4. Evaluation of Results

4.1. Infield Activities

4.1.1. Method of Analysis of Results from Each of IDEA Subprojects: Tagging, Reading and Recovery Activities

The results presented in this chapter have been extracted from the Central IDEA Data Base. The data have been transmitted from each IDEA subproject according to protocols of data recording and transmission defined in the Guide Procedures. The data, which arrived at the JRC, were syntactically and semantically checked and, once their validity was proven, entered in the Central Data Base. No modification or alteration of data has been performed by the JRC, except in some specific cases and after the specific request with written authorisation of the involved IDEA Subcontractor.

Data delivered in any other format (e.g. paper, fax, e-mail) or required for any other purposes in the framework of the IDEA Project (meeting preparation, clarifications, etc…) and not coming from the Central IDEA Data Base have not been included in the different summary tables of this chapter. This information has, however, been used in many cases for the interpretation of the summary tables and analysis of the results.

For the analysis of each IDEA Subproject, several tables were compiled. A first table presents the number of animals, which were expected to be identified in the IDEA Project (Animals to be read) and those readings, which were recorded (readings recorded) at different time intervals (Table 4.1.1.1).

Animal Species	**Identifier Type**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read								
Readings Recorded								
AUF (%)								
Reading Results:								
Successful Readings								
Electr. tag not read								
Electronic tag lost								
Electr. tag broken								
Readers not function.								
Animal not present								
Read. not performed								

Table 4.1.1.1. Number of readings and readings results

For each species, reference is made to the electronic identifier type and brand used. Following the methodology of analysis and evaluation explained in point 3.3.7. the "Animals Unaccounted For" (AUF) and their percentage were calculated, from the number of animals to be read and the number of declared readings.

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" have been taken into account to calculate the percentage of failure of electronic identifiers (Failures %) at different time intervals (Table 4.1.1.2).

It has to be noted that, in some cases, "tag not read", "lost" or "broken" are declared several times for the same animal in different control reading periods and, as a consequence, the failures percentage within each reading period is increased. An analysis has been performed of these cases and the repeated failure declarations have been deleted. Only the new failures, which occurred between two reading periods, are retained in the table of results (Failures Corrected). The new failure percentage within each reading period has then been calculated with these new results.

Species Identifier Type		**Reading type**							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
	Failures (%)								
	Readings								

Table 4.1.1.2 Reading results on animal identified

The readings performed on the slaughtered animals have also been analysed, taking into account the readings at farm departure, at slaughterhouse arrival, at the entrance of the slaughter chain and after recovery. The number of readings performed per reading type in relation of the number of animals slaughtered was compiled. The reading performance at slaughterhouse was evaluated, as well as, the proper functioning of the transponders after recovery. Finally, the number of transponders read after recovery is correlated with the number of transponders recovered.

The failure rate of readers ("Readers not functioning") has been evaluated and is discussed in section 4.5 of this report.

For each subproject the recovery results in field and in slaughterhouse have been compiled per species, tag type and brand using the recovery result codification from the Guide Procedures (Table 4.1.1.3 and Table 4.1.1.4). An attempt has been made to consider the results for different possibilities of recovery. The code 02 "recovered not previously read" takes into account the recoveries of an electronic identifier electronically failed but physically present. On the contrary, code 03 "previously read but not present at recovery" takes into account that the electronic identifier was not physically present at recovery but was always read in previous readings (i.e.: any reading before slaughter or dead or at the entrance of the slaughterhouse).

Slaughterhouse Recovery results	*Identifier Type*							
Species	*ID1*		*ID2*		*ID3*		*TOTAL IB*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Electronic identifier recovered								
Electronic identifier recovered not previously read								
Previously read but not present at recovery								
Not recovered for sanitary reasons								
Other								
Total Electronic Identifiers								

Table 4.1.1.3 Slaughterhouse recovery results

In field Recovery Results	*Identifier Type*							
Species	*ID1*		*ID2*		*ID3*		*TOTAL ID*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Electronic identifier recovered								
Electronic identifier recovered not previously read								
Previously read but not present at recovery								

Table 4. 1.1.4 In field recovery results

The analysis of results has shown that, in many cases the AUF value and the number of readings not performed (mostly for operational reasons) was very high for different reading types. When the sum of both values was larger than 70%, these data were disregarded for the analysis. It was considered that in these cases, the project was not anymore representative of the activities, which had to be performed during the considered control period.

Using the “BI Query and BI Analyse Hummingbird™” software package (described in 3.3.5.3.) further analysis has been performed to verify the effect of different parameters. An analysis has been performed on the possible influence of the tagger/controller people on the declared reading failures. In a number of cases, the number of failures strongly increased in comparison with previous and successive performed readings. If an effect was found (i.e. same person declared a high percentage of the failures) this value has been recalculated and a new value was allocated which represents the mean of reading failures declared by the other tagger/controller people. These new data (Failures Corrected) have been included in the summary table per tag and reading type for each subproject. The influence of other parameters (i.e. presence of magnet in cattle, age of tagging, breed type) have also been analysed.

The detailed results of each of the IDEA subprojects have been reported in a separate document, which was discussed directly with the IDEA participants.

4.1.2 Global Results of the IDEA Project

4.1.2.1 Analysis of Tagging, Reading and Recovery Activities

A total of 882 011 animals were electronically identified and re-tagged with electronic eartags (n= 232310), ruminal bolus (n= 617719) and injectable transponders (n= 29982). Table 4.1.2.1.1. shows the number of animals tagged per specie and electronic identifier type.

	Electronic Eartag	Ruminal Bolus	Injectable Transponder	Total Identified
Buffalo		15 715		15 715
Cattle	139 807	159 430	29 982	329 219
Sheep	92 503	414 043		506 546
Goat	-	30 531		30 531
Total Identified	232 310	619 719	29 982	***882 011***

Table 4.1.2.1.1. Number of animals tagged per specie and electronic identifier type

Animals identified with the mini and small types of Ruminal boluses have been included in this table. The experimental results and the performance evaluation of these bolus types are shown in Chapter 4.1.2.3., which is dedicated to the identification of young animals using small and mini bolus types.

The global results are presented per species and for each species a division has been made per tag type. The first tables show the number of animals to be read per reading period and the number of reading results <u>declared</u> by the IDEA subcontractors.

From the reading results, the Failures % of electronic identifiers with the Failure Range have been calculated and presented in a summary table. These tables take into account the "<u>Corrected Failures</u>" values calculated in case of repeated declaration of a reading failure or when anomalies of the results were found and a clear reason was identified (see section 4.1.1.). The last tables show the recovery results in field and in slaughterhouse per tag type and brand. Finally, a global discussion and comments are presented per species.

a) Analysis of Results on Buffalo

Only the IDEA Lazio subproject performed electronic identification of Buffalo using the Ruminal Bolus type RB1. The Ministero della Sanita IDEA Subproject identified Buffalo with the small type of Ruminal Bolus (RB 5). The results of this bolus type in Buffalo are shown in Chapter 4.1.2.1.2.

Buffalo	**Ruminal Bolus (RB1)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	14 393	14 393	14 382	14 028	11 586	9 317	4 119	1 055
Readings Recorded	14 393	1 431	12 486	12 596	9 444	6 906	1 784	305
AUF (%)	0	476 (3.31)		1 432 (10.21)	2 142 (18.49)	2 411 (25.88)	2 335 (56.69)	750 (71.09)
Reading Results:								
Successful Readings	14 393	1 308	11 593	10 314	5 950	3 753	908	0
Electr. tag not read	0	0	9	17	4	13	0	0
Electronic tag lost	0	0	0	0	0	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	0	0	0	0	0	0	0
Animal not present	0	1	7	5	15	105	3	0
Read. not performed	0	122	877	2 260	3 475	3 035	873	305

Table 4.1.2.1.2. Number of readings and readings results of buffalo with ruminal bolus

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Table 4.1.2.1.3.).

Buffalo **Ruminal Bolus**	**Reading type**

		After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
RB1	Failures (%)	0	0	9 (0.08)	17 (0.16)	4 (0.07)	13 (0.35)	0	0
	Readings	14 393	1 308	11 602	10 331	5 954	3 766	908	0

Table 4.1.2.1.3. Reading results on buffalo identified with ruminal bolus

The following table 4.1.2.1.4. shows the in field recovery results. Data received from the Lazio IDEA subproject show that a total of 264 buffalo died in field during the IDEA Project. A total of 136 buffalo were slaughtered in a slaughterhouse out of the IDEA Project with a 100% recovery efficiency.

In field Recovery Results	***Ruminal Bolus***	
Buffalo	***RB1***	
	n	***%***
Electronic identifier recovered	87	32.9
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	-	-
Not recovered for sanitary reasons	177	67.1
Other	-	-
Total Electronic Identifiers	264	

Table 4.1.2.1.4. In field recovery results of Ruminal Bolus in buffalo

Discussion and comments for buffalo identification

- ***Tagging Activities***

a) Tagging Time

- The Lazio IDEA subcontractor declared in its Final Report that, in average, a total of 50-60 buffalo could be identified per day per tagging team. This number is closely related with the number of animals per farm. If one farm has only 40 animals it is impossible to go to another farm the same day. If the farm has 80 animals or even more, it is possible to finish the identification of all animals in the same day. As a consequence, the tagging efficiency as number of animals /day is better in the case of large farms.
- When taking into account the tagging time/animal, 80% of the animals were identified with a tagging time between 4 and 10 minutes. This distribution is depending from available restraining structures in the farm. Sometimes there are auto-lock systems where all animals are restrained individually and in other cases each animal should be catched and restrained individually increasing the tagging time.
- The tagging time is also conditioned by the production system on which animals are kept. Dairy buffalo are kept in intensive conditions and are normally milked twice a day. Fattening buffalo are kept in semi-intensive conditions. In these restraining conditions, tagging and reading procedures have shown to be feasible for young and adult animals.

b) Age of the animals at tagging

- The major part of the animals in the IDEA Project were adult at the moment of the tagging (more than 1 years old) and only a small number of replacement animals were identified in the IDEA Project. Figure 4.1.2.1 shows the distribution of the age at tagging of buffalo identified with ruminal bolus.

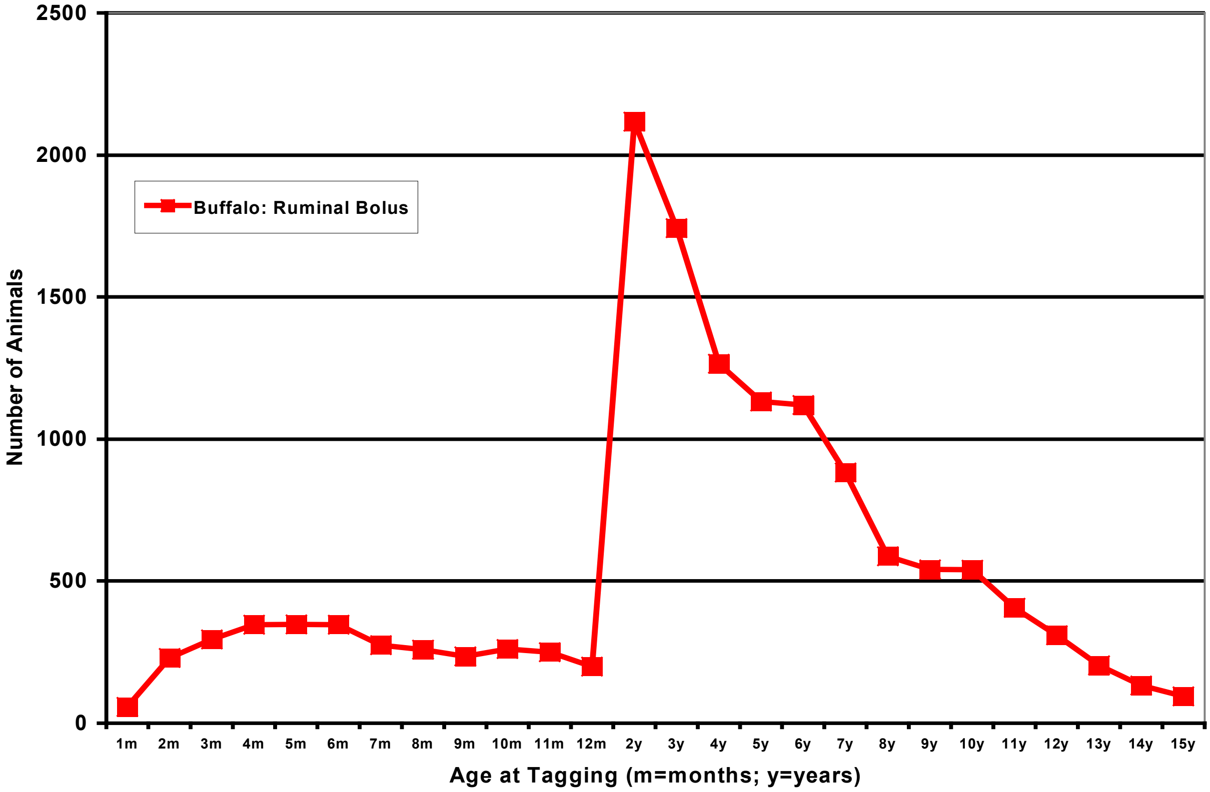

Figure 4.1.2.1. Distribution of the age at tagging of buffalo identified with ruminal bolus.

c) Re-tagging

- The re-tagging has been performed for all animals with ruminal bolus declared as "not read" or "lost".

- ***Reading Activities***

a) Comparison between electronic identifier types and brands

- Only the IDEA Lazio subproject performed electronic identification of Buffalo using the Ruminal Bolus of normal size (RB1). As a consequence, no comparison between tag types and brands could be performed.

b) Readings performed

- The sum of the AUF values and the readings declared as "not performed" were lower than 50% until the control reading at 7 months after tagging. AUF value at 14 months after tagging is 58 %. Beyond this period AUF values and readings "not performed" are very high. As a result, conclusions can be drawn on mid and long-term behaviour of the ruminal bolus in buffalo.
- Concerning the reading system, the Lazio IDEA report states that 60% of the readings were performed in dynamic conditions and 40% in static conditions. One may consider that the reading after tagging is always performed in static

conditions and, as consequence, the percentage of control readings performed in dynamic conditions increases to 80%.

c) Evaluation of the reading performance

- Failure % obtained in buffalo is less than 0.35% and is similar, in average, to those obtained by other IDEA Subprojects for cattle with the same type of ruminal bolus (RB1).
- No significant increase of the reading failures has been found with time. In addition to this fact, the IDEA Lazio subproject states in its report that the bolus reading failures result 15-20 times less than the loss of the plastic eartags currently used.

- ***Recovery Results***
  - The recovery percentages in field added to the percentage of not recovery for sanitary reason, results in a 100% of recovery efficiency in field. The 100% of recovery efficiency at slaughterhouse have been verified. One may conclude that there is absence of problems for the bolus recovery.

b) Analysis of Results on Cattle

As mentioned in Table 4.1.2.1.1. three types of electronic identifiers were used in cattle in the IDEA Project.

b.1. Ruminal Bolus

A total of 8 IDEA Subprojects performed electronic identification of cattle using ruminal bolus (Germany, Spain, Italia Aosta, Italia Lazio, Netherlands, Portugal, France Bourgogne and France Bretagne). Three different types of Ruminal bolus (RB1, RB2 and RB3) have been used for the electronic identification of cattle.

Cattle	**Ruminal Bolus (RB1)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	122 460	122 364	121 783	120 309	101 505	58 537	46 332	11 431
Readings Recorded	122 460	83 062	110 223	108 041	74 381	47 779	35 486	6 721
AUF (%)	0	3 648 (2.98)		12 268 (10.20)	27 124 (26.72)	10 758 (18.38)	10 846 (23.41)	4 710 (41.20)
Reading Results:								
Successful Readings	122 460	82 605	102 190	99 277	65 870	39 418	23 017	6 287
Electr. tag not read	0	88	300	433	133	77	59	6
Electronic tag lost	0	15	9	6	5	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0

Readers not function.	0	91	360	132	185	3	44	5
Animal not present	0	263	889	1 870	2 681	1 109	818	302
Read. not performed	0	0	6 475	6 323	5 507	7 172	11 548	121

Table 4.1.2.1.5. Number of readings and readings results for cattle with Ruminal Bolus RB1

Cattle	**Ruminal Bolus 2 (RB2)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	22 717	22 688	22 177	21 638	17 945	6 657	2 924	2 009
Readings Recorded	22 717	17 855	20 401	18 237	9 562	4 016	38	0
AUF (%)	0	2 050 (9.04)		3 401 (15.72)	8 383 (46.71)	2 641 (39.67)	2 886 (98.70)	2 009 (100)
Reading Results:								
Successful Readings	22 717	13 927	16 792	14 416	5 448	104	1	-
Electr. tag not read	0	80	55	65	121	1	0	
Electronic tag lost	0	5	4	14	8	0	0	
Electr. tag broken	0	0	0	0	0	0	0	
Readers not function.	0	0	20	0	9	0	0	
Animal not present	0	0	7	70	6	4	0	
Read. not performed	0	3 843	3 523	3 672	3 970	3 907	37	

Table 4.1.2.1.6. Number of readings and readings results for cattle with Ruminal Bolus RB2

Cattle	**Ruminal Bolus (RB3)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	13 371	13 370	13 363	13 319	8.868	2.314	346	0
Readings Recorded	13 371	12 895	12 147	11 684	3 259	153	8	0
AUF (%)	0	110 (0.82)		1 635 (12.28)	5.609 (63.25)	2.161 (93.39)	338 (97.69)	0
Reading Results:								
Successful Readings	13 371	12 807	11 993	11 157	3 223	152	8	0
Electr. tag not read	0	81	58	77	33	0	0	0
Electronic tag lost	0	6	1	7	1	1	0	0

Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	0	0	0	2	0	0	0
Animal not present	0	1	9	15	0	0	0	0
Read. not performed	0	0	86	428	0	0	0	0

Table 4.1.2.1.7. Number of readings and readings results of cattle with Ruminal Bolus RB3

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Table 4.1.2.1.8.).

Cattle Ruminal Bolus		**Reading type (corrected)**							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
RB1	Failures (%) Range	0	103 (0.12) 0 - 0.61	161 (0.16) .02-0.45	217 (0.22) .04-0.67	46 (0.07) .003-0.47	13 (0.03) 0 - 0.3	7 (0.03) 0 - 0.08	4 (0.06) 0 - 0.06
	Readings	122 460	82 708	102 351	99 494	65 916	39 431	23 024	6 291
RB2	Failures (%) Range	0	85 (0.61) .12 - 0.9	53 (0.31) 0 - 0.36	69 (0.48) 0 - 0.89	53 (0.96) 0 - 1.6	1 (0.95) 0 - 1.75	0	-
	Readings	22 717	14 012	16 845	14 485	5 501	105	1	-
RB3	Failures (%) Range	0	87 (0.67) -	40 (0.33) -	68 (0.61) -	30 (0.92) -	0	0	-
	Readings	13 371	12 894	12 033	11 225	3 253	152	8	-
Total Bolus	Failures (%) Range	0	275 (0.25) 0 - 0.9	254 (0.19) 0 - 0.45	354 (0.28) 0 - 0.89	129 (0.17) 0 - 1.6	14 (0.04) 0 - 1.75	7 (0.03) 0 - 0.08	4 (0.06) 0 - 0.06
	Readings	158 548	109 614	131 299	125 204	74 670	39 688	23 033	6 291

Table 4.1.2.1.8. Reading results on cattle identified with ruminal bolus

One has to note that the corrected values for the RB1 bolus type are rather important for some control readings. The explanation can be found in section 4.1.1. of this report.

The following tables show the recovery results in slaughterhouse per ruminal bolus brand. Data received from the IDEA subcontractors show that a total of 43 497 cattle with ruminal bolus have been slaughtered during the IDEA Project. Tables 4.1.2.1.9. to 4.1.2.1.10. illustrate the recovery results in slaughterhouse.

Slaughterhouse Recovery results	*Ruminal Bolus*							
Cattle	*RB1*		*RB2*		*RB3*		*TOTAL RB*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Electronic identifier recovered	20 576	48.2	8 089	62.3	4 852	58.4	33 517	52.4
Electronic identifier recovered not previously read	814	1.9	1 175	9.1	1 757	21.2	3 746	5.9
Previously read but not present at recovery	20 287	47.6	2 460	18.9	-	-	22 747	35.6
Not recovered for sanitary reasons	-	-	-	-	-	-	-	-
Other	964	2.3	1 261	9.7	1 693	20.4	3 918	6.1
Total Electronic Identifiers	42 641		12 985		8 302		63 928	

Table 4.1.2.1.9. Slaughterhouse recovery results of Ruminal Bolus in cattle

The following table show the recovery results in field per ruminal bolus brand. Data received from the IDEA subcontractors show that a total of 7 564 cattle with ruminal bolus died in field during the IDEA Project.

In field Recovery Results	*Ruminal Bolus*							
Cattle	*RB1*		*RB2*		*RB3*		*TOTAL RB*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Electronic identifier recovered	3 604	49.9	7	4.9	18	9.4	3 629	47.9
Electronic identifier recovered not previously read	20	0.3	23	16.0	7	3.7	50	0.7

Previously read but not present at recovery	686	9.5	1	0.7	-	-	687	9.1
Not recovered for sanitary reasons	629	8.7	13	9.0	11	5.7	653	8.6
Other	2 289	31.6	100	69.4	156	81.2	2 545	33.7
Total Electronic Identifiers	7 228		144		192		7 564	

Table 4.1.2.1.10. In field recovery results of Ruminal Bolus in cattle

b.2 Electronic Eartag

A total of 5 IDEA Subprojects performed electronic identification of cattle using electronic eartags (Germany, Italia Min. Sanita, Netherlands, France Bourgogne, France Bretagne). Three different types of electronic eartags (EA1, EA3 and EA4) have been used for the electronic identification of cattle.

Cattle	**Electronic Eartag 1 (EA1)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	131 742	131 705	131 449	130 075	66 551	21 483	7 969	2 389
Readings Recorded	131 742	115 387	126 388	124 286	36 835	5 050	2	0
AUF (%)	0	2 891 (2.20)		5 789 (4.45)	29 716 (44.65)	16 433 (76.49)	7 967 (99.97)	2 389 (100)
Reading Results:								
Successful Readings	131 742	75 590	114 378	116 217	26 266	2 006	2	0
Electr. tag not read	0	176	482	728	309	43	0	0
Electronic tag lost	0	7	13	29	40	3	0	0
Electr. tag broken	0	5	24	44	97	2	0	0
Readers not function.	0	2	7	214	0	0	0	0
Animal not present	0	152	117	1 693	4 051	0	0	0
Data lost	0	0	122	457	0	0	0	0
Software problem	0	264	264	354	97	0	0	0
Read. not performed	0	39 191	10 981	4 550	5 975	2 996	0	0

Table 4.1.2.1.11. Number of readings and readings results of cattle with Electronic Eartag EA1

Cattle	**Electronic Eartag 3 (EA3)**
	Reading type

	After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
Animals to be read	2 391	2 391	2 390	2 385	2 170	1 185	201	120
Readings Recorded	2 391	2 391	2 390	2 384	1 989	934	0	0
AUF (%)	0	0		1 (0.04)	181 (8.34)	251 (21.18)	201 (100)	120 (100)
Reading Results:								
Successful Readings	2 391	1 985	2 078	2 018	911	16	0	0
Electr. tag not read	0	12	20	11	11	0	0	0
Electronic tag lost	0	2	4	6	15	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	0	27	28	0	0	0	0
Animal not present	0	0	0	0	14	0	0	0
Read. not performed	0	392	261	321	1 038	918	0	0

Table 4.1.2.1.12. Number of readings and readings results of cattle with Electronic Eartag EA3

Cattle	**Electronic Eartag 4 (EA4)**							
	Reading type							
	After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
Animals to be read	5 727	5 726	5 719	5 674	4 098	1 257	217	141
Readings Recorded	5 727	5 704	5 631	5 683	3 114	843	0	0
AUF (%)	0	22 (0.38)		0	984 (24.01)	414 (32.94)	217 (100)	141 (100)
Reading Results:								
Successful Readings	5 727	3 659	4 605	4 449	1 185	0	0	0
Electr. tag not read	0	2	5	0	0	0	0	0
Electronic tag lost	0	0	1	2	82	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	0	0	0	0	0	0	0
Animal not present	0	0	0	10	10	0	0	0
Read. not performed	0	2 043	1 020	1 222	1 837	843	0	0

Table 4.1.2.1.13. Number of readings and readings results of cattle with Electronic Eartag EA4

From the reading results, the “electronic identifiers not read”, “electronic identifiers lost” and “electronic identifiers broken” (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Corrected Failures, see section 4.1.1.).

Cattle Electronic Eartag		Reading type							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
EA1	Failures (%) Range	0	188 (0.25) 0 - 0.42	512 (0.45) .03-0.70	761 (0.65) .03-1.04	422 (1.6) 0.32-2.4	48 (2.34) 0-7.7	0	-
	Readings	131 742	75 778	114 890	116 978	26 688	2 054	2	-
EA3	Failures (%) Range	0	14 (0.70) -	24 (1.14) -	16 (0.79) -	26 (2.77) -	0	-	-
	Readings	2 391	1 999	2 102	2 034	937	16	-	-
EA4	Failures (%) Range	0	2 (0.05) -	6 (0.13) -	2 (0.04) -	7 (0.6) -	-	-	-
	Readings	5 727	3 661	4 611	4 451	1 192	-	-	-
Total Electronic Eartag	Failures (%) Range	0	204 (0.25) 0-0.7	542 (0.45) .03-1.14	779 (0.63) .03-1.04	455 (1.58) .32-2.77	48 (2.32) 0-7.7	0	-

	Readings	139 860	81 438	121 603	123 463	28 817	2 070	2	-

Table 4.1.2.1.14. Reading results on cattle identified with electronic eartag

The following table (4.1.2.1.15) shows the recovery results in slaughterhouse per electronic eartag brand. Data received from the IDEA subcontractors show that a total of 63 672 cattle with electronic eartags have been slaughtered during the IDEA Project.

Slaughterhouse Recovery results	***Electronic Eartag***							
Cattle	***EA1***		***EA3***		***EA4***		***TOTAL EA***	
	n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Electronic identifier recovered	71 458	89.7	1 164	76.4	868	52.6	73 490	88.7
Electronic identifier recovered not previously read	3 599	4.5	99	6.5	59	3.6	3 757	4.6
Previously read but not present at recovery	323	0.4	108	7.1	472	28.6	903	1.1
Not recovered for sanitary reasons	-	-	-	-	-	-	-	-
Other	4 264	5.4	152	10.0	251	15.2	4 667	5.6
Total Electronic Identifiers	79 644		1 523		1 650		82 817	

Table 4.1.2.1.15. Slaughterhouse recovery results of Electronic Eartags in cattle

Table 4.1.2.1.16. shows the in field recovery results of Electronic Eartags in cattle.

In field Recovery Results	***Electronic Eartag***	
Cattle	***EA1***	
	n	***%***
Electronic identifier recovered	483	59.0
Electronic identifier recovered not previously read	35	4.3
Previously read but not present at recovery	13	1.6
Not recovered for sanitary reasons	4	0.5
Other	284	34.6
Total Electronic Identifiers	819	

Table 4.1.2.1.16. In field recovery results of Electronic Eartags in cattle

b.3 Injectable Transponder

A total of 3 IDEA Subprojects performed electronic identification of cattle using injectable transponders (Germany, Netherlands and France Bourgogne). Two types of injectable transponders (IT1 and IT2) have been used for the electronic identification of cattle.

Cattle	Injectable Transponder 1 (IT1)							
	Reading type							
	After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
Animals to be read	18 146	18 051	17 721	17 699	15 131	7 587	1 020	445
Readings Recorded	18 146	17 668	17 724	17 478	13 284	5 933	0	0
AUF (%)	0	321 (1.78)		221 (1.25)	1 847 (12.21)	1 654 (21.80)	1 020 (100)	445 (100)
Reading Results:								
Successful Readings	18 146	10 830	11 522	12 648	4 251	38	0	0
Electr. tag not read	0	47	59	86	12	0	0	0
Electronic tag lost	0	2	3	4	1	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	39	39	0	6	0	0	0
Animal not present	0	0	2	4	80	2	0	0
Read. not performed	0	6 750	6 099	4 736	8 934	5 893	0	0

Table 4.1.2.1.17. Number of readings and readings results of cattle with Injectable IT1

Cattle	Injectable Transponder 2 (IT2)							
	Reading type							
	After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
Animals to be read	12 182	12 182	12 079	12 004	4 357	3 388	324	0
Readings Recorded	12 182	10 394	11 015	9 605	183	0	0	0
AUF (%)	0	932 (7.65)		2 399 (19.99)	4 174 (95.80)	3 388 (100)	324 (100)	0
Reading Results:								
Successful Readings	12 182	10 325	10 438	9 397	183	0	0	0
Electr. tag not read	0	30	68	114	0	0	0	0
Electronic tag lost	0	37	47	52	0	0	0	0
Electr. tag broken	0	0	0	0	0	0	0	0

Readers not function.	0	2	0	0	0	0	0	0
Animal not present	0	0	4	13	0	0	0	0
Read. not performed	0	0	458	29	0	0	0	0

Table 4.1.2.1.18. Number of readings and readings results of cattle with Injectable IT2

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Corrected Failures, see section 4.1.1.).

Cattle Injectable		Reading type							
		After Tagging	*1 d*	*1 w*	*1 m*	*7 m*	*14 m*	*21 m*	*28 m*
IT1	Failures (%) Range	0	49 (0.45) -	62 (0.54) -	90 (0.71) -	13 (0.30) -	0	0	0
	Readings	18 146	10 879	11 584	12 738	4 264	38	0	0
IT2	Failures (%) Range	0	67 (0.64) -	100 (0.95) 0 - 0.98	145 (1.52) 0 - 1.54	0	0	0	0
	Readings	12 182	10 392	10 538	9 542	183	0	0	0
Total Injectable	Failures (%) Range	0	116 (0.55) .45-0.64	162 (0.73) 0 - 0.98	235 (1.05) 0 - 1.54	13 (0.29) 0-0.30	0	0	0
	Readings	30 328	21 271	22 122	22 280	4 447	38	0	0

Table 4.1.2.1.19. Reading results on cattle identified with injectable transponders

The following table (4.1.2.1.20) shows the recovery results in slaughterhouse per specie and Injectable transponder brand. Data received from the IDEA subcontractors show that a total of 13 549 cattle with injectable transponders have been slaughtered during the IDEA Project.

Slaughterhouse Recovery results	***Injectable Transponder***					
Cattle	***IT1***		***IT2***		***TOTAL IT***	
	n	***%***	***n***	***%***	***n***	***%***
Electronic identifier recovered	5 198	62.3	2 485	37.2	7 683	51.1
Electronic identifier recovered not previously read	547	6.6	3 052	45.7	3 599	24.0
Previously read but not present at recovery	1 778	21.3	-	-	1 778	11.8

Not recovered for sanitary reasons	-	-	-	-	-	-
Other	818	9.8	1 145	17.1	1 963	13.1
Total Electronic Identifiers	8 341		6 682		15 023	

Table 4.1.2.1.20. Slaughterhouse recovery results of Injectable transponder in cattle

Table 4.1.2.1.21. shows the in field recovery results of Injectable Transponder in cattle.

In field Recovery Results	***Injectable Transponder***	
Cattle	***IT2***	
	n	***%***
Electronic identifier recovered	17	8.5
Electronic identifier recovered not previously read	28	13.9
Previously read but not present at recovery	1	0.5
Not recovered for sanitary reasons	20	9.9
Other	135	67.2
Total Electronic Identifiers	201	

Table 4.1.2.1.21. In field recovery results of Injectable transponders in cattle

Discussion and comments for cattle identification

- ***Tagging Activities***

  a) Tagging Time

  - The number of cattle identified per day per tagging team varies much between the IDEA subprojects. As explained for buffalo the tagging efficiency (“number of animals /day”) is depending on farm size, type of production system (intensive or extensive) and housing and restraining systems. The IDEA results show that the time spent to apply a tag varies between 3 and 10 minutes and is independent of the identifier type used. The practical experience from the IDEA subprojects, as mentioned in their reports, is that the application of an electronic identifier does not present any difficulty and/or problem when the animal is well restrained. With this premise, it can be said that in average, a total of 60 cattle (with a range of 50-120) could be identified per day per tagging team.

b) Age of the animals at tagging

- No large differences on the age of the animals at tagging have been observed for the different tag types used (Figure 4.1.2.2.). This is mainly due to the fact that the major part of the animals were adult at the moment of the tagging (more than 1 years old) and only a small number of replacement animals were identified in the IDEA Project.
- Figures 4.1.2.3., 4.1.2.4 and 4.1.2.5 show the age of tagging of cattle electronically identified with ruminal bolus, electronic eartag and injectable transponder, respectively. From these figures, one can note that in the case of Germany 92% of cattle were identified at less than 9 months of age with the 3 types of electronic tags.
  - Ruminal bolus: the distribution of the age of the animals at tagging presents two peaks: between 1 and 6 months (i.e. in Spain 65% of cattle were identified at <6 months of age) and between 1 and 3 years (i.e. in Portugal 90% of cattle were identified at >1 year).
  - Electronic eartags: the largest part of the animals was identified before 5 months of age (i.e. France Bretagne 83% of cattle was identified at <40 d of age). The Ministero della Sanita subproject presents two different ages of tagging: 2.5 months and 1 year, which is directly related with the animal type (young calves for white meat and adult animals).
  - Injectable Transponder: the largest part of the animals was identified before 4 months of age.
- A total of 13 463 cattle have been identified at $\leq$ 20 d of age: 2 933 with ruminal bolus, 6189 with electronic eartags and 4 341 with injectable transponders.

c) Re-tagging

- The re-tagging procedure, which was mandatory for all animals with electronic identifier declared as "not read" or "lost" (IDEA Guide Procedures) was not much followed by the IDEA subprojects (1340 re-tagging from a total of 4160 failures declared).
- Only Lazio and Portugal subprojects with ruminal bolus and Netherlands subprojects with injectable identifier performed the re-tagging on a high percentage of animals with tag declared as "lost" or "not read". In the case of Lazio some cattle with magnet were not re-tagged. The high number of re-tagging declared by the Netherlands subproject, do not correspond with the declared failures (823 vs 76). This could be explained as re-tagging performed at the reading movements because the high percentage of failures declared on this reading type. However, in some readings performed after the re-tagging, both old and re-tagged eartags were successfully read. A more in depth analysis on this issue should be performed.
- A very low percentage of re-tagging was performed in other projects (Germany, Ministero della Sanita) on eartags and no re-tagigngs were performed in Val d'Aosta and in the two French IDEA subprojects (Bretagne, Bourgogne) for all tag types.

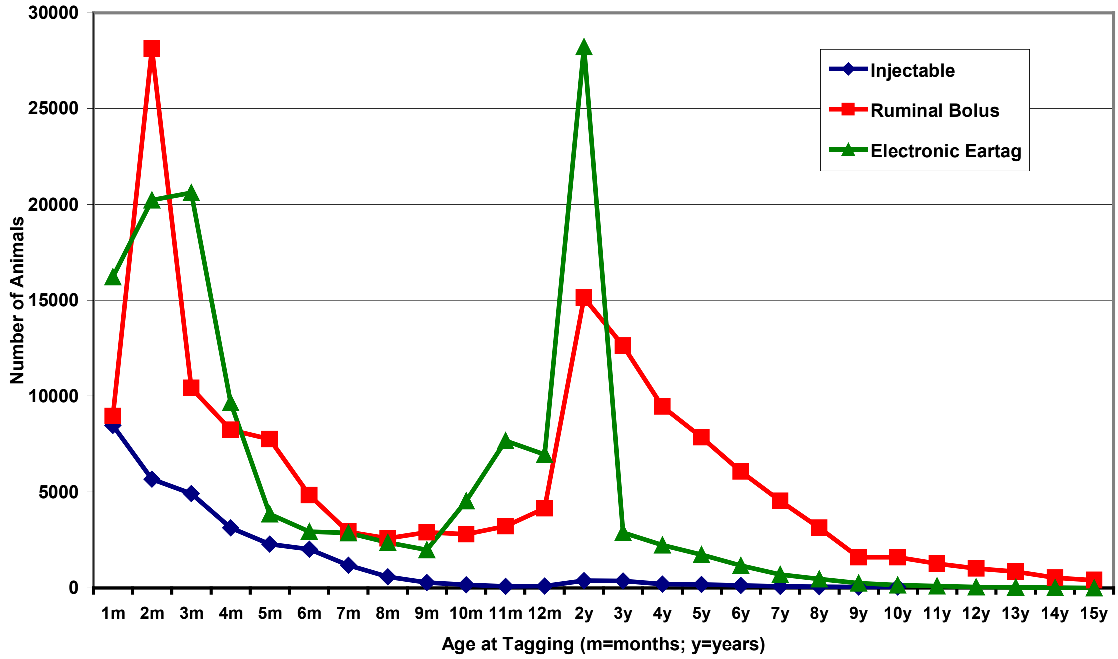

Figure 4.1.2.2. Distribution of the age of tagging of cattle electronically identified.

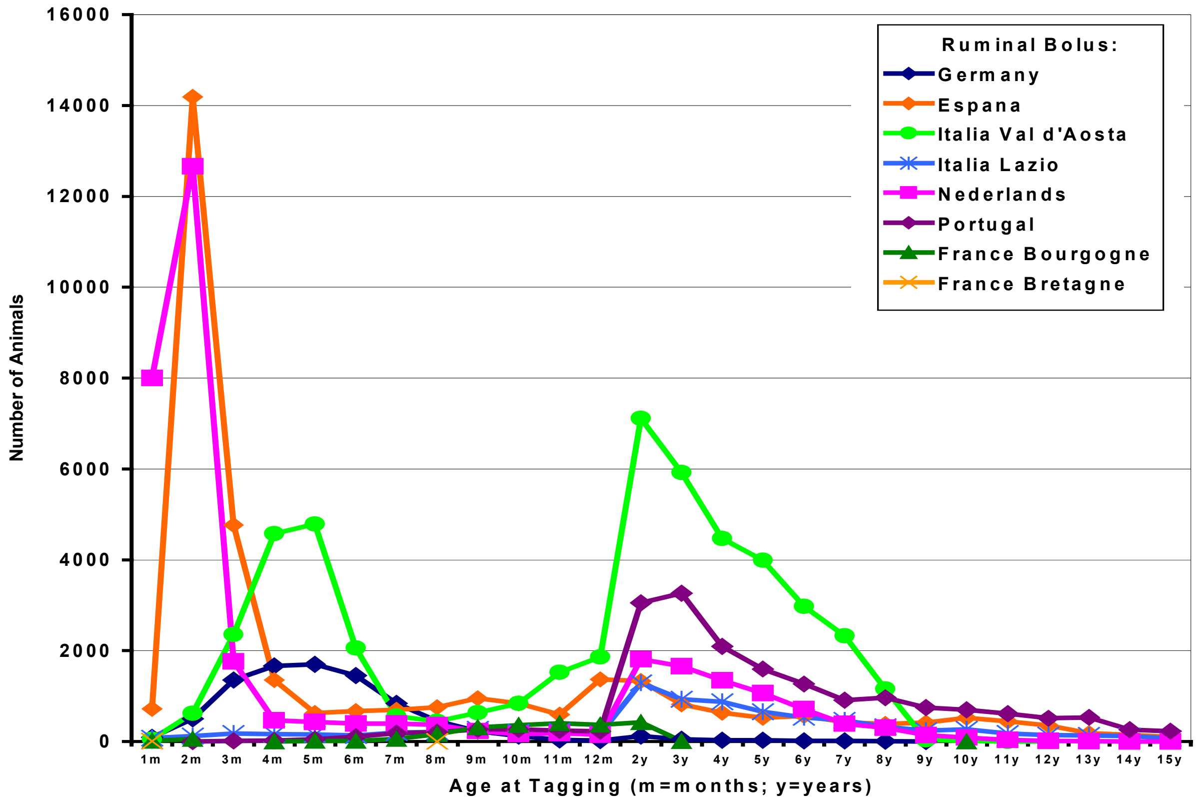

Figure 4.1.2.3. Age of tagging of cattle electronically identified with ruminal bolus.

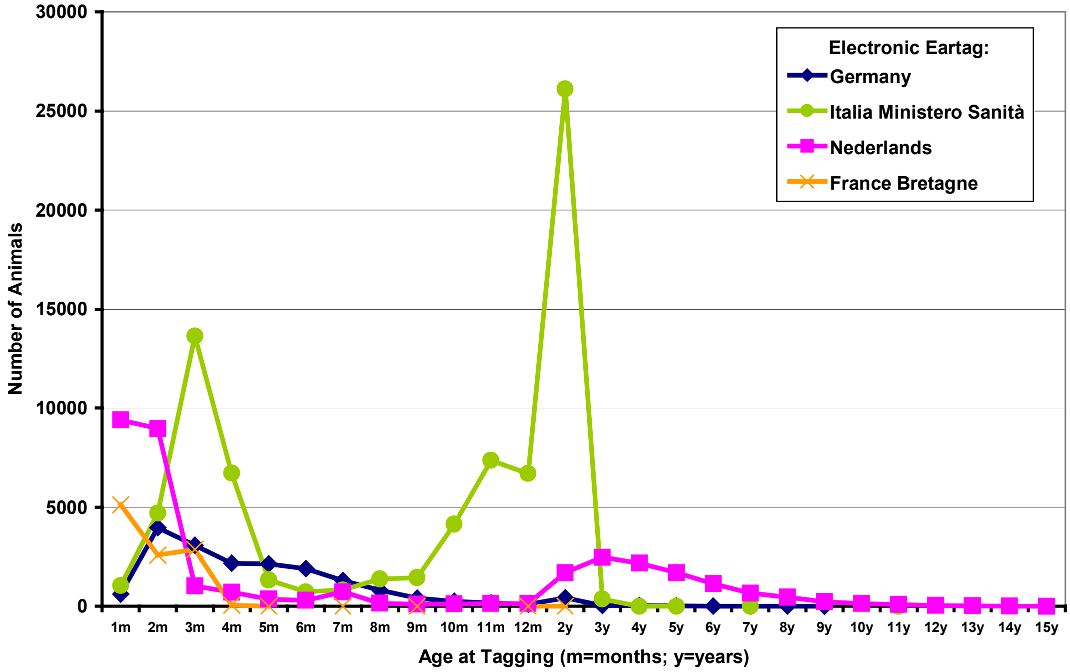

Figure 4.1.2.4. Age of tagging of cattle electronically identified with electronic eartag.

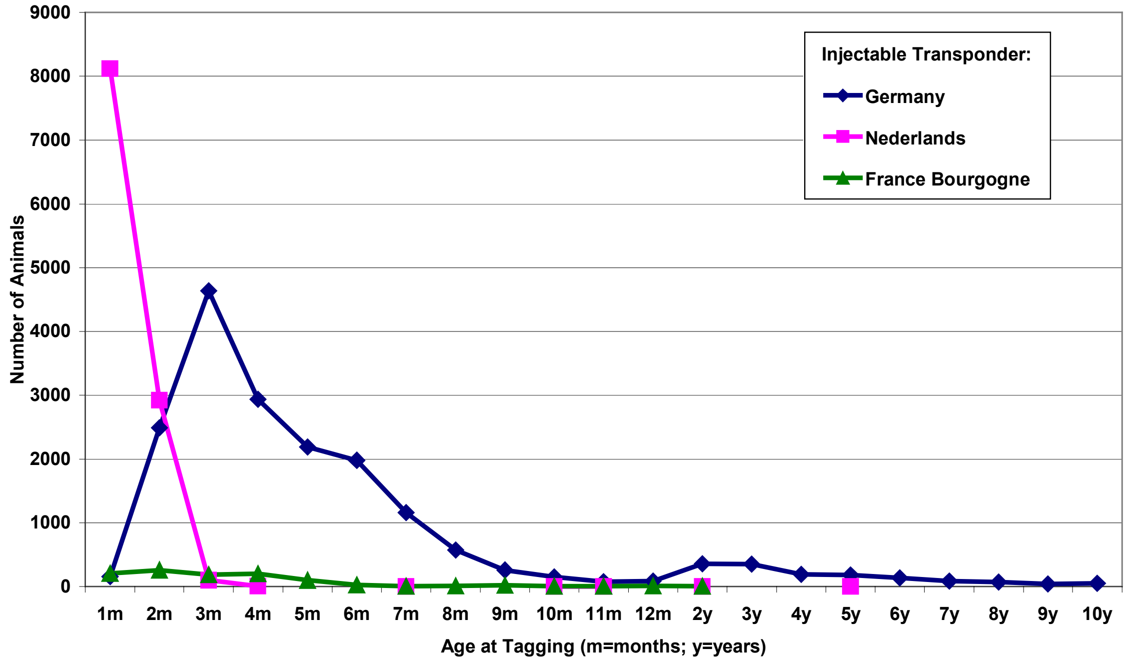

Figure 4.1.2.5. Age of tagging of cattle electronically identified with injectable transponder.

- ***Reading activities***

a) Evaluation of the Reading Performance

- The performance of the different tag types and brands have been compared:
  - *Ruminal bolus:* in global terms the failure % of the ruminal bolus remains rather constant with time and, in average, remained lower than 0.28% in the worst case. One should note that there is some difference on the performance between RB1 and RB2/RB3. In particular, for RB2 at 7 and 14 m after tagging, relatively high rates are observed. No explanation has been found to this fact. RB1 was used by 4 IDEA subprojects on a large number of animals and similar performance results were obtained between the different subprojects. It should be noted that the failures % obtained in cattle is similar to the one obtained by the Lazio subproject in Buffalo with the same type of ruminal bolus (RB1).
  - *Electronic Eartag:* in global terms the failures % of electronic eartags shows a clear tendency to increase after 1 month after tagging with average failure % of 0.63, 1.58 and 2.32% at 1, 7 and 14 months after tagging, respectively. EA3 and EA4 electronic eartag types have been used by only one project. Performance results of EA4 are better than EA3 and EA1 but the number of animals is small. The high failures percentage presented by EA3 could be explained by a problem on the working frequencies of the electronic identifier and the poor quality of the plastic, both observed at laboratory level during the IDEA Quality Control. This brand presented a reading failure for the tag itself that could be the reason of this high failure percentage. The reading results of the electronic eartags at 7 months after tagging and beyond, need to be considered with great caution for performance evaluation due to the high AUF values. As a consequence, it will be difficult to draw conclusions on the long-term behaviour of electronic eartags.
  - *Injectable Transponder:* the failure % of injectable transponder increases to 1% at 1 month after tagging and decreases beyond that time. Differences have been observed between IT1 for the German subproject and for IT2 in Netherlands subproject. Results in France Bourgogne with IT2 are similar to IT1 but it is difficult to take in consideration these IT2 results due to the very small number of animals tagged and readings performed (AUF >60% in all cases). The difference between both injectable transponder types could be explained due to the transponder size. IT2 is longer than IT1 (32 vs 23 mm), which increases the number of transponder losses when applied to young animals.

b) Long-term performance evaluation

- On the long-term behaviour evaluation of the electronic identifiers used there is a large difference between ruminal bolus, electronic eartags and injectable transponders.
  - *Ruminal bolus:* In RB2 and RB3 the sum of the AUF values with “readings not performed” of readings at 7 months are 69% and 63%, respectively. The results need to be considered with great caution for mid-term performance evaluation. RB1 show long-term reading results up to 28 months after tagging with AUF and “readings not performed” values <50% in all cases. Considering the difference on the readings performed between RB1, and the sum of RB2 and RB3 at 7 months after tagging (65

916 vs 8 753), one can conclude that there is enough data to draw conclusions on the long term behaviour of the ruminal bolus in cattle.-

- *Injectable transponders:* Only readings until 1 month after tagging can be taken into account. The sum of the AUF values with "readings not performed" of readings at 7 months after tagging and beyond (71% the best case) makes very difficult to draw conclusions on the long-term behaviour of injectable transponders.
- *Electronic eartags:* Only in the case of EA1 and EA3 the sum of the AUF values with "readings not performed" of readings at 7 months after tagging are <60% and the results need to be considered with great caution for performance evaluation. If these two values are considered as valid, conclusions on the mid-term behaviour of electronic eartags (up to 7 months after tagging) can be drawn, with the tendency to increase of the failures % of electronic eartags with time.

c) Reading System

- In global terms, only 9% of the readings performed in cattle were performed in dynamic conditions. However, 99% of the control readings in dynamic conditions were performed in cattle identified with ruminal bolus.
- The reading system used to perform the control readings mainly depends from the IDEA subcontractors. Five IDEA subcontractors performed control readings in dynamic conditions (Spain, Lazio, Portugal, France Bourgogne and France Bretagne). Portugal and Lazio used the dynamic reading system on 83% and 43% of the readings, respectively. In the other three IDEA subprojects less than 15% of the readings were performed in dynamic conditions.
- In case of the slaughterhouse, the dynamic reading system was used in Italy Min. Sanita and Netherlands IDEA Subprojects with 94% and 100%, respectively, of the readings at slaughterhouse arrival and entrance of the slaughterhouse chain.

- ***Recovery Results***

a) *Slaughterhouse Recovery*

- The recovery percentages in slaughterhouse vary depending on the tag type. Electronic eartag and injectable identifier show the highest percentage of recovery. In the case of the injectable transponder 13% were previously read but not recovered. In the case of ruminal bolus 50% were recovered and 52% of bolus were previously read but not recovered, which could indicate losses occurred inside the slaughterhouse or due to the fact that the slaughterhouse did not perform the recovery. It should be noted that this high percentage of bolus read but not recovered come from the Spanish IDEA subcontractor.

b) *Slaughterhouse readings*

- Electronic Eartags: more than 80% of electronic eartags were read in all cases. Data from the Ministero della Sanita subproject show that on 25% and 35% of the readings at arrival and at the entrance of the slaughter chain,

respectively, the declaration of “reader not functioning” was performed, using the dynamic reading system. From the 77 247 of electronic eartags recovered in slaughterhouse (Table 4.1.2.1.15.) 78% were successfully read after recovery.

- *Ruminal Bolus:* more than 93% of the animals were read at the slaughterhouse arrival, at the entrance of the slaughter chain and at recovery. The 36% of boluses declared as “previously read but not recovered” indicate that the boluses were read at the recovery point but they were not recovered afterwards.
- *Injectable transponder:* readings at departure and at the entrance of the slaughter chain were 80% performed. From the 11 282 injectable transponder recovered in slaughterhouse (Table 4.1.2.1.24.) 52% were successfully read after recovery.

c) *In field recovery*

- On the recovery infield, electronic eartags and ruminal bolus show the highest percentages of recovery (63% and 49%, respectively), which would indicate the absence of recovery problems infield in both tag types. In the case of injectable transponders only 22% were recovered in field (n=201). In the case of ruminal bolus and injectable transponders 9% and 10% respectively, were not recovered for sanitary reasons. However, one may wonder about the high percentage of electronic tags not recovered codified as “other“ reason (highest in injectable: 67%) and the real cause of not recovery (i.e. mistake, impossibility to open the animal, lack of collaboration).

- ***Movement***
  - Only in the case of the Netherlands IDEA subproject an effect of the transport on the reading failure has been observed showing failure percentages of of 9.6% in electronic eartags, 13% in ruminal bolus and 13.5% in injectable transponders. No interpretation of this abnormal high values could be given.

c) Analysis of Results on Sheep

c.1. Ruminal Bolus

A total of 5 IDEA Subprojects performed electronic identification of sheep using ruminal bolus (Spain, Italia Aosta, Italia Lazio, Portugal and France Sud-est). Two different types of Ruminal Bolus (RB1 and RB2) have been used for the electronic identification of sheep.

Sheep	**Ruminal Bolus 1 (RB1)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	408 423	408 396	407 958	405 007	359 848	300 162	178 320	90 382
Readings Recorded	408 423	153 582	370 151	351 203	280 981	174 021	113 837	55 522
AUF (%)	0	20 318 (4.98)		53 804 (13.28)	78 867 (21.92)	126 141 (42.02)	64 483 (36.16)	34 860 (38.57)

Reading Results:								
Successful Readings	408 423	152 245	343 875	329 299	252 167	152 599	88 758	45 878
Electr. tag not read	0	10	207	395	675	485	82	1
Electronic tag lost	0	7	48	56	39	23	3	1
Electr. tag broken	0	0	1	0	0	0	0	0
Readers not function.	0	1	672	333	1 128	542	0	0
Animal not present	0	613	3 180	5 264	11 536	12 826	12 842	8 933
Read. not performed	0	706	22 168	15 856	15 436	7 546	12 152	709

Table 4.1.2.1.22. Number of readings and readings results of sheep with Ruminal Bolus RB1

Sheep	**Ruminal Bolus 2 (RB2)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	350	350	350	350	350	-	-	-
Readings Recorded	350	350	350	350	0			
AUF (%)	0	0		0	350 (100)			
Reading Results:								
Successful Readings	350	350	350	350	0	-	-	-
Electr. tag not read	0	0	0	0	0			
Electronic tag lost	0	0	0	0	0			
Electr. tag broken	0	0	0	0	0			
Readers not function.	0	0	0	0	0			
Animal not present	0	0	0	0	0			
Read. not performed	0	0	0	0	0			

Table 4.1.2.1.23. Number of readings and readings results of sheep with Ruminal Bolus RB2

From the reading results, the “electronic identifiers not read”, “electronic identifiers lost” and “electronic identifiers broken” (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Corrected Failures, see section 4.1.1.).

Sheep Ruminal Bolus		**Reading type**							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
RB1	Failures (%) Range	0	17 (0.01) 0-0.01	252 (0.08) .02-0.34	435 (0.13) .02-0.23	706 (0.28) .02-0.53	283 (0.19) .02-0.65	47 (0.05) 0 - 0.73	2 (0.004) .002-.05
	Readings	408 423	152 262	334 127	329 734	252 873	152 882	88 805	45 880
RB2	Failures (%) Range	0	0	0	0	0	0	0	0
	Readings	350	350	347	350	0	0	0	0
Total Bolus	Failures (%) Range	0	17 (0.01) 0-0.01	252 (0.08) 0-0.34	435 (0.13) 0-0.23	706 (0.28) 0-0.53	283 (0.19) 0-0.65	47 (0.05) 0-0.73	2 (0.004) 0-0.05
	Readings	408 773	152 612	334 474	330 084	252 873	152 882	88 805	45 880

Table 4.2.1.1.24. Reading results on sheep identified with ruminal bolus

Tables 4.1.2.1.25. to 4.1.2.1.26. illustrate the recovery results of ruminal bolus in sheep in slaughterhouse and in field. A total of 12 778 sheep were slaughtered in an IDEA slaughterhouse with 99.7% of bolus recovered. Only 753 bolus readings have been declared at recovery. A total of 3089 sheep with ruminal bolus were slaughtered in a slaughterhouse out of the IDEA project with 99.7% of recovery.

Slaughterhouse Recovery results	***RB1***	
Sheep	***n***	***%***
Electronic identifier recovered	15 820	99.7
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	21	0.13
Not recovered for sanitary reasons	-	-
Other	26	0.17

Total Electronic Identifiers	15 867

Table 4.1.2.1.25. Slaughterhouse recovery results of Ruminal Bolus in Sheep

In field Recovery Results	***RB1***	
Sheep	***n***	***%***
Electronic identifier recovered	35 413	69.9
Electronic identifier recovered not previously read	2	0.004
Previously read but not present at recovery	19	0.04
Not recovered for sanitary reasons	13 751	27.1
Other	1 507	2.97
Total Electronic Identifiers	50 692	

Table 4.1.2.1.26. In field recovery results of Ruminal Bolus in Sheep

c.2. Electronic Eartag

Only 1 IDEA Subproject (France Sud-Est) performed electronic identification of sheep using electronic eartags with one type of Electronic Eartag (EA2).

Sheep	**Electronic Eartag 2 (EA2)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	92 503	92 468	92 434	92 009	55 344	32 421	14 125	4 349
Readings Recorded	92 503	177	77 472	76 259	28 194	2 730	550	0
AUF (%)	0	14 819 (16.03)		15 750 (17.12)	27 150 (49.06)	29 691 (91.58)	13 575 (96.11)	4 349 (100)
Reading Results:								

Successful Readings	92 503	175	17 395	68 650	28 115	2 706	550	0
Electr. tag not read	0	0	0	4	0	0	0	0
Electronic tag lost	0	2	0	108	69	24	0	0
Electr. tag broken	0	0	0	0	0	0	0	0
Readers not function.	0	0	0	0	0	0	0	0
Animal not present	0	0	557	59	10	0	0	0
Read. not performed	0	0	59 520	7 438	0	0	0	0

Table 4.1.2.1.27. Number of readings and readings results of sheep with Electronic Eartag EA2

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Corrected Failures, see section 4.1.1.).

Sheep Electronic Eartag		**Reading type**							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
EA2	Failures (%)	0	2 (1.13)	0	112 (0.16)	68 (0.24)	10 (0.37)	-	-
	Readings	92 503	177	17 395	68 762	28 183	2 716	550	-

Table 4.1.2.1.28. Reading results on sheep identified with electronic eartag

Tables 4.1.2.1.29. to 4.1.2.1.30. illustrates the recovery results of electronic eartag in sheep in slaughterhouse and in field.

Slaughterhouse Recovery results	***EA2***	
Sheep	***N***	***%***
Electronic identifier recovered	36 449	100
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	-	-
Not recovered for sanitary reasons	-	-

Other	-	-
Total Electronic Identifiers	36 449	

Table 4.1.2.1.29. Slaughterhouse recovery results of Electronic Eartag in Sheep

In field Recovery Results	***EA2***	
Sheep	***n***	***%***
Electronic identifier recovered	3 024	100
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	-	-
Not recovered for sanitary reasons	-	-
Other	-	-
Total Electronic Identifiers	3 024	

Table 4.1.2.1.30. In field recovery results of Electronic Eartags in Sheep

Discussion and comments for sheep identification

- ***Tagging Activitie:***

a) Tagging Time

Based on the IDEA Project results it can be said that, in average, it is possible to tag 300 sheep /day per tagging team.
Data coming from Lazio and Portugal IDEA subproject reports show that the tagging time is less than 3 minutes for a total of 218 000 sheep identified with ruminal bolus in these two IDEA subprojects. The Lazio IDEA subproject report states that 80% of sheep required less than 2 minutes to be tagged with a ruminal bolus. In the case of the electronic eartags, data coming from the France sud-est IDEA subproject show that all sheep needed less than 3 minutes to be tagged with an electronic eartag.
As explained for buffalo and cattle, the tagging efficiency “number of animals identified/day” for sheep increases for large farms. However, no differences have been observed on the tagging efficiency between different types of production system (intensive or extensive) and housing and restraining systems.
In the case of young animals of approximately 25 kg weight, the tagging time is increased in order to avoid any injury to the young animal.

b) Age of the animals at tagging

Electronic Eartags: electronic eartags can be placed very early after birth. Data from the IDEA Central Data Base indicate that the earliest age of tagging is 1 day and more than 15 000 lambs were electronically identified before 20 days of age (Figure 4.1.2.6.).

Ruminal Bolus: The normal size bolus can be safely applied on lambs when they have reached a live weight of around 25 Kg. The correlation between this weight and the age of the animals depends mainly on the breed and on the breeding purpose. It means that in some meat breeds this weight can be reached at 2.5 months while in dairy breeds this could be reached later than 6 months of age. In the IDEA Project a large number of newborn animals were identified between 6 months and 1 year age (Figure 4.1.2.6.), which is a normal farm practice, as the replacement animals are identified around that time period when the replacement decision is taken. The largest part of sheep was electronically identified in the IDEA Project at the age of 1 year (Figure 4.1.2.6.). No differences between IDEA subprojects have been observed on the age at tagging for sheep (Figure 4.1.2.7.).

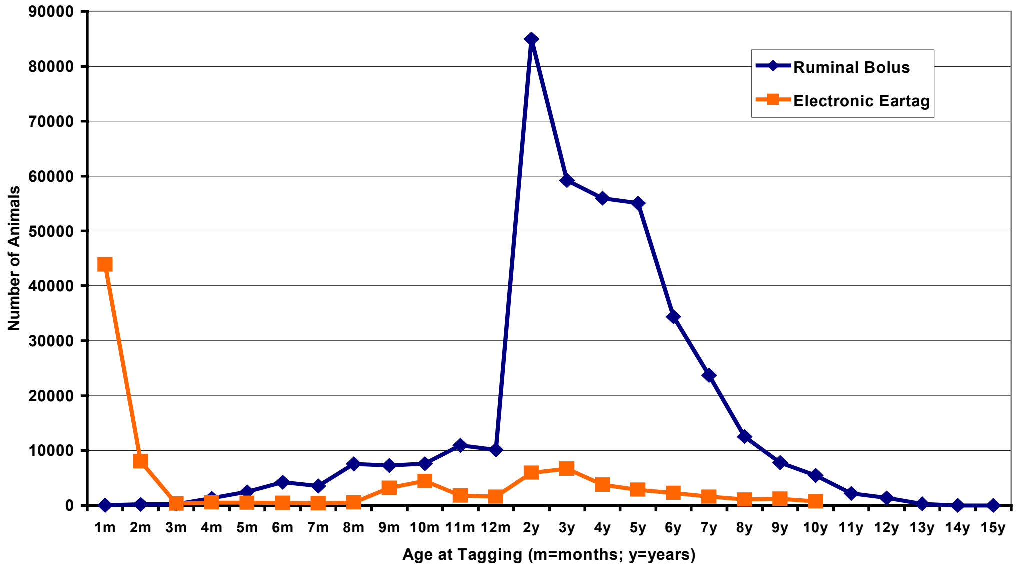

Figure 4.1.2.6. Distribution of the age at tagging of sheep electronically identified.

c) Re-tagging

- The re-tagging procedure, which was mandatory for all animals with electronic identifier declared as "not read" or "lost" (IDEA Guide Procedures) was not much followed by the IDEA subprojects (915 re-tagging from a total of 2 519 failures declared). Only the Lazio and Portugal IDEA subprojects performed the re-tagging on all animals with the electronic identifier declared as "lost" or "not read". A very low percentage of re-tagging was performed in the Spanish IDEA subproject and no re-taggings were performed in the case of the Val d'Aosta with ruminal bolus and in France sud-est with electronic eartags.

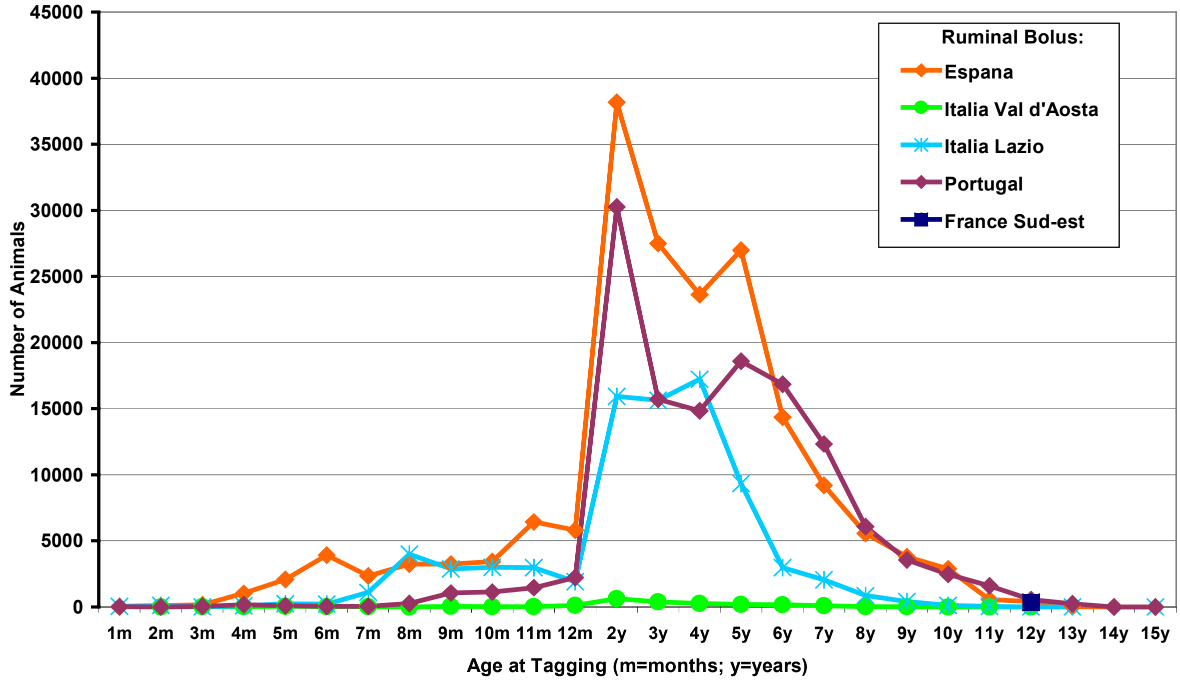

Figure 4.1.2.7. Age at tagging of sheep electronically identified with ruminal bolus

- ***Reading activities***

a) <u>Evaluation of the Reading Performance</u>

Only one type of ruminal bolus (RB1) and one type of electronic eartag (EA2) have been used to perform the electronic identification of sheep. As a consequence, no comparison between tag brands could be performed. The performance of the ruminal bolus and electronic eartag has been compared:
<u>Electronic eartags:</u> the failures % of electronic eartags shows a slight tendency to increase after 1 month after tagging with average failure % of 0.16, 0.24 and 0.37% at 1, 7 and 14 months after tagging, respectively. However, 60% of the identified sheep were fattening lambs slaughtered after 3 months and only for 50% of the remaining sheep the control reading at 7 months after tagging was performed. The reading at 14 months after tagging shows an AUF value of 92%. As a consequence, some conclusions on the mid-term behaviour of electronic eartags (up to 7 months after tagging) can be drawn. There is however, a tendency of increase of the failures % of electronic eartags with time.
<u>Ruminal Bolus:</u> in global terms the observed failure % of normal bolus in sheep remains rather constant with time, and in average, was lower than 0.28%. RB1 show long-term reading results up to 28 months after tagging and on a large number of sheep (n=152 882 at 14 months; n=88 805 at 21 months; n=45 880 at 21 months after tagging.).
No large differences between IDEA subprojects have been observed on the

performance of the ruminal bolus in sheep with and extreme failure % value of

0.73%.

The ruminal bolus used show long-term reading results up to 28 months after tagging
with AUF and "readings not performed" values <50% in all cases. One can conclude that there is enough data to drawn conclusions on the long-term behaviour of the ruminal bolus in sheep.

-

b) Reading System

- More than 2 million control readings have been performed for sheep with 76% performed using the dynamic reading system. This percentage increases to 82% if only the control readings of ruminal bolus are taken into account with a total of 1.9 million of readings performed.
- The dynamic reading system was used to a large extent in sheep by the IDEA subcontractors. Portugal and Spain performed almost all sheep readings in dynamic conditions (97 and 80% respectively). Lazio and France sud-est used the dynamic reading system in 43% and 30% of the control readings performed, respectively.
- As explained in its IDEA Final Report, the Val d'Aosta IDEA subproject did not performed dynamic readings due to the mean farm size of 20 animals/farm and with many farms with less than 10 animals/farm (family and part-time management).
- Only the Lazio IDEA subproject declared dynamic readings in slaughterhouse with a small number of readings (n=475). The France Sud-est performed dynamic readings in slaughterhouse but only readings in static conditions were declared in the IDEA Data Base.

- ***Recovery Results***

- The recovery results for sheep did not show differences between tag types and recovery in field and slaughterhouse. In the case of the electronic eartags a 100% of recovery efficiency was obtained both in field and slaughterhouse. In ruminal bolus 100% were read and/or recovered in slaughterhouse and the 3% of ruminal bolus previously read but not recovered could indicate losses occurred inside the slaughterhouse or that the slaughterhouse did not perform the recovery. The recovery percentages in field added to the percentage of recovery for sanitary reasons show that no problems appeared for the bolus recovery in field.
- On the slaughterhouse readings a total of 50 895 sheep with electronic eartags were read at departure and at arrival and 49 476 were read at the entrance of the slaughter chain. A total of 42 408 electronic eartags were read and recovered. The France Sud-est performed dynamic readings in slaughterhouse but only readings in static conditions were declared in the IDEA Data Base. In the case of the ruminal bolus, from the total of 15 867 ruminal bolus recovered only 753 bolus readings have been declared at recovery.

d) Analysis of Results on Goats

A total of 4 IDEA Subprojects performed electronic identification of goats using ruminal bolus (Spain, Italia Aosta, Italia Lazio and Portugal). Only one type of Ruminal Bolus (RB1) has been used for the electronic identification of goats.

Goat	**Ruminal Bolus 1 (RB1)**							
	Reading type							
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
Animals to be read	30 627	30 609	30 577	30 304	26 429	18 978	14 190	5 874
Readings Recorded	30 627	12 270	26 912	26 657	21 171	10 787	6 701	3 653
AUF (%)	0	2 050 (6.70)		3 647 (12.03)	5 258 (19.89)	8 191 (43.16)	7 489 (52.78)	2 221 (37.81)
Reading Results:								
Successful Readings	30 627	12 136	23 254	22 826	18 028	9 283	4 731	2 892
Electr. tag not read	0	39	186	395	544	285	4	3
Electronic tag lost	0	0	166	201	374	110	2	0
Electr. tag broken	0	0	1	0	0	0	0	0
Readers not function.	0	13	0	0	0	2	1	2
Animal not present	0	82	798	941	1 850	866	653	411
Read. not performed	0	0	2 507	2 294	375	241	1 310	345

Table 4.1.2.1.31. Number of readings and readings results of goats with Ruminal Bolus RB1

From the reading results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers (Corrected Failures, see section 4.1.1.).

Goat Ruminal Bolus		**Reading type**							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
RB1	Failures (%) Range	0	39 (0.32) 0-5.13	350 (1.51) 0.05-2.8	519 (2.22) 0.14-4.3	758 (4.03) .11-8.12	294 (3.07) 0-11.96	6 (0.13) 0-0.16	3 (0.10) 0-0.11
	Readings	30 627	12 175	23 251	23 345	18 786	9 577	4 737	2 895

Table 4.1.2.1.32. Reading results on goat identified with ruminal bolus

Goat Ruminal Bolus		Reading type (without Spain)							
		After Tagging	***1 d***	***1 w***	***1 m***	***7 m***	***14 m***	***21 m***	***28 m***
RB1	Failures (%) Range	0	6 (0.05) 0 - 0.07	27 (0.22) .05-0.56	27 (0.23) .15-0.43	14 (0.15) .11-0.24	7 (0.1) 0 – 0.16	6 (0.13) 0-0.16	3 (0.10) 0-0.11
	Readings	14 002	11 532	11 883	11 997	9 628	7 177	4 737	2 895

Table 4.1.2.1.33. Reading results on goat identified with ruminal bolus without results of the Spanish subproject

Tables 4.1.2.1.34. and 4.1.2.1.35. illustrate the recovery results of ruminal bolus in goat in slaughterhouse and in field. A total of 1 012 goats were slaughtered in an IDEA slaughter with 100% of bolus recovered and 50% of the bolus were read after recovery. A total of 300 goats were slaughtered in a slaughterhouse out of the IDEA project with same recovery percentages as before.

Slaughterhouse Recovery results	***RB1***	
Goat	***n***	***%***
Electronic identifier recovered	1312	99.9
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	1	0.1
Not recovered for sanitary reasons	-	-
Other	-	-
Total Electronic Identifiers	1 313	

Table 4.1.2.1.34. Slaughterhouse recovery results of Ruminal Bolus in Goat

In field Recovery Results	***RB1***	
Goat	***n***	***%***
Electronic identifier recovered	1 947	34.9
Electronic identifier recovered not previously read	-	-
Previously read but not present at recovery	388	6.9

Not recovered for sanitary reasons	2 970	53.2
Other	279	5.0
Total Electronic Identifiers	5 584	

Table 4.1.2.1.35. In field recovery results of Bolus and Eartags in Sheep and Goats

Discussion and comments on goat identification

- ***Tagging Activities***

  a) Tagging Time

  - Based on the IDEA Project results it can be said that, in average, it is possible to tag 300 goats /day per tagging team. The Lazio IDEA subproject states in its Final Report that in case of goats there is effect of the farm /size, which decreases the tagging efficiency in terms of "number of animals/day".
  - From a total of 30 627 goats identified in the IDEA Project, 91% of the taggings were performed in "less than 3 minutes". Only in the case of the Lazio IDEA subproject 2 722 goats needed between 3 and 5 minutes to be identified.
  - As explained for sheep, in the case of young animals of approximately 25 kg weight, the tagging time is increased in order to avoid any injury to the young animal.

  b) Age of the animals at tagging

  - The ruminal bolus can be safely applied on kids when they have reached a live weight of around 25 Kg. The correlation between this weight and the age of the animals depends mainly on the breed and on the breeding purpose. The age at which the kids can reach 25 kg weight is older than in lambs, and in certain breeds this weight is reached even after 1 year of age (in Portugal only 129 goats were identified at less than 1 year old). In the IDEA Project the largest part of goats were electronically identified between 1 and 2 years old (Figure 4.1.2.8.). No differences between IDEA subprojects have been observed on the age at tagging in goats (Figure 4.1.2.9.).

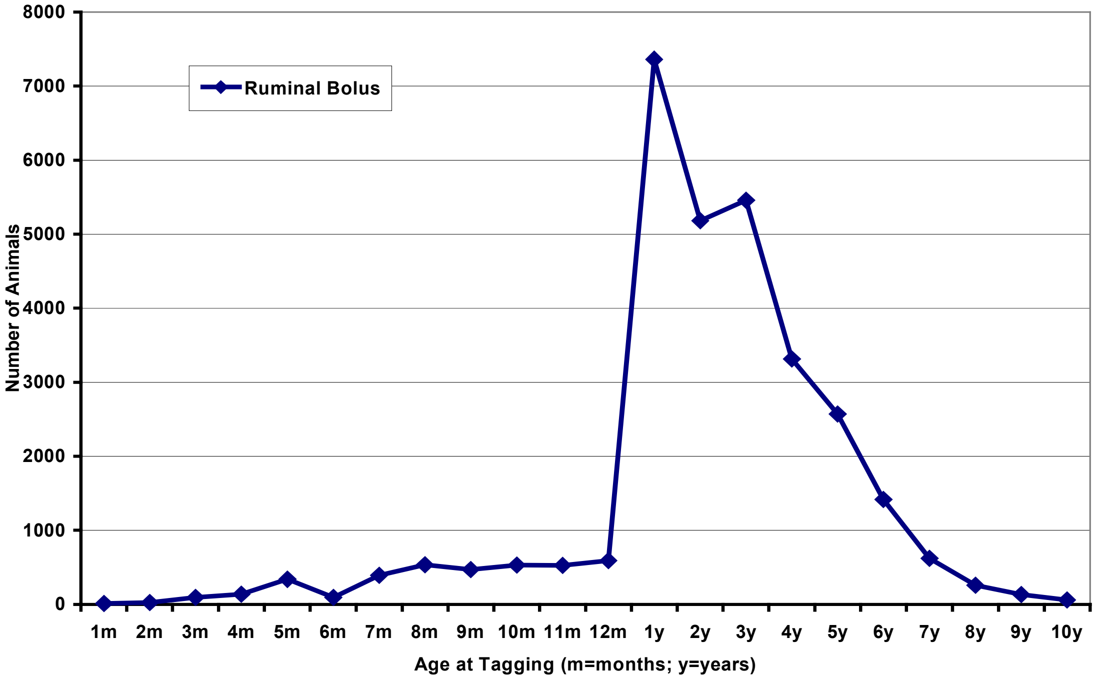

Figure 4.1.2.8. Distribution of the age at tagging of goats electronically identified.

c) Re-tagging

Lazio and Portugal IDEA subprojects performed the re-tagging on a high percentage of animals with tag declared as "lost" or "not read". It should be stressed that the Spanish IDEA subcontractor did not perform the re-tagging due to the very high percentage of tags "not read and lost" in the Spanish goat (n=2228). No re-taggings were performed in the case of the Val d'Aosta IDEA subproject.

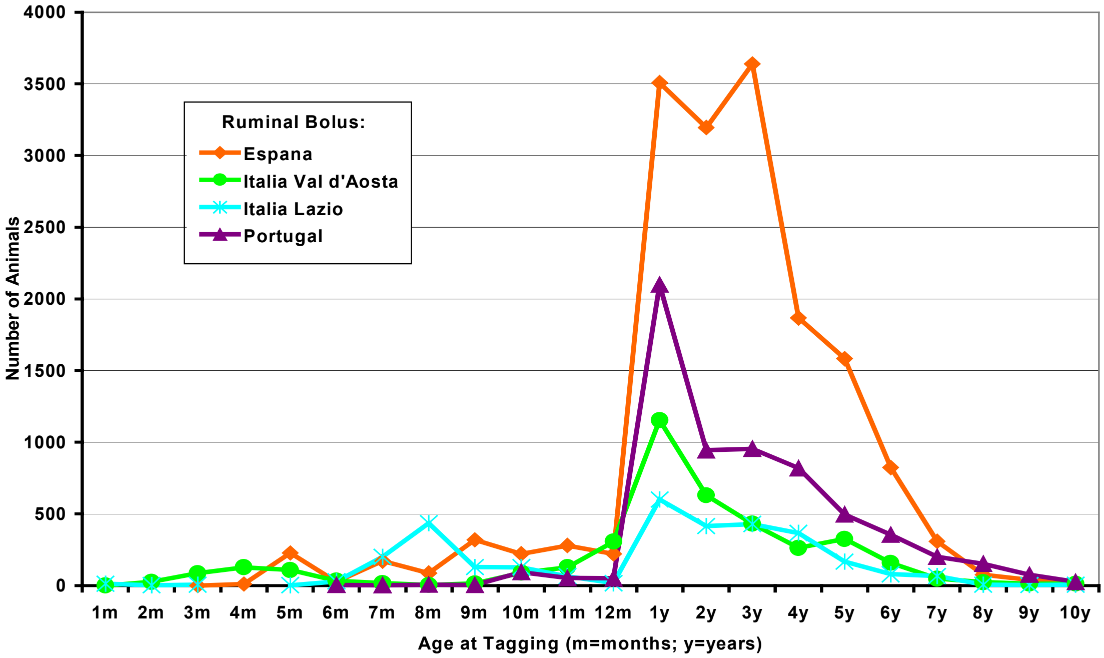

Figure 4.1.2.9. Age at tagging of goats electronically identified with ruminal bolus

- ***Reading activities***

a) Evaluation of the Reading Performance

- Only one type of ruminal bolus (RB1) has been used to perform the electronic identification of goats. As a consequence, no comparison between tag brands could be performed.
- The observed failure % of ruminal bolus in goats is globally higher than those obtained in sheep. In particular, in the Spanish IDEA subproject the mean failure percentage of ruminal bolus (8.2%) is very high in comparison with the results presented by other IDEA Subcontractors (Lazio 0.2%; Portugal 0.1%) where failures in goats are comparable to the results obtained for sheep. Also, reading at 21 and 28 months after tagging come only from Lazio and Portugal IDEA subprojects, showing similar values of failure percentage than in sheep. As a consequence, two different types of evaluation have been made, with and without the Spanish goats (Tables 4.1.2.2.21 and 4.1.2.2.22).
- In the Spanish IDEA subproject no effect of the tagger and controller people and no effect of the production and housing systems on the reading failures % was detected. No differences between the static and dynamic reading system were found. A breed effect was found with a higher percentage of failures in two goat breeds (Malagueña and Murciano-Granadina). In the Saanen breed, the global percentage of failures of 0.36 % is similar to the percentage obtained in the Lazio IDEA subproject.
- If only the Lazio, Val d'Aosta and Portugal IDEA subprojects are taken into account, the failure % of the ruminal bolus remains rather constant with time and, in average, is lower than 0.23% in the worst case.

- The ruminal bolus used show long-term reading results up to 28 months after tagging with AUF and “readings not performed” values <50% in all cases. One can conclude that there is enough data to drawn up conclusions on the long-term behaviour of the ruminal bolus in goats.

b) Reading System

- More than 50% of the control readings for goats have been performed using the dynamic reading system.
- Spain and Lazio IDEA subprojects performed 43% and 34%, respectively of the control readings in dynamic conditions. In Portugal, 95% of the control readings were performed using the dynamic reading system.
- As explained for sheep, the Val d’Aosta IDEA subproject did not perform dynamic readings due to the mean farm size of 20 animals/farm and with many farms with less than 10 animals/farm (family and part-time management).
- Only the Lazio IDEA subproject used the dynamic reading system in slaughterhouse with a very low number of declared readings (n=10).

- ***Recovery Results***

- Slaughterhouse recovery results show that 100% of bolus were read and/or recovered. The recovery percentages in field added to the percentage of recovery for sanitary reasons show that no problems appeared for the bolus recovery in field.
- Slaughterhouse readings were performed on 50% of the animals slaughtered in an IDEA slaughterhouse.

4.1.2.2. Animal Casualties

According to the recommendations made in the Guide Procedures (17), trained operators should perform all tagging activities. In the case of the ruminal bolus a minimum animal age and/or weight of application was also recommended. However, during the tagging activities some IDEA subcontractors reported problems of animals injured or death occurring after application of the electronic identifiers.

With the final objective to identify the main causes of injuries or death after electronic identifier application, the JRC requested information from the IDEA subcontractors. The following information was provided:

1) list of dead animals after bolus application including information on electronic ID code, specie, breed, birth date, tagging date, death date and cause of death. The list of causes which have been identified is:

    (a) *Incorrect application:* application performed in a wrong way.
    (b) *Applicator type:* some types of bolus applicator can damage the throat and the oesophagus, provoking the death of the animal.
    (c) *Training:* death cause during training sessions by non experienced operators.
    (d) *Young age/weight:* the size/weight of the animal is linked to the cause of death.
    (e) *Normal bolus application assumed:* death due to pathology associated with the bolus application (oesophagus perforation, pneumonia, etc…) during or after normal tagging activities.
    (f) *Management:* animals death / sacrificed due to a management incident during the tagging activities (i.e.: extremities broken).
    (g) *Other*

2) list of animals identified at < 20 days of age including information on electronic ID code, specie, breed, birth date, tagging date, age and incidences (if occurred).

Table 4.1.2.2.1 summarizes the information concerning the death of cattle, sheep and goats per age, cause of death and tag type. Table 4.1.2.2.2. shows the number of dead animals per cause of death and specie.

Subcontractor	Tag Type	Specie	Age	Number	Cause
Germany	Bolus	Cattle	>40 d	3	Normal application assumed.
Spain	Bolus	Cattle	Adult	10	Mostly due to untrained operators, incorrect application and management
		Sheep	Adult	64	
		Goats	Adult	2	
Val d'Aosta (I)	Bolus	Goats	5 years	1	Bolus between reticulum and omasum
Lazio (I)	Bolus	Sheep	4-6 m	7	The applicator type provoked the deaths
		Sheep	Adult	11	
Netherlands	Bolus	Cattle	<20 d	6	Normal application assumed. Some deaths during training
		Cattle	>20 d	5	
	Injectable	Cattle	2 wk	2	
Portugal	Bolus	Cattle	Adult	4	Normal application assumed. Plastic collar tightening the neck. Adult sheep with weight <25 Kg.
		Sheep	Adult	32	
Bourgogne(FR)	Bolus	Cattle	5-8 d	4	No more bolus tagging were performed
Bretagne (FR)	Bolus	Cattle	4-8 d	2	Normal application assumed.
			TOTAL	**153**	

Table 4.1.2.2.1. Summary of animals per specie, age and cause of death

Cause of death		Cattle	Sheep	Goat
1	Incorrect application	-	59	2
2	Applicator type	-	18	-
3	Training	2	-	-
4	Young age/weight	4	8[1]	-
5	Normal bolus application	25[3]	14	-
6	Management	2	1	-
7	Other	3	14[2]	1
Total		***36***	***114***	***3***

[1]: adult sheep tagged at live weight <25 Kg; [2] : sheep with a plastic collar preventing the bolus deglution (all deaths in the same farm); [3] : two cattle identified with injectable transponders

Table 4.1.2.2.2. Number of dead animals per specie and cause

Data presented in table 4.1.2.2.2. Identified that, in sheep, more than 65% of the deaths occurred due to an incorrect application, or due to a bad applicator type (cause 1 and 2). Only 14 sheep died during a normal tagging activity declared by the IDEA subcontractor, which gives a death percentage of 0.0034%, taking into account that a total of 408 773 sheep had been identified in the IDEA project with ruminal bolus of normal size.

It has to be noted that in one farm in Portugal, a total of 22 sheep died after the bolus application. From these, 8 sheep had a live weight <25 Kg. In addition, all sheep in the farm carried a plastic collar that tightened the neck preventing from bolus deglutition. There are still animals alive on that farm which have the ruminal bolus in the beginning of the neck, which has been detected by X-ray radiography.

In cattle, a total of 23 animals died during normal tagging activity declared by the IDEA subcontractor, which gives a death percentage of 0.0145%, taking into account that a total of 158 548 cattle had been identified in the IDEA project with ruminal bolus of normal size. If the same calculation is made on cattle identified with injectable transponders (n=30 328) gives a death percentage of 0.0066 %.

In order to verify the effect of age at application on the probability of death after the ruminal bolus application, the IDEA subcontractors were asked to supply data on how many cattle were identified with ruminal bolus at <20 days of age and a detail of the incidences (if) occurred after the bolus application. These data has been updated with data coming from the IDEA Central database.

Table 4.1.2.2.3. shows the number of adult cattle identified with ruminal bolus per IDEA subcontractor and the number of calves identified at less than 20 d of age and the number of animals dead respectively.

One has to note the low number of animals identified at <20 days of age in France Bourgogne and France Bretagne IDEA subprojects, which increases the final percentage of dead animals. In the case of the France Bourgogne IDEA subproject no more bolus were applied after the first trial, so no verification of the tagger effect on the death percentage could be verified. A total of 14 Charolais breed calves have been identified in other two IDEA subproject and no deaths after application occurred. The death percentage on calves of <20 days of age has been recalculated without the data coming from the French IDEA subprojects, giving a value of 0.18%. However, it should be pointed out that all calves dead come from one IDEA subproject.

Subcontractor	Total Cattle ID	Total Death	Death %	Cattle ID <20 d	Death <20 d	Death %
Germany	8 700	3	0.034	59	0	0
Spain	35 118	10	0.03	245	0	0
Val d'Aosta (I)	52 587	0	0	12	0	0
Lazio (I)	8 374	0	0	28	0	0
Netherlands	32 744	13	0.039	2 887	6	0.2
Portugal	18 654	4	0.021	0	0	0
Bourgogne (FR)	2 182	4	0.18	14	4	28.6
Bretagne (FR)	28	2	7.14	28	2	7.14
TOTAL	**158 387**	**36**	**0.023**	**3 273**	**12**	**0.37**

Table 4.1.2.2.3. Death percentage of adult and young cattle (<20 d) identified with Ruminal Bolus

From this data, the effect of the tagger people on the death percentage seems to exist, but a firm statement is not easy to make. It has to be noted that the highest death rate of calves after application occurred, in the Netherlands subproject. In the discussion of the Netherlands subproject results, it is stated that taggings were performed by the farmer itself, and not by trained personnel, and this may have been a cause.

It can be concluded that training is essential when performing electronic identification using ruminal bolus in sheep, goat and cattle species. Lack of training combined with the young age (<20 d of age) of calves at identification could cause the death of young calves after bolus application.

4.1.2.3 Issues related to the identification of young animals

During the plenary meeting held in Brussels on 23 October 2001, some IDEA participants presented problems encountered in the use of ruminal bolus for animal identification (identification age, death of animals, refusal of the farmers to use such technology, etc…).

Recent developments showed that there is the possibility to use ruminal bolus of smaller dimension. This bolus type may be administrated at a very young age. Limited trials with this type of bolus showed a promising retention rate at a young age and when the animal becomes an adult.

The JRC made a market research for electronic identifiers of smaller dimension allowing the animal identification at a young age and/or weight. At present, two types of small ruminal bolus are available:

- Mini Bolus type (RB4): 38 x 9.5 mm, 9 g, suitable for sheep >6 kg weight
- Small Bolus type (RB5): 67 x 17 mm, 52 g, for animals >17 kg weight

Following the IDEA rules, both types of electronic identifiers were tested and certified at the TEMPEST laboratory of the JRC, Ispra (10). After this, the JRC suggested that some of the IDEA subcontractors perform complementary research on the use of the small types of ruminal bolus identifying some of the replacement animals. All identified animals with these bolus types had to follow the IDEA Procedures in terms of reading protocol, bolus recovery, data recording, etc…. The objectives of this complementary research were the following:

- determination of the age at which the mini/small bolus types can be introduced in young animals
- verification that the min/small bolus types remain in the animal for a long-term period.

The JRC made available 2 500 ruminal bolus of each type (mini and small). Four IDEA subcontractors expressed their wish to participate in this additional experiment for sheep and goats and a total of 2 300 small ruminal bolus and 2 430 mini bolus were delivered to these subcontractors.

IDEA Subproject	**Bolus type**	
	Mini	***Small***
Spain	500	800
Lazio	630	800
Ministero Sanita	500	-
Portugal	800	500
FR Bourgogne	-	200
TOTAL	**2 430**	**2 300**

Table 4.1.2.3.1 Number of bolus delivered by JRC per type and IDEA subcontractor

The Italia Ministero della Sanità IDEA subcontractor increased its participation in the trail with the identification of 7 200 buffalo, cattle sheep and goat with the small bolus (RB5).

The first tagging using small and mini bolus for young and adult animals began in May 2001. Tagging results partially recorded in the IDEA Central database indicate that RB4 has been applied to 95 lambs at < 20 d of age, 21 between 20-60 d and 416 at >60 d of age. In the case of RB5, more than 80% of cattle and sheep were identified at >60 d of age (n=148)

Table 4.1.2.3.2. shows the number of animals identified by each IDEA subcontractor with both types of ruminal bolus. Part of this data comes from the JRC IDEA central database and part was delivered by the IDEA subcontractors in other formats (e-mail, fax, etc…).

IDEA Participant	**Ruminal Bolus Type**					
	Mini (RB 4)		Small (RB 5)			
Specie	***Sheep***	***Goat***	***Buffalo***	***Cattle***	***Sheep***	***Goat***
Spain	581				262	
Lazio	549				408	
Ministero Sanita	498		1 387	1 043	4 764	5
Portugal	323	245				
Total	**1 951**	**245**	**1 387**	**1 043**	**5 434**	**5**

Table 4.1.2.3.2. Number of animals identified with the mini and small bolus types

The following tables show the number of readings with the reading results declared by the IDEA subcontractors. The tables have been divided by specie and ruminal bolus type in order to evaluate the differences on the reading performance between both types of ruminal bolus. As the experience began in 2001, no readings later than 7 months after tagging have been performed.

Buffalo	**RB 5**				
	Reading type				
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***
Animals to be read	1 387	1 387	1 387	1 386	-
Readings Recorded	1 387	1 387	1 387	256	
AUF (%)	0	0	0	1 130 (81.5)	
Reading Results:					
Successful Readings	1 387	161	1 374	256	
Electr. tag not read	0	0	10	0	
Electronic tag lost	0	0	0	0	

Electr. tag broken	0	0	0	0	
Readers not function.	0	0	0	0	
Animal not present	0	0	0	0	
Read. not performed	0	1 226	3	0	

Table 4.1.2.3.3. Number of readings and readings results of buffalo with small bolus type

Cattle	**RB 5**				
	Reading type				
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***
Animals to be read	1 043	1 043	1 043	1 043	-
Readings Recorded	1 043	1 041	1 041	1 041	
AUF (%)	0	2 (0.19)	2 (0.19)	2 (0.19)	
Reading Results:					
Successful Readings	1 043	391	897	883	
Electr. tag not read	0	0	138	151	
Electronic tag lost	0	0	0	0	
Electr. tag broken	0	0	1	1	
Readers not function.	0	0	0	0	
Animal not present	0	19	0	6	
Read. not performed	0	631	5	0	

Table 4.1.2.3.4. Number of readings and readings results of cattle with small bolus type

Sheep	**RB 5**				
	Reading type				
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***
Animals to be read	5 434	5 434	5 434	5 405	
Readings Recorded	5 434	5 169	5 161	4 731	
AUF (%)	0	265 (4.9)	273 (5.0)	674 (12.5)	
Reading Results:					
Successful Readings	5 434	618	5 103	4 605	
Electr. tag not read	0	2	9	39	
Electronic tag lost	0	0	0	0	

Electr. tag broken	0	0	1	0	
Readers not function.	0	0	20	0	
Animal not present	0	1	28	84	
Read. not performed	0	4 548	0	3	

Table 4.1.2.3.5. Number of readings and readings results of cattle with small bolus type

A total of 5 goats were identified with RB 5. Readings were performed at 1d, and 1 month after tagging and 1 bolus was not read at both 1w and 1 m readings. No table has been made in this case due to the small number of animals tagged.

Sheep	**RB 4**				
	Reading type				
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***
Animals to be read	1951	1 949	1 719	1 494	814
Readings Recorded	1 951	1 560	1 451	1 153	316
AUF (%)	0	389 (19.9)	268 (15.6)	341 (22.8)	498 (61.2)
Reading Results:					
Successful Readings	1 951	1 554	1 380	1 127	302
Electr. tag not read	0	2	11	6	2
Electronic tag lost	0	4	4	7	0
Electr. tag broken	0	0	0	0	0
Readers not function.	0	0	0	11	0
Animal not present	0	0	2	2	12
Read. not performed	0	0	54	0	0

Table 4.1.2.3.6. Number of readings and readings results of sheep with mini bolus type

Goat	**RB 4**				
	Reading type				
	After Tagging	***1 d***	***1 w***	***1 m***	***7 m***
Animals to be read	245	245	245	245	-
Readings Recorded	245	245	245	245	
AUF (%)	0	0	0	0	
Reading Results:					

Successful Readings	245	243	243	240	
Electr. tag not read	0	2	2	4	
Electronic tag lost	0	0	0	0	
Electr. tag broken	0	0	0	0	
Readers not function.	0	0	0	0	
Animal not present	0	0	0	1	
Read. not performed	0	0	0	0	

Table 4.1.2.3.7. Number of readings and readings results of goats with mini bolus type

From the results, the "electronic identifiers not read", "electronic identifiers lost" and "electronic identifiers broken" (shaded rows) are taken into account to calculate the Failures % of electronic identifiers.

RB5		**Reading type**				
		AT	***1 d***	***1 w***	***1 m***	***7 m***
Buffalo	Failures (%)	0	0	10 (0.72)	0	-
	Readings	1 387	61	1 384	256	-
Cattle	Failures (%)	0	0	139 (13.4)	152 (14.7)	-
	Readings	1 043	391	1 036	1 035	-
Sheep	Failures (%)	0	2 (0.32)	10 (0.19)	39 (0.84)	-
	Readings	5 434	620	5 113	4 644	-

Table 4.1.2.3.8. Reading results with small bolus type

RB4		**Reading type**				
		AT	***1 d***	***1 w***	***1 m***	***7 m***
Sheep	Failures (%)	0	6 (0.38)	15 (1.1)	13 (1.14)	2 (0.66)
	Readings	1 951	1 560	1 395	1 140	304
Goat	Failures (%)	0	2 (0.82)	2 (0.82)	4 (1.64)	-

	Readings	245	245	245	244	-

Table 4.1.2.3.9. Reading results with mini bolus type

Based on the results obtained from the tagging with the small and mini bolus types, one may draw some conclusions:

- There is a large difference of the performance of RB5, between cattle and buffalo at 1 week after application, which is not in agreement with results observed in the normal size bolus, where Failures percentage was similar between buffalo and cattle. In any case, the high Failures percentage of RB5 in cattle excludes its use in favour to the normal size bolus.
- The same happened for goats with a high percentage of failures at 1 month but on small number of animals tested.
- In sheep, failure rates obtained are not much different than those obtained in the IDEA project and with the advantage that with the small bolus type a lamb can be identified very early, allowing the traceability of the animal during all its life. From the results 3 scenarios can be drawn, depending on the bolus type used:
    - Mini Type: Full traceability of sheep livestock from 6 kg after birth but with an expected failure rate > 1%.
    - Small Type: Traceability of sheep livestock from 17 kg after birth but with an expected failure rate of approximately 1%.
    - Normal Type: Traceability of sheep livestock >25 kg after birth but with a expected failure rate < 0.5%.

These conclusions are drawn from a limited experience and results need to be confirmed for a longer time period. In addition, other trials performed outside the framework of IDEA showed results not in accordance with the IDEA findings. For this reason, it is recommended to pursue the effort to confirm on a longer time period and larger number of animals the results obtained, but also to investigate the possible use of different types of small size bolus.

4.1.2.4. Electronic Identification of Cattle in Finland: Operation and Functioning of Electronic Identification Devices in Northern Cold Climate

In northern European countries livestock are kept under very cold conditions, characterized by extremely low temperatures (down to -50 °C) and rapid and frequent temperature fluctuations between 5-25 degrees. An experiment has been designed in Finland with the main objective to evaluate the performance of the electronic identification devices in northern winter climate. This experiment has been performed outside of the framework of IDEA. The results, however, are of interest to the general issue of electronic identification of livestock in EU. The results enhance also JRC's work in defining appropriate test procedures and standards.

Laboratory Reference Testing

Reference tests of the equipment used in cold conditions were previously performed in the climatic chambers at the TEMPEST Laboratory of the JRC Ispra. Ruminal boluses were not tested, as environmental conditions do not affect their performance. The laboratory tests were performed according with the environmental conditions described by the Finnish participant:

a) **Electronic Eartag:** ***Test 1:*** Operation at –40°C

b) **Portable Readers:** ***Test 2:*** Reading duration at –25°C
Test 3: Reading efficiency at –10°C
Test 4: Recovery from –25°C to ambient temperature

c) Stationary Readers: ***Test 5:*** Operation at –40°C
Test 6: Operation under –30°C / +30°C thermal cycle

No damage or breakage was observed at laboratory level for electronic eartags and stationary and portable reader subjected to different thermal stresses. The unique problem observed during the cold test at –25° C and –10 ° C was the impossibility to read the number on the display, mainly because the formation of frost on it.

In-field Activities

A total of 273 cattle from different breeds (Hereford n= 133; Holstein Friesian n=98; Ayrshire n=27; Aberdeen Angus n=7; Limousine n=6 and Finnish n=2) were electronically identified with Ruminal Bolus (n= 165) and electronic eartags (n=108). Animals were located in four farms with different breeding aptitude and temperature conditions.

- Very Cold Conditions (pen in nearby area, forest, etc...): outside without any insulation (VCC)
- Cold Conditions: inside without heating system (CC)
- Warm Conditions: inside with heating system (WC)

Table 4.1.2.4.1. shows the number of animals electronically identified on each farm, the tag types and brands, the breeding aptitude and the temperature conditions of each farm:

Farm	Breeding Aptitude	Tag type	Temperature Conditions			TOTAL
			VCC	CC	WC	
Suckler cow Unit Tohmajärvi Exp. Farm	Beef Cattle	Eartags Bolus	36 5	65 8	7	108 13
Sampo Rauma	Beef calves	Bolus		56		56
Kitee Learning Centre	Beef calves	Bolus			14	14
Suitia Research Farm	Dairy cows	Bolus		40	42	82
		TOTAL	41	169	63	**273**

Table 4.1.2.4.1 Number of animals identified on each farm and temperature condition

Two temperature/humidity (T/RH) recorders were installed in two farms, Tohmajärvi Experimental Farm and Suitia Research Farm in order to record the environmental operating conditions of the readers. The recorders were previously calibrated at the TEMPEST laboratory (JRC Ispra) to obtain real temperature and humidity values. The T/HR recorders were installed close to the fixed reader and set up to perform one T/HR recording every 30-min. The recorders were periodically unloaded and the recorded files transferred to the JRC for analysis and evaluation.

During the tagging activities the temperature recorded manually and with the Hobo logger varied between –10 °C (December 1999) and + 22 °C (July 2000) in the different farms. Following the procedures of the IDEA project (17) all electronic identifiers were read before and after application and animal data was recorded in the Hokofarm Portable reader. The tagging data on ASCII format from the portable reader were downloaded to a portable computer and converted to an excel file. Both, ASCII and excel files were transferred to the JRC via e-mail for evaluation and analysis.

Following the Guide Procedures of the IDEA Project the electronic identifiers were read at different periods after tagging (1 day, 1 week, 1 month, 7 months, every 7 months). Due to the large distance between farms the reading at 1 week after tagging was skipped.

A summary of the readings performed on each farm with the reading date, the number of animals, the reading type, the reading efficiency and the temperature and humidity conditions during the reading are shown in table 4.1.2.4.2.

Farm	Reading type / date				
	1 day	1 month	7 months	Every 7 months	Every 7 months
Tohmajärvi Exp. Farm	21/12/99 Dynamic 100% (48/48) –16 °C, 75%	22/03/00 Dynamic 100% (95/95) +3 °C, 70%	13/07/00 Dynamic (n=101) Static (n=7) 100% (108/108) +23°C, 80%	12/12/00 Dynamic 100% (101/101) +8 °C, 98%	29/03/01[1] Dynamic 100% (99/99) –1 °C, 83%
Kitee Learning Centre	21/12/99 Static 100% (14/14) –6 °C	22/03/00 Static 100% (10/10) +4 °C	All animals slaughtered	-	-
Sampo Rauma	22/03/00 Dynamic 91% (41/45) +4 °C	13/07/00 Dynamic 100% (19/19) +23°C	07/03/01 Static 100 % (2/2) –6 °C	All animals slaughtered	-
Suitia Research Farm	30/03/00 Static 100% (82/82) Dynamic 0 % +13 °C, 57%	18/05/00 Static 100% (82/82) Dynamic 0 % +18 °C, 53%	19/12/00 Dynamic (n=17) Static (n=65) 100 % (82/82) +13 °C, 80%	8/03/01 Dynamic (n=57) Static (n=4) 100% (62/62) +13 °C, 75%	25/04/01 Dynamic 93.4% (57/61)[2]

[1]: An additional reading was performed during the JRC visit on 07/03/01 with 100% or reading efficiency (101/101); [2]: No checked with Portable Reader

Table 4.1.2.4.2. Summary of the readings with the reading date, type, the reading efficiency and T/HR conditions

Discussion and conclusions

The absence of losses and breakage of the electronic identifiers used (electronic eartags and ruminal bolus) could be due to the great care taken by the operators to perform the electronic tagging and also the intensive conditions where the animals were kept. This aspect is very important in the case of the electronic eartags. However, small number of animals (n=273) electronically identified does not permit to make a strong statement on the failure rate.

However, the retention rate results obtained for ruminal bolus are in agreement with those obtained by Caja et al. (1999) and Conill et al. (1999) with 0.3 % of losses in 1 487 calves and also with the IDEA project at 14 months after tagging (n=39 945; 0.19 % losses). In the case of the electronic eartags, the retention rate results obtained are lower than those obtained in the IDEA project at 7 months after tagging (n=26 712; 1.67 % losses).

The results obtained on the environmental conditions showed that the cold temperature combined with high humidity (-16° C; 75% HR) does not affect the reading efficiency of the system, but also that the same system is able to operate under and combination of warm and high humidity conditions (18-23° C; 75-98%). The in-field results confirm what was obtained in the laboratory for electronic eartags and stationary and portable reader with no damage or breakage of the devices subjected to different thermal stresses.

These results are in agreement with the results obtained by Nehring et al. (1994) who found reduction on the reading distance of 60% at –30 ° C, placing both transponder and reader inside a freezer. A lower reduction on the reading distance (25%) was obtained when temperatures tested were around 0 ° (-5 to +5 °C) or even less when the reader was kept at room temperature. From 5 to 140 ° C the same author did not find any reduction on the reading distance.

It can be concluded that the operation and functioning of the electronic identification devices used is not affected when used for different types of cattle kept at different temperature (including low) and humidity conditions. However, other aspects, such as training of the operators and usability of the devices in cold conditions should be taken in consideration.

4.2. Suitable Tagging and Reading Equipment

Two transponder technologies exist (so-called HDX and FDX-B) in accordance with ISO 11784 and ISO 11785 standards and each subproject did base its choice for identifiers on one or the other technology. This means that for the IDEA project both technologies have been applied. This situation is expected to be also the case, if electronic identification will be implemented in the future on the EC livestock. With animals moving from one country (or region) to the other, one will encounter animals with HDX or FDX identifiers. As a consequence, it will be indispensable to use only the so-called full ISO portable and stationary readers (i.e. readers able to read HDX and FDX-B identifiers). This is also mandatory according to ISO 11785 standard. Table 4.2.1.1 and 4.2.1.2 gives the list of such portable readers certified during the IDEA project.

Reader No.	Supplier	Reader Model	Idea Certificate	Used in IDEA
P 1	Allflex	RFID model 930002.001	050/1998	**Yes**
P 3	Datamars	Isomax I	001/1997	**Yes**
P 4	Datamars	Isomax II	002/1997	No
P 5	Datamars	Isomax III	035/1997	**Yes**
P 7	Datamars	DHP 112 Version II	069/1999	No
P 9	Diehl/Hotraco	Workabout + DHP 102	058/1998	No
P 10	Diehl/Hotraco	Workabout + DHP 112	059/1998	**Yes**
P 11	Diehl/Hotraco	Workabout + DHP 111	060/1998	No
P 13	Gesimpex	Gesreader I ISO	006/1997	No
P 14	Gesimpex	Gesreader II ISO	007/1997	**Yes**
P 18	Gesimpex	Stick Gasiso	045/1998	**Yes**
P 19	Gesimpex	Gesreader 2 S	072/1999	**Yes**
P 20	Gesimpex	Stick for Gesreader 2S	073/1999	**Yes**

Table 4.2.1: ISO portable readers certified for the IDEA project

Thirteen ISO portable readers which are at present available on the market were certified for the IDEA project. This should guarantee already to day the possibility to provide a reasonable choice of readers to future users and at the same time provide assurance for "universality" in reading capacity within the EU.

Concerning the reading distance for eartags, for all identifiers certified in the IDEA project, one of the acceptance criteria was the mandatory reading distance of 25 cm with a tolerance of –3 cm. If one considers that the eartags placed on the animals are visible, one can at least touch the ear of the animal with the portable reader in order to read the identifier (this is not the case for boluses). Considering this practical aspect and if one does not take into account the IDEA mandatory reading distance of 25 cm (-3cm.), 13 ISO portable readers (Table 4.2.1.1) are compatible with each eartag type (HDX and FDX).

Table 4.2.2 provides a list of six ISO stationary readers and antennae available on the market and certified for the IDEA project.

Reader No.	Supplier	Reader Model	Idea Certificate	Used in IDEA
S 2	Datamars	Powermax	049/1998	No
S 4*	Hotraco	DSE 500 corridor reader	064/1998	No

S 5	Hotraco	DSE 200 stationary reader	065/1998	No
S 7	Gesimpex	F 110 + GO3C antenna	019+013/1997	No
S 8	Gesimpex	F 210 + GO3C antenna	020/1998+013/1997	**Yes**

Table 4.2.2: Number of ISO stationary readers certified for the IDEA project

Based on the experience gained during the IDEA project, in field as well as in the TEMPEST laboratory (in terms of equipment certification, performance and reliability testing of the devices), one has to consider the following points for the future implementation of electronic identification of EC livestock (cattle, buffalo, sheep and goat).

1. Electronic tagging of livestock can be done using electronic eartags, boluses and injectable transponders from HDX and FDX-B technologies in accordance with ISO 11784 and ISO 11785 standards.
2. In order to assure that one can read animals independently of the choice of the transponder technology, only full ISO portable and stationary readers must be used (i.e. readers able to read HDX and FDX-B transponders). The list of such IDEA certified readers is given in tables 4.2.1 and 4.2.2.
3. Depending on the animal specie and the performances requested, the following identifiers types can be used:
   - cattle and buffalo: electronic eartags, boluses, injectable transponders
   - sheep and goats: electronic eartags, boluses
4. Based on the experience gained during infield tests and the fact that eartags are visible, the mandatory reading distance of electronic identifiers can be reduced to 12 cm with a tolerance of –20% with portable readers (with the best orientation of the eartags) for all type of animals.
5. In the case of sheep and goats, and based on the IDEA in-field experiments, the mandatory reading distance (with tags oriented in their best reading position) for dynamic reading (i.e. using stationary readers) can be reduced to 50 cm with a tolerance of –10 % depending on the width of the animals and on the reading corridors.
6. In the case of sheep and goats, and based on the IDEA in-field experiments, the mandatory reading distance using portable readers and boluses can be reduced to 20 cm with a tolerance of –10 % due to the width of the animals.
7. In the case of cattle and buffalo, the mandatory reading distance for dynamic reading (i.e. using stationary readers) must remain 80 cm with a tolerance of – 5 cm as in the case of the IDEA project.
8. In the case of cattle and buffalo, the mandatory reading distance using portable readers must be 25 cm with a tolerance of – 4 cm.
9. In the case of injectable transponders and using portable readers, the mandatory reading distance can be reduced to 12 cm with a tolerance of -20 %

Based on the various points developed before, tables 4.2.3 below presents the various solutions presently available with equipment tested and certified in the TEMPEST laboratory, in order to run a full implementation of electronic identification for livestock in Europe:

For the electronic identification of cattle and buffalo, a summary of the possible combinations is the following (18):

- 12 certified ISO portable readers can be used in combination with the 15 certified eartags or 13 eartags can be used with the 13 certified ISO portable readers,
- 3 certified ISO stationary readers can be used with 3 certified eartags or 1 certified ISO stationary reader with the 15 certified eartags,
- 12 certified ISO portable reader can be used with 10 of the certified boluses or the 14 certified boluses can be used with 10 of the certified ISO portable readers,

- the 5 certified ISO stationary readers can be used with 4 certified boluses or 9 of the certified boluses can be used with 4 of the certified ISO stationary readers,
- the 13 certified ISO portable readers can be used with the 3 certified injectable transponders,
- the 5 certified ISO stationary readers can be used with only one certified injectable transponder or 2 injectable transponders can be used with 3 certified ISO stationary readers;

For the electronic identification of sheep and goats, a summary of the possible combinations is the following:

- 12 of the certified ISO portable readers can be used with the 5 certified eartags or 4 of the certified eartags can be used with the 13 certified ISO portable readers,
- 3 certified ISO stationary readers can be used with the 5 certified eartags or the 5 certified ISO stationary readers with 3 of the certified eartags, certified ISO portable reader can be used with the 13 certified boluses or the 13 certified ISO portable readers can be used with 9 of the certified boluses,
- certified ISO stationary readers can be used with 9 certified boluses or the 13 certified boluses can be used with 3 of the certified ISO stationary readers.

Cattle and Buffalo Electronic Identification						
Portable ISO Readers	**Electronic Eartags Compatible**		**Ruminal Boluses Compatible**		**Injectable Transponders**	
Allflex RFID model 930002.001	All	15	All	14	All	3
Datamars Isomax I	All	15	All	14	All	3
Datamars Isomax II	All	15	All	14	All	3
Datamars Isomax III	All	15	All	14	All	3
Datamars DHP 112 Version II	All	15	11	78.5 %	All	3
Hotraco Workabout + DHP 102	All	15	11	78.5 %	All	3
Hotraco Workabout + DHP 112	All	15	11	78.5 %	All	3
Hotraco Workabout + DHP 111	All	15	11	78.5%	All	3
Gesimpex Gesreader I ISO	All	15	10	71.4 %	All	3
Gesimpex Gesreader II ISO	All	15	10	71.4 %	All	3
Gesimpex Stick Gasiso	All	15	11	78.5 %	All	3
Gesimpex Gesreader 2 S	All	15	10	71.4 %	All	3
Gesimpex Stick for Gesreader 2S	13	87 %	10	71.4 %	All	3
Stationary ISO Readers						
Datamars Powermax	4	26.6 %	All	14	1	33.3%
Hotraco DSE 500 corridor reader	All	15	All	14	All	3
Hotraco DSE 200 stationary read.	2	13.3 %	4	28.6%	0	0
Gesimpex F 110 + GO3C antenna	4	26.6 %	9	64.3 %	2	66.6 %
Gesimpex F 210 + GO3C antenna	5	33.3%	9	64.3 %	2	66.6%
Sheep and Goats Electronic Identification						
Portable ISO Readers						
Allflex RFID model 930002.001	All	5	All	13		
Datamars Isomax I	All	5	All	13		
Datamars Isomax II	All	5	All	13		
Datamars Isomax III	All	5	All	13		
Datamars DHP 112 Version II	All	5	All	13		
Hotraco Workabout + DHP 102	All	5	12	92.3 %		
Hotraco Workabout + DHP 112	All	5	10	76.9 %		
Hotraco Workabout + DHP 111	All	5	12	92.3 %		
Gesimpex Gesreader I ISO	All	5	10	76.9 %		
Gesimpex Gesreader II ISO	All	5	All	13		
Gesimpex Stick Gasiso	All	5	11	84.6 %		
Gesimpex Gesreader 2 S	All	5	11	84.6 %		
Gesimpex Stick for Gesreader 2S	4	80%	10	76.9 %		
Stationary ISO Readers						
Datamars Powermax	All	5	All	100 %		
Hotraco DSE 500 corridor reader	All	5	All	100 %		
Hotraco DSE 200 stationary read.	All	5	All	100 %		
Gesimpex F 110 + GO3C antenna	3	60 %	11	78.6 %		
Gesimpex F 210 + GO3C antenna	4	80 %	11	78.6 %		

Table 4.2.3: Possibilities of electronic identification of cattle, buffalo, sheep and goats using portable and stationary ISO readers

Table 4.2.3 shows the various possible combinations reader / electronic identifier:

- for each animal species, each IDEA certified reader is presented in combination with the type (eartag, bolus, injectable transponder) and number of tags compatible.
- for each tag type, and each reader, the number of electronic identifiers compatible is presented in the following way: in the first tag column, "all" means that all the certified electronic identifiers are compatible. The second column indicates the number of certified tags corresponding to all. A number written in the first column of the tags indicates the number of certified compatible with this reader. The percentage in the second column corresponds to the percentage of the total certified tags of each type (electronic eartag, ruminal bolus, injectable).

Based on the experience gained during the IDEA project, the implementation of electronic tagging for European livestock including cattle, buffalo, sheep and goat is technically (instrumental point of view) feasible, taking into account the necessary compatibilities between identifiers and readers. Furthermore, new devices are under development and one may expect that the choice of devices and readers will substantially enlarge and improve in the near future.

4.3. Quality Control of Equipment (ref. 11, 19)

According to the quality control procedure detailed in chapter 3.3.3, the main results can be summarised as follows: for 20 quality controls performed on new identifiers, four types of non conformity were detected as presented in table 4.3.1 below.

Contractor / Code	Non Conformity
France – Sud Est / 10	In the cases of the eartags samples taken in field, the colour of the samples were different from the certified ones. It was justified by the supplier and no other characteristic was different compared to the certified ones.
Italy (Teramo) / 05	See France Sud Est
Holland / 06	See France Sud Est
Holland / 06	Two of the sampled boluses did not have an IDEA-ISO 11784 code. It was declared as a mistake from the contractor when giving the samples to the EC people
Holland / 06	One of the sampled bolus was easily opened by hand when received at the TEMPEST laboratory. The contractor was informed about this critical problem and answered that other boluses had the same problem but were not used for tagging. This is a critical point which can be due to a manufacturing problem
Germany / 01	See France Sud Est
Germany / 01	Some eartags resonance frequency were found out of the ISO 11785 standard. This can have a direct influence on the reading performance of the tag using portable and stationary readers.

Table 4.3.1 Summary of the results for QC on new tags

On the 19 quality controls performed on recovered identifiers, three types of non conformity were detected as presented in table 4.3.2 below from which one (no.5) is very important for a large scale utilisation of this type of identifier, especially in terms of retention and reading efficiency.

Contractor / Code	Non Conformity
Italy – Teramo / 05	In the cases of the samples taken in field, the colour of the samples were different from the certified ones. It was justified by the supplier and no other characteristic was different compared to the certified ones.
Holland / 06	See Italy Teramo
Germany / 01	See Italy Teramo
Germany / 01	The Printed Number was not visible on 2 recovered eartags.

Germany / 01	The transponder disk was separated from the plastic support (mechanical failure). 7 eartags on 10 out of ISO 11785 resonance frequency tolerance
France – Sud Est / 10	See Italy Teramo
France – Sud Est / 10	See Italy Teramo

Table 4.3.2 Summary of the results for QC on recovered tags

The non conformities observed in the Netherlands subproject (bolus opened by hand) and Germany subproject (transponder out of the plastic of the eartag and frequencies out of the ISO 11785 tolerances) may have a direct impact on the reading efficiency results presented by the Dutch and German contractors.

4.4. Specific Themes for Reading Efficiency Study

4.4.1. Interaction magnet / bolus (ref. 20)

Several IDEA subprojects (Germany, Lazio, France Bretagne, France Bourgogne) applied ruminal boluses identifiers on bovines which already had a magnet. Some problems of reading efficiency (during dynamic readings) were observed for these animals. The phenomena observed in field of decrease of the reading efficiency can be summarised as follows:

- some animal did not show any reading problem
- alternately some good readings and no readings were observed
- alternately some sequences of good and "bad" readings were observed.
- systematically "no readings" were observed. This last case was observed with pregnant cows.

Based on these observations, a test campaign was conducted in the TEMPEST laboratory in order to study if a magnet can have a significant effect, which systematically causes non-reading of the bolus.

Three different magnet types with and without plastic cages were supplied by a contractor in order to run the tests with various boluses and portable and stationary readers certified for the IDEA project.

Based on the results of this study (8), it has been observed that when the distance between the magnet and the bolus is longer than 15 mm, the negative effect of the magnet on the reading efficiency disappears.

For a distance smaller than 15 mm the effect of the interaction between boluses and magnets in terms of reading efficiency is directly linked to the type of bolus and magnet used, as well as, the type of reader.

At the same time, information were supplied by the German subproject indicating that some of their bovines were equipped with magnets and identified with ruminal bolus and no problems were observed.

The impact on the reading efficiency of the presence of a magnet with a ruminal bolus was studied for in-field readings recorded in the IDEA central database, as declared by various subprojects.

Two magnet types were used (only data defining the magnet type are taken into consideration for this analysis):

- with plastic cage (PC) - without plastic cage (WC)

The overall percentage of reading efficiency of animals equipped with magnets (without taking into account either breed, bolus and magnet types) is 77%. If one considers the magnet type used (with plastic cage: PC; without plastic cage: WC), the reading efficiency is 90% for PC magnets and 74% for WC magnets.

Based on the results presented before, it is clear that the magnet type without plastic cage influences more the reading efficiency than the one with a plastic cage. This is mainly due to the fact that the percentage of possibilities that a bolus is close to the magnet itself is more important in the case of the magnet without any plastic case.

The influence of the WC magnets on the reading efficiency was clearly put in evidence in the report of the Lazio subproject as described in section 4.1.1.4..

It is clear that reducing the use of the magnets (especially the ones without plastic cage) will eliminate an important cause of reduced reading efficiency of ruminal bolus.

4.4.2. Immunity of stationary readers against conducted electromagnetic perturbations

Various IDEA certified ISO stationary readers where exposed to voltage dips, bursts (21), conducted high frequency perturbations (22), as well as, conducted harmonics perturbations (23) as these perturbations can practically be generated by vacuum pumps, cooling systems, saws etc…

The readers were tested to all levels of the corresponding IEC immunity standards.

The results obtained can be summarised as follows:

- The IDEA certified ISO readers are not sensitive to voltage dips as defined in IEC 61000-4-11 standard.
- Concerning the burst tests conducted on the main power lines (according to IEC 61000-4-4, all readers are more or less affected by these perturbations. At the highest test level, none is operating correctly. In the worst cases the readers were sent back for reparation due to power supply failures. In other cases the reading efficiency was directly affected (reading speed decreased or no readings were observed). The summary of the results is presented in table 4.4.2.1 below:

	Test Level			
Reader	**0.5 kV**	**1kV**	**2kV**	**4kV**
Datamars Powermax	O.K.	Power supply out	-	-
Gesimpex F 100	O.K.	O.K.	O.K.	Irregular readings
Gesimpex F 110	O.K.	Irregular readings	Irregular readings and no readings	Irregular readings and no readings
Gesimpex F 200	O.K.	Necessity to reset	Power supply out	-
Gesimpex F 210	O.K.	O.K.	Reduction of the reading speed	Reduction of the reading speed. Irregular readings
Hotraco DSE 200	O.K.	O.K.	No readings during half of the tests	No readings during half of the tests
Hotraco DSE 500 corridor	O.K.	O.K.	Irregular readings	No readings. Necessary to reset continuously the reader
Innoceramics F 2000	O.K.	O.K.	O.K.	Cases of no readings. Reset of the reader
Nedap VC 4 Single Feeder	O.K.	O.K.	Reader shuts down.	No readings and unregular readings. Reset of the reader

Table 4.4.2.1: Results of stationary readers burst immunity tests during IEC 61000-4-4 immunity testing

- The effects of conducted disturbances, induced by radio-frequency fields (according to IEC 61000-4-6 standard) can be summarised as follows in percentages of the RF frequency range (150kHz - 80Mhz) over which readings were observed:

Reader / Test Level	1Vrms	3Vrms	10Vrms
Datamars Powermax	82.00%	64.60%	40.40%
Gesimpex F100	98.90%	97.80%	94.80%

Gesimpex F110	100.00%	99.10%	78.70%
Gesimpex F200	99.20%	97.00%	66.70%
Gesimpex F210	89.10%	81.20%	55.00%
Hotraco DSE 200	81.70%	60.00%	39.70%
Hotraco DSE 500 Corridor	97.30%	79.90%	46.10%
Innoceramics F2000	99.80%	89.60%	61.90%
Nedap VC4	88.20%	69.20%	45.80%

Table 4.4.2.2: Reading efficiency of stationary readers depending on test level during IEC 61000-4-6 immunity testing

The readers showing the best immunity to these perturbations are both packed in a metallic box (Gesimpex F 100 and F 110) with separated power supply.

Only small effects of the current harmonics were observed on the reading efficiency of some of the stationary readers tested (according to IEC 6100-4-13).

In conclusion, one can say that the reading efficiency of the stationary readers can be increased in disturbed environments by protecting them against the conducted perturbations occurring on their main power line as defined before.

4.4.3. Conducted Electromagnetic Emission of Stationary Readers (ref. 23, 24)

The IDEA certified stationary readers were tested in order to study their conformance to electromagnetic conducted emission levels (generated by their power supply) according to the various standards shown in table 4.4.3.1 below.

Standard	Title
EN 55011 Cls A Grp 1 mains	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Equipment designed to be operated anywhere exept in domestic environments and with low voltage network
EN 55011 Cls A Grp 2 mains	As before but group 2
EN 55011 Cls B Grp 1+2 mains	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Equipment designed to be operated in domestic environments and with low voltage network
EN 55022 Cls A mains	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement. Class A: other equipments than class B but respecting class A limits
EN 55022 Cls B mains	Information technology equipment Radio disturbance characteristics – Limits and methods of measurement.

	Class B: equipment used in residential environment
EN 50081 – 1 mains continuous	Electromagnetic Compatibility – Generic emission standard-Part 1: Residential, commercial and light industry
EN 50081 – 2 mains	Electromagnetic Compatibility – Generic emission standard-Part 2: Industrial Environment
IEC 61000-3-2	Electromagnetic Compatibility (EMC) – Limits for harmonics current emissions (equipment input current ≤ 16 A per phase)

Table 4.4.3.1 Summary of the standards

All readers comply to all the standards except one (Datamars Powermax) which does not comply to EN 55011, EN 55022 and EN 50081-1 and 2 standards.

4.5 Readers reliability

4.5.1 Reading failures due to reader problems

In order to study the reliability of each reader type, two separated cases were investigated: the readings failed due to readers not functioning (IDEA Guide Procedures: failure code 04), first for readings in field and secondly for readings when animal movements are taking place and at slaughterhouses. The data used for this analysis are those declared by the subprojects to the IDEA Central database.

4.5.2 Study of the readers failures during in-field control readings

The reliability of the readers have been studied by analysing the number of different readers, which failed as well as the number of readings, which failed due to readers not functioning.

Table 4.5.2.1 shows the type of reader, which failed during control readings, the total number of readings performed with these readers and the number of readings that failed with each type of readers. The readers used for control readings and which did not show any failure are not represented in table 4.5.2.1.

In order to study the number of readers that failed during control readings, a detailed analysis was made by checking each reader's serial number.

Reader Type which failed	**Total Readings per Reader Type**	**Readings Failed per Reader Type (% of Total Readings per Reader Type)**	**No. of Readers Failed per type**
R 2	178 397	20 = 0.011 %	1
R 3	533 526	2 313 = 0.433 %	5
R 4	1 499 036	2 975 = 0.198 %	12
R 7	125 378	203 = 0.161 %	9
R 11	67 089	179 = 0.266 %	2
R 12	167 223	31 = 0.018 %	1
R 14	233 380	5 = 0.002 %	4
Total	**Control Readings * 3 238 119**	**5726 = 0.18 %**	**34**

Table 4.5.2.1. Readers' failures during in field control readings

***The total number of control readings performed** includes all the control readings (i.e. also the readings performed with readers that did not failed) .

General Comment

As a general comment, the majority of the cases of "readers not functioning" (e.g. repeated non readings at the same place by the same controller at the same moment), is due to the lack of reliability of the readers. In addition, however, in several cases the reading operator did not follow properly the Guide Procedures, for instance, by not using a replacement reader and thus accumulating the "non readings" before changing the failed reader.

4.5.3 Study of readers failures at movements and at slaughterhouse activities

The reliability of the readers when animals are transferred at slaughterhouse was studied by analysing the number of different readers that failed, as well as, the number of readings, which did not function.

Table 4.5.2.2. below shows the type of IDEA certified reader, which failed during animal movement and slaughterhouse readings. The number of failed readings, compared to the total number of readings performed with each reader type is also indicated.

The readers used for animal movements and for slaughterhouse readings, which did not fail are not presented in table 4.5.2.2.

Reader Type which Failed	**Total Readings per Reader Type**	**Readings Failed per Reader Type (% of Total Readings per Reader Type)**
R 9	122 165	52 432 = 42.91 %
R 10	3 025	186 = 6.15 %
R 11	2 396	25 = 1.04 %
R 14	657	5 = 0.76 %
Total Number of Readings Performed *	**743 403**	**52 648 = 7.08 %**

Table 4.5.2.2. Readers' failures in movements and slaughterhouse readings

***The total number of control readings are those made** at animal movements and at slaughterhouse (i.e. also the readings performed with readers that did not fail).

The high percentage of readings failed with IDEA reader R9 was studied in detail. All these non-readings were obtained in slaughterhouses during the set-up phases of the reading systems. The problems of non-readings were due to cables disconnected, power failures, etc. No information were given by the slaughterhouse to the contractor in order to fix these problems as soon as they occurred. As a consequence, the animals continued to enter without being read. One can conclude that these failures are not due to a quality problem of the readers but to an implementation of the readers and to a management problem at the slaughterhouse level.

The non-readings with reader R10 (which were only observed in a slaughterhouse) can be explained for the same reason.

If one eliminates the non readings performed with R9 and R10 readers the corrected readers reliability can be presented as follows:

	Readings Failed	**Total Readings**	**% Readings Failed**
Total	30	743 403	0.004

Table 4.5.2.3. Reading failed due to readers not functioning in movements and slaughterhouse (corrected)

In order to investigate the details of readers failures observed in movements and slaughterhouse readings, table 4.5.2.4 below gives the details of the number of readers failed per reader type, as declared by the contractors in the IDEA central data base.

Reader Type	**No. of Readers Failed**	**No. of Readers Failed per Type**
R 9	18	18
R 10	1	1
R 11	1 the same as for control readings	1
R 14	1	1
Total	**21 (from which one still failed in**	**21 (from which one still failed**

	control readings)	in control readings)

Table 4.5.2.4: Readers failures during movements and slaughterhouse readings - Summary

4.5.4 Overall Results on Readers Failures

The overall results of readers' efficiency, including in field control readings (except readings after tagging), as well as, movements and slaughterhouse readings, can be presented as follows in table 4.5.2.5. This table is a combination of tables 4.5.2.1./4.5.2.2. and 4.5.2.4. and presents all the certified readers used in the IDEA project.

IDEA Reader	Readings per Reader Type	Readings Failed per Reader Type	% of Readings Failed	Total Readers Used	Readers Failed (%)
R 1	20 697	0	0	11	0
R 2	216 934	20	0.009	36	1 = 2.77
R 3	645 798	2 313	0.36	54	5 = 9.26
R 4	1 582 861	2 975	0.19	35	12 = 34.28
R 5	217 472	0	0	12	0
R 6	34 650	0	0	14	0
R 7	139 013	203	0.15	82	9 = 10.97
R 8	31 400	0	0	3	0
R 9	122 165*	52 432*	42.92*	21*	18 = 85.71*
R 10	3 025*	186*	6.15*	2*	1 = 50*
R 11	93 214	204	0.22	9	2 = 22.22
R 12	205 020	31	0.015	4	1 = 25
R 13	326 439	0	0	11	0
R 14	287 224	10	0.003	181	5 = 2.76
R 15	47 907	0	0	1	0
R 16	7 703	0	0	3	0
Total	**3 981 522**	**58 374**	**1.46 %**	**479**	**54 = 11.27 %**
Total corrected from R9 and 10	**3 850 000**	**5 942**	**0.15**	**458**	**36 = 7.9 %**

Table 4.5.2.5. Overall number of readers failed during the IDEA project without taking into account the readings after tagging.

Based on each contractor declaration, taking into account the control readings as well as the movements and the slaughterhouse readings (and eliminating readers R9 and R10 for the reasons explained in chapter 4.4.3), one can conclude that:

- more than 3 850 000 readings were performed during the IDEA project, including in-field control readings (without readings after tagging), movements and slaughterhouse readings
- 0.15 % of these readings failed due to readers not functioning
- 7.9 % of the readers used in the IDEA project failed.

4.6 Data Base, Data Recording and transmission activities

As mentioned in section 3.3.5, the activities, related to the establishment of the subproject and central data bases and the rules for the data transmission, started at the beginning of the project with the definition of a number of basic components, such as glossary, functional analysis and data dictionary.

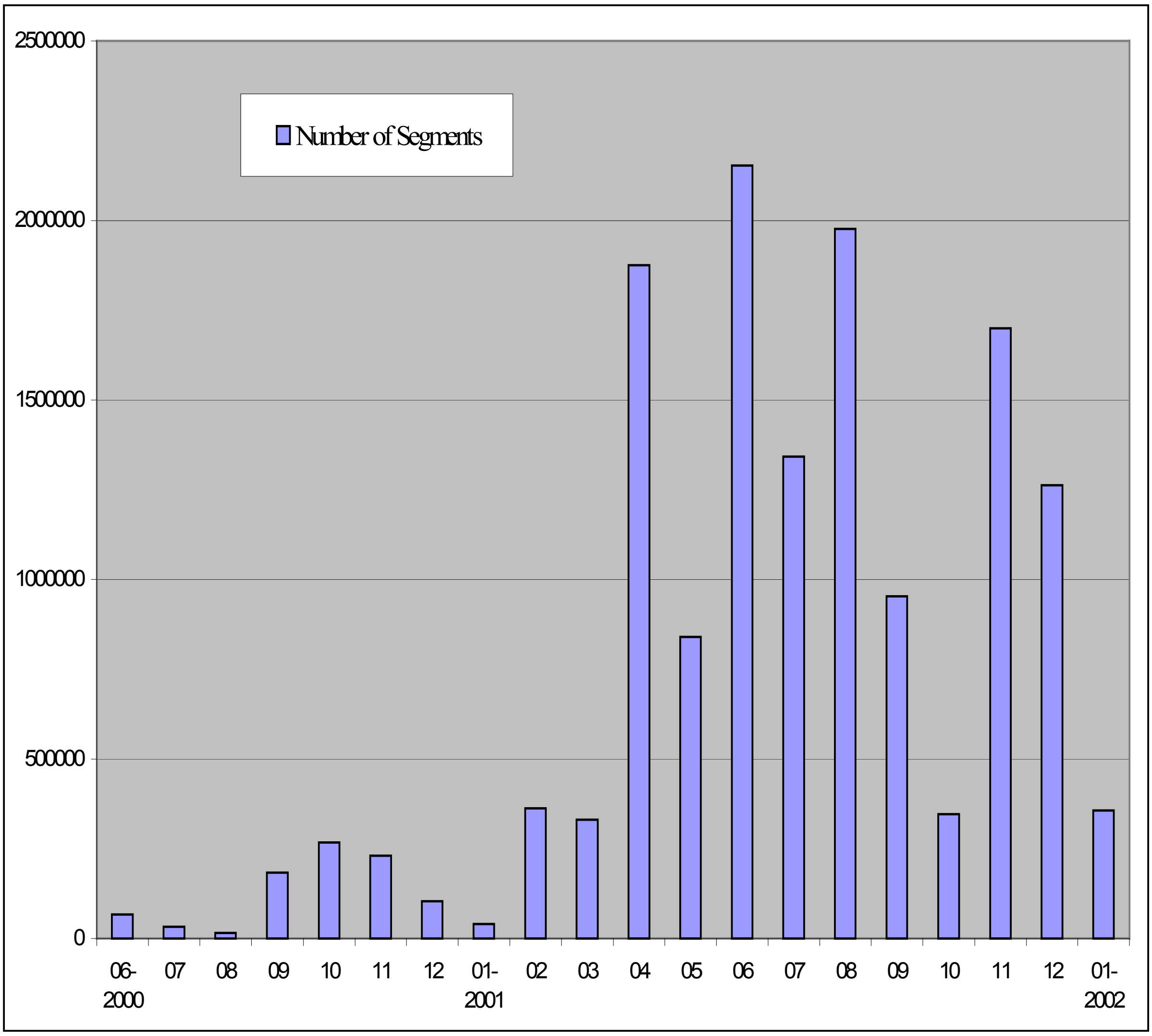

Figure 4.6.1. Data elaborated during the IDEA project

Once this phase was concluded the development of the database initiated. The development, test and operation of the database took place, in practice, while the first tagging and reading activities already took place. As a result, the transmission of the data between the subcontractors and central database started from June 2000.

4.6.1. Data Transmission

The transmission of the data between the subprojects data bases and the Central data base increased gradually, reaching a maximum of intensity during the second trimester of 2001. Figure 4.5.1 shows the evolution of the number of data transferred per month to the IDEA Central Data Base.

Due to a number of problems related to technological choices or organisational matters, which were not well adapted to the execution of the IDEA project, some subprojects had great difficulties to transfer data. In practice, one can state that the IDEA procedure to communicate data, requested by the Guide procedures (e.g. animal tranfers, control readings) 15 days after the activity was not respected by the subprojects.

During the IDEA project a total of 2929 EDIFACT envelopes, 4439 messages and 1452 E-Mails were exchanged between subcontractors and the JRC responsible of the Data Base.

The information exchange (message frequency and quantity of items per message) has been very different for the different subcontractors as is illustrated in figure 4.6.2. This figure reflects also the difference in approach for the data management.

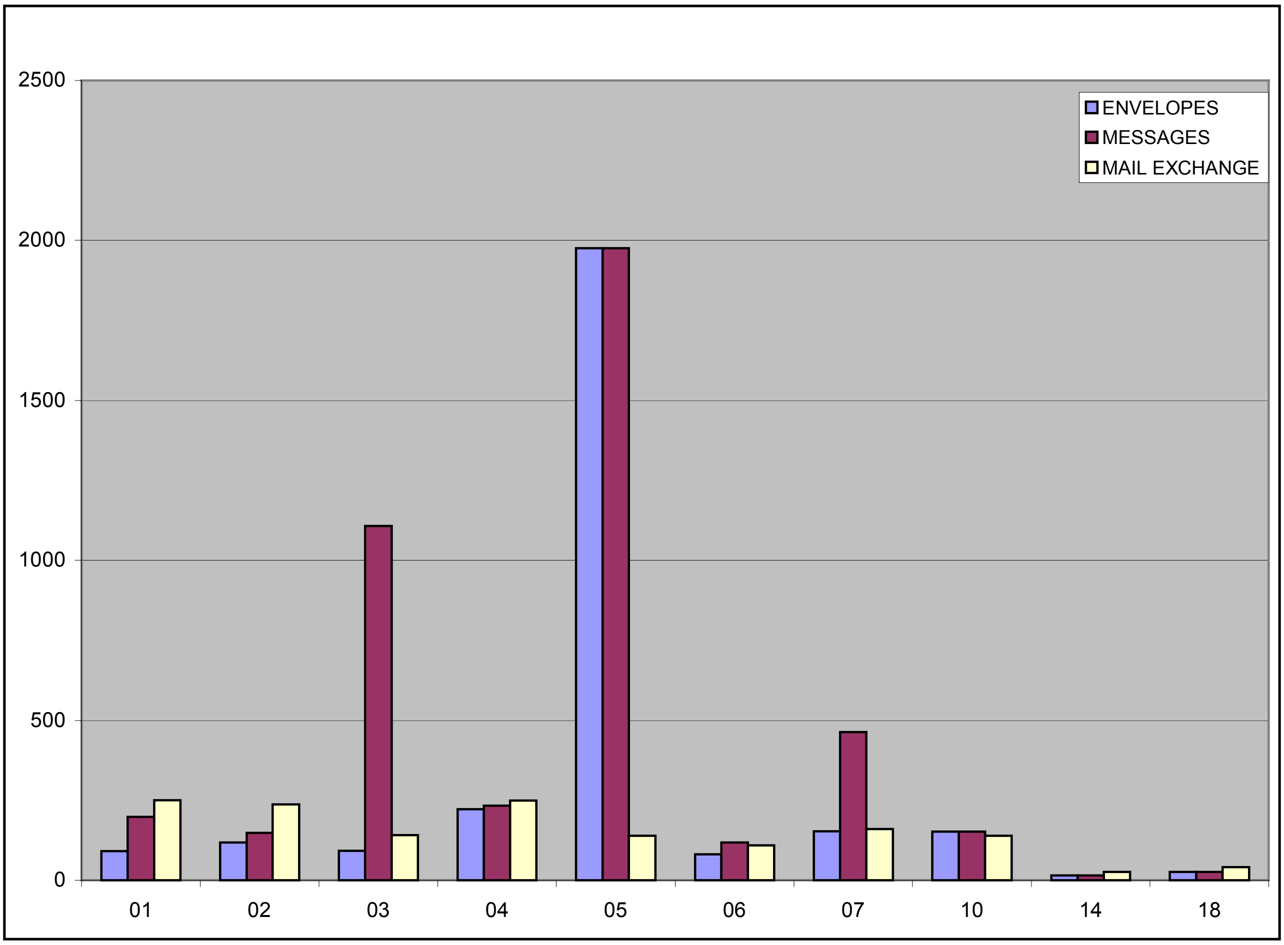

Figure 4.6.2. Project activities, messages, envelopes, and mail exchange

In the case of subcontractor 05, the transmission of data has been regular and the content (quantity of data) of the EDIFACT messages was rather homogeneous. This has resulted, in general, in the transfer of good quality data and the validation process at the JRC was greatly simplified.

For the subcontractor 03, the transmission of data has been concentrated in rather few transfers. In fact, the tagging and reading activities were performed during a limited time period, because of the type of breeding conditions in the mountain region.

For the subcontractor 07, important difficulties were encountered during the initial phase of the development of the data base, while the field activities were very intensive and well organised. Finally, when the difficulties for the development and test of the informatic system were overcome, the subcontractor transmitted a large number of data in a reduced number of transfers.

4.6.2 Data Recording

-

For the data recording difficulties were encountered, which were often due to a wrong application of the Guide Procedures (e.g. readings performed outside of requested periods, readings not performed and or not declared to the data base, same readings declared several times) or for reasons of a more organisational character.

These points have created an important and unexpected effort for the validation of the data before acceptance in the IDEA Central Data Base.

The most important problems identified in order of priority are:

- Low level of reliability in the management and declarations of the movements of animals from one place to another (e.g. animals supposed to be shipped to one place but in practice shipped to another place or animals declared as shipped but in practice never moved);
- Records in farm register not updated, which created difficulties in the establishment of the "previous list", necessary to perform the periodic identifier reading activities;
- Control readings not performed because of the risk of contamination after the outbreak of the foot and Mouth disease.

Other problems identified are related directly to the utilisation of devices (electronic identifiers, automatic readers). In fact, many instruments were not synchronised (correct setting of date and time). This factor is important to establish the exact animal history in respect to movements between holdings, transfers to slaughterhouses. In many declarations animals arrived in one place before they departed from the previous place, or animals where slaughtered before they entered the slaughterhouse.

The combination of these problems generated significant quantities of data rejected due to errors, or placed in stand-by, particularly when control reading data were involved. 10% from all the control readings sent to the IDEA Central Data Base included errors.

More specifically the errors were of the following types:

- repetition of recorded data
- control reading declared prior to tagging data
- control readings, of slaughtered animals, after the date of slaughter
- reading of animals in a production unit where the production unit didn't exist
- sequences of readings with incorrect type and date (e.g. reading type 04 at one month with date for seven months)
- reading with wrong date/time format
- reading declaring time "hh,mm,ss" but with code failed (i.e. reading time of a non-present animal)

The figure 4.6.3 shows the distribution of type of errors in control readings data.

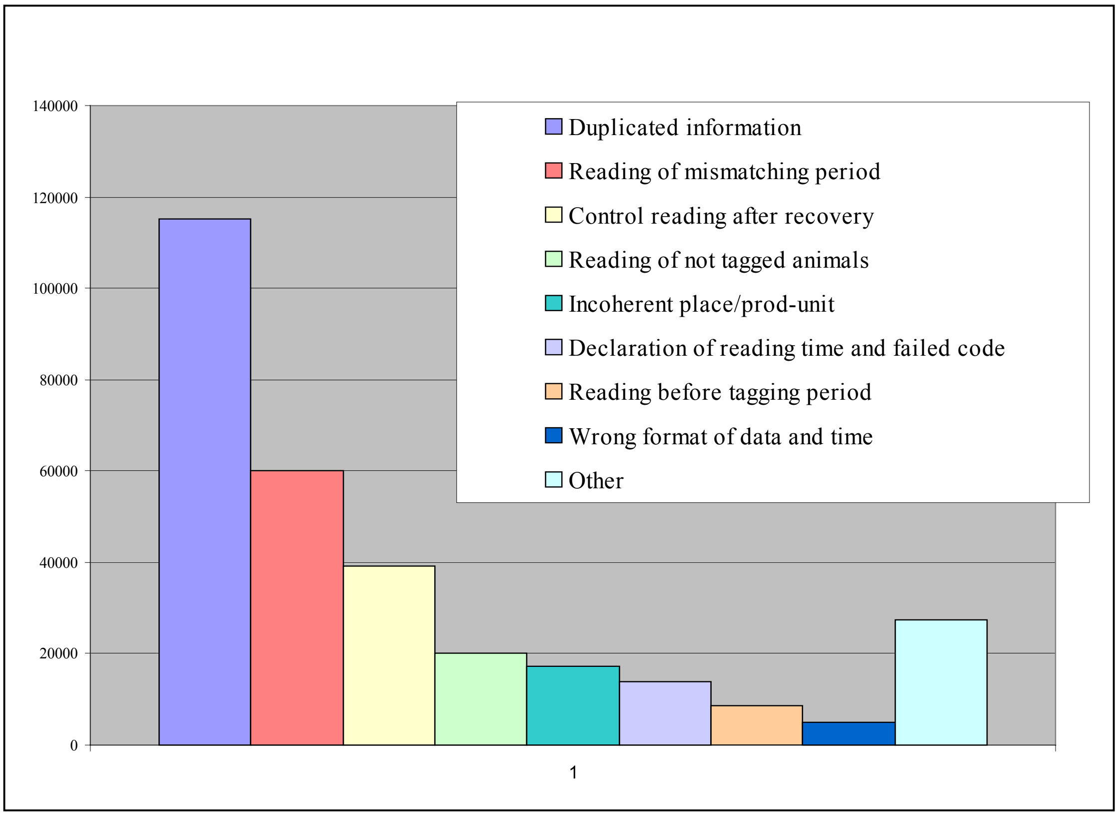

Figure 4.6.3. Type of errors for control reading data

More than 14.500.000 data elements have been recorded into the IDEA Central database. These data are subdivided in a number of categories, summarised in table 4.6.1..

Administrative Data	Contractors	10
	Organisations	66
	Manufacturers and Suppliers	42
	Holdings	5.023
	Slaughterhouses	124

	Markets	23
	Pastures	1
	Transport Companies	59
	Persons	5.597
Materials Data	Tempest certifications	89
	Electronic tags	970.829
	Readers	2.121
	Antennas	1.101
Animal data	Animal tagging	881.224
	Animal re-tagging	2.348
	Animal tagging sessions	18.451
	Animal readings sessions	130.378
	Control readings (02,03,04,05)	3.007.844
	Other type of readings (08,09,13)	750.090
Animal Movements	Animal movements(06,07)	539.090
	Recoveries transponders (10,11)	229.883

Table 4.6.1. Categories of information loaded in the IDEA Central Data Base

Finally, two service type activities were performed by the JRC and requested an important effort:

- The e-mail service, with a specific server dedicated only to the exchange of data for the IDEA project. This service was needed, because, except two subprojects (France and Ministero delle Sanita), all the other subprojects did not have available an e-mail service operating with the X400 protocol.
- The Broker service (installed on the server IDEA OUT) was made available to the subprojects in order to visualise their respective data, introduced in the Central database. This allowed performing on line directly on the JRC server statistical evaluations. A special course was organised for the use of this service and a manual was prepared. These services were very much used by the subprojects during the execution of the IDEA project

As a conclusion, the following general remarks need to be made, in relation to the data transmission, registration and management experience:

a) In order to overcome the lack of homogeneity in the informatic systems for the management of data, it was decided from the start of the IDEA project to create a glossary of terms used and a data dictionary, inherent to livestock management. This did, in practice, result for most of the subprojects in an improved homogenisation and harmonisation of the subproject and IDEA central database.
b) The use of the protocol X400/435 plus EDIFACT used for transmitting data from the subproject to the central data base allowed the transmission of more than 4500 messages in a complete and secure way and not one message got lost.
c) There has been a great number of wrong declarations related to control readings (due to a wrong application of the guide procedures), which had as

consequence that it was not easy to define the reading efficiency according to control periods.

d) There has been also a number of wrong declarations related to animal transport, which had as consequence that it was not easy to determine where animals were located.

e) At the registration of readings, in many cases, the date and the time, which is automatically registered by the reading system, was not checked. The information on tagging and reading were not correct due to wrong settings of the instruments. This results in a lack of coherence in the animal's data declaration and affected the overall traceability of the animal.

f) An important issue has been the management of the previous list. Technical problems and the difficulty of updating easily and timely the farm register has provided incomplete information of animal stock present in a production unit at the moment of preparing the control check (previous) list.

4.7 Technical Support and Meetings

As described in 3.3.6. JRC staff performed periodical visits to the IDEA subprojects to review the development of each subproject. On average, four visits to each subproject were performed since October 1998. In addition to these visits, some IDEA subcontractors requested the technical assistance of the JRC in order to solve problems mainly related to the application of the infield procedures or with the data recording and transmission.

The requested technical assistance on the infield procedures can be summarized in two categories:

- training on the livestock electronic identification system methodology: e.g. general support to training courses, training on the injection techniques, reading methodologies.
- difficulties appeared on the practical application of the Guide Procedures in real farm conditions: e.g. difficulties on the re-tagging of dangerous animals, individual check of the not-read animals after a dynamic reading, the lack or reliability of the data recorded at farm.

The type of informatic technical support requested by the subprojects has been different depending on the progress made and the status of the IDEA subproject and may be summarized as follows:

- In the initial phase of the IDEA Project, the technical assistance was focused on the definition of the structure of the Data Base or on the validation of an existing Data Base which was adapted to the IDEA definitions and requirements.

- During the project several interventions were requested to solve specific situations which needed specific analysis of the problems.
- In the latter part of the project the support was intensified and mainly focused on the data transmission, on solving the data inconsistency and on the generation of the EDIFACT messages to send the data to the IDEA Central Data Base.

The technical support made on the subprojects' Information System put in evidence that, in general, the importance of the Data Base development and the set up of the necessary data process and treatment tools was underestimated. In several cases the lack of manpower to perform these tasks was identified.