VNIVERSITAT DE VALÈNCIA

Facultat d'Economia

DEGREE IN BUSINESS ADMINSTRATION

35836 Operations Management: Decisions and Resources (OR/English Group)

Solved Practical Exercises Chapter 4 Process Selection + Decision Trees

Course : 202223

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PROCESS MAPPING AND SELECTION AND DECISION TREES EXERCISES

DECISION TREES

As a tool to help us to take sound decisions, we're going to practise the decision trees technique and the taking of decisions under uncertainty conditions.

For this matter, you're to study the attached document:

HEIZER RENDER MUNSON 2017 DECISION TREES

Pages 677-680 and 682-692 Not the part of the taking of decisions under uncertainty), looking to the solved problems with special attention.

Once the theory has been studied, following exercises will be practised in the classroom:

Exercise nº 4.1

Andrew Thomas, a sandwich vendor at Hard Rock Cafe's annual Rockfest, created a table of conditional values for the various alternatives (stocking decision) and states of nature (size of crowd):

	STATES OF NATURE (DEMAND)		
ALTERNATIVES	**BIG**	**AVERAGE**	**SMALL**
Large stock	$22,000	$12,000	–$2,000
Average stock	$14,000	$10,000	$6,000
Small stock	$ 9,000	$ 8,000	$4,000

The probabilities associated with the states of nature are 0.3 for a big demand, 0.5 for an average demand, and 0.2 for a small demand. Please determine the alternative that provides Andrew the greatest expected monetary value (EMV).

SOLUTION:

EMV= SUM(PROB · PAYMENT)

		STATES OF NATURE	PROB	PAYMENT	EMV	
a)DECISIONS						
	LARGE STOCK	BIG DEMAND	0,3	22000		
	LARGE STOCK	AVG DEMAND	0,5	12000	12200	BEST DECISION
	LARGE STOCK	SMALL DEMAND	0,2	-2000		

	AVG STOCK	BIG DEMAND	0,3	14000		
	AVG STOCK	AVG DEMAND	0,5	10000	10400	
	AVG STOCK	SMALL DEMAND	0,2	6000		
	SMALL STOCK	BIG DEMAND	0,3	9000		
	SMALL STOCK	AVG DEMAND	0,5	8000	7500	
	SMALL STOCK	SMALL DEMAND	0,2	4000		

Exercise nº 4.2

Zhu Manufacturing is considering the introduction of a family of new products. Long-term demand for the product group is somewhat predictable, so the manufacturer must be concerned with the risk of choosing a process that is inappropriate. Faye Zhu is VP of operations. She can choose among batch manufacturing or custom manufacturing, or she can invest in group technology. Faye won't be able to forecast demand accurately until after she makes the process choice.

Demand will be classified into four compartments: poor, fair, good, and excellent. The table below indicates the payoffs (profits) associated with each process/demand combination, as well as the probabilities of each long-term demand level:

	POOR	FAIR	GOOD	EXCELLENT
Probability	.1	.4	.3	.2
Batch	–$ 200,000	$1,000,000	$1,200,000	$1,300,000
Custom	$ 100,000	$ 300,000	$ 700,000	$ 800,000
Group technology	–$1,000,000	–$ 500,000	$ 500,000	$2,000,000

Based on expected value, what choice offers the greatest gain?

SOLUTION:

		PROB	PAYMENT	SUM	
BATCH MFG	POOR DEMAND	0,1	-200000		
BATCH MFG	FAIR DEMAND	0,4	1000000	1000000	BEST DECISION
BATCH MFG	GOOD DEMAND	0,3	1200000		
BATCH MFG	EXCELLENT DEMAND	0,2	1300000		
CUSTOM MFG	POOR DEMAND	0,1	100000		
CUSTOM MFG	FAIR DEMAND	0,4	300000	500000	
CUSTOM MFG	GOOD DEMAND	0,3	700000		
CUSTOM MFG	EXCELLENT DEMAND	0,2	800000		
GROUP TECHNOLOGY	POOR DEMAND	0,1	-1000000		
GROUP TECHNOLOGY	FAIR DEMAND	0,4	-500000	250000	
GROUP TECHNOLOGY	GOOD DEMAND	0,3	500000		
GROUP TECHNOLOGY	EXCELLENT DEMAND	0,2	2000000		

Exercise nº 4.3

The University of Miami bookstore stocks textbooks in preparation for sales each semester. It normally relies on departmental forecasts and preregistration records to determine how many copies of a text are needed. Preregistration shows 90 operations management students enrolled, but bookstore manager Vaidy Jayaraman has second thoughts, based on his intuition and some historical evidence. Vaidy believes that the distribution of sales may range from 70 to 90 units, according to the following probability model:

Demand	70	75	80	85	90
Probability	.15	.30	.30	.20	.05

This textbook costs the bookstore $82 and sells for $112. Any unsold copies can be returned to the publisher, less a restocking fee and shipping, for a net refund of $36.

a) Construct the table of conditional profits.

b) How many copies should the bookstore stock to achieve highest expected value?

SOLUTION:

	STATES OF NATURE	PROB	COPIES SOLD		COPIES RETURNED		PAYMENT	EMV	
			NUMBER	REVENUE	NUMBER	COST			
STOCK 70 COPIES	DEMAND 70 COPIES	0,15	70,00	2100,00	0,00	0,00	2100,00		
STOCK 70 COPIES	DEMAND 75 COPIES	0,30	70,00	2100,00	0,00	0,00	2100,00		
STOCK 70 COPIES	DEMAND 80 COPIES	0,30	70,00	2100,00	0,00	0,00	2100,00	2100	
STOCK 70 COPIES	DEMAND 85 COPIES	0,20	70,00	2100,00	0,00	0,00	2100,00		
STOCK 70 COPIES	DEMAND 90 COPIES	0,05	70,00	2100,00	0,00	0,00	2100,00		
STOCK 75 COPIES	DEMAND 70 COPIES	0,15	70,00	2100,00	5,00	-230,00	1870,00		
STOCK 75 COPIES	DEMAND 75 COPIES	0,30	75,00	2250,00	0,00	0,00	2250,00		
STOCK 75 COPIES	DEMAND 80 COPIES	0,30	75,00	2250,00	0,00	0,00	2250,00	2193	BEST DECISION
STOCK 75 COPIES	DEMAND 85 COPIES	0,20	75,00	2250,00	0,00	0,00	2250,00		
STOCK 75 COPIES	DEMAND 90 COPIES	0,05	75,00	2250,00	0,00	0,00	2250,00		
STOCK 80 COPIES	DEMAND 70 COPIES	0,15	70,00	2100,00	10,00	-460,00	1640,00		
STOCK 80 COPIES	DEMAND 75 COPIES	0,30	75,00	2250,00	5,00	-230,00	2020,00		
STOCK 80 COPIES	DEMAND 80 COPIES	0,30	80,00	2400,00	0,00	0,00	2400,00	2172	
STOCK 80 COPIES	DEMAND 85 COPIES	0,20	80,00	2400,00	0,00	0,00	2400,00		
STOCK 80 COPIES	DEMAND 90 COPIES	0,05	80,00	2400,00	0,00	0,00	2400,00		
STOCK 85 COPIES	DEMAND 70 COPIES	0,15	70,00	2100,00	15,00	-690,00	1410,00		
STOCK 85 COPIES	DEMAND 75 COPIES	0,30	75,00	2250,00	10,00	-460,00	1790,00		

STOCK 85 COPIES	DEMAND 80 COPIES	0,30	80,00	2400,00	5,00	-230,00	2170,00	2037	
STOCK 85 COPIES	DEMAND 85 COPIES	0,20	85,00	2550,00	0,00	0,00	2550,00		
STOCK 85 COPIES	DEMAND 90 COPIES	0,05	85,00	2550,00	0,00	0,00	2550,00		
STOCK 90 COPIES	DEMAND 70 COPIES	0,15	70,00	2100,00	20,00	-920,00	1180,00		
STOCK 90 COPIES	DEMAND 75 COPIES	0,30	75,00	2250,00	15,00	-690,00	1560,00		
STOCK 90 COPIES	DEMAND 80 COPIES	0,30	80,00	2400,00	10,00	-460,00	1940,00	1826	
STOCK 90 COPIES	DEMAND 85 COPIES	0,20	85,00	2550,00	5,00	-230,00	2320,00		
STOCK 90 COPIES	DEMAND 90 COPIES	0,05	90,00	2700,00	0,00	0,00	2700,00		

Exercise nº 4.4

The company Acerilar, S.A. considers the possibility of expanding its facilities to cope with an increase in its demand. The alternatives being considered are building a new factory 10 km from the current one, expanding the current one incorporating new technology or doing nothing.

The economic growth forecasts for the coming years show a 70% probability that demand will increase, 20% that it will continue and 10% that it will go into recession. Recommend the most favorable option taking into account the expected profits according to the following table (data in MEUR):

Millions EUR	Demand increases	Stable demand	Demand decreases
Building a new factory	5	3	-3
Enlarge existing factory	4	1	-2
Doing nothing	1	0	-1

SOLUTION:

	STATES OF NATURE	PROB	PAYMENT	EMV	
BUILD NEW FACTORY	DEMAND INCREASES	0,7	5.000.000		

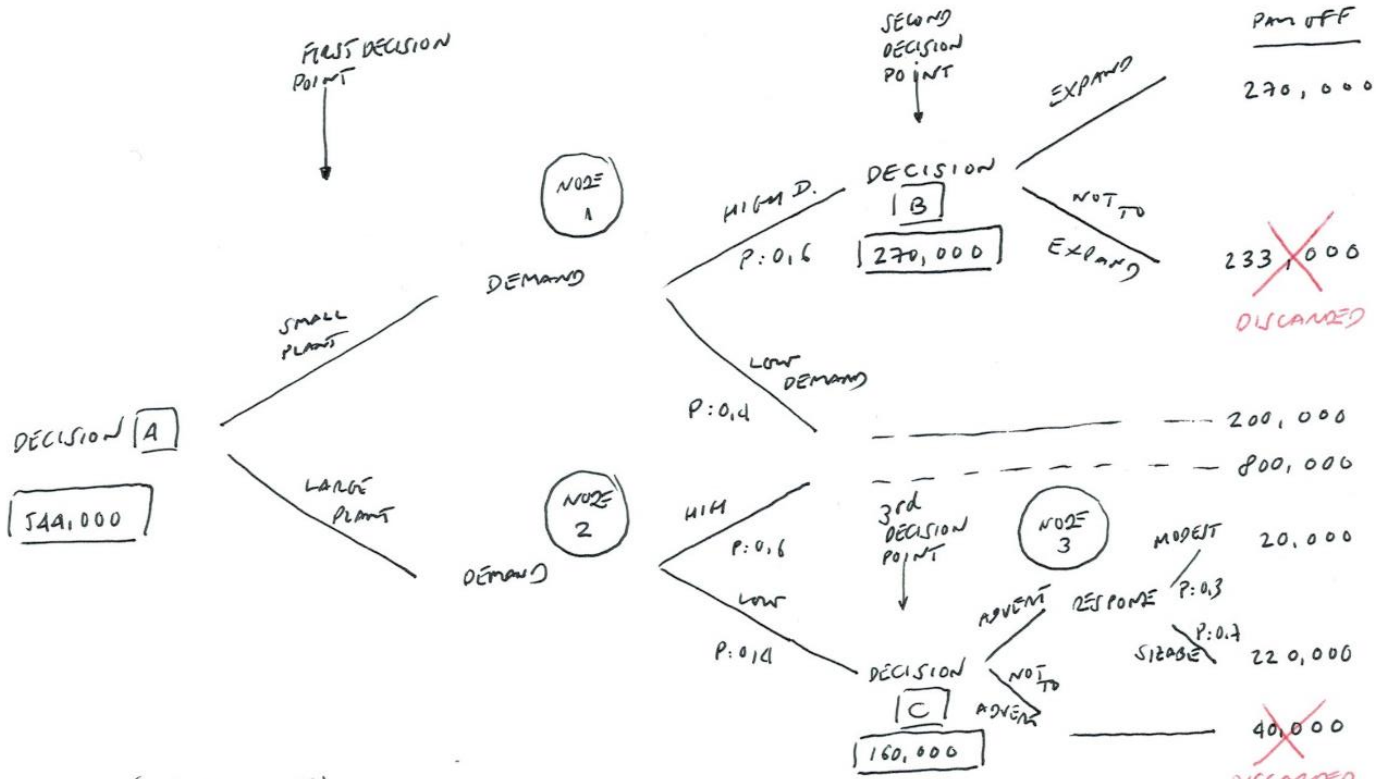
BUILD NEW FACTORY	STABLE DEMAND	0,2	3.000.000	3.800.000	BEST DECISION
BUILD NEW FACTORY	DEMAND DECREASES	0,1	-3.000.000		
ENLARGE EXIST. FAC.	DEMAND INCREASES	0,7	4.000.000		
ENLARGE EXIST. FAC.	STABLE DEMAND	0,2	1.000.000	2.800.000	
ENLARGE EXIST. FAC.	DEMAND DECREASES	0,1	-2.000.000		
DO NOTHING	DEMAND INCREASES	0,7	1.000.000		
DO NOTHING	STABLE DEMAND	0,2	0	600.000	
DO NOTHING	DEMAND DECREASES	0,1	-1.000.000		

Exercise nº 4.5

F. J. Brewerton Retailers, Inc., must decide whether to build a small or a large facility at a new location in Omaha. Demand at the location will either be low or high, with probabilities 0.4 and0.6, respectively. If Brewerton builds a small facility and demand proves to be high, he then has the option of expanding the facility. If a small facility is built and demand proves to be high, and then the retailer expands the facility, the payoff is $270,000. If a small facility is built and demand proves to be high, but Brewerton then decides not to expand the facility, the payoff is $223,000. If a small facility is built and demand proves to be low, then there is no option to expand and the payoff is $200,000. If a large facility is built and demand proves to be low, Brewerton then has the option of stimulating demand through local advertising. If he does not exercise this option, then the payoff is $40,000. If he does exercise the advertising option, then the response to advertising will either be modest or sizable, with probabilities of 0.3 and 0.7, respectively. If the response is modest, the payoff is $20,000. If it is sizable, the payoff is $220,000. Finally, if a large facility is built and demand proves to be high, then no advertising is needed and the payoff is $800,000.

a) What should Brewerton do to maximize his expected payoff?
b) What is the value of this expected payoff?

SOLUTION:



DECISION B: ALWAYS EXPAND (HIGHER PAYOFF)

DECISION C : ADVERTISE : MODEST RESPONSE PAYOFF · PROB MODEST + SIZEABLE PAYOFF · PROB SIZEABLE

(NODE 3) $20,000 \cdot 0,3 + 220,000 \cdot 0,7 = \boxed{160,000}$

NODE 2 EMV = HIGH DEMAND PAYOFF · PROB HIGH DEMAND + LOW DEMAND PAYOFF · PROB LOW =

$800,000 \cdot 0,6 + 160,000 \cdot 0,4 = \boxed{344,000}$ → PREFERRED

NODE 1 EMV: HIGH DEMAND PAYOFF · PROB H.D + LOW DEMAND PAYOFF · PROB L.D

$270,000 \cdot 0,6 + 200,000 \cdot 0,4 = 242,000$

DECISION A : BUILD A LARGE PLANT

Exercise nº 4.6:

Hyundai Motors is considering three processes- A. B. and C to build its new-model automobile, the Hyundai Sport C150. The goal is to have a minimum-cost process, where cost is measured by the annual fixed plus variable costs of production. Hyundai Motors has gathered the following data:

Process	Annualized Fixed Cost	Variable cost per auto produced
A	10,000,000 $	2,500 $
B	20,000,000 $	2,000 $
C	25,000,000 $	1,000 $

The firm knows it will produce between 0 and 60,000 Sport C 150s at the new plant each year, but, thus far, that is the extent of its knowledge about production plans.

a) For what values of volume, V, of production, if any, is process C a recommended one?

b) What volume indicates process A is optimal?

c) Over what range of volume is process B optimal? Why?

Solution: (In thousands of dollars)

Cost process A: $C_A = 10000 + 2.5 \cdot x$

Cost process B: $C_B = 20000 + 2.0 \cdot x$

Cost process C: $C_C = 25000 + 1.0 \cdot x$

Comparison A vs B:

$C_A = 10000 + 2.5 \cdot x = C_B = 20000 + 2.0 \cdot x \rightarrow x =$ 20000 cars/year

Comparison A vs C:

$C_A = 10000 + 2.5 \cdot x = C_C = 25000 + 1.0 \cdot x \rightarrow$ x= 10000 cars/year

Comparison C vs B:

$C_C = 25000 + 1.0 \cdot x = C_B = 20000 + 2.0 \cdot x \rightarrow$ x= 5000 cars/year

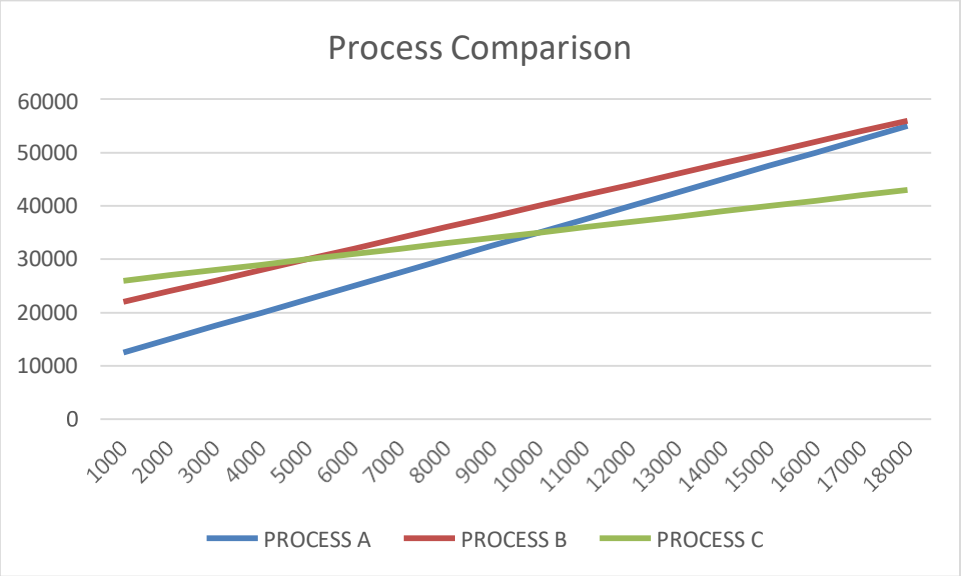
a)Process C is the cheapest for volumes over 10000 cars/year

b) Process A is optimal for volumes 0-10000 cars/year

c) Process B is not recommended for any volume

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
PROCESS A	12500	15000	17500	20000	22500	25000	27500	30000	32500	35000
PROCESS B	22000	24000	26000	28000	30000	32000	34000	36000	38000	40000
PROCESS C	26000	27000	28000	29000	30000	31000	32000	33000	34000	35000

	10000	11000	12000	13000	14000	15000	16000	17000	18000
PROCESS A	35000	37500	40000	42500	45000	47500	50000	52500	55000
PROCESS B	40000	42000	44000	46000	48000	50000	52000	54000	56000
PROCESS C	35000	36000	37000	38000	39000	40000	41000	42000	43000



Exercise nº 4.7

Peggy Lane Corp., a producer of machine tools, wants to introduce a new production process. Two are considered, process A and process B. Process A carries fixed costs of $800,000 per year and variable costs of $14,000 per standard unit produced. Process B, on the contrary, would have annual fixed costs of $920,000 and variable costs of $13,000 per standard unit. The finished items sell for $29,000 each.

a) At what volume of output would the two processes have the same profit?

b) For what range of output would process A be superior (have higher profits)?

c) For what range would process B be superior?

d) What is the relevance of break-even points for these processes?

e) Solution: (In thousands of dollars)

f) Profit process A: $P_A = (29-14) \cdot x - 800$

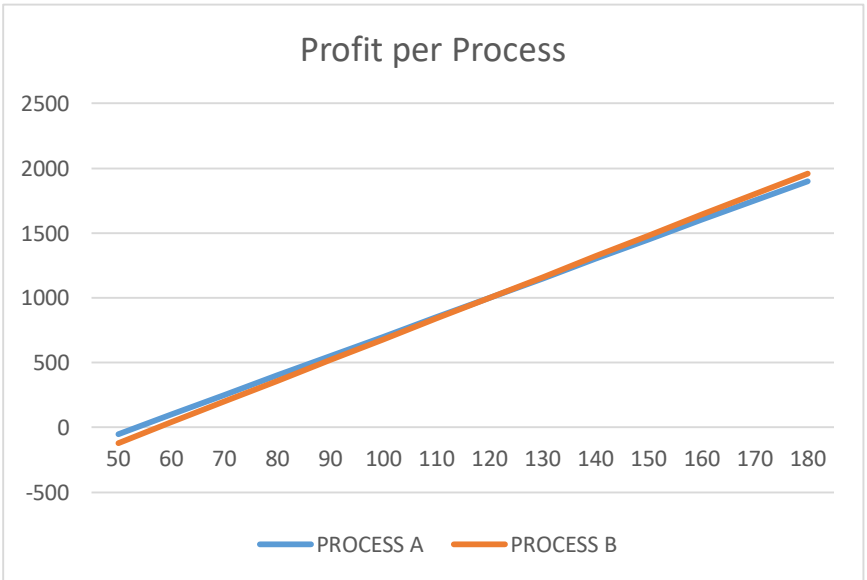
g) Profit process B: $P_B = (29-13) \cdot x - 920$

h) Comparison A vs B:

i) $P_A = P_A = (29-14) \cdot x - 800 = P_B = (29-13) \cdot x - 920 \rightarrow x =$ 120 units/year

j) Less tha 120 units per year: process A; more than 120: process B

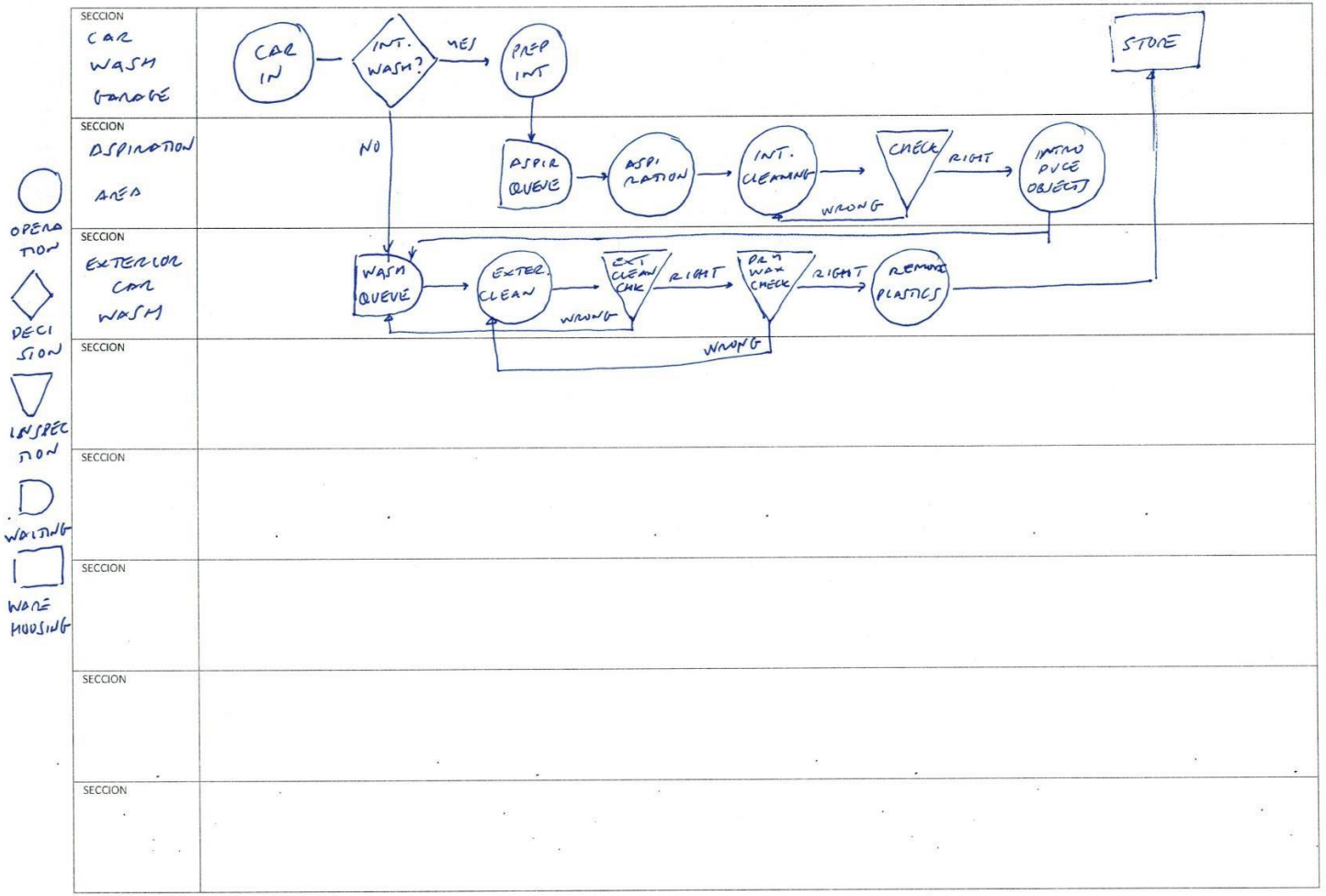
	50	60	70	80	90	100	110	120	130	140	150	160	170	180
PROCESS A	-50	100	250	400	550	700	850	1000	1150	1300	1450	1600	1750	1900
PROCESS B	-120	40	200	360	520	680	840	1000	1160	1320	1480	1640	1800	1960



Exercise 4.8

Please map the following process:

Put the car in the car wash garage (CAR IN). If the customer requests an interior wash, put hygienic plastics on the driver's seat, remove the objects from the vehicle (PREPARE INTERIOR) and take it to the aspiration area. Otherwise, take it to the queue of the exterior wash train (WASHING QUEUE). In the aspiration area, the vehicle waits for the previous vehicles to finish (ASPIRATION QUEUE), and when it is its turn, the floor mats are removed, the vehicle is vacuumed inside, the floor mats are vacuumed and put into the vehicle (ASPIRATION). Then the interior windows and mirrors of the vehicle are cleaned, and the interior plastics of the vehicle are cleaned (INTERIOR CLEANING). The interior of the vehicle is checked for cleanliness while the extracted objects are being inserted. (REVIEW and INTRODUCE OBJECTS). The vehicle is taken to the wash train and is left in a waiting queue until its turn arrives (WASHING QUEUE). The vehicle is cleaned in the car wash (EXTERIOR CLEANING). The quality of the exterior cleaning is checked (EXTERIOR CLEANING CHECK). If there are still dirty areas, it is reintroduced into the washing train queue. If there are no dirty areas, the drying and waxing is reviewed manually (REVIEW EXTERIOR CLEANING). The hygienic plastics are removed from the driver's seat (REMOVE PLASTICS) and the vehicle is stored in the garage until collection by the customer. (STORE) (END)


SECCION
CAR WASH GARAGE
SECCION
ASPIRATION AREA
SECCION
EXTERIOR CAR WASH
SECCION
SECCION
SECCION
SECCION
SECCION
CAR IN
INT. WASH?
YES
NO
PREP INT
STORE
ASPIR QUEVE
ASPI RATION
INT. CLEANING
CHECK
RIGHT
WRONG
INTRO DUCE OBJECT
WASH QUEVE
EXTER CLEAN
EXT CLEAN CHK
RIGHT
WRONG
DRY WAX CHECK
RIGHT
WRONG
REMOVE PLASTICS
OPERATION
DECISION
INSPECTION
WAITING
WARE HOUSING

Exercise 4.9

Please map the following process:

An order is received by mail, fax, telephone or via web (ORDER RECEIPT), if it is a new customer, the customer is registered in the ERP (CUSTOMER REGISTRATION). Then the order is entered in the ERP (ORDER INPUT) and the ERP checks if the ordered products are in stock. It may be that a product supplied by a supplier is missing, in which case an urgent order is placed with the supplier (ORDER TO SUPPLIER). If the missing product is produced internally, a production order is issued (MANUFACTURING ORDER), and in either case, you have to wait for the product to arrive in the warehouse (PRODUCT WAITING). Once we have all the products of the order in the warehouse, the picking order is made to conform the order (PICKING ORDER), an email is sent to the carrier to pick up the order (PICKING ORDER), the delivery note and the invoice are issued (DELIVERY TO CUSTOMER), (INVOICE TO CUSTOMER), and the customer is notified of the expected delivery date of the goods (CONFIRM DELIVERY DATE), and the goods are stored at the loading dock until the carrier arrives (STORE GOODS). Once the carrier drops off the goods to the customer, the customer is called to verify that everything is correct (VERIFY DELIVERY), and the process is completed.

Processes can be mapped using MS Visio or an open code alternative:

Dia Diagram Editor download | SourceForge.net.

Exercise 4.10

The management of the Just Like Home Restaurant has asked you to analyze some of its processes. One of these processes is making a single-scoop ice cream cone. Cones can be ordered by a server (for table service) or by a customer (for takeout).

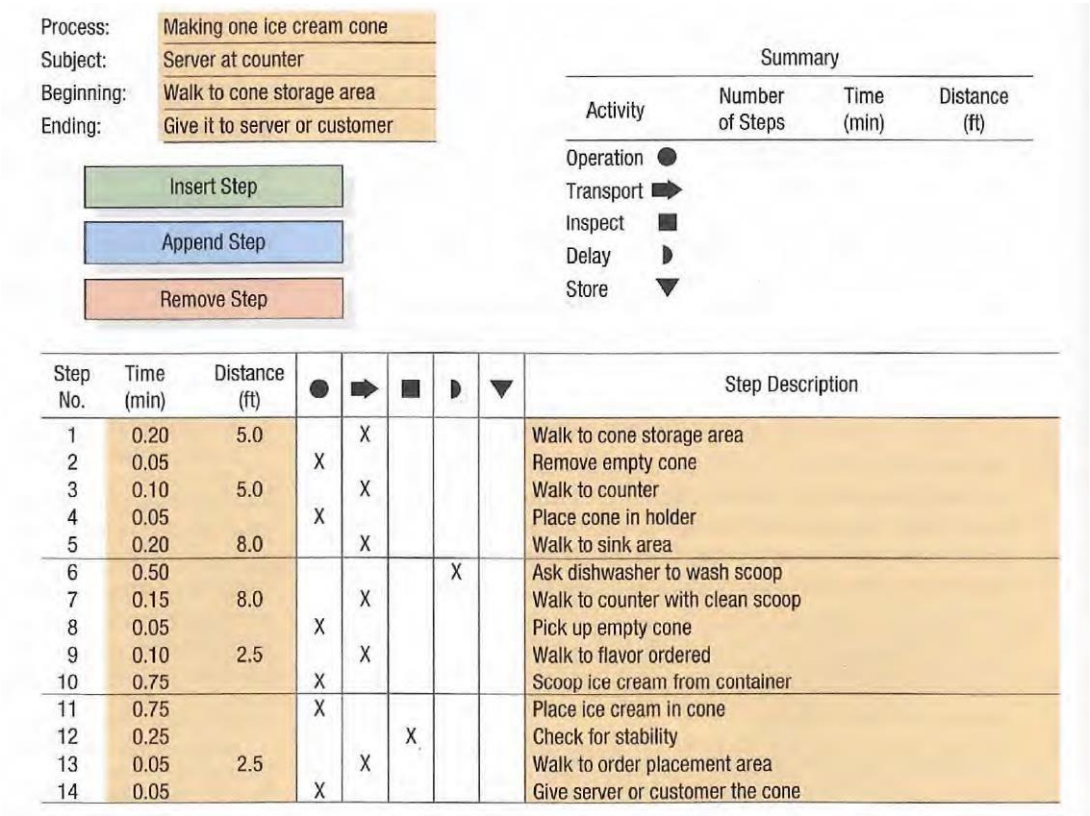
You'll find attached the process chart for this operation. Some data

- The ice cream counter server earns $10 per hour (including variable fringe benefits).
- The process is performed 10 times per hour (on average).
- The restaurant is open 363 days a year, 10 hours a day.

a. Complete the Summary (top-right) portion of the chart.

b. What is the total labor cost associated with the process?

c. How can this operation be made more efficient? Make a new process chart of the improved process. What are the annual labor savings if this new process is implemented?



Process: Making one ice cream cone
Subject: Server at counter
Beginning: Walk to cone storage area
Ending: Give it to server or customer

Insert Step
Append Step
Remove Step

Summary

Activity	Number of Steps	Time (min)	Distance (ft)
Operation ●			
Transport ➡			
Inspect ■			
Delay ◗			
Store ▼			

Step No.	Time (min)	Distance (ft)	●	➡	■	◗	▼	Step Description
1	0.20	5.0		X				Walk to cone storage area
2	0.05		X					Remove empty cone
3	0.10	5.0		X				Walk to counter
4	0.05		X					Place cone in holder
5	0.20	8.0		X				Walk to sink area
6	0.50					X		Ask dishwasher to wash scoop
7	0.15	8.0		X				Walk to counter with clean scoop
8	0.05		X					Pick up empty cone
9	0.10	2.5		X				Walk to flavor ordered
10	0.75		X					Scoop ice cream from container
11	0.75		X					Place ice cream in cone
12	0.25				X			Check for stability
13	0.05	2.5		X				Walk to order placement area
14	0.05		X					Give server or customer the cone

SOLUTION

Original situation: Summary

ACTIVITY	Nº of steps	Time (min)	Distance (ft)
OPERATION	6	1,70	
TRANSPORT	6	0,80	31
INSPECT	1	0,25	
DELAY	1	0,50	
STORE	0		
TOTAL	14	3,25	31

Cost of process:

363 day x 10 hr day x 10 times/hour= 36300 processes/year

Cost of hours worked: 363 day x 10 hr /day x 10 usd/hour= 36300 usd

So, each process (original form) costs 1 usd, although its work contents is:10 usd-hour / 60 min * 3,25 min= 0,54 usd.

Rest of cost is inactivity cost, or being

used in other tasks.New improved

process:

Step nº	min	Dist feet	○	⇨				Step description
1	0,05		x					Remove empty cone
2	0,10	2,5		x				Walk to flavor ordered
3	0,75		x					Scoop ice cream in cone
4	0,75		x					Put ice cream in cone
5	0,35				x			Check cone for stability
6	0,10	2,5		x				Return to counter
7	0,05		x					Place cone in holder
8	0,10		x					Payment time (only external customers)
9	0,05		x					Deliver cone to customer
Total	2,30	5						

New process cost: 10 usd-hour/60 min * 2,30 min= 0,38 usd