



Financial efficiency estimation for a dental radiology laboratory

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Abstract

Background and aims. Considering nowadays trend among dentists to install a radiology laboratory beside their current practice, we proposed to investigate the aspect of financial efficiency related to such investment.

Methods. We evaluate two existing options: simple investment, consisting of intra-oral equipment and accessories, or investment in a radiology center that includes panoramic and CBCT equipment. The initial investment includes equipment acquisition, fitting out of the location, radiology accreditation and other miscellaneous expenses. Costs were estimated based on current quotations on the specific market available in Romania. We also described a financial model to estimate the financial risk.

Results. The analysis was made under the assumptions that the laboratory is operated by the dentist who made the investment in the form of a legal person and paying corporate tax like all Romanian entities. The analysis took into account current fees for different types of X-rays, usual expenses of such a laboratory, and describes the approach to this analysis, starting with the initial investment estimation and forecast of revenues and expenses. Based on these projections and assessment of the working capital, we have built the cash flows forecast. Following a risk analysis we could assess the financial efficiency of the two investment alternatives.

Conclusions. Our study reveals that the radiology center represents a more profitable investment due to the higher economic return rate.

Keywords: finances, financial risk, cash flow, oral radiology, cost, investments

Background and aims

Radiological examinations are indispensable for the diagnosis and represent one of the main treatment planning methods used in all fields of medicine. Together with the benefits of X-rays, comes also one important issue represented by the fact that a certain amount of radiation is inevitably delivered to patients. Nowadays, the use of digital radiographs offers a potential dose reduction [1].

In dentistry, 2D X-rays (intraoral, panoramic and cephalometric X-rays) and 3D Cone-Beam Computer Tomography (CBCT) are considered the starting point for endodontic, dental anomalies, malocclusions and

maxillofacial traumatic emergencies. The increasing use of CBCT in dental medicine is a sensitive point considering the radiation doses involved, especially for pediatric patients. Thus, for some specific pathological conditions, the 3D imaging for children is justified. The use of CBCT plays an important role in the planning and treatment for impacted and supplementary teeth, orofacial cleft, dentoalveolar trauma and dental anomalies [2].

According to the UNSCEAR Report [1], dental examinations are the most frequent type of radiological procedures. The number of dental X-rays in Romania is increasing on a yearly basis. In 2008, the total number of dental examinations was 342.943 per year, while

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in 2014 it doubled, to 750.445 [3].

There is increased interest in the field of dental radiology in Romania [4].

Like dental practice, the oral radiological center is a private field. The current trend is that beside the private clinic, the dentist must also have a radiological center. Benefits do not only improve diagnosis, save time and increase the prestige of the clinic, but also increase the practice's profit. Investments in such devices are still complex, costly and even risky if they are not well documented and phased.

Considering the current interest and trend that dentists would install a radiology laboratory beside their current practice, this study investigates the issue of financial efficiency related to such investment in order to estimate the break-even-point of such investment, the financial efficiency to be expected and describe a financial model for assessing the financial risk of investment in an oral radiology laboratory that could be extended to others regions in Europe.

Methods

Our analysis took into consideration two alternatives: (A) investment in a simple radiology laboratory beside a current dental practice, consisting only of intraoral equipment, hereinafter referred to as "Intraoral Radiology" and (B) investment in a complex radiology center, comprising intraoral equipment and panoramic-CBCT equipment, referred to as "Radiology Center".

The feasibility of an investment was analyzed by means of the return that may be obtained on that investment. The return on investment (ROI) was studied by means of the internal rate of return (IRR) and the net present value of the investment (NPV). NPV represents the present value of present and future cash flows. The investment is the sum to be paid for the achievement of the investment plan and represents a present negative cash flow. Future cash flows to be derived from operating such investment were discounted using a discount rate in order to reflect the money value over time. The sum of all these discounted cash flows represents the net present value of the investment. IRR represents the discount rate for which an investment is equal to the present value of the future expected benefits (cash flows) or the discount rate at which the present value of expected future benefits is equal to the investment (at break-even point). The investment was considered attractive if the IRR was higher than the discount rate.

The analysis of the financial feasibility considered the following steps, for each aforementioned alternative: (1) Estimation of the necessary investment; (2) Revenues forecast; (3) Expenses forecast; (4) Budget, working capital and capital investment forecast; (5) Cash flow forecast.

The analysis was made on a forecast period of 10 years, taking into account that this represents the minimum period of life of the acquired equipment. An

average investment level was considered for the Intraoral Radiology, while in the case of the Radiology Centre, the analysis took into account a maximum investment level.

The Intraoral Radiology is operated by a dentist, hence the investment must be made in the form of a legal person paying corporate tax as all Romanian entities. In Romania, the corporate taxes amount to 16%. In terms of location, the Intraoral Radiology is supposed to be a space ancillary to the dental practice.

In the present study the considered costs, fees and prices do not include VAT, and all the prices are estimated in euro (EUR).

Revenues forecast

The revenue forecast was estimated based on the following: the mean number of X-rays to be made and fees per X-ray. The mean number of X-rays to be made was estimated by months for the first year, when a monthly increase is considered. The monthly increase is based on the expectancy to increase the number of clients as the Radiology center is better known, achieving at the end of the year a number of X-rays per day aligned to the current market expectations. For year two, the monthly number of X-rays is considered to remain constant, at the level of Month 12 from Year 1. Starting with Year 3, a small 1% year by year increase was taken into account. The fees per X-ray are based on current market fees. Starting with Year 2, a small yearly 1% fee increase was taken into account.

Expenses forecast

Expenses forecast relied on the issues summarised in table I for the Oral Radiology center and table II for the Radiology Center. Expenses related to equipment, certifications, medical staff and location were considered.

Consumable costs per type of X-ray were estimated based on the numbers of X-rays to be made, for each type of radiological equipment and practice. Maintenance and certification costs include necessary costs with equipment accreditation and service and disinfection materials. For Year 1 these expenses, apart from the disinfection materials, were included in the initial investment.

Other expenses are estimated as 10% of total revenue. These include unplanned expenses, mainly administrative (cleaning, materials, telephone costs, promotion materials etc.).

Staff expenses are related to wages and wages costs and are based on the number of personnel, the average net wage of a radiologist and the expenses to be paid on wages. The staff includes only radiologists and the number increases to two subsequent to the number increase of daily X-rays. Medical training costs: are based on necessary certificates and are calculated based on the personnel number, certification costs and frequency.

The rent is estimated according to the area believed necessary (Intraoral Radiology: 20 sqm; Radiology Center: 40 sqm). Rent level is estimated based on current market quotations and location assumptions. Utilities (electricity,

water, heating) cost is estimated based on the area and current market prices and are presented by a monthly average level.

Depreciation is estimated based on investment costs and depreciation duration taken into account (5 years for computers and 10 years for radiology equipment). Costs are supposed to increase with a 1% per year moderate increase, while utilities are estimated to grow by 5% yearly.

Budget, working capital and capital investment forecast

Budgets are estimated on the basis of expenses and revenues presented above. No financial revenues and expenses were considered.

Cash flow forecast

The cash flow for both alternatives was constructed based on the cash flow of equity model. Considering that no financing flows were taken into account, the cash flow includes cash flow from operations and cash flows from investment. The elements used are presented in tables XIII and XIV. Operational flows include net profit and working capital change. The net profit was taken from tables XI and XII. The working capital for each year was estimated based on a 30 days period rotation for inventory and payables. For receivables, a 1 to 5 days rotation period was considered (usually these services are paid upfront). Investment flows include depreciation as input and capital investment

expenses (CAPEX) as expense. Depreciation was taken from tables XI and XII. Capex was estimated at a level of 10 to 25%, beginning with the Third year, considering that only accidental replacements might be needed. In year Five, a new computer acquisition is scheduled.

Also, for estimating the net present value of the investments and the internal rate of return, a discount rate was estimated as measure of perceived risk, used to discount future expected benefits to a present value, thus reflecting the time value of money. The discount rate estimation was made based on the CAPM model.

Results

The estimated investment is presented in table I for Intraoral Radiology, respectively table II for Radiology Centre. Table I presents the minimum and maximum estimates and an average, which is the selected scenario. Table II presents only the minimum and maximum estimated investment, the selected scenario being the maximum investment.

Revenue forecasts for both practice types are presented monthly for the First year (table III and table V) and yearly for the entire forecast period (table IV and table VI). Estimated costs are presented monthly for the First year (table VII and table VIII) and yearly for the entire forecast period (table IX and table X).

Table I. Estimation of investment for Intraoral Radiology.

Investment estimate - Intraoral Radiology				
No	Investment item	Estimated cost		
EUR		Min	Max	Average
1	Equipment			
	Intraoral equipment	1,800	2,300	2,050
	Digital detector for intra-oral	3,000	4,000	3,500
	Printer dry film	5,000	6,000	5,500
	Radiosafety equipment	320	370	345
	Computer	700	1,200	950
	Total equipment	10,820	13,870	12,345
2	Location related costs			
	Rent for the set-up duration	400	600	250
	Radiology cabinet fitting	1,500	2,000	1,750
	Total location related costs	1,900	2,600	2,000
3	X-ray Laboratory Accreditation			
	Radiological expertise	200	300	250
	Public Health Authority	100	100	100
	National Authority for Radioprotection	600	600	600
	Total Accreditation costs	900	1,000	950
4	Staff training costs			
	Health certificate	20	30	25
	Individual dosimetry	25	35	30
	Total staff training costs	45	65	55
5	Marketing	100	150	125
6	Miscellaneous	693	1,769	774
	Total	14,458	19,454	16,249
	Total investment (rounded)	14,500	19,500	16,200

Table II. Estimation of investment for a Radiology Center.

Investment estimate – Radiology Center			
No	Investment item	Estimated cost	
		Min	Max
EUR			
1	Equipment		
	Intraoral equipment	2,300	2,300
	Digital detector for intra-oral	10,000	10,000
	CBCT + Panoramic	120,000	200,000
	Printer dry film	5,000	6,000
	Radiosafety equipment	320	370
	Computer	700	1,200
	Total equipment	138,320	219,870
2	Location related costs		
	Rent for the set-up duration	600	1,000
	Radiology cabinet fitting	2,000	3,000
	Total location related costs	2,600	4,000
3	X-ray Laboratory Accreditation		
	Radiological expertise	400	600
	Public Health Authority	200	200
	National Authority for Radioprotection	1,000	1,000
	Total Accreditation costs	1,600	1,800
4	Staff training costs		
	Health certificate	20	30
	Individual dosimetry	25	35
	Total staff training costs	45	65
5	Marketing	100	150
6	Miscellaneous	7,148	11,274
	Total investment	149,813	237,159
	Grand Total	150,000	237,000

Table III. Revenues estimated monthly for the first year for Intraoral Radiology.

Estimated revenues for the first year - Intraoral Radiology														
Description	MU	Month												Total Year 1
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	
Number of radiographies	Pcs/month	400	440	484	532	585	644	696	731	768	806	846	888	7,820
<i>No increase factor</i>			0%	10%	10%	10%	10%	10%	8%	5%	5%	5%	5%	
Unit free	EUR/Pcs	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Revenue intraoral radiography	EUR	1,300	1,430	1,573	1,729	1,901	2,093	2,262	2,376	2,496	2,620	2,750	2,886	25,415

Table IV. Revenues estimated yearly for Intraoral Radiology.

Estimated revenues for the first year - Intraoral Radiology												
Description	MU	Year										
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Number of radiographies	Pcs/year	7,820	10,656	10,763	10,871	10,980	11,090	11,201	11,313	11,426	11,540	
<i>No increase factor</i>				1%	1%	1%	1%	1%	1%	1%	1%	
Unit free	EUR/Pcs	3.25	3.28	3.32	3.35	3.38	3.42	3.45	3.48	3.52	3.55	
<i>Fee increase factor</i>			0	0	0	0	0	0	0	0	0	
Revenue intraoral radiography	EUR	25,415	34,978	35,683	36,401	37,134	37,881	38,643	39,419	40,211	41,019	

Table V. Revenues estimated monthly for the first years for Radiology Center.

Estimated revenues for the first year - Radiology Center														
Description	MU	Month												Total
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	
Number of intraoral radiographies	Pcs/month	600	660	726	799	879	967	1,044	1,096	1,151	1,209	1,269	1,332	11,732
<i>No increase factor</i>			10%	10%	10%	10%	10%	10%	8%	5%	5%	5%	5%	
Unit free	EUR/Pcs	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
Revenue intraoral radiography	EUR	1,920	2,112	2,323	2,557	2,813	3,094	3,341	3,507	3,683	3,869	4,061	4,262	37,542
Number of panoramic radiographies	Pcs/ month	400	440	484	532	585	644	696	731	768	806	846	888	7,820
<i>No increase factor</i>			10%	10%	10%	10%	10%	10%	8%	5%	5%	5%	5%	
Unit free	EUR/Pcs	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Revenue panoramic radiography	EUR	2,800	3,080	3,388	3,724	4,095	4,508	4,872	5,117	5,376	5,642	5,922	6,216	54,740
Number of CBCT	Pcs/ month	100	104	109	113	116	118	119	120	121	122	123	124	1,389
<i>No increase factor</i>			4%	5%	4%	3%	2%	1%	1%	1%	1%	1%	1%	
Unit free	EUR/Pcs	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Revenue CBCT	EUR	4,500	4,680	4,905	5,085	5,220	5,310	5,355	5,400	5,445	5,490	5,535	5,580	62,505
Total revenue	EUR	9,220	9,872	10,616	11,366	12,128	12,912	13,568	14,024	14,504	15,001	15,518	16,058	154,787

Table VI. Revenues estimated yearly for Radiology Center.

Estimated revenues - Radiology Center												
Description	MU	Year										
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Number of intraoral radiographies	Pcs/year	11,732	15,984	16,144	16,305	16,468	16,633	16,799	16,967	17,137	17,308	
<i>No increase factor</i>				1%	1%	1%	1%	1%	1%	1%	1%	
Unit free	EUR/Pcs	3.20	3.23	3.26	3.30	3.33	3.36	3.40	3.43	3.47	3.50	
<i>Fee increase factor</i>		0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Revenue intraoral radiography	EUR	37,542	51,660	52,699	53,757	54,837	55,941	57,064	58,211	59,382	60,574	
Number of panoramic radiographies	Pcs/year	7,820	10,656	10,763	10,871	10,980	11,090	11,201	11,313	11,426	11,540	
<i>No increase factor</i>				1%	1%	1%	1%	1%	1%	1%	1%	
Unit free	EUR/Pcs	7.00	7.07	7.14	7.21	7.28	7.36	7.43	7.50	7.58	7.66	
<i>Fee increase factor</i>		0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Revenue panoramic radiography	EUR	54,740	75,338	76,855	78,403	79,981	81,590	83,231	84,903	86,609	88,348	
Number of CBCT	Pcs/year	1,389	1,488	1,503	1,518	1,533	1,548	1,563	1,579	1,595	1,611	
<i>No increase factor</i>				1%	1%	1%	1%	1%	1%	1%	1%	
Unit free	EUR/Pcs	45.00	45.45	45.90	46.36	46.83	47.30	47.77	48.25	48.73	49.22	
<i>Fee increase factor</i>		0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Revenue CBCT	EUR	62,505	67,630	68,994	70,380	71,786	73,213	74,662	76,181	77,722	79,287	
Total revenue	EUR	154,787	194,628	198,549	202,540	206,604	210,744	214,957	219,295	223,713	228,209	

Table VII. Estimated costs presented monthly for the first year for Intraoral Radiology.

Estimated costs for the first year – Intraoral Radiology															
Description	MU	Unit Cost	Month												Total
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	
Number of radiographies	Pcs/month		400	440	484	532	585	644	696	731	768	806	846	888	7,820
Consumables	EUR		410	451	496	545	600	660	713	749	787	826	867	910	8,016
Consumable price	EUR/pcs	1.00	400	440	484	532	585	644	696	731	768	806	846	888	7,820
Tonner	EUR/pcs	0.025	10	11	12	13	15	16	17	18	19	20	21	22	196
Maintenance and certification costs	EUR		-	-	-	-	-	-	-	-	-	-	-	-	600
Annual technical certificate and service	EUR/year	1000	-	-	-	-	-	-	-	-	-	-	-	-	-
OTDM X-ray equipments certificate	EUR/2 years	500	-	-	-	-	-	-	-	-	-	-	-	-	-
Radiosafety equipments certificate	EUR/2 years	350	-	-	-	-	-	-	-	-	-	-	-	-	-
Disinfection materials	EUR/year	600	50	50	50	50	50	50	50	50	50	50	50	50	600
Other expenses	EUR		130	143	157	173	190	209	226	238	250	262	275	289	2,542
Staff expenses	EUR		495	495	495	495	495	495	495	495	990	990	990	990	8,415
Number of persons	EUR	1	1	1	1	1	1	1	1	2	2	2	2	2	2
Wages and wages expenses	EUR/person	495	495	495	495	495	495	495	495	495	495	495	495	495	5,940
Medical training costs	EUR		-	-	-	-	-	-	-	-	45	-	-	-	45
Health certificate	EUR/5 years	20	-	-	-	-	-	-	-	-	20	-	-	-	20
Individual dosimetry	EUR/5 years	25	-	-	-	-	-	-	-	-	25	-	-	-	25
Rent	EUR/month	100	100	100	100	100	100	100	100	100	100	100	100	100	1,200
Utilities	EUR/month	50	50	50	50	50	50	50	50	50	50	50	50	50	600
Depreciation	EUR		111	111	111	111	111	111	111	111	111	111	111	111	1,330
Radiology equipment	EUR	1139.5	95	95	95	95	95	95	95	95	95	95	95	95	1,140
Computer	EUR	190.0	16	16	16	16	16	16	16	16	16	16	16	16	190
Total costs	EUR		1,166	1,207	1,252	1,301	1,355	1,416	1,469	2,045	2,038	2,077	2,118	2,161	22,747

Table VIII. Estimated costs presented monthly for the first year for Radiology Center.

Estimated costs for the first year – Radiology Center															
Description	MU	Unit Cost	Month												Total
			Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	
Total number of radiographies; of which	Pcs/month		1,100	1,204	1,319	1,444	1,580	1,729	1,859	1,947	2,040	2,137	2,238	2,344	20,941
<i>Intraoral</i>	<i>Pcs/month</i>		<i>600</i>	<i>660</i>	<i>726</i>	<i>799</i>	<i>879</i>	<i>967</i>	<i>1,044</i>	<i>1,096</i>	<i>1,151</i>	<i>1,209</i>	<i>1,269</i>	<i>1,332</i>	<i>11,732</i>
<i>Panoramic</i>	<i>Pcs/month</i>		<i>400</i>	<i>440</i>	<i>484</i>	<i>532</i>	<i>585</i>	<i>644</i>	<i>696</i>	<i>731</i>	<i>768</i>	<i>806</i>	<i>846</i>	<i>888</i>	<i>7,820</i>
<i>CBCT</i>	<i>Pcs/month</i>		<i>100</i>	<i>104</i>	<i>109</i>	<i>113</i>	<i>116</i>	<i>118</i>	<i>119</i>	<i>120</i>	<i>121</i>	<i>122</i>	<i>123</i>	<i>124</i>	<i>1,389</i>
Consumables	EUR		1,050	1,154	1,268	1,393	1,530	1,681	1,813	1,903	1,997	2,096	2,199	2,307	20,388
Consumable price	EUR/pcs	1.000	1,000	1,100	1,210	1,331	1,464	1,611	1,740	1,827	1,919	2,015	2,115	2,220	19,552
Tonner	EUR/pcs	0.025	25	28	30	33	37	40	44	46	48	50	53	56	489
CD price (for CBCT)	EUR/pcs	0.250	25	26	27	28	29	30	30	30	30	31	31	31	347
Maintenance and certification costs	EUR		100	100	100	100	100	100	100	100	100	100	100	2,100	3,200
Annual technical certificate and service	EUR/year	2,000	-	-	-	-	-	-	-	-	-	-	-	-	2,000
OTDM X-ray equipments certificate	EUR/2 years	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-
Radiosafety equipments certificate	EUR/2 years	350	-	-	-	-	-	-	-	-	-	-	-	-	-
Disinfection materials	EUR/year	1,200	100	100	100	100	100	100	100	100	100	100	100	100	1,200
Other expenses	EUR		922	987	1,062	1,137	1,213	1,291	1,357	1,402	1,450	1,500	1,552	1,606	15,479
Staff expenses	EUR		1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	1,890	22,680
Number of persons	EUR	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Wages and wages expenses	EUR/person	630	630	630	630	630	630	630	630	630	630	630	630	630	7,560
Medical training costs	EUR		-	-	-	-	-	-	-	-	-	-	-	-	-
Health certificate	EUR/5 years	20	-	-	-	-	-	-	-	-	-	-	-	-	-
Individual dosimetry	EUR/5 years	25	-	-	-	-	-	-	-	-	-	-	-	-	-
Rent	EUR/month	500	500	500	500	500	500	500	500	500	500	500	500	500	6,000
Utilities	EUR/month	70	70	70	70	70	70	70	70	70	70	70	70	70	840
Depreciation	EUR		1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	22,107
Radiology equipment	EUR	21,867	1,822	1,822	1,822	1,822	1,822	1,822	1,822	1,822	1,822	1,822	1,822	1,822	21,867
Computer	EUR	240	20	20	20	20	20	20	20	20	20	20	20	20	240
Total costs	EUR		6,374	6,543	6,731	6,931	7,145	7,374	7,572	7,707	7,850	7,998	8,153	10,315	90,694

Dental Medicine

Table IX. Estimated costs presented yearly for Intraoral Radiology.

Estimated costs – Intraoral Radiology											
Description	MU	Year									
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Number of radiographies	Pcs/month	7,820	10,656	10,763	10,871	10,980	11,090	11,201	11,313	11,426	11,540
Consumables	EUR	8,016	11,032	11,251	11,475	11,703	11,936	12,173	12,415	12,661	12,913
Consumable price	EUR/pcs	7,820	10,763	10,979	11,200	11,426	11,656	11,890	12,129	12,373	12,621
Tonner	EUR/pcs	196	269	272	274	277	280	283	286	289	291
Maintenance and certification costs	EUR	600	1,859	1,020	1,936	1,051	2,034	1,173	2,254	1,361	2,579
Annual technical certificate and service	EUR/year	-	1,000	1,020	1,051	1,051	1,105	1,173	1,257	1,361	1,489
OTDM X-ray equipments certificate	EUR/2 years	-	505	-	520	-	547	-	586	-	641
Radiosafety equipments certificate	EUR/2 years	-	354	-	364	-	383	-	410	-	449
Disinfection materials	EUR/year	600	606	618	637	663	697	739	793	858	939
Other expenses	EUR	2,542	3,498	3,568	3,640	3,713	3,788	3,864	3,942	4,021	4,102
Staff expenses	EUR	8,415	11,999	12,119	12,240	12,362	12,486	12,611	12,737	12,864	12,993
Number of persons	EUR	2	2	2	2	2	2	2	2	2	2
Wages and wages expenses	EUR/person	5,940	5,999	6,059	6,120	6,181	6,243	6,305	6,368	6,432	6,496
Medical training costs	EUR	45	-	-	-	47	47	-	-	48	-
Health certificate	EUR/5 years	20	-	-	-	21	21	-	-	21	-
Individual dosimetry	EUR/5 years	25	-	-	-	26	26	-	-	27	-
Rent	EUR/month	1,200	1,212	1,224	1,236	1,249	1,261	1,274	1,287	1,299	1,312
Utilities	EUR/month	600	630	662	695	729	766	804	844	886	931
Depreciation	EUR	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330
Radiology equipment	EUR	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Computer	EUR	190	190	190	190	190	190	190	190	190	190
Total costs	EUR	22,747	32,164	31,792	33,188	32,847	34,344	33,967	35,601	35,330	37,098

Table X. Estimated costs presented yearly for Radiology Center.

Estimated costs – Radiology Center											
Description	MU	Year									
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total number of radiographies; of which	Pcs/month	20,941	28,128	28,410	28,694	28,981	29,271	29,563	29,859	30,158	30,459
Intraoral	Pcs/month	11,732	15,984	16,144	16,305	16,468	16,633	16,799	16,967	17,137	17,308
Panoramic	Pcs/month	7,820	10,656	10,763	10,871	10,980	11,090	11,201	11,313	11,426	11,540
CBCT	Pcs/month	1,389	1,488	1,503	1,518	1,533	1,548	1,563	1,579	1,595	1,611
Consumables	EUR	20,388	27,955	28,235	28,517	28,803	29,091	29,382	29,676	29,973	30,272
Consumable price	EUR/pcs	19,552	26,906	27,176	27,448	27,722	28,000	28,280	28,563	28,849	29,136
Tonner	EUR/pcs	489	673	679	686	693	700	707	714	721	728
CD price (for CBCT)	EUR/pcs	347	376	380	383	387	391	395	399	403	407
Maintenance and certification costs	EUR	3,200	3,384	2,040	3,465	2,081	3,578	2,123	3,727	2,166	3,919
Annual technical certificate and service	EUR/year	2,000	2,020	2,040	2,061	2,081	2,102	2,123	2,144	2,166	2,187
OTDM X-ray equipments certificate	EUR/2 years	-	1,010	-	1,041	-	1,094	-	1,173	-	1,282
Radiosafety equipments certificate	EUR/2 years	-	354	-	364	-	383	-	410	-	449
Disinfection materials	EUR/year	1,200	1,212	1,236	1,274	1,326	1,393	1,479	1,586	1,717	1,878
Other expenses	EUR	15,479	19,463	19,855	20,254	20,660	21,074	21,496	21,929	22,371	22,821
Staff expenses	EUR	22,680	22,907	23,136	23,367	23,601	23,837	24,075	24,316	24,559	24,805
Number of persons	-	3	3	3	3	3	3	3	3	3	3
Wages and wages expenses	EUR/person	7,560	7,636	7,712	7,789	7,867	7,946	8,025	8,105	8,186	8,268
Medical training costs	EUR	-	-	-	-	142	-	-	-	-	149
Health certificate	EUR/5 years	-	-	-	-	21	-	-	-	-	22
Individual dosimetry	EUR/5 years	-	-	-	-	26	-	-	-	-	28
Rent	EUR/month	6,000	6,060	6,121	6,182	6,244	6,306	6,369	6,433	6,497	6,562
Utilities	EUR/month	840	882	926	972	1,021	1,072	1,126	1,182	1,241	1,303
Depreciation	EUR	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107
Radiology equipment	EUR	21,867	21,867	21,867	21,867	21,867	21,867	21,867	21,867	21,867	21,867
Computer	EUR	240	240	240	240	240	240	240	240	240	240
Total costs	EUR	90,694	103,969	103,656	106,139	105,984	108,459	108,156	110,956	110,631	113,815

Table XI. Yearly estimated budgets for Intraoral Radiology.

Estimated Budget – Intraoral Radiology										
EUR	Year									
Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Revenues	25,415	34,978	35,683	36,401	37,134	37,881	38,643	39,419	40,211	41,019
Total costs	(21,417)	(30,835)	(30,462)	(31,858)	(31,517)	(33,014)	(32,638)	(34,271)	(33,999)	(35,768)
Consumables	(8,016)	(11,032)	(11,251)	(11,475)	(11,703)	(11,936)	(12,173)	(12,415)	(12,661)	(12,913)
Maintenance and certification costs	(600)	(2,465)	(1,638)	(2,572)	(1,714)	(2,731)	(1,912)	(3,047)	(2,220)	(3,518)
Other expenses	(2,542)	(3,498)	(3,568)	(3,640)	(3,713)	(3,788)	(3,864)	(3,942)	(4,021)	(4,102)
Staff expenses	(8,415)	(11,999)	(12,119)	(12,240)	(12,362)	(12,486)	(12,611)	(12,737)	(12,864)	(12,993)
Medical training costs	(45)	-	-	-	(47)	(47)	-	-	(47)	-
Rent	(1,200)	(1,212)	(1,224)	(1,236)	(1,249)	(1,261)	(1,274)	(1,287)	(1,299)	(1,312)
Utilities	(600)	(630)	(662)	(695)	(729)	(766)	(804)	(844)	(886)	(931)
EBITDA	3,998	4,144	5,221	4,543	5,616	4,867	6,005	5,148	6,212	5,250
Depreciation	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)	(1,330)
EBIT	2,669	2,814	3,891	3,213	4,287	3,537	4,675	3,819	4,883	3,921
Corporate tax	(427)	(450)	(623)	(514)	(686)	(566)	(3,587)	(611)	(781)	(627)
Net profit	2,242	2,364	3,269	2,699	3,601	2,971	1,088	3,208	4,101	3,293

Table XII. Yearly estimated budgets for Radiology Center.

Estimated Budget – Radiology Center										
EUR	Year									
Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Total Revenues	154,787	194,628	198,549	202,540	206,604	210,744	214,957	219,295	223,713	228,209
Total costs	(68,587)	(81,862)	(81,549)	(84,032)	(83,877)	(86,352)	(86,049)	(88,849)	(88,524)	(91,708)
Consumable price	(20,388)	(27,955)	(28,235)	(28,517)	(28,803)	(29,091)	(29,382)	(29,676)	(29,973)	(30,272)
Maintenance and certification costs	(3,200)	(4,596)	(3,277)	(4,739)	(3,407)	(4,972)	(3,602)	(5,313)	(3,883)	(5,796)
Other expenses	(15,479)	(19,463)	(19,855)	(20,254)	(20,660)	(21,074)	(21,496)	(21,929)	(22,371)	(22,821)
Staff expenses	(22,680)	(22,907)	(23,136)	(23,367)	(23,601)	(23,837)	(24,075)	(24,316)	(24,559)	(24,805)
Medical training costs	-	-	-	-	(142)	-	-	-	-	(149)
Rent	(6,000)	(6,060)	(6,121)	(6,182)	(6,244)	(6,306)	(6,369)	(6,433)	(6,497)	(6,562)
Utilities	(840)	(882)	(926)	(972)	(1,021)	(1,072)	(1,126)	(1,182)	(1,241)	(1,303)
EBITDA	86,201	112,766	117,000	118,508	122,727	124,392	128,907	130,446	135,189	136,501
Depreciation	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)	(22,107)
EBIT	64,094	90,659	94,893	96,401	100,620	102,285	106,800	108,339	113,082	114,394
Corporate tax	(10,255)	(14,505)	(15,183)	(15,424)	(16,099)	(16,366)	(17,088)	(17,334)	(18,093)	(18,303)
Net profit	53,839	76,154	79,710	80,977	84,521	85,919	89,712	91,005	94,989	96,091

Table XIII. Cash flows for Intraoral Radiology.

Estimated Cash Flows – Intraoral Radiology										
EUR	Year									
Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net profit	2,242	2,364	3,269	2,699	3,601	2,971	1,088	3,208	4,101	3,293
Depreciation	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330
WACC change	(71)	(124)	(103)	(6)	(6)	(6)	(6)	(6)	(7)	(7)
CAPEX	-	-	(130)	(130)	(130)	(680)	(330)	(330)	(330)	(330)
Total cash flow	(16,200)	3,500	3,570	4,365	3,893	4,794	3,614	2,082	4,201	5,094
Discount rate	8.25%									
Investment	16,200									
NPV	8,949									
IRR	20.0%									

Table XIV. Cash flows for Radiology Center.

Estimated Cash Flows –Radiology Center											
EUR	Year										
Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Net profit	53,839	76,154	79,710	80,977	84,521	85,919	89,712	91,005	94,989	96,091	
Depreciation	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107	22,107	
WACC change	(860)	(762)	(584)	(607)	(56)	(57)	(59)	(60)	(61)	(62)	
CAPEX	-	-	(2,210)	(2,210)	(2,210)	(3,410)	(2,210)	(2,210)	(2,210)	(22,107)	
Total cash flow	(237,000)	75,086	97,499	99,023	100,267	104,361	104,559	109,551	110,842	114,825	96,028
Discount rate	9.25%										
Investment	237,000										
NPV	360,014										
IRR	38.0%										

The yearly budgets for the Intraoral Radiology Laboratory and the Radiology center are presented in table XI and table XII, respectively.

Tables XIII and XIV present the cash flows, discount rate, NPV and IRR for each alternative considered. In both alternatives, the net present values (NPV) and the internal rate of return (IRR) show that the investment is feasible and that, in a 10 year term, there is a positive substantial return.

Discussion

Nowadays, a number of intraoral and extra-oral imaging modalities are available to assist the radiological examination in dental medicine, one important reason for dentists to also have a Radiology Center. Commonly used two-dimensional (2D) modalities, which include bitewing, periapical and panoramic X-ray are suitable because they are easily acquired, inexpensive and provide high-resolution images, however none without limitations: overlapping anatomical structures, difficulty in standardization, underestimating size and bone defect [5].

The 3D imaging technique, such as the Cone Beam Computed Tomography (CBCT) images, started to be used more often by the dentists as it carries highly informative value. The use of CBCT in clinical practice offers a number of potential advantages over conventional tomography and 2D techniques, including easier image acquisition, high image accuracy, reduced artefacts and lower effective radiation doses [6].

Therefore, for dental practice, we took into account two investment types, the first being an Intraoral Radiological center and, owing to the benefits provided by the CBCT imaging, the second investment type proposed in the current study was a Radiology Center.

Regarding the estimated cost of the two investment types, they vary substantially. The estimated cost for the Radiology Center is about ten times higher than for the Intraoral Center. This difference arises from the price of

the CBCT machine, which is six time higher than the price of the intraoral equipment. Another important difference is represented by the fact that in the case of the Radiology Center, beside the CBCT equipment it also requires intraoral and panoramic radiological equipment [7].

The risk model used in the current study, the Capital Asset Pricing Model (CAPM) offers the possibility to compare different versions of placement in the financial markets. On the other hand, it justifies the estimation made on scientific basis of the expected future value of profits generated by a financial instrument. Thus, CAMP model approximated with accuracy the differences between the two models of investment proposed in this paper [7].

The current study anticipated that the cost difference between CBCT and conventional imaging methods may vary both within and also among different clinical conditions. Hence, a certain clinical condition of the patient may require a varying number of CBCT volumes or the use of different sizes of the field of view.

Higher volumes may represent a wider range of conditions for which CBCT is used, larger populations, different thresholds for referral, different catchment populations or a combination of these factors [8].

Thus, in many clinical conditions as dental anomalies, implantology, orthognathic surgery, endodontic assessments, CBCT examination is required even if it is more expensive, almost two times higher than the price of an intraoral X-ray [9].

This study examines a financial model to estimate financial risk, which could be extended at European level. Financial risk appears due to the instability and loss in the financial market caused by movements in stock prices and currencies, and is inherent in any investment, its proper manager being key in running a successful business [10]. The risk model used for the two investment types presented here, namely the CAMP model is widely used to estimate financial risk.

CAPM is designed to establish a link between the risk of an asset and its expected return and it is frequently used due to the simplicity of the method and also because it offers the possibility of easy comparisons of investment alternatives [11].

Regarding the estimation of financial risk, there are several factors that should be taken into consideration: increased volatility of financial markets; developments in technology; increased number and model of radiology equipment, government regularization, liquidity and cash flow [12].

Starting from the idea that financial risk influenced directly and indirectly the profits of a business nowadays, certain companies from Europe introduced risk committees, whose main task is to identify, monitor and manage the company's risks [12].

The Radiology Center and the Intraoral Radiology presented in the current study are managed by the dentist. The major focus of the dentist should be to reduce harm and injury to both the patients and the radiological technician and to improve outcomes from the Radiology Center [13].

Hence, certain risks may be directly controlled, while others depend on factors unrelated to the dentist's managerial skills. The best thing a manager can do is to try to anticipate potential controllable risks, assess the potential impact on the business and be prepared with a second plan to react [14].

As regards the Intraoral Radiology investment, it is noticeably a more sensitive case. The return, if the maximum investment level is chosen, is much smaller than in the average case and twice as small in NPV terms. Also, investment is recovered in a period of 5 to 6 years.

Therefore, an investment in a Radiology Center is much more profitable and the return is much higher. The investment may be recovered in a 3 to 4 years' time and the IRR is much higher. With an internal rate of return much higher, the Radiology Center provides a much better chance of strong development. Nevertheless, we have to take into account that the magnitude of the initial investment is quite large. This would usually involve a quota of borrowed capital, meaning interest payment, hence a more reduced IRR.

The current study has some limitations. Those limits concern the fact that the CAMP model consists in determining a linear relationship between profitability and the financial market risk assumed by an investor, in this case the dentist. In reality, there are some external factors that influence the financial model estimation, such as interest rate changes, inflation, recession and changes in the market demand [12].

Conclusions

This study reveals an important input for economic evaluation in comparing costs and profits for two types

of investments, Intraoral Radiology and Radiology Center. According to our findings, the Radiological center represents a more profitable investment due to a higher economic rate of return, even if the initial estimated budget is substantially larger than the budget for Intraoral Radiology.

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