agriXchange
network for data exchange in agriculture

WP-2 Analysis of current situation in EU27+Sw

Country report of IRELAND

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About the agriXchange project

agriXchange is a EU-funded project and it is a coordination and support action to setup a network for developing a system for common data exchange in the agricultural sector.

Project summary

Within the knowledge-based bio-economy, information sharing is an important issue. In agri-food business, this is a complex issue because many aspects and dimensions play a role. An installed base of information systems lack standardization, which hampers efficient exchange of information. This leads to inefficient business processes and hampers adoption of new knowledge and technology. Especially, the exchange of information at whole chain or network level is poorly organized. Although arable and livestock farming have their own specific needs, there are many similarities in the need for an integrated approach. Spatial data increasingly plays an important role in agriculture.
The overall objective of this project is to coordinate and support the setting up of sustainable network for developing a system for common data exchange in agriculture. This will be achieved by:

- establishing a platform on data exchange in agriculture in the EU;
- developing a reference framework for interoperability of data exchange;
- identifying the main challenges for harmonizing data exchange.

First, an in-depth analysis and investigation of the state-of-the art in EU member states will be carried out. A platform is built up that facilitates communication and collaborative working groups, that work on several, representative use cases, guided by an integrative reference framework. The framework consists of a sound architecture and infrastructure based on a business process modeling approach integrating existing standards and services. The development is done in close interaction with relevant stakeholders through the platform and international workshops. The results converge into a strategic research agenda that contains a roadmap for future developments.

Project consortium:

- Wageningen University & Research Center (LEI, LSR, Alterra) - The Netherlands
- Kuratorium für Technik und Bauwesen in der Landwirtschaft (KTBL) - Germany
- MTT Agrifood Research - Finland
- Wireless Info (WRLS) - Czech Republic
- Institut de l'Elevage (ELEV) - France
- Institut de Recerca i Tecnologia Agroalimentàries (IRTA) - Spain
- Teagasc - Ireland
- Universität Rostock -Germany
- Forschungsinstitut für Biologischen Landbau (FIBL) - Switzerland
- Altavia - Italy
- Poznan University of Life Sciences (PULS) - Poland
- ACTA Informatique - France
- Progis software - Austria

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Executive summary

AgriXchange is an EU-funded coordination and support action to setup a network for developing a system for common data exchange in the agricultural sector. In this network a reference framework for interoperability of data exchange is being developed. Analysis of the situation concerning data exchange in agriculture in individual EU member states (including Switzerland) is an integral component of this support action.

In this paper the results of the investigation of the state-of-the art around agricultural data exchange in EU member states is reported. This research on data exchange and data integration is running in the 27 EU member states and Switzerland. For each country separate reports have been prepared. The investigation employs experts to quantitatively and qualitatively inquire about agricultural data exchange in the EU. For the research a template was developed using a framework in which attention was paid to different integration levels, within as well as between enterprises.

The results presented in this paper are mainly based on the available country reports and consist of trends in the characteristics of European farming enterprises, the state of the art in the application of farm automation and information integration (data exchange and standardization issues).

Up to now, efforts have mainly been directed on capturing the state of the art. Most important weaknesses and opportunities identified are:

- Aging of farmers in conjunction with the lack of adaption and investments on ICT;
- Lack of broadband internet in rural areas;
- Problematic issues around mobile technologies, while the potential of computing based on mobile devices (smart phones and others) is recognized;
- Fast up scaling agricultural countries have the opportunity to build new infrastructures, skipping the old structures of others;
- Big differences between areas in the EU in terms of level of data integration and standardization.

The quantification of the benefits arising from overcoming these barriers is beyond the scope of this analysis. Discussion of the meaning and value of data exchange, and the way to standardize agricultural data has started, and will continue in the course of the project.

Keywords: agriculture, ICT, information, data exchange, standardisation

1. Agricultural characteristics

Ireland exports over 80% of both beef and milk that it produces. Milk output is commodity based with the main market for cheddar cheese in the UK and most of the powders exported outside of the EU. The main export market for branded butter is Germany through the Kerrygold brand. Ireland exports both live animals and beef carcases. The main export market is within the EU with lower value beef cuts exported external to the EU. Ireland plants approximately 400,000ha of tillage annually with the main crops being Spring and Winter Barley and wheat. Ireland is not self sufficient in grain and ends up importing approximately 2,000,000 tonnes annually for mainly the feed industry. There are 5,000Ha of forestry planted in Ireland with mainly Spruce trees annually which has largely been supported and funded by Irish and EU government grants over the past number of years. However these grants have been reduced and the level of planting is expected to reduce as the funding is reduced.

Ireland witnessed a massive boom between 1997 and 2007 which saw large annual growth rates. This boom while initially was driven by exports subsequently was fuelled by the building industry. As a result of the 2007 banking crises Ireland's economy driven by the construction industry has experienced a very substantial fall in terms of GDP.

Ireland decided to fully decouple support payments under the Luxembourg agreement component of the CAP reform. The reference years were 2000 to 2002. In the case of milk production the support was decoupled from production in 2005.

1.1 Short Description of general characteristics

Total agricultural output was worth €4.8 billion in 2009 which was a decline of 18% from 2008. This was derived from a reduction in agricultural output across all of the agricultural sectors (see table 1.) which was most obvious in the livestock products category. Table 1 shows the evolution of agricultural output from Ireland between 2003 and 2009. There is significant variation between years with 2007 and 2008 showing strong performance as a result of high prices across the agricultural sectors. The main commodities were cattle, milk, pigs, sheep, cereals, forage plants and others, which were worth €1,489 million for cattle, €1,063 million milk, €292 million pigs, €159 million sheep, €96 million cereals, €771 million others and €857 million for forage plants.

Table 1. The value at agricultural output in Ireland between 2003 and 2009

	2003	2004	2005	2006	2007	2008	2009
All livestock (€* million)	2065.4	2212.8	2274.9	2417.0	2399.0	2540.8	2253.9
All livestock products (€* million)	1470.6	1459.3	1375.8	1367.4	1706.9	1677.5	1142.0
All crops (€* million)	1302.7	1350.6	1376.0	1453.9	1595.4	1605.2	1371.7
Total (€* million)	4838.7	5022.8	5026.7	5238.4	5701.4	5823.4	4767.6

There were 128,200 farm holdings in Ireland with an average farm size of 32.3Ha in Ireland in 2009. There was a total labour input of 143,900 (incl. non regular workers). There was 4.14 million hectares of land used in agricultural production in 2009. There was 293,000 Ha of cereals in 2009 with the main crop being barley (both Winter and Spring). The main area in Ireland is permanent grassland with over 80% of the total agricultural area defined as permanent pasture. There were 18,900 dairy farmers who produced 4.8 billion litres of milk in 2009 with 1.1 million dairy cows, with an average herd size of 59 cows. There was 1.14 million suckler cows with 142,000 farmers defined as having beef (having one beef animal constitutes having beef on the farm). There was 1.6 million animals slaughtered in Ireland in 2009. There were 600 commercial pig farmers registered in Ireland with an average number of sows per farm of 300 in 2005. There was on average 1.6 million pigs in the country with 2.4 million slaughtered in 2009. There was 41,200 farmers with sheep in Ireland in 2005. There was 2.7 million sheep slaughtered in 2009 which came from a population of 3.2 million ewes and 4.3 million sheep (Table 2).

Table 2. Key agricultural statistics for Ireland

		2009
Number of holdings (#)		128,200
Utilised agricultural area (UAA) (ha)		4,140,860
UAA per holding (ha)		32.3
Arable production		
Main arable crops:		
	Cereals (ha)	293,000
	Maize silage (ha)	20,900
	Potatoes (ha)	12,900
	Grass silage (ha)	1,033,900
	Hay (Ha)	220,300
	Pasture (Ha)	2,092,400
Dairy production		
Number of dairy holdings (#)		18,900
Dairy cows (#)		1,107,000
Dairy cows per holding (#)		58.6
Annual milk yield per cow (kg)		4,746

Beef Production	
Number of Beef holdings (#)	142,000
Beef cows (#)	1,069,500
Number of animals slaughtered	1,597,000
Pig production	
Number of holdings	600
Number of pigs	1,602,100
Number slaughtered	2,420,700
Sheep Production	
Number of holdings	41,200
Number of ewes	3,208,600
Number of sheep	4,257,000
Number slaughtered	2,730,100

1.2 Expected development

The relaxation and removal of milk quotas across Europe will result in increased milk production from Ireland. A number of studies both in Ireland and across Europe have shown that milk production will increase in Ireland with the relaxation of milk quotas. Dairy farmers are currently responding to the increased milk quota available by increasing the level of AI used to breed replacement heifers. In 2009 there was an increase in the number of dairy bred heifer calves born and in 2010 it would appear that this trend has continued. A recently published Government report (Food Harvest 2020) has stated that milk production will increase in Ireland by 50% by 2020. The expected development in the other sectors is less clear. While increased volatility is expected in dairy markets in the EU in the future a focus on low cost grass based systems of milk production will under pin Irish milk production. The need for technology will increase around the use of grazed grass. Web based tools that allow dairy farmers to communicate with one another, the milk processor, the marts, cattle breeding companies etc. will facilitate increased efficiency at farm level. As dairy herds expand the use of herd based packages to record information on animals within the herds will become more frequently used on dairy farms.

With increases in dairy cow numbers the availability of beef calves will increase and may form the greatest potential for profitable beef production in Ireland. The pig sector which has not had the support of CAP will be dictated by the feed price to pig meet price ratios. The biggest limitation is the environmental restrictions that the nitrates directive imposes through restrictions around the land spread of organic manures. The forestry sector in Ireland has seen significant growth over the past number of years largely through funding from Government grants. However the recent declines in the Irish economy has seen significant pressure placed on the availability of money for forestry. This may put pressure on future development in Ireland.

2 Farm automation level

2.1 Technologies in current use

The use of mobile phone technologies (e.g. SMS) is most significant in the European Union (EU) and Ireland in particular is a high user of SMS. The pervasiveness of mobile technology in the rural context presents particular opportunities due to the take up of these devices and their ability to operate in the more remote areas. There were over 10 billion SMS messages sent in Ireland in 2009, a 180% increase compared to 3.6 billion in 2004. If the total number of messages was averaged over all subscriptions that would average at 193 messages per subscriber for Q4 2009 compared to 183 per subscriber for the same period in 2008.

Informed users now expect to be able to access the Internet at all times whether it is in the home or on the road. To date, farmers who are using the Internet are in the main using it to search for information. They are not necessarily using it to conduct their business yet, but they treat it as an informal decision support system in that they are gathering facts about prices, trends, weather, etc. This type of information helps farmers significantly in allowing them to make decisions on tasks and issues presenting themselves on the farming front.

Figures supplied by DAFF show a large proportion (87%) of the Department's customers, do not fall into the 20 - 40 age range (i.e. left school in last 20 years), and consequently may have had no exposure to PC use at all. The availability of off-farm employment opportunities, especially in recent years, together with changes in agricultural practices have led to a rise in the number of farmers combining their farming activities with outside employment in Ireland. This means that there is now a pattern developing whereby the majority of intensive farming production is now being carried out by a smaller number of full time farmers.

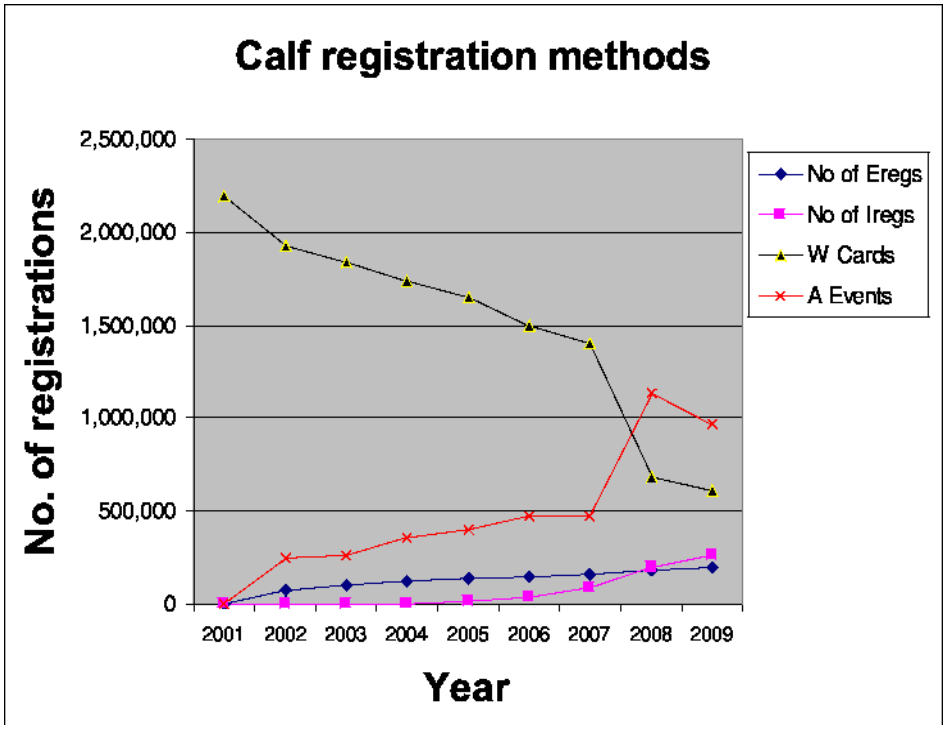
Just fewer than 70% of all farms were part-time in 2009. In approximately 49% of all full-time farms, either the farmer and/or spouse were also working in off farm employment; this has risen from 38% since 2005. In these circumstances, it is probably safe to say that for many of these farmers there may be a scarcity of time available to them to work on their farms, especially in livestock enterprises. The use of ICT in these cases could significantly improve their ability to be better informed for making key decisions and being better able to manage their farms. Part-time farmers are more likely to own a PC than their full time colleagues. About 15% of farmers in 2004 used their PC for farming purposes. In 2004 just over 74% of farms had access to a computer, 65% had Internet access but 68% of farmers used the computer for farm business. In early 2010 96% of farmers have access to a PC either through a part-time workplace, family friend, library or other source and 83% owning their own computer. In contrast to the 2004 figure of 15%, the 2010 research found that 44% of farmers who now use a PC use it for home/farm accounts or for running farm management software. In Ireland, the use of farm management software is not confined to those farmers with large farm holdings. One might have

expected that the larger farming operations would have a greater uptake of ICT use but in fact the usage of products is spread evenly across farms of all sizes. This suggests that some large farms not using ICT might be "too busy" or not see the benefit of using IT. At the same time farmers, with small farms, will use technologies where they find a benefit.

In 2006 Ireland only had 5.6% of its SPS claims registered by on-line means, this was a lot less than the 23% of farmers who had signed up for electronic services in the Department and were capable of making these claims electronically via an agent or independently. The number of SPS claims received online has much improved with circa 33% of claims having been received online in 2010 (of the online claims - 12% were submitted by individual farmers and 88% by an authorised agent). Between 2007 and 2010 there was a major reduction in the number of farm payment forms of paper origin received by the Department (35,000) over the last three years. The percentage of applications made online (by farmer or agent) has increased from 5.65% in 2007 to approximately 33% in 2010 (note the figures for paper forms are estimated for 2010).

Similarly, there has been an increase in use of online methods to register calf births, from just 3% of all animals being registered online by farmers using a farm software package or www.AgFood.ie in 2002 to 23% in 2009 (Figure 1). The year to date figures at the end of August 2010 suggest that this has increased further to 26%. A further example is the Department's online forestry application (IFORIS iNet). The system was placed into production in February 2009 and facilitates the online submission of pre-approval applications by Registered Foresters. The usage uptake of this system has increased steadily since 2009 with 64% of all pre-approval applications now received online. The expectation is that this level will rise to 80% by end of 2010.

Figure 1. Calf registrations by year



There still however appears to be a digital divide occurring across sectors of Agriculture with regard to access to and use of information, and also even in productivity and management of enterprises. Table 3 shows the adoption of PC use and uptake for business use for the farm, comparing figures for 2004 and 2008. The figures show that Dairy and Tillage Farmers were more likely to have access to a PC and engage with ICT as a communication tool and for supporting their farms more so when compared to Cattle Farmers. While the Dairy sector may be more intensive and have larger enterprises these figures demonstrate that there is still a requirement to close the divide between the farming sectors.

Table 3 – Personal Computer ownership and use

Farming	Access to a PC		Used for farming purposes	
category	2004	2008	2004	2008
Dairy Farmers	54%	65%	26%	35%
Tillage Farmers	55%	68%	23%	31%
Cattle Farmers	33%	44%	9%	15%

Fifty One percent of Irish farm households had access to a PC in 2008 with mostly medium and large size enterprises being more likely to have a PC. The increase in

computer access since 2004 was greatest among small-scale farmers. As outlined earlier there is a growing population who are now leaving school who will have good exposure to new technologies and ICT in general. These people will/should be able to realise the benefits available from ICT and be in a better position to utilise the technologies. At the same time there is a growing population of older farmers and these farmers will not or are less likely to adopt ICT readily unless clear benefits can be demonstrated.

At this point in time the agricultural sector does not have a large number of ICT service offerings with just a handful of Irish companies providing farm management software packages to the farming community. Some of these providers would have clients that actively use ICT including using hand held devices that are used on a daily basis. In the case of larger tillage operators and tillage contractors the use of technologies such as GPS would be common. However, numbers would ultimately be small. In addition, the Irish Cattle Breeders Federation (ICBF) and Teagasc also provide specific services to farmers who can use technology to assist them in their business. The individual milk processors would have at least 50% of their milk suppliers who access their own details through their dedicated websites. The Department has its own on-line services, www.AgFood.ie, which farmers may use to view and record their own information.

3 Data exchange: process level

Which relevant data exchanges are used at process level (bottlenecks, challenges)?

Key words:
farm process automation vs. information systems, farmers IT vs. national/EU systems, farmers IT vs. extension services, farmers IT vs. production chain systems

Data exchange processes are happening in Ireland across all sectors of agriculture at different levels. Most used in Ireland centre around the livestock sectors.

3.1 CMMS

The cattle Movement and Monitoring System (CMMS) involves the development of a passport for all animals on the farm for the whole period that they are on the farm. Animals are tracked as they move between herds leading to information being available on all animals at all times of their lives. A number of different groups interchange data in order to be able to track the animals. Animals are registered when they are born either through a paper transaction, through the Department of Agriculture website or through an independent farm software provider. As stated earlier the number of animals directly registered through the Department of Agriculture and Food Website (DAFF) is continually increasing. When animals move between herds the movement takes place with or without a mart being involved. If there is no mart involved the transfer of information happens through a paper transaction or again through the DAFF website and ultimately the CMMS. If a mart is involved, there is an exchange of data between the mart and CMMS. This process allows the transfer of animals between herds without the farmer having to get involved. When animals are slaughtered the factory interchange data with the CMMS system. Finally when an animal dies the knackery feed the information to the CMMS system. All of this information has become increasingly important since the introduction of the nitrates directive was introduced in Ireland. The average organic N output of a farm is calculated based on the livestock on the farm with the land area coming from Land Parcel Identification Systems (LPIS).

3.2 ICBF

The Irish Cattle Breeding Federation (ICBF) was launched in 1998 with the objective of achieving the greatest possible genetic improvement in the national cattle herd for the benefit of Irish farmers, the dairy and beef industries and members.
Through the development of a data base information is collected and organised in such a way that a computer program can quickly select desired pieces of data.

In order to identify the most profitable animals in genetic terms, there are two critical elements:
1. Ancestry data (i.e. Sire and Dam).
2. Performance data (i.e. how well animals performed in various aspects).

The ICBF database stores all this information in one location.

Ancestry data comes from two main sources:

Calf Registration - in order to get an animal passport, a farmer indicates the sex, date of birth, dam of the calf, and since the introduction of Animal Events, the sire information.

- Herd-books - who have been maintaining the ancestry of pedigree animals for many years.

Performance data comes from a wide variety of sources.

1. Dairy animal performance data comes from
    - a. Milk Recording organisations (Milk, Fat, Protein, SCC).
    - b. Calf registration (Calving Interval - how long since the last calving; Survival - how many calves has a cow had;
      Calving performance - how easy/difficult are the calvings from a particular bull).
    - c. Slaughter Factories (Culled cow weights/grades, fattened animal weights/grades).
    - d. Linear scoring data - used as a predictor of survival.
2. Beef animal performance data comes from
    - a. Calf registration (as above).
    - b. Weaning weights and linear scores.
    - c. Slaughter Factories (as above).

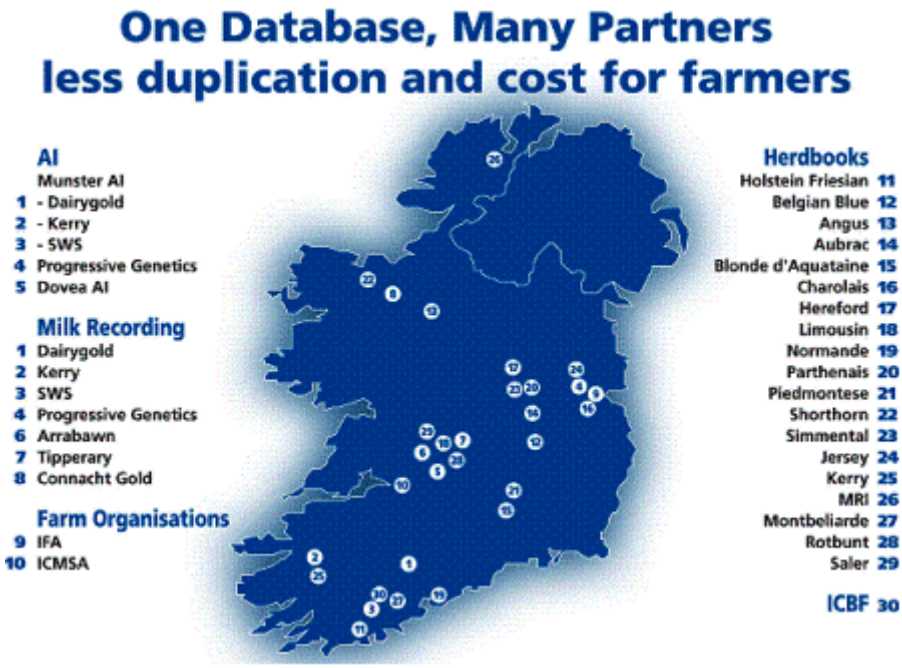
The system for recording information on farms is termed "Animal Events". The principle of Animal Events is that farmers should record information once only and

that all cattle breeding organisations would then have access to this data for the purpose of providing cattle breeding services to the farmer. Having one standard system removes any unnecessary duplication of time and expense on behalf of both the farmer and the service organisations, i.e. the principle of "single point of entry and no duplication".

Farmers can contribute data to the database either by filling an Animal Event Booklet or electronically transferring the relevant data using approved farm computer packages.

The map below shows the location of the different organisations that use the ICBF cattle breeding database on a daily basis. They are linked to the database through various means of telecommunications. Before the establishment of the ICBF database, almost all of these organisations had a separate database of their own. Obviously, there has been a massive reduction in duplication of data.

Figure 2. Data providers and users of milk recording in Ireland.



There are currently 6 milk recording groups carrying out milk recording in Ireland. All of the information from these groups is being centralised in the ICBF data base. There are 5,922 herds milk recording which corresponds to 484,637 cows nationally (Figure 2).

3.3 Teagasc, Milk processor, ICBF, Agri Trader, Bank

A pilot project has been developed where data from a number of sources is being transferred into a central database. The objective of this project is to maximize the usefulness of the data that is being stored by the individual groups. This data is currently not being used to increase farm sustainability. A set of reports are developed and these reports can then be used to benchmark one farmer against a group of his or her peers for one or a number of traits of interest. This creates a situation where what if type questions can be asked between members of the groups and ultimately farmers are forced to ask questions about what they are doing. There have been a number of reports developed to date around milk production and milk quality and it is expected that there will be more reports developed around farm finance where data from banks and accountants would be used to create benchmarking reports.

4Data exchange: Application level

Concerning the processes mentioned in 3, what (kind of) applications can be mentioned? Describe this in common and if relevant by (some) processes.

Key words:
software, databases

4.1 DEPARTMENT OF AGRICULTURE, FISHERIES AND FOOD (DAFF)

The Department of Agriculture, Fisheries and Food has a number of electronic services available to clients at present which can be accessed via its website at www.agriculture.gov.ie or www.agfood.ie. These include:

- Access to your Single Payment Scheme (SPS)/Area Aid application information
- Access to Animal Identification and Movement facilities,
- Access to annual Nitrogen and Phosphorus Statements:
- Access for registered forestry companies to their clients' forestry grant applications, and allows submission by those companies of forestry pre-approval applications. IFORIS iNet covers Afforestation, FEPS, and Roads schemes and includes:

4.2 The Cattle Movement Monitoring System (CMMS)

The CMMS is a national computerised database that tracks all movements of bovine animals in Ireland and has been fully operational since 1 January 2000.
The National Beef Assurance Scheme (NBAS) Act, 2000 spurred further development of the CMMS animal identification and tracing system, including the use of the system to verify the origin, identity and life history of cattle before they entered the food chain.

4.3 Irish Cattle Breeding Confederation (ICBF)

The services provided by ICBF include: http://www.icbf.com/

* HerdPlus

- G€N€ IR€LAND
- Genetic Evaluations
    - Farm Software Bull Files
- Genomic Selection
- Tully Beef Centre
- GROW
- Milk Recording
- Herdbook Services
- Suckler Scheme

4.4 Stand Alone Farm Management Packages

There are stand alone applications available at farm level. Data can be exported via email both to DAFF and the ICBF from these packages. Also add mobile computing as a key area going forward. Farmers don't work in an office, a good mobile solution is key in long term - the iphone/ipad type interface will take over phones as time passes and software on these devices will be key for farmers.

Milk Processors

Teagasc

IFAC

Independent suppliers

4.5 Bottlenecks

Web based technology is the key and providing a central database in order that the flow of data can happen on behalf of the farmer. In most cases if the system requires the farmer to be involved in the data transfer it is the weakest link. Links and data flows between marts, co-ops, icbf, agfood, farmer, etc. should be possible without the farmer getting involved. The potential for dairy farmers to use more software as they expand will be limited. Some of the bigger farmers are don’t see the benefit from IT as they state that “They're 'too busy”.

5Data exchange: Data level

Are data definitions available in order to be able to share data? Describe this in common and if applicable on earlier mentioned processes.

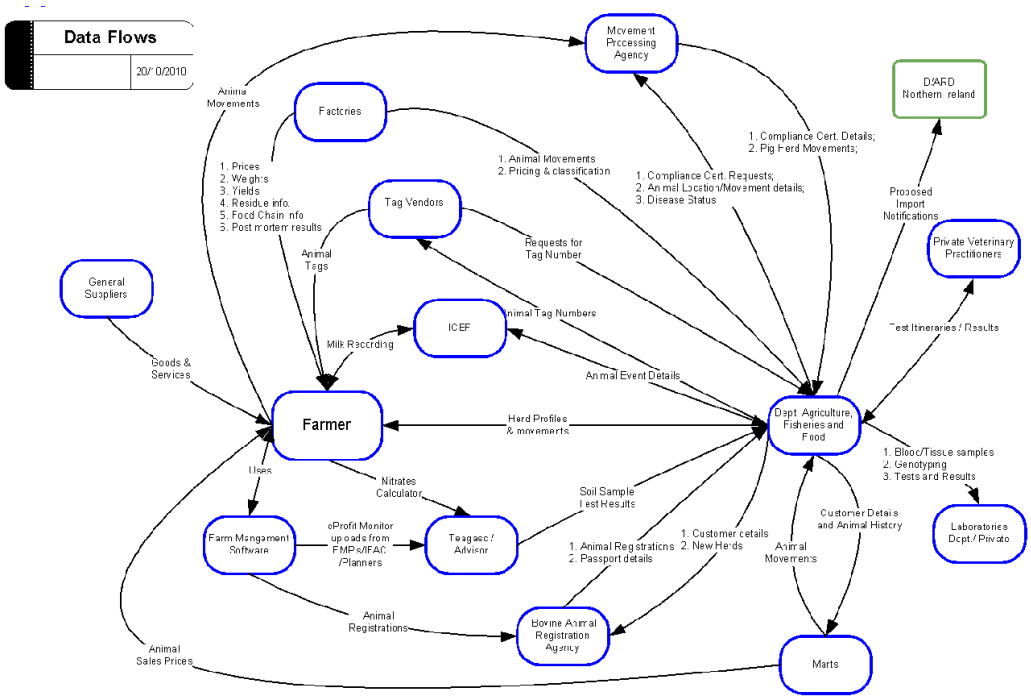
Key words:
syntaxes, semantics, organization, maintenance, availability, costs, bottlenecks

Figure 3 shows the number of data sources, IT providers and data users in Ireland. The flow diagram shows all of the actors involved in the chain. While observing the number involved it becomes apparent the complexity of interrelations. For example in Ireland there are currently 18 milk processors. To develop a system where data was flowing from each processor into a central database, a separate agreement and arrangement would have to be put in place for each provider.

5.1 Bottlenecks

Costs of setting up independent systems for each data provider
Likely use of the data by the end user.
Number of data providers involved.

Figure 3 shows the number of data sources, IT providers and data users in Ireland



6 Data exchange: physical level

Give information about the technical infrastructure. What is available? How is it organized?

Key words:
broadband infrastructure (adsl, sdsl, cable, satellite, isdn), network protocols (FTP, e-mail/smtp, http, XML), database structures, information hubs/brokers

Broadband, ftp, AS2, http, email are all used for data transfer in Ireland. The likelihood of each being used is dependent on the service provider and the data involved. The level of broadband penetration has increased dramatically over the past number of years with independent IT companies report very little of their client base using dial up connections. While are a few blind areas this is shrinking fast.

7 Use cases

Use cases and relevance in EU regions

Also the relevance of the Use cases should be discussed for each country. The use cases in the project are LPIS, Geo farmer and fertilizer, Animal registration, Animal identification (see for more details: Annex II of AgriXchange DoW).

Which of these use-cases are relevant for your country? Describe which interests there are. Who is interested, what initiatives, which challenges?

7.1 Animal registration animal identification

The live export of animals from Ireland in the form of male calves from the dairy herd for veal production, weanlings from the suckler herd and dairy in calf heifers to mainland Europe and the UK create interesting phenomenon's around animal identification. As part of the use cases in this project an evaluation of how inter country transfer between herd numbers takes place and how the interaction of differing databases handles these transfers. The tracking of these animals in their adopted countries would facilitate information for example around creating carbon numbers for dairy products through the apportionment of emissions between different sectors.

8 Other remarks

Finally relevant issues (gaps) not mentioned so far should be mentioned and discussed.

Key words:
data protection, data ownership, privacy, teaching, learning

8.1 Remarks

These are areas that the ICT providers are acutely aware of and are 100% focused on using data in the right mannor on behalf of farmers. It has become more important now that central databases rather than PC databases are becoming the norm. Farmers need to be continuously reassured on this area as they are sceptical in this regard.

8.2 Experts Network for Ireland

Barry Lynch Irish Farm Computers
Anne Geoghegan Teagasc, Moorepark

8.3 References

www.cso.ie

http://europa.eu

http://www.icbf.ie

http://www.agriculture.gov.ie