
Electronic Tracing of Livestock

Co-ordinator's Report

Industry led EID research Phases 3 & 4
2012 - 2014

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Executive Summary

- E1. On behalf of a joint Scottish Government/Industry Working Group, the Scottish Agricultural Organisation Society (SAOS) co-ordinates research into the feasibility of electronic identification (EID) of livestock within Scotland. The research is motivated primarily by existing and proposed European Union (EU) regulations relating to sheep and cattle EID respectively.
- E2. The research is organised through ScotEID which acts (via a staffed Information Centre plus a website) as a point of contact for users of a central database containing livestock records. The database has various user interfaces and links to other databases. Importantly, control of the data is held in common by those providing the data and by bodies requiring access to the data.
- E3. The research commenced in 2008 and Phase 4 has now been completed. Earlier Phases were dominated by overcoming significant technical challenges (there was no off-the-shelf solution for the range of Scottish conditions), but Phase 3 saw delivery of working EID for sheep. Phase 4 continued to refine aspects of the sheep system, but also extended the research to movement reporting for pigs and to cattle in terms of a component for recording test results for Bovine Viral Diarrhoea (BVD) and field-testing of dual UHF-LF technology for cattle EID (if the EU permits - or at least does not preclude - it, dual technology offers greater flexibility to users than only LF or only UHF).
- E4. From the outset, proactive engagement with stakeholders was used to conceptualise, design, launch and test elements of the system. In particular, unlike some other EID research projects, partner farms, marts and abattoirs have been involved throughout in order to test and develop hardware, software and procedures under a variety of challenging conditions.
- E5. Completion of four Phases of EID research has delivered sheep and pig movement reporting systems (14.7m and 3.7m moves respectively) plus a system for recording BVD status (37k tests) – all of which are in place and functioning to support a number of statutory requirements and policy objectives. In addition, the experience gained across five years of R&D has greatly increased understanding of how modern database systems and web services can be used to improve traceability.
- E6. The involvement of partner farms, marts and abattoirs in the testing and development of hardware, software and management procedures under commercial rather than experimental conditions has also provided valuable lessons on the relative importance of data accuracy and data interfaces. Specifically, rather than attempting to force uniform solutions onto heterogeneous users, the focus should be on getting accurate information into the database as efficiently as possible using whatever methods best suit particular users' needs. Appreciation of the gains from technical and procedural flexibility underpinned the move to CCPs, the retention of different reporting methods for pigs and the development of dual LF-UHF technology for cattle EID.
- E7. The ScotEID system is already a notable achievement with few (if any) international parallels. However, the feasibility of using it for a variety of potential purposes has yet to be explored fully. For example, there may be disease-control benefits of using a multi-species database whilst sharing information along supply-chains may offer quality assurance and production efficiency gains.
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- E8. Exploring and realising such potential required technical work (e.g. on linking databases) but also, crucially, attention to protocols for the sharing, control, processing and protection of data. Achieving this required good governance arrangements, with the principle of “data controllers in common” being essential to maintaining Industry trust.
- E9. In particular, dialogue with all stakeholders was needed to agree legitimate uses of data (e.g. statutory reporting, regulatory inspection and enforcement, food chain quality assurance, academic analysis). The same data can have different uses and overall benefits will be maximised by treating data as shared infrastructure.
- E10. Total expenditure on ScotEID through SAOS, including industry support for tags and readers to test the feasibility of high volume sheep tag data from around the country, amounts to c.£5m over the period April 2008 to November 2014. A further c.£0.5m of Scottish Government research funding for EID has been used for specific activities undertaken outwith ScotEID.



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Electronic Tracing of Livestock: Co-ordinator's Progress Report

Introduction

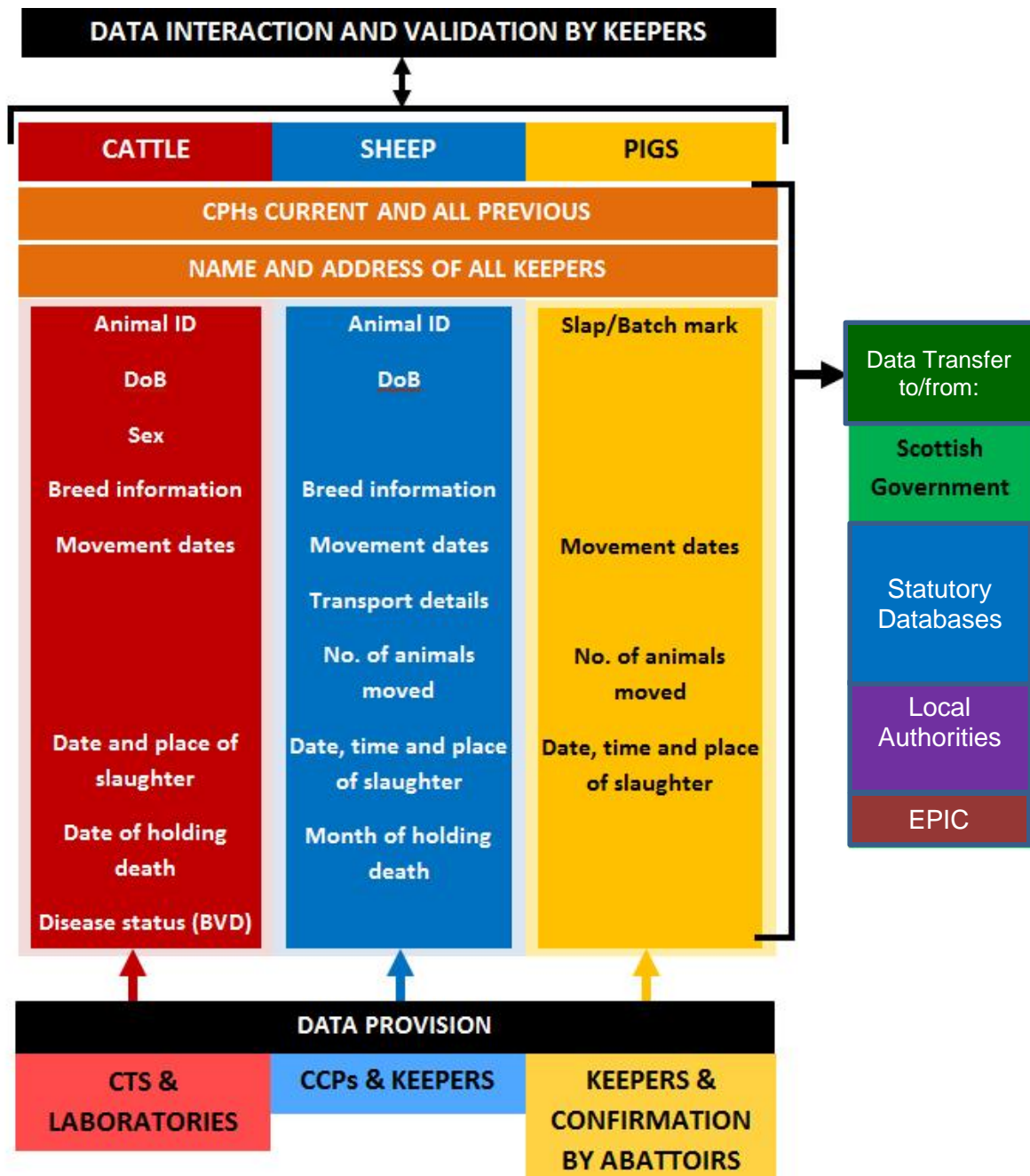
1. The Scottish Agricultural Organisation Society (SAOS) acts on behalf of the joint Scottish Government/ Industry Working Group as project co-ordinator for research into the feasibility of electronic identification (EID) and Electronic Data Transfer (EDT) for livestock (sheep, goats, cattle and pigs). The overall aim is to utilise applied research and development of modern database systems to meet the need for more accurate and faster tracing of animals through their various supply chains, in a manner that meets regulatory requirements and is understood and accepted by industry.
2. Motivation for the research stems largely from the implementation of existing European Union (EU) requirements for EID in sheep (and goats) plus EU discussions on voluntary EID for cattle. Promotion of EID is also consistent with the strategic goals set out in Scotland's Digital Future.¹
3. Drawing on various sources of expertise, the research is organised through ScotEID which acts as point of contact (via an Information Centre Help Desk at Huntly plus a website) for industry participants plus as holder of electronic register and movement data held in the ScotEID database. Importantly, unlike most other movement databases, control of the data is retained "in common" by those providing the data, with users (principally Keepers of livestock) agreeing to Terms & Conditions that grant access to approved bodies for research and regulatory purposes.
4. The ScotEID system is written using open source software within industry-leading database and software frameworks, and is capable of accommodating multiple species and differences between, for example, different types of computer running various vintages of different operating systems and web browsers.
5. Beyond recording movements, the system is also capable of managing data transfers to and from a variety of other databases via web services. This supports Scottish Government (SG) legislative requirements but also allows other organisations to explore the benefits of using such data across the food chain (see Figure 1 for a summary data flow diagram).
6. For example, discussions are underway with bodies such as Quality Meat Scotland (QMS) and the Food Standards Agency (FSA). On a GB basis, discussions are ongoing with, for cattle, the British Cattle Movement Service (BCMS) and, for cross-border sheep moves, with the Welsh Assembly Government and the Department for Environment and Rural Affairs' (Defra) delivery partners South Western and the Animal Health & Veterinary Laboratories Agency. Inter-database linkages have highlighted the importance of maintaining data accuracy through continual checking and refinement of data.
7. In-line with best practice guidance on government IT projects,² ScotEID has adopted an approach of proactive engagement with stakeholders to conceptualise, design, test and launch elements of the system. A core team of staff has provided continuity of involvement throughout, but has been supplemented by additional specialist skills as

¹ <http://www.scotland.gov.uk/Publications/2013/02/4411>

² For example, the UK government's "Digital by Default" service standards <https://www.gov.uk/service-manual/digital-by-default>.

required during particular development and implementation stages (see Figure 2 for organisational diagram). Being based on open source software and an object-oriented approach with in-line comments, the structure and performance of the system is relatively transparent.

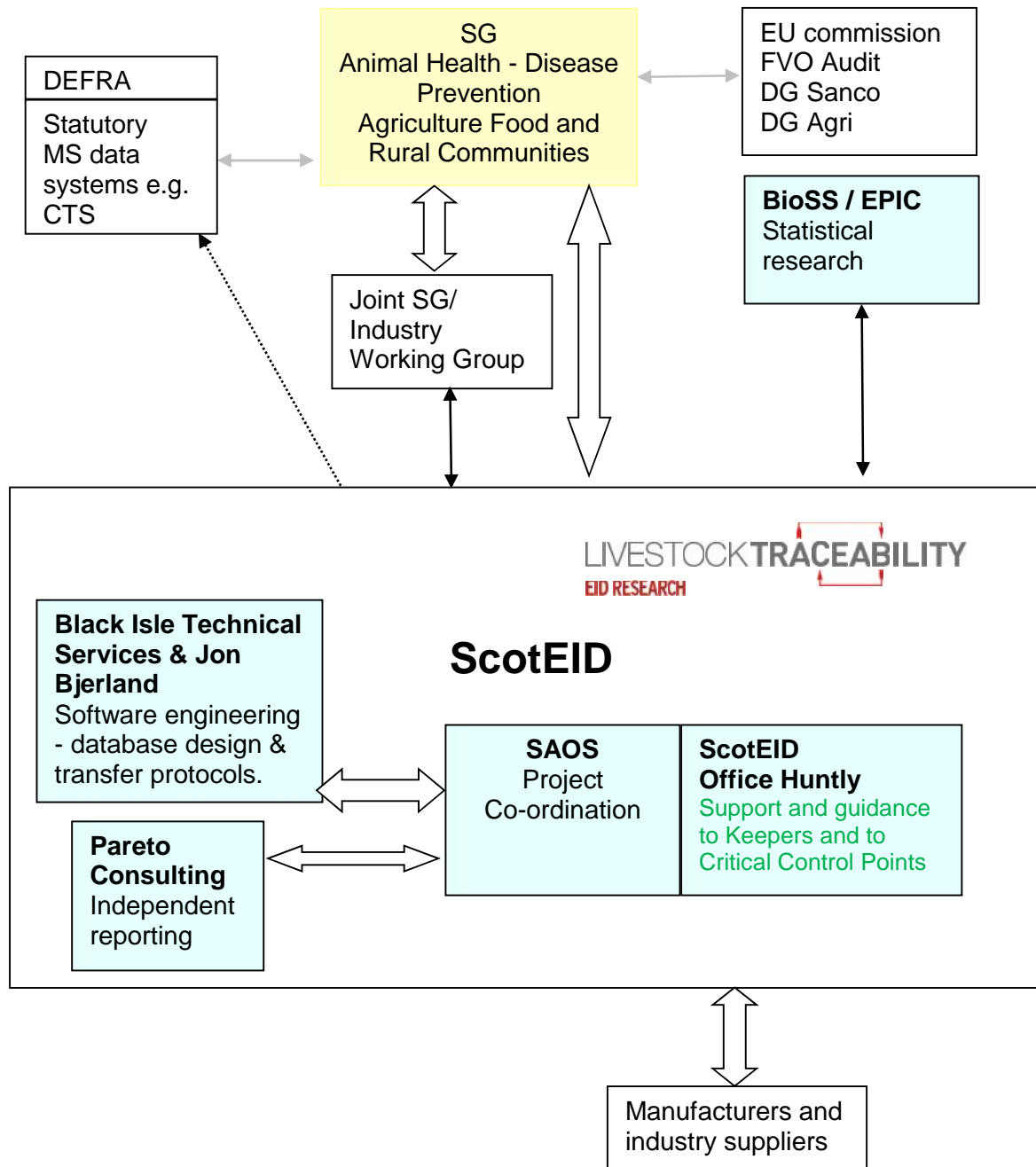
Figure 1: ScotEID summary data content and flow diagram



Keepers and Critical Control Points (CCPs) can notify movements electronically to ScotEID. The Huntly Office monitors all reporting via CCPs. External statutory databases may include: eAML2, BCMS, ETAS, AHVLA & RADAR via LMED, FSA. EPIC (Epidemiology, Population health and Infectious disease Control) is the Scottish Government’s academic Centre of Expertise on Animal Disease Outbreaks.

Figure 2: Organisation diagram

The diagram below summarises the structure of the project team and its relationships to other partners and stakeholders. The team draws together a wealth of expertise and experience of the livestock industry, EID, data systems, economic analysis and statistical interrogation.



9. Working with industry, through both the joint SG/Industry Working Group but also through involving large numbers of livestock under commercial rather than experimental conditions, has facilitated significant practical involvement of industry stakeholders and “learning by doing” in the design, testing, monitoring and adjusting of equipment and practices under working conditions at farms, marts and abattoirs. For example, with respect to the choice of tags/transponders and electronic readers, and the configuration of readers and software to communicate with the ScotEID database system whilst minimising disruption to existing on-site management regimes.
10. This report provides an update on progress achieved under Phase 3 (2011 – 2012) and under Phase 4 (2013 – 2014) of ScotEID, particularly with respect to completion of sheep movement recording, extension of movement recording to pigs, introduction of BVD monitoring, field-testing of cattle EID equipment and consideration of the feasibility of encompassing multiple species in the same database for traceability purposes.
11. However, in summary, completion of four Phases of EID research has delivered sheep and pig movement reporting systems plus a system for recording BVD status – all of which are in place and functioning to support a number of statutory requirements and policy objectives. In addition, the experience gained across five years of R&D has greatly increased understanding of how modern database systems and web services can be used to improve traceability.
12. The involvement of partner farms, marts and abattoirs in the testing and development of hardware, software and management procedures under commercial rather than experimental conditions has also provided valuable lessons on the relative importance of data accuracy and data interfaces. Specifically, rather than attempting to force uniform solutions onto heterogeneous users, the focus should be on getting accurate information into the database as efficiently as possible using whatever methods best suit particular users’ needs.

Prior Phases

13. Phase 1 (2008 to 2009) focused primarily on the practicalities of identifying and configuring appropriate Low Frequency (LF) hardware for sheep (i.e. tags and readers) and software to permit reliable movement recording and reporting to the ScotEID database system. Over 200 partner farms were involved in this Phase, together with six marts and three abattoirs. Considerable on-site technical efforts led to the successful development of solutions to suit a range of circumstances (e.g. local conditions, existing software). At the same time, the ScotEID database structure capable of meeting existing and anticipated regulatory requirements was designed and created. Almost 40k sheep movements were recorded, demonstrating proof-of-concept for the approach taken.
14. Phase 2 (2009 to 2011) extended sheep enrolment to over 3500 farms, 30 marts and 20 abattoirs, plus two ferry terminals and two collection centres. Experience gained during Phase 1 was applied to guide wide-spread adoption at the farm-level, plus on-site support was offered to new mart and abattoir partners. Extending farm enrolment greatly increased the number of EID sheep, leading to a significant increase in the volume of movements reported electronically to the ScotEID database system: over 2m movements were recorded, confirming the feasibility of transferring large data volumes in close to real-time.

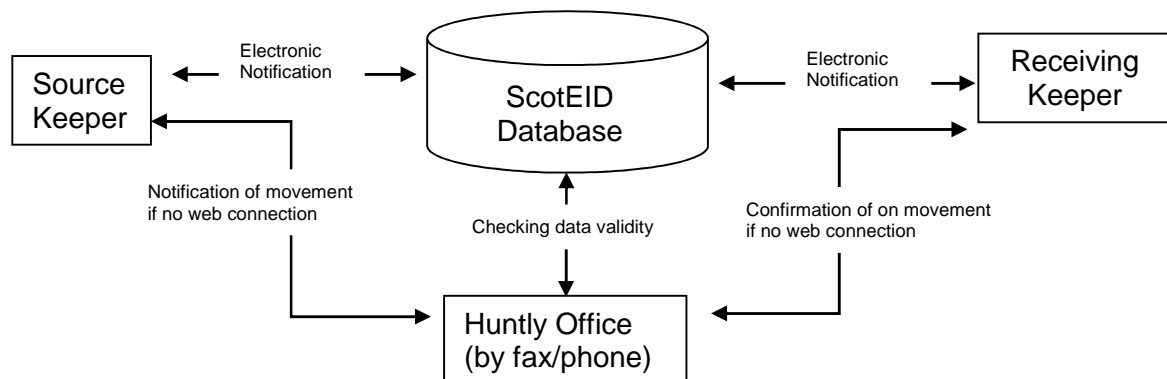
15. Phase 3 (2011 – 2013) effectively extended coverage to the entire sheep sector, with over 14.7m movements within 1.1m batches now held on the ScotEID database system. Further refinements were made to technical and procedural aspects of recording and reporting sheep movements, but scope of the research was also widened to include other species. Specifically, pig movements (3.7m within 41k batches) were added to the system as was a preliminary disease component for combining data from various sources (e.g. lab test, CTS) to support control of Bovine Viral Diarrhoea (BVD) in the Scottish cattle herd. In addition, looking ahead to bovine EID, exploratory testing of Ultra High Frequency (UHF) technology and dual LF/UHF for cattle EID was undertaken to establish the technical feasibility and practical capability of different configurations.
16. ScotEID has now completed Phase 4 (2012-2014) and the remainder of this report is structured around the stated objectives and activities for this Phase, grouped by sector. Phase 3 achievements are summarised alongside Phase 4 work to illustrate continuity of activities. The report ends with an overview of governance and funding.

Phase 3 & 4 sheep

17. Earlier research Phases were dominated by establishing a working system for electronic reporting of sheep movements. Significant effort was required to identify and configure appropriate hardware under different circumstances and to design flexible software interfaces.
18. Phase 3 concluded with the delivery of a working sheep tracing system and the formal transfer of its Intellectual Property Rights to the Scottish Government. This was accompanied by an undertaking from SAOS to have responsibility for and maintain operations of the sheep system through to December 2014. Future arrangements will be devised during Phase 5.
19. However, in addition, two specific extensions to the existing system were proposed for Phase 4 in relation to the Movement Document Derogation Article 6(4) and the Register derogation Article 5(4):
 - a) To allow all sheep and goat movements to be reported either electronically or by paper to ScotEID, with continuing attention to practical and cost issues encountered across a stratified national flock and extensive production systems in remote areas.
 - b) To enable livestock keepers to view and amend their movement and flock register data via ScotEID, with a view to reducing paper-based administrative burdens and cross-compliance liabilities.
20. Both objectives reflect a desire to accelerate the necessary process of transition from previous paper-based reporting arrangements. Specifically, although ScotEID automatically received electronic notifications of movements during Phase 3 from CCP's, farm-to-farm moves notifications were still typically paper-based, reported to the Scottish Animal Movement Unit (SAMU) within Scottish Government, meaning that there were in effect two separate movement databases.
21. Phase 4 development means that paper-based notifications sent to SAMU in Dumfries are now entered by SAMU staff directly into the database via a web interface developed by ScotEID. Hence there is now a single repository for all movement data, enhancing coverage for traceability and allowing farmers to see all of their reported movements online.

22. Possibilities for completely avoiding the need for a paper movement document have been discussed with the Working Group in relation to the derogation available under Article 6(4) linked to Annex C1(e) of 21/2004. Discussions are ongoing to agree the best method of integrating transport information within the movement notification to the database, the necessary last step to make the derogation available to keepers.
23. Pig keepers submitting a paper-based notification are contacted and advised of alternative (non paper-based) reporting methods. These include automatic electronic reporting from readers, manual reporting via a web interface on a PC, or manually 'phoning through the details. Looking ahead, this model of several entry routes may be actively promoted for sheep and cattle – the key point being that getting accurate information into the database is the primary objective, and the best method for achieving this inevitably varies across different users.
24. Striving for universal digital uptake is tempered by acknowledgment that (as alluded to in the second part of the objective) some individuals may be unable to report electronically due to constraints such as a lack of internet access and/or lack of confidence in using technology. Hence, the approach taken by ScotEID is one of raising awareness of electronic reporting and its advantages, offering advice and training on how best to use it, but accepting that it may not be appropriate in all circumstances (see Figure 3).
25. This also applies to objective b), where procedures for viewing and (if errors are identified) amending notified movement data and maintaining flock registers online are now in place, but the Huntly Information Centre provides back-up support and alternative ways of checking and updating data (e.g. by 'phone or fax). The online flock register has the potential for also providing a convenient annual inventory.
26. Again, the approach taken is one of offering advice and training to promote the advantages of online access in terms of strengthening personal validation of data accuracy and avoiding unnecessary duplication and paper records. For example, over 12 months to October 2014, the Help Desk handled 570 sheep enquiries, 1029 cattle (BVD) enquiries and 1755 pig (movement) calls.
27. Goats are mentioned within objective a) since they fall within the same EU reporting requirements as sheep, but were not addressed explicitly during previous Phases as they are relatively few in number (e.g. only 536 movements have been made in the past 12 months) and a derogation means that the use of EID is not compulsory. Goat movement paper-based notifications sent to SAMU in Dumfries are now also entered by SAMU staff directly into ScotEID via the web interface.

Figure 3: Process diagram for notifying pig moves directly or via the Information Centre



28. Advance notification of a movement is given by the source keeper and subsequently confirmed by the receiving keeper, either electronically to the database or via the Huntly office using fax or 'phone.
29. In addition to the specific objectives relating to extensions of the database system, system performance is also monitored. In particular, the Huntly office checks CCPs' notifications on a daily basis (see Figure 4) and contacts any CCP where there is a data anomaly requiring attention.

Figure 4: CCP monitoring screen snapshot

CCP monitoring		View Incomplete Lots													
Start Date: 15/06/2013															
Abattoirs		S	S	M	T	W	T	F	S	S	M	T	W	T	F
scotbeefairage - 89/715/8500	0	0	0	398	484	341	0	0	0	0	868	87	0	0	
Portlethen - 80/471/8000	0	0	504	494	526	494	557	0	0	502	418	539	541	497	
orkney_reader - 87/620/8002	0	0	0	9	0	0	0	0	0	0	13	0	0	0	
Turriff - 66/083/8000	0	0	313	565	484	474	860	0	0	636	658	1061	0	0	
Rhinds - 85/593/8000	0	0	146	356	0	0	0	0	0	161	0	0	0	0	
Vivers - 75/297/8000	0	0	27	0	0	68	0	0	0	82	0	0	194	0	
St Andrews - 78/431/8002	0	0	10	0	6	34	23	0	0	10	0	17	15	0	
Laxfirth - 94/875/8011	0	0	70	0	0	0	0	0	0	62	0	0	0	0	
Scotch_Prem - 66/062/8004	0	0	0	0	99	0	0	0	0	0	160	130	0	0	
millers_speyside - 85/586/8500	0	0	0	0	99	0	0	0	0	0	0	81	0	0	
Munro_Dingwall - 91/740/8500	0	0	0	55	14	42	0	0	0	0	63	56	31	0	
chapman_shotts - 83/548/8500	0	0	0	54	33	12	0	0	0	6	43	55	0	0	
DS_Dunblane - 89/715/8501	0	0	0	12	22	0	51	0	0	0	20	36	0	0	
Wishaw_Abattoir - 83/546/8500	0	0	0	0	0	0	106	0	0	0	0	86	18	0	
paisley - 90/725/8004	0	0	86	0	0	0	0	0	0	0	0	0	0	0	
lockerbie_abattoir - 75/319/8005	0	0	33	4	2	0	0	0	0	0	64	0	0	0	
mull_abattoir - 68/166/8000	0	0	10	44	7	0	0	0	0	0	0	0	0	0	

30. In addition, attention has been directed at improving understanding of why low read rates are occasionally observed. This involves physical examination of batches with low read rates to check for possible causes such as lost tags, malfunctioning tags and/or user errors, and entails site-visits during sales to witness batches of sheep being sold and local procedures. For example, during the 2013 sales season, sales batches at various markets throughout Scotland were checked and revealed that missing and/or incorrect tag usage was the most common reason for lower-than-average read rates in a given batch.
31. Separately, the database can be used to identify departure keepers with regular instances of low read rates, with the aim of alerting them to official recognition of a problem and offering independent advice on best practice for tagging.

Phase 3 & 4 cattle

32. Notably, Phase 3 developed a preliminary cattle component of ScotEID to support ambitious disease control targets in relation to Bovine Viral Diarrhoea (BVD). Continuation of this work plus further attention to cattle is reflected in three Phase 4 objectives:
- To enable the ScotEID database system to play a key role in the eradication of BVD.
 - To allow Scotland to consider the feasibility of an electronic cattle movement system taking into account the outcomes of EU proposals for bovine EID.
 - To carry out field trials to research EID technologies for cattle on farms, at marts and in abattoirs.

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33. Subsequently, ScotEID was also asked if assistance could be offered to SG with establishing the basis for running the new Beef Efficiency Scheme (BES) element of Pillar I support under the Common Agricultural Policy (CAP).
 34. Cattle within the EU are already identified individually through the use of numbered ear tags (a primary plus a secondary) and paper passports. These are used to record various pieces of animal-specific information and to report movements. Movements of Scottish cattle are notified to BCMS which is part of the Rural Payments Agency (RPA), an Executive Agency of Defra. The vast majority of movement notifications (over 96%) are made electronically via the online version of the Cattle Tracing System (CTS) run by BCMS.
 35. However, the European Parliament recently adopted an EU Regulation (653/2014) for the introduction of EID for cattle.³ Although the secondary legislation on the technical details has yet to be drafted and circulated, the Regulation confirms the intention to allow voluntary adoption of cattle EID as a means of reducing some of the cumbersome burdens and errors associated with the current paper-based passport identification system.
 36. The new Regulation allows for the abolition of cattle passports for the national herds (they may still be required for intra-community trade and will be required for Third Country trade). Under EID, abattoirs and livestock markets are likely to gain from faster accurate authentication of ID's and movement history. EID also offers potential opportunities for improved on-farm management of cattle by making it easier to monitor and record the performance and status of individual animals as well as reporting their movements.

BVD (Bovine Viral Diarrhoea)

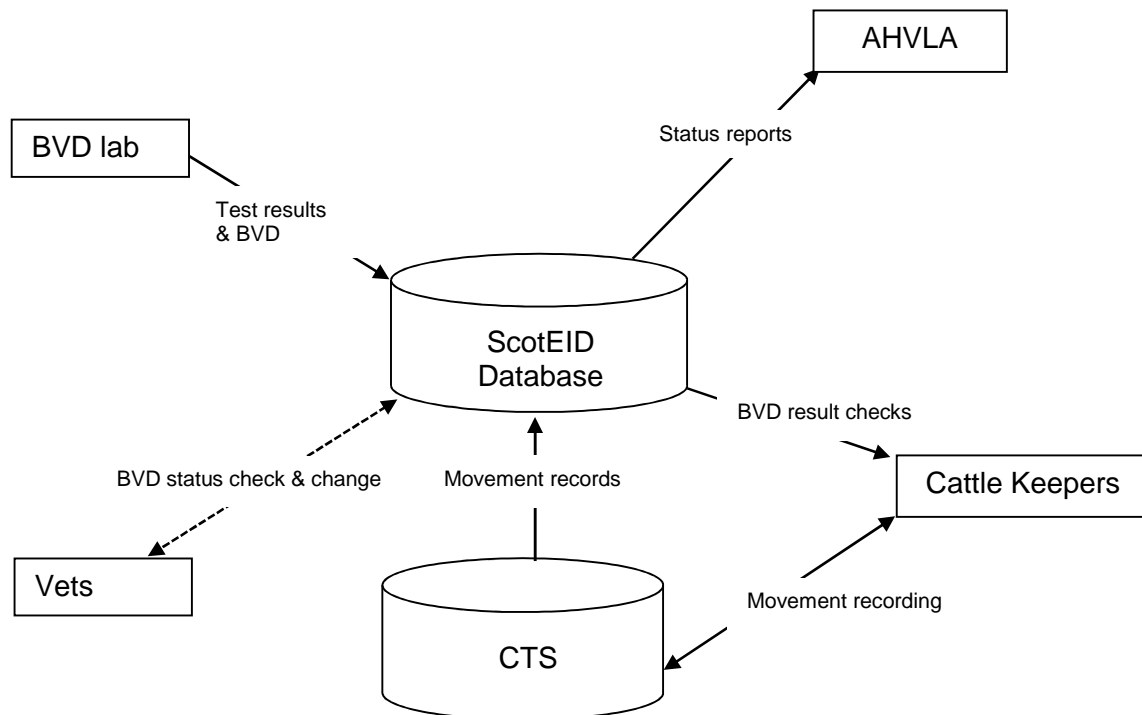
37. Objective c) was motivated by the advent (during late 2011) of the ambitious industry-led Scottish BVD eradication programme and its requirement for a comprehensive and up-to-date database to link BVD test results to animals' IDs and locations. Although this could perhaps have been developed as a standalone system or through (e.g.) AHVLA, adding a BVD component to ScotEID was considered to be cost-effective.
38. A preliminary BVD component of the ScotEID database system was duly designed in outline during Phase 3. The BVD system and management procedures were completed and launched as part of Phase 4, displacing planned volume UHF testing and an industry roll out of the derogations noted at paragraph 19, (see Figure 5 for process diagram) with AHVLA being informed of non-compliance and any breaches in movement restrictions. This entailed considerable development effort.
39. For example, the navigational layout of the existing system had to be restructured to accommodate cattle alongside sheep and pigs in such a way that all of a given farmer's data could be accessed through the same web page under a common login procedure. The design was updated at the start of 2014 when the testing regime altered.
40. The system also has to allow changes to herd holding status by keepers' vets. In the absence of an existing comprehensive digital list of vets, granting qualified vets the ability to change the BVD status of any holding involves Huntly staff in a paper-based authorisation process.

³ See

http://www.parlament.gv.at/PAKT/EU/XXV/EU/02/04/EU_20424/imfname_10456161.pdf

41. More problematically, in the first-instance, BVD results from test laboratories were received in spreadsheet form that required manual loading and significant checking of data accuracy in terms of format and legitimate IDs. In particular, additional effort was expended on proactively encouraging labs to send better quality data, including through designing user interfaces to help them enter data more reliably and on data-checking algorithms to verify data upon receipt.

Figure 5: BVD process flow diagram & screen snapshot



42. Similarly, matching lab records to animal locations requires a link to CTS, ideally in real-time to facilitate imposition of movement restrictions and allocation of cohort status. However at present only static snapshots are provided to ScotEID. This means that movement data are not contemporaneous with test results and data matching algorithms have to allow for some variation in dates in order to notify movement restrictions on not-negative and positive animals. Moreover, importing CTS data revealed the need for checking, correcting and then regularising future import specifications. Discussions have been held with BCMS and daily CTS updates have now been integrated into the database.
43. Initial scoping work during Phase 3 was substantially refined and extended during Phase 4, but some small improvements are still needed to meet all of the requirements in a robust manner. For example, there is scope to further improve the speed of laboratory test result updates and data validation procedures require further consideration. Nevertheless, adding cattle movement data to ScotEID has significantly enhanced the system as a multi-species database.
44. The BVD workstream is industry-led under the Animal Health & Welfare Strategy and demonstrates the value of open sharing of disease information to support policy delivery. For example, voluntary declarations and automatic data feeds from laboratories and CTS allow rapid detection of issues in a transparent manner. It is already possible to monitor persistently infected animals and the experience gained with BVD may serve as a model for other diseases.

45. In anticipation of legislative changes during 2015, work is on-going by the Huntly office to formalise procedures (to broaden the scope of their ISO 9001:2008 accreditation) and support information to assist keepers with interpreting their BVD data, which are now available on-line.

Feasibility of a Scottish cattle movement system

46. Currently, cattle movements into, within and out of Scotland are notified to and retrieved from BCMS via CTS, either online or using paper. CTS will require to be updated for bovine EID. However, for Scotland, bovine EID opens up the possibility of recoding electronic moves to ScotEID. The experience with constructing the BVD component of ScotEID suggests that a Scotland-specific electronic movement system for cattle would be advantageous.
47. Local operational gains can be envisaged. In particular, Bovine EID leads the way for data to be recorded online and used as the farm register. Inclusion of cattle movements in ScotEID would also enhance real-time, multi-species coverage, which may be important for some disease control purposes. Delivering traceability and continuing to meet legislative requirements would require interface with existing UK and MS approved database.
48. Any change to the current cattle movement reporting arrangements would require a transition plan and would entail detailed discussions and planning. Hence, objective d) will be influenced by the outcomes of EU-level deliberations about bovine EID.
49. The design of any Scottish cattle movement system will be informed by the experience of using CTS plus experience of designing the sheep and pig systems, utilising the BVD component of ScotEID and of results from trialling EID in the field. For example, attention will need to be paid to interfaces with existing databases⁴ and data management processes, necessitating investigation of data structures and web services to interact with various government systems and industry software systems.

Field trials

50. Objective e) mirrors previous research into sheep EID, using industry partners and commercial conditions to identify workable solutions across a range of farms, marts and abattoirs. In particular, field-testing of different hardware configurations, technical procedures and software interfaces aims to determine reading accuracy, robustness and reliability under a variety of circumstances.
51. For sheep, the technology prescribed by the EU is Low Frequency (LF). For cattle, no decision has yet been taken by the Commission although it has been indicated that LF will be the preferred technology supported by majority of other Member States. The cattle industry in Scotland has indicated a preference for a hybrid solution (LF & UHF) to allow users choice according to their circumstances whilst also allowing movements within the MS and EU using the EU prescribed technology.
52. LF is already familiar to all abattoirs and livestock auction markets plus many farmers, however, considerable worldwide R&D expenditure on UHF technology over the past decade has developed it significantly and it now offers distinct advantages. For

⁴ For example, ScotEID can handle multiple keepers on a single holding, but CTS cannot. As CTS continues to remain the single Member State database any dataflow to it has to be in such a form and manner that can be easily uploaded to CTS without incurring costly upgrades to the CTS.

example, directional antennae and radio rather than magnetic signals allow EIDs to be read at a greater distance than with LF whilst UHF's anti-collision properties and faster data transfer rates allow EIDs to be read more quickly than with LF. UHF also more easily offers true WYSIWYG capabilities, although current encoding standards rather than technical factors are the main constraint on this.⁵

53. Consequently, UHF not only speeds up the identification process for larger numbers of cattle but by avoiding the need for close handling/confinement it also provides significant health and safety benefits for stockmen plus animal welfare gains. UHF tags can also hold more information, offering further possibilities for storing (e.g.) passport data, management data and/or security data.
54. At Scottish industry request, Phase 4 tested a variety of available UHF tags and readers, plus developed prototypes of dual LF-UHF tags capable of supporting both technologies. Hardware performance was evaluated under experimental/laboratory conditions and demonstrated at Dingwall mart, with particular attention to reader direction, reading distances, anti-collision properties, data storage capacity and non-interference with LF systems already in use for sheep and many dairy cattle. Handheld dual readers capable of reading both LF and UHF tags were subsequently developed towards the end of Phase 4. The design specification for these drew on readily available but specialised components, some of which had to be modified to house both technologies within a battery-powered, rugged, handheld device. Ten readers have been manufactured and are currently being evaluated with industry partners.
55. Dual UHF-LF technology offers flexibility to users, allowing those already with LF readers to continue to use them but also permitting users wishing to take advantage of UHF capabilities to do so. If the EU does opt for LF as the preferred technology, the use of UHF alongside it should still be possible provided that it is not explicitly precluded – which it should not be, given the co-existence of different identification technologies is merely an extension of current practice, as exemplified by the presence of written and barcode representations of IDs on conventional tags and paper passports.
56. Experimental trials at Dingwall mart using purposively-tagged cattle and UHF equipment routinely achieved high performance over a range of reading distances and cattle volumes. This included demonstrations to an international conference held in March 2013.⁶ ScotEID was also invited to demonstrate UHF systems in three markets in Eire during September 2013. This demonstration was funded by ICOS and demonstrated faultless data transmission to the database.
57. Phase 4 cattle EID field trials are being conducted using dual-technology management⁷ tags and readers. Tags are marked externally with the animal ID, plus contain both LF and UHF transponders coded to the same ID. These tags allow direct comparisons of different methods of reading IDs under identical conditions (i.e. same

⁵ An earlier ScotEID paper outlined how consistent WYSIWYG could be achieved for both LF and UHF. See

<http://www.scoteid.com/Public/Documents/WYSIWYG%20EID%20for%20cattle%20v1.5.pdf>

⁶ http://www.scoteid.com/Public/Documents/uhf_conference_report.pdf

⁷ EID transponders cannot currently be used in a primary cattle tag but can be used in a secondary tag. However, a high proportion of secondary cattle tags in Scotland are metal fold over tags incapable of carrying an EID transponder. Consequently, ScotEID has opted to use a third, management tag for the field trials. Ideally, since the prohibition makes little sense and is an odd retrospective interpretation of pre-EID legislation, the European Commission will be asked to consider and permit the use of transponders in primary tags once bovine EID is introduced.

animal at same location at same time), and reduce the total number of cattle required. All tags have been colour-coded pink for ease of visual detection.

58. To-date, c.12k appropriate EID tags have been sourced from commercial suppliers and have been distributed to partner farms, (A further 8k tags are available for use) together with appropriate reading equipment. Insertion of tags and configuration of on-site hardware and software has been assisted by ScotEID field-staff.
59. Twice or thrice-daily milking of large dairy herds provides a convenient means of rapidly testing accuracy and reliability over a large number of movements. Some of the partner dairy farms already use LF management systems. In these cases, it will be possible to test the compatibility of legacy systems with the dual LF-UHF tags being trialled, or with UHF only tags if new LF tags conflict with the existing farm system (e.g. HDX tag vs.HDX collar transponder incompatibilities⁸).
60. Beef cattle generally have less frequent routine movements, but the enrolled beef farms have been selected on the basis of willingness to use EID for management purposes (e.g. profiling individual animals, recording growth rates and veterinary treatments) to ensure a reasonable number of opportunities for reading tags.
61. To-date, relatively few movements have been recorded on partner farms as enrolment, tagging and equipment installation have been delayed due to prioritisation of work on the BVD workstreams. However, prior to a wider roll-out of the trials, more active testing has been conducted on two farms – one beef one dairy - in order to test transponder robustness, readers and management system interfacing. This has allowed early identification and resolution of minor technical problems as well as testing comparative performance of LF and UHF.
62. Beyond the farm-level, trials are also being conducted at marts and abattoirs. In these cases, on-site assistance with installation and the design of handling procedures compatible with existing management systems has been provided. Given the experience of all markets and abattoirs to-date with sheep systems, many have expressed a keen interest in assisting with cattle EID trials.
63. Early results confirm that hybrid LF-UHF tags and readers perform as expected (i.e. no performance impairment from being combined) and offer users flexibility in how to read EIDs. Hybrid tags can be read by LF reading equipment, UHF reading equipment and hybrid reading equipment – but UHF technology offers faster reading of a greater amount of data at a greater distance than LF. For example, a fixed UHF reader installation on a weighing crate has dramatically reduced the staffing levels and time required for recording live weight gains for a beef herd, and time savings from using EID rather than manual recording more generally have been widely reported by participating partners.

Phase 4 system usage

64. In addition to marking delivery of a sheep movement reporting system, Phase 3 also marked the creation of the preliminary BVD component plus the development of a trial movement reporting system for pigs. Access to CTS data for the BVD component means that the building blocks are now in place to explore the feasibility of a Scottish electronic cattle movement system. Moreover, since data on the three main species

⁸ Collar transponders used in dairy farms for in-parlour identification

involved in the 2001 outbreak of Foot & Mouth Disease (which motivated the shift to EID) are now available through ScotEID, there is potential to explore the value and purpose of a unified multi-species database with links to MS CA databases to transfer movement data.

65. This is a notable achievement with few (if any) international parallels to-date and reflects considerable effort in terms of conceptualisation, stakeholder engagement, development of equipment and software, and the establishment of linkages to other databases.
66. However, beyond demonstrating the ease with which database queries can be developed and data can be extracted, consideration has yet been given to how best to arrange and maintain specified database queries to different stakeholders' needs
67. For example, if a disease outbreak were to occur, what precise questions would need to be asked and how should resulting information be presented? Equally, outwith an outbreak, how could the database be used to inform a proportionate, risk-based inspection regime or to improve industry statistics? Consequently Phase 4 has the following two objectives:
 - f) To investigate (with specialist support from BLOSS/EPIC) how data held in a multi-species database system are able to improve traceability/cohort connections between species and how links to other data systems may aid disease control (e.g. for BVD).
 - g) To help others investigate how the technology and data systems may be used to help support other requirements across the food chain e.g. QMS/FSA derived carcass health data and information which may impact meat eating quality and more efficient production.
68. Objective f) is central to how data collected by ScotEID can be put to best use, both for routine regulatory purposes and in disease emergency situations. Addressing such issues need not necessarily entail significant technical developments, but it will require liaison between ScotEID, government, industry and analysts (e.g. EPIC) to discuss data needs, improve users' understanding of database capabilities, agree appropriate analytical and visualisation tools and to agree data sharing protocols.
69. A common data sharing agreement has been developed and signed between ScotEID and all of the EPIC partners. The EPIC partners have access to ScotEID using a web interface specifically designed for their requirements. In turn the EPIC partners will provide ScotEID with feedback to achieve objectives (f) and (g).
70. Preliminary discussions with stakeholders have identified BVD as a convenient empirical example to focus on in the first instance. Consequently, the live roll-out of the BVD component is being accompanied by testing of how information on PIs can be used. Other possible examples include swine fever and sheep scab. Importantly, the development of analytical tools is outwith ScotEID's remit and is in any case more suited to external specialists able to add value – ScotEID's role is as only as data manager and controller.
71. There is scope to more proactively promote ScotEID in terms of its functionality and potential value to a range of stakeholders. Actions that could be taken in this regard include (in addition to the website and help desk) development and distribution of promotional poster/leaflet/video material and continuation of a series of presentations to Government, Local Authorities, farmers and academics.

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72. Objective g) extends the relevance of EID beyond its original main purpose of enhanced disease control to wider supply-chain uses. This reflects the policy interests of other bodies, such as QMS and the FSA, in continuous monitoring and sharing information along the supply-chain to improve overall efficiency and quality assurance. Indeed there are opportunities for data sharing and wider communication to help build links between different parts and sectors of the red meat Food Chain, to enhance viability and robustness. This highlights how the value of core data held for one reason may be enhanced by extending its usage to other purposes and users.
 73. To-date, preliminary discussions have been held with bodies such as the FSA and QMS regarding potential uses both before and after slaughtering (i.e. for live animals but also meat products). ScotEID awaits clarification of their requirements, although some previous work was undertaken with QMS on the problem of “black loss” (disappeared animals) amongst extensive sheep farms
 74. Objectives g) and, to a lesser extent, f) raise significant procedural issues regarding data sharing. Various protocols for data sharing, control, processing and data protection have been developed by ScotEID and agreements are now in place with a number of parties (e.g. the EPIC members).
 75. The challenge of achieving this was substantial, requiring dialogue with all stakeholders to agree legitimate uses of different data. For instance, for statutory reporting, for enforcement, for academic research and for commercial purposes. Yet the same sets of data have multiple uses. For example, QMS has an interest on checking quality assurance throughout the supply-chain. It is clear from discussions with industry stakeholders that data sharing amongst them is accepted as crucial to development of the Scottish livestock industry, but (as also noted in the Pack “red tape” report) there are industry concerns about extending regulatory reach through easier access to more data.
 76. The distinction between core regulatory and other uses of data will need to be maintained, as will the distinction between data management functions (within ScotEID’s remit) and separate analytical functions (outwith the remit). That is, the same data can have different uses and the overall benefits are maximised by maintaining and managing these in parallel, treating the data as shared infrastructure. Data sharing agreements need to be in place to clarify mutual understanding amongst all stakeholders of the status of the database, its purpose and permitted usage of the data. In particular, it is important to distinguish between control of the data and access to them for legitimate purposes.
 77. As currently configured, the data are owned by the industry whilst the Scottish Government owns the database code structure and has access to the data in order to meet EU regulatory requirements for livestock identification and traceability (DG Sanco) and compliance (DG Agri) and undertake livestock tracings.
 78. This model appears to be working in that, since the data may be used for inspection purposes, keepers have an incentive to check, update and correct any errors in their own data. Moreover, since the data may also be used for management purposes, keepers need to retain shared control over the data for their own needs - Government does not have exclusive control. Indeed, both Government and Industry are “data controllers” in that they “determine the purposes for which and the manner in which any personal data are processed - they are “data controllers in common” in terms of

the Data Protection Act.⁹ Moreover, since the data are held in a single database rather than across multiple databases, compliance checking is simpler.

79. As such, industry trust in (and thus co-operation with) the system is arguably higher than it might be under alternative models. The use of commercial intermediaries could impose higher costs on both keepers and government whilst exclusive control by government could undermine transparency and trust. The Pack report also favoured openness and data sharing for agreed purposes.

Governance

80. During Phase 3, the formal legal status of ScotEID was established as a company limited by guarantee with no assets and no financial transactions. The guarantor of ScotEID.com Limited is SAOS which assumes and manages various associated risks. The company's risk is confined to the content and quality of the data provided by the industry and any advice provided concerning the use of the data. A liability/professional indemnity insurance policy is maintained. The SAOS/ScotEID structure protects project funds and SAOS assets from any dispute by a user of ScotEID who is relying on data provided by another user.
81. SAOS maintains and co-ordinates the ScotEID system in trust for the industry until such a time that the liabilities and risks are fully understood, and the wider industry (with Scottish Government) is sufficiently confident to take a formal governance role. This structure offers protection to industry against any potential liabilities arising from operation of ScotEID, whilst still emphasising industry joint control of the data. That is, ownership of the data is separate from use of the data.
82. Ownership of and responsibility for the data are fundamental to the governance of ScotEID. Whilst Scottish Government and regulatory bodies require access to movement/register data to meet various statutory and policy needs, this does not mean that Government and its Agencies require ownership and exclusive control of the data.
83. Although access and ownership could be held jointly, ScotEID has deliberately separated them to enhance industry confidence in the accuracy and neutrality of the database system. That is, the imposition of sheep EID has not been welcomed by the industry and suspicions remain over how and why Government and its Agencies will use any data. Issues of data provision, access, control, ownership, protection and use are treated as separate (but inter-linked) and all require consideration across the entire supply chain and regulatory environment. This distinctive Scottish approach of openness and transparency has proven to be somewhat successful in gaining industry trust and providing accurate, up-to-date data throughout the supply-chain.
84. By separating ownership from access, industry suspicions of any untoward intrusions have been reduced and a degree of acceptance of sheep EID movement reporting has been established. Moreover, allowing farmers to view and (if errors are detected) amend their data such that there is confidence in the accuracy of what is being shared with Government encourages self-responsibility for monitoring data accuracy.
85. Within this, the Huntly Information Centre plays a pivotal role. Not only does it act as a point of contact and advice for farmers, but it also liaises with (including site visits to) Critical Control Points (CCPs) to ensure that they are reporting movements correctly

⁹ See guidance from the Information Commissioner's Office at http://www.ico.org.uk/for_organisations/data_protection/the_guide

on behalf of farmers. It also liaises with Regulatory Bodies to assist their access to and interpretation of any data.

Expenditure

86. Total expenditure through SAOS¹⁰ for Phases 1 to 4 (from April 2008 to October 2014) amounts to c.£5m. This total is spread across 5.5 years and divided across a number of separate (if related) budget heading activities including software development, data transfer systems, reader development, management, statistical research etc.
87. Collectively, funding of these activities has delivered the potential for an operational, multi-species movement reporting system. This includes managing the operation of the sheep system since August 2010, the pig system since September 2012 and the BVD system since April 2013.
88. Moreover, the building blocks for achieving this have included: design and development of appropriate readers able to provide continuous reading in challenging environments; stress testing (e.g.) data coming from various geographically dispersed sources simultaneously; building industry capacity in terms of (e.g.) how to operate systems Data for statistical analysis – which has been vital for conversations with the Commission; and, information on tags and reader performance.
89. Of total expenditure, the largest share relates to the research and development of data transfer systems for farms, marts and abattoirs (supported by the provision of equipment and field support to partners) to provide high volumes of test data. This enabled rapid generation of significant volumes of data to test the performance and robustness of different hardware (i.e. tags, transponders and readers) and software configurations, and to provide robust data for analysis important to negotiations and discussions with the EU commission and the industry. The structure of the relational database had to be logically robust, yet sufficiently flexible to accommodate its expansion from sheep to cover other species - as happened with the addition of pigs and then cattle (for BVD). In addition, input to and output from the database had to be via a variety of modes, including web browsers (of different types and vintages) and to be able to accommodate direct links to other databases.
90. It is important to note here that previous EID testing, such as by the EC¹¹ and Defra¹², had relatively small sample sizes and was not conducted under conditions directly comparable to those found in the Scottish sheep sector e.g. stratified structure and highly seasonal peak flows. By contrast, deliberately seeking to involve a large number of industry partners provided a convenient means of gaining large sample sizes under a variety of commercial conditions. Moreover, proactive involvement of the industry also helped to foster trust - which was an important consideration given acknowledged wariness if not hostility amongst many stakeholders (the Huntly Office reflects on-going operational support to users).
91. It is also worth noting here that it rapidly became apparent during Phase 1 that there was no off-the-shelf solution to EID due to a lack of standardisation across readers in

¹⁰ Approximately £0.5m has also been allocated directly by Scottish Government for some technical laboratory work i.e. not through SAOS or ScotEID.

¹¹ JRC (2007; 2009) Economic Analysis of Electronic Identification (EID) of Small Ruminants in Member States. Presentation & Final Report by the Joint Research Centre, Ispra, Italy

¹² Defra (2008) UK EID Evidence Report: Electronic identification of sheep and goats: Commission report in connection with article 9(4) of Regulation (EC) No 21/2004 Defra, London.

terms of how data were recorded or transmitted. Combined with the existence of a variety of proprietary farm management and office software across the industry, this meant that considerable early efforts had to be devoted to creating flexible interfaces - culminating in the Java application now in use.

92. Project Management by SAOS encompasses day-to-day management, project administration, data control, risk management, travel & subsistence costs for meetings with Scottish Government and support for partners and stakeholders across Scotland, plus – importantly - governance. Other expenses include the hardware hosting the ScotEID system, independent analysis & reporting (by BLOSS and Pareto Consulting) and legal advice.
93. Despite a modest outlay, legal advice is an important expenditure item since it facilitates formal arrangements for data sharing and supported the creation of ScotEID as a separate entity as a means of managing liability risks.
94. Other approaches were considered but are viewed as disproportionately expensive. For example, security arrangements with accompanying ISO accreditation could be implemented, but would incur considerable expense without demonstrably improving actual security (i.e. there is no cost-benefit gain). Moreover, they are not necessary given that livestock identification and movement data are categorised as personal but not sensitive data and industry representatives are content with the current protective arrangements in place. However, the applicability of ISO 27001 is being reviewed to augment the current ISO 9001/2008 management systems.
95. ScotEID is monitoring the evolution of best practice in the UK and internationally and will continue to update system governance and implementation. It is hoped that the open partnership approach will continue as Government and Industry understanding of the system and of its value as shared infrastructure evolves. That is, in aggregate, the data supports different uses throughout the supply-chain and regulatory environment and maximum value can be extracted through working together to manage disease risks, regulatory burdens and supply-chain productivity.