WP4: Tutorial about the cost of an investment: The example of a radiography equipment

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Materials and method:

This tutorial is meant to help the students understand the idea of fixed and variable costs through an investment choice.

The main goals of the training for the students are:

- To be able to explain the difference between expenses and costs ;
- To get the ideas of variable and fixed costs and their consequences ;
- To be able to define and calculate a break event point ;
- *A minor goal would be to define and calculate amortization and repayment of loan.*

The main goals of the tutorial for the lecturer are:

- ***To let students discover the main questions by themselves. (That the reason why the cost elements are given step by step.)***
- *It is possible to drive the tutorial step by step. The student may work into small groups and gather at the end of one step to get the explanations of the lecturer.*

Questions:

This tutorial is an introduction to the main questions vets will have to deal with concerning the cost calculation in their activities. The case study deals with an investment, that is to say the decision to spend money today to purchase equipment or production facilities to be used over time. The cost elements will be added step by step to reach the correct way to calculate costs.

Suppose you are a vet responsible for a vet surgery and you would like to buy numerical radiology equipment:

- The cost of new equipment is 56 K€.
- There is no need to maintain it, but you should contract an insurance against damage or breakage which costs 300 €/year.
- Each radiology uses consumables (0.50 €/radiology).
- The expected number of radiologies you will have to perform is 150 radiologies a year.
- The expected longevity of the equipment is 7 years.

In the whole tutorial, suppose you don't aim at any profit on this peculiar activity, that is to say you are on your break-even point (easier to work on costs).

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First step : fixed and variable costs, amortization

Q1: What is the marginal cost of radiology, once the investment cost is paid? What part is fixed? What part is variable?

Q2: Suppose you buy the radiology equipment. What are your annual expenses?

Q3: How much would the client the first year pay to cover these expenses? The other years? Do you find it fair? What solutions can you imagine?

Second step : Cost of a the availability of money (loan)

Q4: Suppose now you have to obtain a loan to buy your radiology equipment :

- The loan duration is 4 years and you ray each year one fourth of the amount of money lent to you.
- You have to pay to the bank each year 10% interest on the amount of money still available to you at the beginning of the year.

What are your annual expenses?

Q5: What are your annual costs? Are they variable or fixed?

Q6: How much would the client the first year pay to cover these costs? The other years? Do you find it fair? What solutions can you imagine?

Third step : overhead costs (example of work time)

Q7: Now suppose you would like to calculate a complete cost. You don't allocate any cost concerning the building, but you take work time in consideration. You employ a nurse whose wage is about 3 200 €/month (160 h work), social contributions included. What would now be the total costs for a numerical radiology, which takes 10 minutes pro radiology to perform?

Q8: What are the consequences on other costs in the surgery if you choose to allocate work time in your cost calculation? Do you consider it really worthwhile to take the work time in consideration?

Fourth step : economies of scale

Q9: Would your conclusion be the same if you were to perform 200 radiologies a year ? 300 ? 400 ?

Q10: What if the clients were ready to pay only 43 € a radiology?

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Answers:

First step: fixed and variable costs, amortization

Q1: What is the marginal cost of radiology, once the investment cost is paid?

- Variable cost : 0.50 € consumable
- Fixed cost allocation : 300 € insurance/150 radiographies : 2 €/radiology
- Total cost / radiology : 2.50 €

Q2: Suppose you buy the radiology equipment. What are your annual expenses?

Table 1: Annual expenses

EXPENSES	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Purchase	56 000						
Insurance	300	300	300	300	300	300	300
Consumables	75	75	75	75	75	75	75
Total	**56 375**	**375**	**375**	**375**	**375**	**375**	**375**
Cost/radiology	376	2,50	2,50	2,50	2,50	2,50	2,50

Q3: How much would the client the first year pay to cover these expenses? The other years? Do you find it fair? What solutions can you imagine?

- It doesn't seem fair to let the clients of first year pay for the whole equipment which will be on use for 7 years. As you use the equipment each year to provide a service to the clients, it seems more logical to allocate cost on the whole time scale. You destroy each year one seventh of the equipment for your activity. In this case, you allocate each year one seventh of the radiology equipment to radiology activity; this is called "amortization". The cost pro radiology is then the same from year 1 to year 7.

Table 2 : Annual costs including amortization

COSTS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Amortization of purchase (56 000 €/7 years)	8 000	8 000	8 000	8 000	8 000	8 000	8 000
Insurance	300	300	300	300	300	300	300
Consumables	75	75	75	75	75	75	75
Total	**8 375**	**8 375**	**8 375**	**8 375**	**8 375**	**8 375**	**8 375**
Cost/radiology (150 radiologies a year)	56	56	56	56	56	56	56

Costs differ from expenses. Expenses are the use of money for any purchase of material inputs or services. Costs deal with **the allocation of resources to production**. In this case, we pay 56 K€ on year 1 to buy the radiology: this is an expense. But as we will use the machinery during 7 years, the resources allocated to production of radiologies each year is 8 K€. This is a fixed cost as you have bought the equipment at the beginning, no matter if you really use it.

The spreading of the costs over years in relation with the production rhythm is one of the most important concerns in cost calculation.

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Second step: Cost of a the availability of money (loan)

Q4: Suppose now you have to obtain a loan to buy your radiology equipment.

- The loan duration is 4 years and you pay each year one fourth of the amount of money lent to you.
- You have to pay to the bank each year 10% interest on the amount of money still available to you at the beginning of the year.

What are your annual expenses?

N.B.: The lecturer might have to explain how a loan works so that the students may complete this question. It can be achieved in the simplest way.

Table 3: Loan

LOAN	Year 1	Year 2	Year 3	Year 4	TOTAL
Capital still due at the beginning of the year (a = aN-1 - cN-1)	56 000	42 000	28 000	14 000	
Interest (10%) (b=10%*a)	5 600	4 200	2 800	1 400	14 000
Repayment (c=56 000/4)	14 000	14 000	14 000	14 000	56 000
Total (d=b+c)	19 600	18 200	16 800	15 400	70 000

- The main aim of the loan is to turn a one year expense (56 K€ on year 1) into a four year expense (14 K€ from year 1 to year 4). The disadvantage is that you also generate an extra cost due to the interest paid to the bank to remunerate the availability of cash flow (14 K€).

Q5: What are your annual costs? Are they variable or fixed?

- On another hand, even if the expense is spread over 4 years, you still use the equipment during 7 years. Then, the costs (resources allocation) you take into account are the amortization and the interest, and not the repayment.
- The interest is due from year 1 to 4. It is a fixed cost, even if it decreases over time. Why? Because it does not depend on the number of radiology the vet performs a year.

Table 4: Annual costs including interest

COST	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total	Average
Amortization	8 000	8 000	8 000	8 000	8 000	8 000	8 000		8 000
Interest (b)	5 600	4 200	2 800	1 400	-	-	-	14 000	2 000
Insurance	300	300	300	300	300	300	300		300
Consumables	75	75	75	75	75	75	75		75
Total cost	**13 975**	**12 575**	**11 175**	**9 775**	**8 375**	**8 375**	**8 375**	**72 625**	
Cost/radiology (150 radiologies a year)	93	84	75	65	56	56	56		69

The way you finance your activity has an impact on your cost through the interest (or remuneration of capital). The production and associated costs are spread over years, but the cash flow needs are not, and you pay for money being available whenever you need it.

Third step: overhead costs (example of work time)

Q6: How much would the client the first year pay to cover these costs? The other years? Do you find it fair? What solutions can you imagine?

- We have got the same problem as in question 3: should the first clients support the interest cost and not the last clients?

The lecturer might introduce here the notion of break even point, i.e. the point when you make neither profit nor loss (namely based on cost and not expenses!)

- This question is not really about cost calculation, but on price setting. You are free to determine the time scale you like to set your break even point (here, seven year – no actualization taken into account). If you do so, however, you might be aware that you have losses at the beginning of the period and profit at the end.

Table 5: Price setting over time

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
Total cost	**13 975**	**12 575**	**11 175**	**9 775**	**8 375**	**8 375**	**8 375**	72 625
Price/radiology	69	69	69	69	69	69	69	
Receipes (150 radiologies a year)	10 375	10 375	10 375	10 375	10 375	10 375	10 375	72 625
Profit or loss	**- 3 600**	**- 2 200**	**- 800**	**600**	**2 000**	**2 000**	**2 000**	-

Q7: Now suppose you would like to calculate a complete cost. You don't allocate any cost concerning the building, but you take work time in consideration. You employ a nurse whose wage is about 3 200 €/month (160 h work), social contributions included. What would now be the costs for a numerical radiology, which takes 10 minutes pro radiology to perform?

Table 6: Costs including work time valuation

	Time (h)	Salary (€)	Per unit (€/h)	Cost/radiology	
Wage	160	3 200	20	Without time	Work time included
Numerical radiology	0,15		3	69	72

Q8: What are the consequences on other costs in the surgery if you choose to allocate work time in your cost calculation? Do you consider it really worthwhile to take the work time in consideration?

- In this case, work time is not really significant, especially in the case of numerical radiology (4% of the cost, 1% of the work time of your nurse). Furthermore, you would have to change your costs estimation on other activities taking less work time into account.

Table 7: Time spent for radiology each year

	Time (h)	Pro year	
Wage	160	1 920	
Numerical radiology (150 radiologies a year)	0,15	23	1%

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The lecturer may also evocate two cases:

- *In one case, the nurse or salaried vet has some free time in his/her work time. Should the work time be taken in consideration in this case?*
- *In the other case, the nurse or salaried vet won't have a minute to perform a radiology and the surgery should employ more salaries. Should the work time be taken in consideration in this case?*

Costs calculation is based on accounting but depends also on your management choice. It is not an exact science but a matter of decision making.

Fourth step: economies of scale

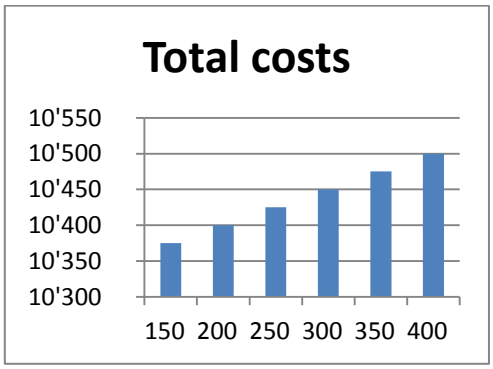
Q9: Would your conclusion be the same if you were to perform 200 radiologies a year? 300? 400?

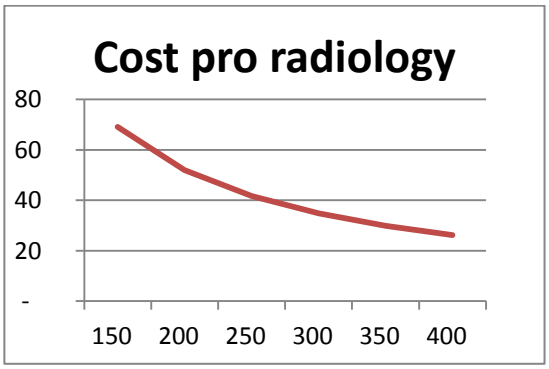
- The total costs increases with the number of radiologies whereas the cost pro radiology decreases. The fixed costs are indeed shared between the radiologies, and each one supports less fixed costs when the number is higher.

The lecturer may illustrate the purpose with a graph and explain the fixed and variable cost on it.

Table 8: Cost pro radiology ([1] See Table 4 to get the average fixed costs)

		Number of radiologies					
Numerical radiology	**Variables costs / unit**	**150**	**200**	**250**	**300**	**350**	**400**
Fixed costs		10 300	10 300	10 300	10 300	10 300	10 300
Variable costs	0,50	75	100	125	150	175	200
Total costs		**10 375**	**10 400**	**10 425**	**10 450**	**10 475**	**10 500**
Cost pro radiology		69	52	42	35	30	26





Q10: What if the clients were ready to pay only 43 € a radiology?

- Considering your fixed costs and the fact that you perform 150 radiologies only, this activity can't be self-sufficient. You have the choice between :
  - not to perform radiologies,
  - to perform them and loose money on this peculiar activity because you consider it's too important to let it down,
  - or to develop it and perform at least 250 radiologies a year (but what about the medical usefulness ? partnerships / referees with other vets ?)

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