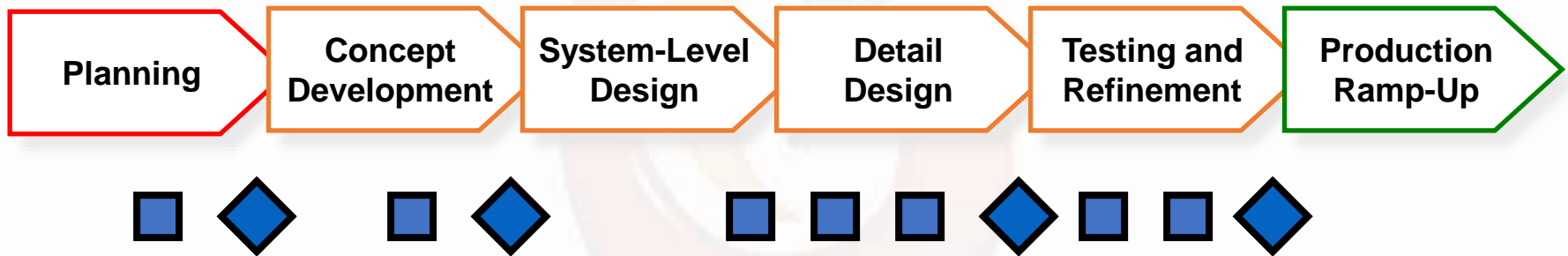
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Product Development Economics

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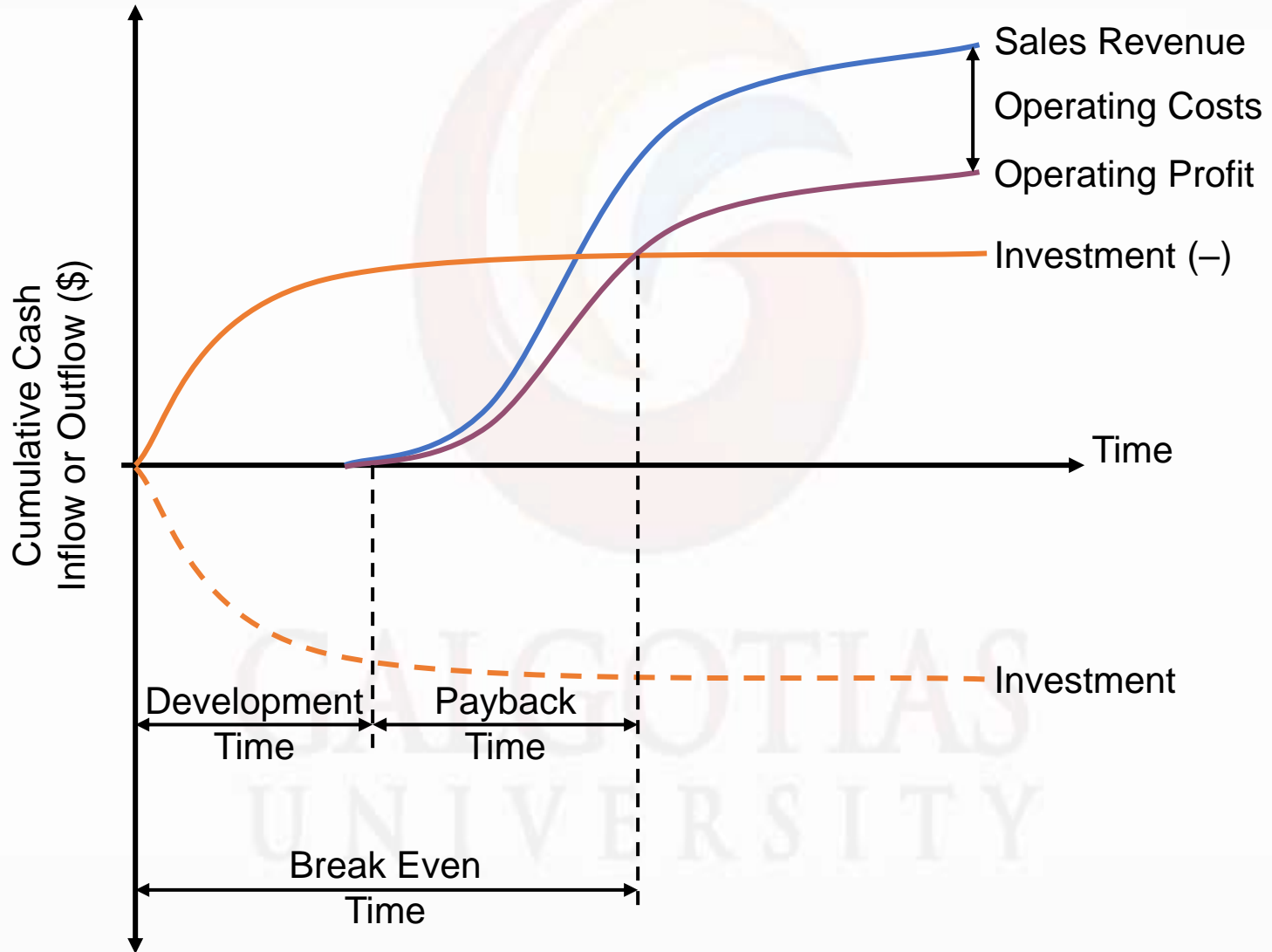
Product Development Process



Project Financial Analysis

- ◆ Go/No-Go Decision Gates
- Sensitivity and Trade-off Analysis

Product Development Cash Flow



Questions to Answer with PD Project Financial Modeling

- Will the project be profitable enough to pay back the initial investment?
- What if our financial projections are wrong?
- What is the worst case for breakeven?
- Is it worth it to invest in more expensive [tooling, design, packaging, recycling]?
- Can we sell machines at a loss in order to get a stream of ongoing revenue from sales of [consumables, renewables, service]?
- What is the cost (value) of recycling?
- What if a new competitor joins the market?

Net Present Value

$$\text{NPV} = \sum_{\text{periods}} \frac{\text{period cash flow}}{(1 + \text{discount rate})^{\text{period}}}$$

$$\text{NPV} = \sum_{i=1}^N \frac{C_i}{(1+r)^i}$$

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Typical Inputs for NPV Analysis

- Development and testing cost (+ timing)
- Tooling investment (+ timing)
- Ramp-up cost and timing
- Marketing and support (+ timing)
- Sales volume (+ lifetime)
- Unit production cost
- Unit revenue
- Recycling cost or revenue
- Discount rate

Base-Case Model Inputs

<u>Model Inputs</u>	<u>Model Values</u>
Sales Volume Growth, machines	15% per year
Initial Sales Volume, machines	200000 units/year
Initial Retail Price, machines	\$260 per unit
Distributor + Retail Margin	40%
Retail Price Growth, machines	-10% per year
Sales Volume, capsules	400 capsules/machine each year
Initial Retail Price, capsules	\$0.60 per unit <input checked="" type="checkbox"/> Capsule Sales
Retail Price Growth, capsules	5% per year
Product Development	5.0 \$M over 1 year
Equipment and Tooling	4.0 \$M over 1/2 year
Production Ramp-up	2.0 \$M over 1/2 year
Market Launch	10.0 \$M over 1/2 year
Marketing and Support	5.0 \$M/year
Production Cost, machines	\$55 per unit
Production Overhead	1.0 \$M/year
Production Cost, capsules	\$0.050 per unit
Recycling Rate, capsules	20% <input type="checkbox"/> Recycling
Recycling Overhead	0.50 \$M/year
Recycling Cost, capsules	\$0.010 per unit
Recycling Recovery Value	\$0.0010 per unit (1g Al @ \$1/kg)
Discount Rate	7%

Coffee Machines Only

Values in \$M (except where noted)	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Sales, machines					6.24	7.80	7.80	9.36	6.46	8.07	8.07	9.69	6.68	8.36	8.36	10.03
<i>Sales Volume, machines (units/qtr)</i>					40,000	50,000	50,000	60,000	46,000	57,500	57,500	69,000	52,900	66,125	66,125	79,350
<i>Unit Wholesale Revenue, machines (\$/unit)</i>					156	156	156	156	140	140	140	140	126	126	126	126
Total Revenue					6.24	7.80	7.80	9.36	6.46	8.07	8.07	9.69	6.68	8.36	8.36	10.03
Product Development	1.25	1.25	1.25	1.25												
Equipment and Tooling			2.00	2.00												
Production Ramp-up				1.00	1.00											
Marketing and Support				6.25	6.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Production, machines					2.45	3.00	3.00	3.55	2.78	3.41	3.41	4.05	3.16	3.89	3.89	4.61
Total Costs	1.25	1.25	3.25	10.50	9.70	4.25	4.25	4.80	4.03	4.66	4.66	5.30	4.41	5.14	5.14	5.86
Period Cash Flow	-1.25	-1.25	-3.25	-10.50	-3.46	3.55	3.55	4.56	2.43	3.41	3.41	4.39	2.27	3.22	3.22	4.16
Period Present Value	-1.23	-1.21	-3.09	-9.80	-3.17	3.20	3.14	3.97	2.08	2.87	2.82	3.57	1.82	2.52	2.48	3.15
Net Present Value	13.1															

Coffee Machines and Capsules

Values in \$M (except where noted)	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Sales, machines					6.24	7.80	7.80	9.36	6.46	8.07	8.07	9.69	6.68	8.36	8.36	10.03
<i>Sales Volume, machines (units/qtr)</i>					40,000	50,000	50,000	60,000	46,000	57,500	57,500	69,000	52,900	66,125	66,125	79,350
<i>Unit Wholesale Revenue, machines (\$/unit)</i>					156	156	156	156	140	140	140	140	126	126	126	126
Sales, capsules					1.44	3.24	5.04	7.20	9.30	11.47	13.65	16.25	19.17	21.79	24.42	27.56
<i>Sales Volume, capsules (units/qtr)</i>					4,000,000	9,000,000	14,000,000	20,000,000	24,600,000	30,350,000	36,100,000	43,000,000	48,290,000	54,902,500	61,515,000	69,450,000
<i>Unit Wholesale Revenue, capsules (\$/unit)</i>					0.36	0.36	0.36	0.36	0.38	0.38	0.38	0.38	0.40	0.40	0.40	0.40
Total Revenue					7.68	11.04	12.84	16.56	15.76	19.55	21.72	25.94	25.85	30.15	32.77	37.59
Product Development	1.25	1.25	1.25	1.25												
Equipment and Tooling			2.00	2.00												
Production Ramp-up				1.00	1.00											
Marketing and Support				6.25	6.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Production, machines					2.45	3.00	3.00	3.55	2.78	3.41	3.41	4.05	3.16	3.89	3.89	4.61
Production, capsules					0.20	0.45	0.70	1.00	1.23	1.52	1.81	2.15	2.41	2.75	3.08	3.47
Total Costs	1.25	1.25	3.25	10.50	9.90	4.70	4.95	5.80	5.26	6.18	6.47	7.45	6.82	7.88	8.21	9.34
Period Cash Flow	-1.25	-1.25	-3.25	-10.50	-2.22	6.34	7.89	10.76	10.50	13.37	15.25	18.50	19.03	22.26	24.56	28.25
Period Present Value	-1.23	-1.21	-3.09	-9.80	-2.04	5.71	6.99	9.37	8.98	11.24	12.60	15.02	15.19	17.46	18.93	21.41
Net Present Value	125.5															

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Model Uncertainty

Model Inputs	Model Values
Sales Volume Growth, machines	15% per year
Initial Sales Volume, machines	200000 units/year
Initial Retail Price, machines	\$260 per unit
Distributor + Retail Margin	40%
Retail Price Growth, machines	-10% per year
Sales Volume, capsules	400 capsules/machine each year
Initial Retail Price, capsules	\$0.60 per unit <input type="checkbox"/> Capsule Sales
Retail Price Growth, capsules	5% per year
Product Development	5.0 \$M over 1 year
Equipment and Tooling	4.0 \$M over 1/2 year
Production Ramp-up	2.0 \$M over 1/2 year
Market Launch	10.0 \$M over 1/2 year
Marketing and Support	5.0 \$M/year
Production Cost, machines	\$55 per unit
Production Overhead	1.0 \$M/year
Production Cost, capsules	\$0.050 per unit

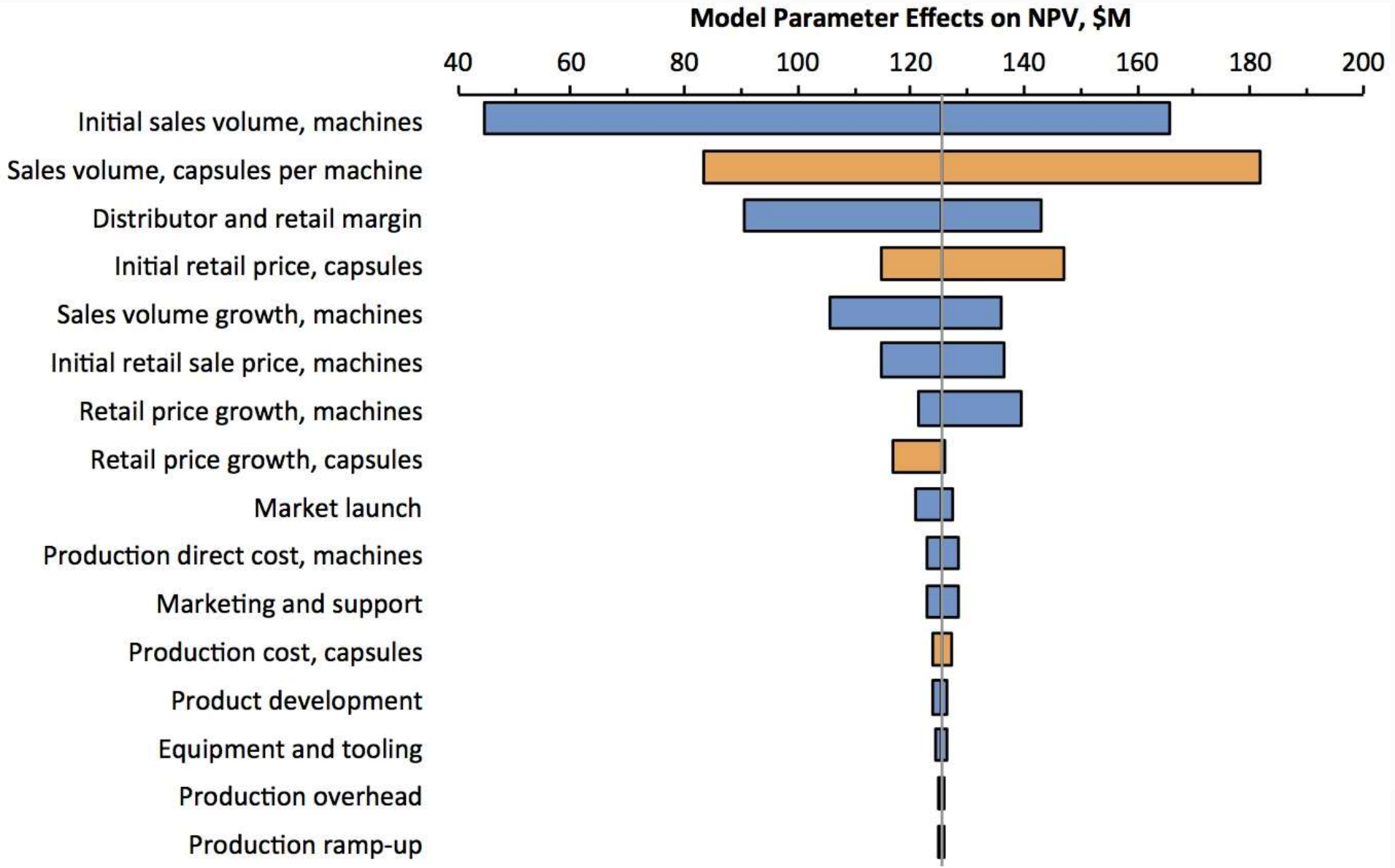
Uncertainty of Model Values		
Base	Worst	Best
15%	-5%	25%
200000	100000	250000
\$260	\$225	\$295
40%	50%	35%
-10%	-15%	5%
400	250	600
\$0.60	\$0.55	\$0.70
5%	0%	5%
5.0	7.0	4.0
4.0	5.0	3.0
2.0	2.5	1.5
10.0	15.0	8.0
5.0	6.0	4.0
\$55	\$60	\$50
1.0	1.2	0.8
\$0.050	\$0.055	\$0.045

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Sensitivity Analysis – with capsules

		Uncertainty of Model Values			with Capsules	
		Base	Worst	Best	Base NPV \$125.5M	
Model Inputs	Model Values				Worst	Best
Sales Volume Growth, machines	15% per year	15%	-5%	25%	105.9	136.1
Initial Sales Volume, machines	200000 units/year	200000	100000	250000	44.8	165.9
Initial Retail Price, machines	\$260 per unit	\$260	\$225	\$295	114.7	136.4
Distributor + Retail Margin	40%	40%	50%	35%	90.6	143.0
Retail Price Growth, machines	-10% per year	-10%	-15%	5%	121.2	139.4
Sales Volume, capsules	400 capsules/machine each year	400	250	600	83.4	181.7
Initial Retail Price, capsules	\$0.60 per unit <input checked="" type="checkbox"/> Capsule Sale	\$0.60	\$0.55	\$0.70	114.8	147.1
Retail Price Growth, capsules	5% per year	5%	0%	5%	116.8	125.5
Product Development	5.0 \$M over 1 year	5.0	7.0	4.0	123.6	126.5
Equipment and Tooling	4.0 \$M over 1/2 year	4.0	5.0	3.0	124.6	126.5
Production Ramp-up	2.0 \$M over 1/2 year	2.0	2.5	1.5	125.1	126.0
Market Launch	10.0 \$M over 1/2 year	10.0	15.0	8.0	120.9	127.4
Marketing and Support	5.0 \$M/year	5.0	6.0	4.0	122.8	128.3
Production Cost, machines	\$55 per unit	\$55	\$60	\$50	122.7	128.4
Production Overhead	1.0 \$M/year	1.0	1.2	0.8	125.0	126.0
Production Cost, capsules	\$0.050 per unit	\$0.050	\$0.055	\$0.045	123.9	127.2

Tornado Chart Displays Uncertainty Analysis





Nespresso
Capsule
Recycling

NESPRESSO.

Recycling Decision

- Recycling costs
 - Infrastructure
 - Take-back program
 - Marketing activity
- Recycling benefits
 - Environmental impact
 - Materials recovery
 - Sales



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References

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2. Stephen C. Armstrong (2005), Engineering and Product development Management– The Holostic Approach, Cambridge University Press, ISBN: 978-0-521-01774-9.
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Thank you

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