Opportunities of using data analytics and AI in non-IACS EAFRD measures to shift towards a more risk-based control system and to prevent the risk of overfunding

A visit report from the seminar on the 29th and 30th of September in Brussels (Belgium), organized by the Flemish Paying Agency

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ABSTRACT

On Wednesday 29 and Thursday 30 of September, a SmartPro CAP seminar was organized in Brussels. Overall, the aim of the seminar was to explore opportunities of using data analytics and AI in non-IACS EAFRD measures to shift towards a more risk-based control system and to prevent the risk of overfunding.

In order to be able to use data analytics for any purpose, it is vital to have access to well-structured and good-quality data in the organization. Aspects of data strategy, data collection and data governance within the Flemish Department of Agriculture and Fisheries are presented in Part I – subsection 1. We discuss elements of data strategies, data quality and some challenges concerning sharing data, data sources and the GDPR. Related to data quality and availability, there was a demonstration of the TIBCO Spotfire software that can be used for data visualization and data exploration. The advantages of this or similar software, the use of a logical datawarehouse, and the necessity to train staff to obtain the necessary skills are discussed in Part I – subsection 4.

Once the prerequisites of availability of well-structured and good-quality data, and the presence of the necessary skills within the organization are ensured, there is a need to develop methods and procedures to include their use in protecting the EU funds in our processes. One source of inspiration for data-analytic and AI uses can be found within our own organization, namely the IACS measures, which already extensively make use of new technologies, including AI. Our AI expert from the IACS measures gave a presentation of how satellite images and AI are already used for these measures (e.g. for Control by Monitoring and LPIS updates). A summary can be found in Part I – subsection 2. When introduced, these solutions were revolutionary for the IACS measures, making the control system both more effective (e.g. check of 100% of files) and more efficient. The extrapolation of this technology and techniques to non-IACS measures is not straightforward, but we discuss the potential for certain (sub)measures or checks.

A second use, is the use of data analytics to improve the effectiveness of risk analyses for on-the-spot checks (OTSCs). Through data analysis, we can not only evaluate whether our current risk analysis is effective and which risk factors contribute the most, if there is enough data available, we can also identify new risk factors to include. Data-

visualization is 1 way to identify outliers and abnormal patterns that could be an indication for potential risk factors. Other possibilities are the use of more advanced techniques such as training neural networks on historical data or community analysis of beneficiaries. During a brainstorm the participants tried to identify the best criteria to identify risk factors in non-IACS measures and discussed different ways on implementing risk analyses. The results are presented in Part I – subsection 3.

Another important way to ensure the protection of the EU funds, is through a careful design of the measure, its criteria and administrative checks. A well-designed measure simplifies further management, prevents mistakes and facilitates the early detection of irregularities. However, in practice, there are many challenges. We explored some challenges for investments measures as a casus in Part I – subsection 5. First, we discussed the options to ensure the reasonableness of costs, making sure there is no overfunding, but also no underfunding of (sub)investments. A short introduction of the different options, the methods used within the Flemish department of Agriculture and Fisheries, and a brainstorm session on the options used in other Paying Agencies (PA) are presented below. Second, we give an example of how selection criteria and a well-designed selection procedure can contribute to the allocation of funds towards predefined objectives. However, there is a delicate balance to be found in level of detail that is used.

In Part II we present yet another way of using data to detect possible irregularities with EU funds, using the risk scoring tool Arachne. Because the Flemish Paying Agency has no experience yet with the tool, a colleague from the ERDF funds presented their experiences. Advantages and challenges are discussed.

PART I Mapping the areas, methods, software and resources used to ensure correct spending of public funding

Subsection 1: The importance of good data management and a data strategy

- ***Improves the awareness of the PAs' staff on the importance of the correct and appropriate use of data***
- ***Points out main learning points of 1) how to develop a good data strategy for the whole organization; 2) how to guarantee good data quality; 3) the possibilities and pitfalls of data sharing***
- ***Shares an idea of possible/desirable future state of data sharing and guaranteeing of data quality***

Background and starting point

With the increase of data availability and digitalization, a need arose for an update of data management procedures. The availability of all these data opens up many possibilities, but also brings along several new challenges. It is important to develop a modern and robust data management plan and an explicit data strategy within each organisation.

Data strategy

The Flemish Paying Agency is embedded in the Flemish department of Agriculture and Fisheries. Over time, data has become increasingly available and important within the department, but every unit or division handled this separately. In 2016, it was realized that there was a need for an overall framework for topics concerning data, information and knowledge. This led to the development of a general data strategy with specific targets and objectives in 2019.

There are two main strategic targets:

1. The Flemish department of Agriculture and Fisheries wants to be a data-driven organization (e.g. maximal use of authentic external data sources, high quality and reliable data management, and a data literate organisation).
2. The department wants to be a data authority for the agricultural and fisheries sector (e.g. the department shares consistent and high quality data with third parties).

Our solutions

Data governance

In order to implement the data strategy, there was a need to create a central unit, called ‘Clients and Data’, responsible for the coordination of the data strategy. In addition, a working group was created with members from all divisions, the Data Protecion Officer (DPO), a legal advisor and representatives from IT. This working group follows up on the data strategy actions and guarantees that the solutions are implemented within the different divisions.

Data structure

Within the Paying Agency we traditionally use one central database. Apart from that one there are also two smaller databases for data concerning fisheries and the monitoring network. To combine those the option of a logical datawarehouse was chosen over a physical one.

Data collection

Data comes from different sources.

1. When collecting data provided by the farmer or other clients it is important to do it in a digitalized way.
2. When using other, external data sources, we maximally use authentic sources.
3. Furthermore, we exchange data internally.
4. An extra source of data, is data we create ourselves through calculations and processing.

Data quality

In the Flemish Paying Agency, the quality checks are mainly embedded in the processes. There is no central data quality manager appointed. There are actions concerning data quality, but on a rather ad hoc basis.

On the contrary, in the Estonian PA there is a general data quality manager, who is part of the development department (not from a perspective of controls or audits). From experience, it was remarked that the background and experience for a person in this position is very important. For example, a background in data analysis is strongly recommended. Only someone who understands how data are collected, where they come from and where problems could arise, can be a good data quality manager. It is also important that the person is in a neutral position (no link with a certain measure), and has the power to demand for changes in the systems. The

position is in nature more part of the development of the processes, rather than part of the control or audit system. The role is more pro-active.

In the Croatian PA, there is no general quality manager either, but there are quality checks that happen during the process. They stress the importance of this. In order for data to be useful, you have to be sure that the basic data you rely on are correct and trustworthy. From experience, they found that problems can arise when combining data from different sources or different measures, because data can be collected in a somewhat different way. Actions concerning this are followed-up but on an ad hoc basis.

In the Italian PA there is an important role for IT in following up on data quality, however there is also not one appointed data quality manager.

Data sharing

Data is shared on different levels:

- Internal data sharing (possibly constricted by GDPR data agreements)
- Data exchange with other government bodies (via GDPR data agreements)
- Data exchange with the private sector (this is more challenging)
- Open data (via the website landbouwcijfers.vlaanderen.be and according to the EU Open Data Directive)

The most challenging and complicated exchange is with the private sector. A data agreement is not enough for this category, but specific consent from the farmer is necessary. Because this can get complicated very quickly, both for the farmer and the administration, we currently investigate the use of consent platforms that group farmers' consent. There are two platforms being developed:

- DjustConnect: a platform built by ILVO (Flemish Agriculture Research Institute), where farmers can manage their data consents
- Datanutsbedrijf (data utility company): A platform built by the Flemish government that will be created for exchange between public and private partners based on consent, or between two private partners.

Data exchange with private partners is quite new in the Flemish PA, so we are still exploring of how this can be done.

In Croatia, the farmers give explicit consent when applying for funding. The consents are thus collected by the Croatian PA. Data is not shared with private companies.

Furthermore, it is clear that different Data Protection Officers have sometimes somewhat different interpretations of the GDPR. In Estonia, the GDPR applies only to natural persons, not to companies. In Flanders, however, one-man-businesses are treated as natural persons, so the GDPR is applicable for them as well. This is a big proportion of farmers in Flanders. In Italy, the interpretation also changed over time and became stricter. It is agreed that there is no clear black-and-white solution.

There is also the question of how to handle the *reasonable retention period requirement* and *right to be forgotten*. In the Flemish PA, old identification data was recently deleted after years of debating this issue. In practice, this means that all identifiers are erased. In Italy data is kept, because it is legally required and might be needed at some point in the future. If an enterprise is no longer active for more than 15 years, or 15 years after the death of a natural person, the identification data are erased (e.g. name, address, relations, etc.). However the client's number is kept as a central key. Likewise, in Estonia, data that are gathered under the law cannot be forgotten. Legal data should be kept for 10 years, but it is unclear at which point the counting starts. They also still struggle with the question whether older data should be deleted or anonymized. Deleting is complicated, but often data are connected to other data. In all participating PA's the issue of what to do with older data is still under debate and procedures are still under development.

Data sources

In Flanders, several data sources are used, as often as possible authentic sources.

Basic registers:

- Crossroads Bank for Enterprises (CBE): basic data of companies and business units + a unique identification number to each company or business unit
- National Register: registration of all Belgian citizens and residents with a unique identification number

Specific registers (access restricted GDPR-wise):

- Diplomas (via Flemish Education Administration)
- Professional income (via Federal Tax Administration)

- Social security data (via Federal Social Security Administration)

Under investigation for use:

- Private data sources (Agrofood companies, soil analysis laboratories,…)
- Public sources (Social media? Google? Staatsbladmonitor?)

The use of this latter category is still debated in the Flemish PA. There are still some GDPR-related uncertainties. Because there is an imbalance in power between a government and a beneficiary, it is argued that the consent cannot be seen as given freely. The Estonian colleagues remark that Arachne also includes open media data.

Lessons learnt

Everyone agreed on the importance of good data management and a sound data strategy within every organization. It is increasingly important, not only because there is more data available, but also because it is used more broadly.

During the conference, we had some fruitful discussions about:

- how to guarantee data quality and the need of a specifically appointed data quality manager (see above);
- the challenges of data sharing, mainly with private partners, and the use of different data sources (see above);
- what to do with older data and how to handle the right to be forgotten (see above).

From these topics we learned how the challenges are handled in each PA and how sometimes regulations are interpreted in a different way, leading to other decisions or solutions. National law can also differ. For some topics we have come a long way and already stand strong. For these aspects, constant fine-tuning and updates are necessary in a field that continuously changes. Other challenges are newer, e.g. data exchange with private partners. For these challenges, there are often no perfect solutions available. Exchanges of views and experiences from different Paying Agencies and different points of view are extra important for these newer topics. We have learned that we have many similar challenges and that we can learn a lot from each other about how to tackle these challenges.

Subsection 2: extrapolating experiences with “modern technology” from pillar 1 to non-IACS measures

- ***Improves the awareness of the PAs’ staff on existing solutions/potential for solutions in pillar 1***
- ***Points out main learning points of exploring existing solutions that could be applied to other measures***
- ***Shares an idea of possible/desirable future state of using modern technologies to 1) lower error rates, and 2) reduce burden of controls, both for the farmer and the administration***

Background and starting point

The main question in this subsection is how non-IACS measures can benefit from experiences with modern technology used in LPIS. LPIS is the Land Parcel Identification System that identifies parcels with their boundaries, land use/crops, its user, etc. Each year, it is declared by farmers via an e-application. The LPIS has been used for management and control of pillar 1 support for several years in Flanders. Around 1993 the Flemish PA started with a LPIS based on at the time paper maps that were each year digitized by the staff in a GIS layer. From around 2000 onwards, the use of remote sensing (satellite images) for controls started, leading to a Control by Monitoring (CbM) procedure for parcel-based pillar 1 IACS measures from 2018 onwards.

In a Control by Monitoring system, **all** relevant activity is monitored on **all** parcels during the **entire** year. This has significant advantages over the field control system of only 5% of parcels that is done once a year.

Our solution

Data sources for CbM

For the CbM system three data sources are used:

- Copernicus (ESA) satellite images with free access
- Sentinel 1 and Sentinel 2 images (approx. 1 image/5 days)

The easiest to use are the Sentinel 2 images. They are optical with 16 colour bands and have a 10m/pixel size. Several parameters can be calculated based on the images. E.g. a growth index (NDVI) were green indicates strong growth and brown no

growth at a given moment. When plotted over the year, the growth curves of different crops are distinctive and allow to determine which crop was planted on the parcel that growing season. The main disadvantage of Sentinel 2 images is clouds, which obscure the image and make it unusable.

Sentinel 1 on the other hand uses RADAR (radio waves) and is not hampered by clouds. Images are the same size (10-meter pixels) and are recorded with a frequency of 1 image/3 days. The downside here is that the interpretation is very difficult even for a trained observer. It is at this point that Artificial Intelligence (AI) comes to the rescue. AI is very efficient at finding patterns and can be trained to distinguish different crops. Even with data containing some errors, AI is very good at finding patterns and disregarding the errors.

CbM has a lot of potential for reducing workload for controls and at the same time reducing error rates and thus undue spending of public money. E.g. for crop detection, thanks to CbM in Flanders only 0,8% of eligible parcels need a field visit, compared to 3-5% before monitoring, while 96,8% of parcels are verified (instead of the visited 3-5%).

LPIS updates

LPIS has to be updated and improved continuously (removing ineligible areas such as sealed and water surfaces, and identifying permanent features such as greenhouses and fruit trees). For this purpose Sentinel data are not detailed enough, therefore aerial images are used, with a detail of 0,25m/pixel, but a frequency of 1 image/year. At least 33% of the parcels has to be checked annually. This is a very time-intensive task if done manually, which makes it expensive and quality can be inconsistent. Inspiration from self-driving cars led the Flemish PA to dream of digitizing all relevant ineligible features automatically, using AI. AI systems such as Deep Convolutional Neural Networks have a very high accuracy. The disadvantage of these very complex networks is that they require an enormous amount of examples. A solution is to use a pre-trained network, built up of different layers with an increasing specificity. A training data set is created using examples (that are used in several variations for data augmentation purposes), the pre-trained network is re-trained on these examples, used to predict or detect, and in the next phase false positives and false negatives are identified. Training is an iterative process, we thus go through the phase of re-adding

examples and re-training the network several times. With the help of AI, fewer parcels have to be checked manually by the operators, making the process much more efficient. Due to continuous updates using AI, there is also a stark decline in the amount of incoherences in ETS in the last years in the Flemish PA, showing that the system has become more effective as well.

Geotagged photo apps

So far the Flemish PA has not yet used a geotagged photo app, but is looking forward to use one in the future. An app is currently in development, to be launched in 2022. The main advantage that we perceive is that when there is some doubt in a file, additional information to clarify can be asked more easily and some extra field visits will be unnecessary. It is thus more cost-efficient. It also means less burden for a farmer if a control visit can be replaced by taking photos.

In Italy, a geotagged photo app is already in use. If farmers encounter problems with the technology, they mainly ask someone in their circle to help with it. They are currently looking for solutions for mountainous regions, where there is no complete data-coverage and an offline mode of the app is required. They are also working on possible security issues (e.g. detection of fake gps-trackers).

The Estonian PA did not develop a specific app, but started using photos as a way of verification of investments during the pandemic. For them, the pandemic meant an opportunity to develop more ‘smart’ ways of checks.

In Croatia, geotagged photos were also used during the pandemic, but mainly for field visits in the context of administrative checks, much less for OTSCs. They do not have a specific app. The feedback is mixed. Some controllers prefer to stick to ‘the old ways’ and feel more sure when they have been to a place. At the same time, the Croatian PA sees potential in the app.

A challenge when using the geotagged photos is to give good instructions to beneficiaries on how to take the photos and what is required. Farmers tend to mainly take very detailed photos, but an overview picture can also be very useful. Furthermore, sometimes the quality of the photos is insufficient.

The Flemish PA is also investigating whether it would be helpful to make use of the geotagged photos for non-IACS measures. It could be useful as a prove that an activity

took place at a certain location, or to check the specific location of an investment. E.g. for investments the farmer could make a photo of the investment, or an advisor could make a photo during the visit on the farm to prove that he was there, a teacher could make a photo during the lesson to prove that the lesson took place, ... One of the challenges is GDPR when using images of persons.

Reuse of experience in other areas

The experience can be reused for a diversity of (policy and other) purposes, e.g. estimating the amount of solar panels on agricultural land, visualizing the increase of urbanization based on old cartographic maps, detecting permanent greenhouses that are not used, follow up on the percentage of sealed surfaces in a region (hot topic in Belgium), and many more.

More specifically for non-IACS measures, there is some potential for following-up on long-term investments. Certain investments have to be kept for a number of years after subsidies were received for the investment. This is the case for example for non-productive investments (NPIs). Currently, yearly 1% of these long-term investments have to be checked on the spot. With the use of GIS and aerial photos, this number could be reduced for specific types of investments. In a first stage, aerial photos could be used to manually check whether an investment is still in place (e.g. fodder silos), on screen. In a second phase, AI could be used to automate these checks. The advantages are the same as in pillar 1: much less field controls would be required and approx. 100% of files of this type of investment could be verified (compared to 1% now).

Lessons learnt

Use of satellite images proved very successful in pillar 1. More files could be checked with a reduction in control costs, making the CbM more efficient and more effective at the same time. Until now, these experiences have not yet been translated to the pillar-2 context, but we see potential, e.g. for the checks on long-term investments.

A geotagged photo app could be promising in the management of several non-IACS measures to check whether an activity (lesson, advice, seminar, …) took place at a certain moment and time, or to check the specific location of an investment. One of the challenges is that it strongly depends on the ability of farmers to use this

technology. A second challenge is how to deal with GDPR in case one would consider to make use of photos of persons.

Subsection 3: potential uses of data-analytics to improve risk analyses

- ***Improves the awareness of the PAs' staff on ideas to improve the effectiveness of risk analyses***
- ***Points out main learning points on how to use data and data-analytics to improve risk analyses***
- ***Shares an idea of possible/desirable future state of more data-driven risk analyses***

Background and starting point

When selecting a population for on-the-spot checks of non-IACS measures, two sampling methods are used: random sampling and sampling based on a risk analysis. The sampling based on the risk analysis is the most challenging. Except for the requirement of performing a risk-based sampling, there are very few specifications about the risk analysis EU-legislation. Member states have a considerable freedom on how they perform the risk analysis.

In practice, there are several challenges for risk analyses in rural development measures:

- There is a big set of measures in the RDP and every measure is different;
- There are no time series for every year (in contrast to direct aid, where a sequence of years can be compared for a beneficiary);
- Big variety in amount of data and the type of data that is available per measure. For some measures there are only very few applications (possibly with a substantial amount of data per application) whereas other measures have a very large number of applications;
- Setting up a risk analysis for new measures is difficult as you can't test the effectiveness of a risk analysis if you have no data yet.

Our solution

The quest for the most effective risk analysis

The first challenge is how to find a risk factor. Different sources can be used to identify risk factors:

- Data about the beneficiary (link with other companies/beneficiaries, other aid applications, contact details, location, parcels, type of company, activities, etc.);
- Data about the aid application and payment claim (administrative errors, amount of aid, logging of the IT-application, invoices, payments,…);
- Historical data (analysis of the errors that were found in the past).

After performing the risk analysis and controls, it is important to evaluate the risk analysis. It is essential to be critical about the method and factors used, and learn from the errors what works and what does not. Additional information can be obtained from comparing the error rate in the risk population and the error rate in the randomly selected population. The former should be higher than the latter.

How to implement these risk analyses?

In the Flemish PA, a custom built .NET-application called RISK is used to perform risk analyses for risk and random selection for IACS and non-IACS measures. The RISK-application calculates a risk score for each payment claim. The risk score is the sum of the scale values for all risk factors. This calculation is based on 3 principles: risk factors, scale values and weights. Risk factors are the parameters that are considered as relevant in determining the risk. Scale values are used to transform data that looks incomparable to comparable data by assigning a value between 0 to 5 for every value/strata/… Every risk factor gets a weight in order to determine its' importance in the risk analysis. Negative weights decrease the risk score, while higher positive weights, increase the risk score. For every subsidy measure the configuration of risk factors, scales and weights is customised in the RISK-application.

The control agent selects de first X payment claims with the highest risk score for an OTSC. If necessary, a stratified system can be used (first X payment claims per region or per group). Log reports are generated for every calculation that is made in RISK.

Risk analyses in the future

There are several options to improve the risk analyses in the future. The first is to fine-tune and optimize the currently used RISK application, by including new risk factors and fine-tuning scales and weights. Another possibility is to use new technologies or techniques. Some possibilities:

- Data visualisation (check distributions, variability, outliers, etc.);

- Anomaly detection (by a system that learns to identify ‘normal’ and ‘abnormal’ behaviour);
- Community analysis (mapping links between companies/beneficiaries);
- Supervised machine learning (based on historical data, errors from the past).

A important constraint for RDP measures is the availability of sufficient high-quality data. This can be an important bottleneck for using advanced data analytics.

Lessons learnt

A brainstorm was organised in order to stimulate the exchange of ideas between the different member states.

Brainstorm session

For the brainstorm session, participants were split in 4 groups. Two groups answered the questions from an investment-support point of view assuming there is a database with a lot of applications and thus data about the investments, beneficiaries, administrative controls, …

The other two groups answered the questions assuming they manage measure 1 (vocational training). They could assume to have a database with a little amount of projects, with every project consisting of a set of several training courses. There was data about the training centres, courses, administrative controls, … .

Each group was asked to discuss about 3 questions and present the answers after the brainstorm.

1) <u>How would you identify the risk factors in a RDP measure? What are the requirements for a good risk factor?</u>

Several risk factors were suggested by all the groups:

- Type of the project: construction vs machinery, assuming that investments for construction are generally more expensive and could be a higher risk for irregularities
- Financial data of the beneficiaries (e.g. size of company compared to size of investment) + history of changes in the company (e.g. were there changes in the management/address/… of the company just before or after the application was submitted?).
- Are there multiple beneficiaries that live on the same address or a neighbours?

- Result of previous applications: is there a history of mistakes/irregularities. The PA could also take into account if there were mistakes or irregularities in other subsidy measures
- Are there links between the beneficiary and the supplier
- When was the last time the beneficiary was controlled
- Opportunities for human mistakes in the application/process flow. How high is the risk for irregularities in the application (e.g. paper forms vs web application with automated checks).
- How many people are involved in the application. If there are fewer people involved, it might be easier to manipulate something
- Speed of the project: is the timing realisitic
- Has the beneficiary a high income from other governmental sources?
- Applications that were handed in close to the deadline

One group mentioned that it is very important to take into account an experts opinion (e.g. a file handler who is an expert in the measure) as they know the strengths and weaknesses of the measure and the procedures and are able to identify potential risk factors.

There was discussion between groups whether the amount of support was a good risk factor. Some groups argued that bigger amount support is often given to greater companies or a bigger project and one could assume that such bigger projects are managed in a more professional way what could reduce the risk of errors.

An interesting tip from one of the PA is that to check the risk of double funding, it is not necessary to share all the data, it is sufficient to exchange e.g. invoice numbers and amounts with tax authorities. This might limit GDPR issues.

A very useful suggestion that can be used for every measure is to focus on ‘border cases’. E.g. if the minimum threshold to receive support for investments is €15.000, or the minimum number of participants for a training is 10 persons, it is useful to pay attention that are on or close to this threshold.

2) <u>What techniques would you use to implement your risk analysis?</u>

For measures with a small amount of data, one of the groups suggested that the PA could consider to make selections for on the spot checks only by random selection as it's very complicated to make a good risk analysis if there is very limited data available.

Another interesting suggestion was to make heat maps for every measure taking into account the total amount of support for the measure, the error rates, the risk for errors, … The PA could then focus on organising the on the spot checks for the measures that are a higher risk on the heat map instead of performing a risk analysis for every small measure

- Register risk factors in a central risk registry in order to make it a useful source of information for future initiatives (e.g. other measure)
- Create a value x probability x impact matrix and focus on the files above a certain threshold (high probability with low impact or low probability with high impact)

3) How would you set it up, test it and optimise it?

One aspect that was identified as very important is the continuous evaluation of the risk factors. It is important to keep evaluating the risk and identifying potential new ones. A possible problem is that if you identify a possible new risk, the data to optimally check or calculate this risk are not available or not digitalized.

Most of the groups agreed that the methodology presented by the Flemish PA by using risk factors, scales and weights was a useful technique although the biggest challenge is to find good risk factors.

Some interesting suggestions were made on how to evaluate the effectiveness of the risk analysis:

- Continuous analysis of the error rates of the controls (random vs risk)
- For small measures with a low number of beneficiaries the suggestion was made to focus on random selection rather than trying to set-up a risk analysis. PA should also take into account costs vs benefits when implementing a risk analysis in an IT-application for measures where there is only a limited amount of data available.

Subsection 4: the potential of data visualization tools

- ***Improves the awareness of the PAs' staff on the potential of data visualization tools in supporting the management of non-IACS measures***
- ***Points out main learning points of importance of data visualization and exploration for all units within the PA and the need to train and support people to achieve this***
- ***Shares an idea of possible/desirable future state of the more widespread use of data visualization and data analysis within the department and by all operational services***

Background and starting point

Recapping the data strategy of the Flemish department of Agriculture and Fisheries, the department wants to be the authority on agriculture and fisheries for society at large and bring the agricultural viewpoint based on correct and high-quality data (goal 1). Moreover, the department wants insight into its own organisation and processes (goal 2). That is why it wants to enable its employees to research their own data. Furthermore, the department believes in the potential of data analysis to innovate. To remain competitive, it is building advanced data analysis competencies and integrating them into as many of its processes as possible (goal 3).

Our solution

After a market research, the Flemish PA decided to use TIBCO Spotfire. The software is less known than some of its competitors, but is a very powerful and mature product that fits well with the authority, democratization and data-lab strategy of the department.

Goal 1: data visualization to inform citizens (demo 1: website)

In 2021, the Flemish department of Agriculture and Fisheries launched a new website, landbouwcijfers.vlaanderen.be, that publishes data, but also commentaries, explanations and background information to put the data in context. This way the department wants to be the data authority for the sector within society at large. The website is continuously under expansion.

Goal 2: data visualization enabling exploration (demo 2: exploration of financial data)

Every unit or division within the department is responsible for his or her own data research. Therefore, from every unit someone is encouraged to get training in the use of Spotfire and use it for data exploration and visualization.

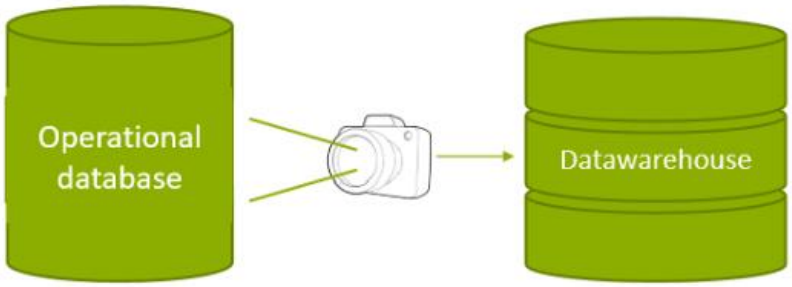
Some uses of visualization are: identifying outliers, judging quantities and proportions, identify big cases/big beneficiaries/beneficiaries that submit many claims, variability within the data, geographic spread over different cities or provinces, etc.

The goal is that for every measure, there is a manager who is trained in data visualization and exploration and uses these skills to improve the measure management. Spotfire is a tool to accomplish this.

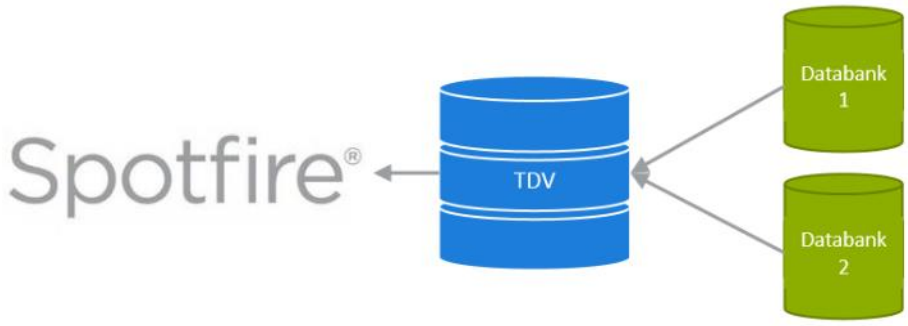
Goal 3: integrating advanced analytics in data visualizations (demo 3: integration of Python/R)

There is a lot of potential for advanced data analysis, but knowledge of Python or R is necessary for the programmer. By integrating those in data visualisation tools the end-user can benefit from the advantages without personal programming knowledge.

Datawarehouses



A physical datawarehouse stores data snapshots within an operational database. A logical datawarehouse however, offers transformed, user-friendly data, ready for analysis. It can disclose more data sources than only the physical datawarehouse.



The TIBCO Data Virtualization (TDV) creates a virtual database based on (several) underlying real databases. It is a logical datawarehouse easy to use and combine data from different sources, and with an extra layer to limit access to sensitive data.

Lessons learnt

Since starting to use the visualization software, the potential for measure management and general organization management has clearly been shown. The Flemish PA is convinced of the importance of integrating data visualization and exploration in processes. The main challenges include:

- motivating staff to take part in training and to remain up-to-date on software use;
- integrating recurrent use in existing processes and freeing up time to do this.

The main advantages are:

- increased insight in data in preparation for risk analysis;
- identifying incongruities that merit further investigation;
- rapid experimentation with different criteria to be used within risk analysis.

Subsection 5: Investment support

- ***Improves the awareness of the PAs' staff on the importance and challenges of a reasonableness-of-costs assessment and the potential of using selection methods to reach objectives***
- ***Points out main learning points of checks on the reasonableness of costs and selection procedures***
- ***Shares an idea of possible/desirable future state of management of investment support measure***

Background and starting point

First of all some specifics about the agricultural situation and investment support in Flanders. Flanders is a very densely populated area, with a very high pressure on ground. This makes it difficult for farmers to acquire new parcels. There are multiple specialties, often concentrated in a region (e.g. the fruit-tree region in Limburg and intensive livestock farming in West-Flanders). The average age of farmers is high, as in many member states. All these characteristics have an influence on policy choices.

Investment support (in Flanders called the 'VLIF measures') are organized in two ways:

- For regular investment support, start aid for take-over, development of small enterprises and non-productive investments the application for aid by the farmers can be done almost continuously. Every 3 months there is a selection of files that will receive funding.
- For projects (innovation projects by farmers, but also by practice centres and by the agro-food sector), there is a system of calls that open with a deadline. These calls are often thematic.

The biggest part of the budget goes to regular investment support for the modernisation of farms (measure 4 in European legislation).

M04 in Flanders

The whole workflow from aid application over approval to controls is digitized. Farmers can upload and see information on their files via a digital platform that is also used internally. This way of working assures that we have a lot of data that is digitalized from the start.

When applying, the farmer has to fulfil many (non-European) eligibility criteria. This allows the PA to target support where it is most needed or wanted. On the downside, it is administratively burdensome for both the farmer and the measure managers. To further make sure that we support the investments that are desired, we use a system of very detailed investment codes. For projects, there are codes for every sub-investment. Projects are thus split-up in sub-investments and can receive only partial funding. There is a long list of codes that is updated every 3 months. Every code has a score for selection and a specific support rate. Sustainable investments receive 30% support, the percentage is raised to 40% when the investment contributes to the climate objective above average, and 15% for other investments. For the 30% and 40% investments, young farmers receive a surplus of 10% support.

The most important advantage of the use of sub-investments and very detailed investment codes is that the most desired (sustainable) investments can be selected and you can really steer the available aid on the investments or parts of investments that you want to encourage. An important disadvantage is the complexity of the files. Because of the many details and distinctions, handling files becomes more complex

(e.g. many invoices are only partially eligible because only certain sub-investments were selected for support). Other aspects of managing the measure also become more challenging, such as the checks on the reasonableness of costs.

Our solution

The Reasonableness of Costs (RoC)

Different systems to check on RoC

The importance of checks on the reasonableness of costs is stressed by the European Commission by considering it one of the key controls. In the implementation regulations, some suitable evaluation systems are mentioned: using reference costs, a comparison of different offers or an evaluation committee. All of these systems have their own advantages and disadvantages and vary in administrative burden and complexity.

1. Three-offers option: This seems to be the favourite of the European Commission, as it is most often promoted. However, there are some important downsides, such as how to guarantee that offers are independent, competitive and comparable?
2. Reference costs: Some problems for this system are the need for a detailed database that is updated regularly and that catalogue prices not always reflect market prices.
3. Evaluation committee: The main challenges here are guaranteeing that there is sufficient experience, that judgment can vary and that it is hard to document correctly why certain decisions are taken.

However, this list is not exhaustive. A Danish study compared the use of historical data, market research and an expert panel to determine Simplified Cost Options, and found out that historical data best reflected true market prices, better than market surveys or expert opinions. The great amount of data that is historically available ensures the robustness of this system. In the Danish study, it is considered the best method for reducing the risk of over- or undercompensation of beneficiaries and thus lowering the risk for the fund. Further, it is easy to document and ensures traceability.

How the problem is tackled in the Flemish PA for M04

As mentioned above, in the Flemish PA works with (sub)investment codes. Because of the large amount of codes, which, in addition, change over time, the checks on the RoC is complex. For 70% of the investment codes there is a reference cost determined

based on market research (e.g. based on the KWIN database by Wageningen University). The reference cost is considered a maximum cost, if an invoice is lower, the amount of support is also lower. For the other 30% of investment codes, we developed an evaluation system based on historical data.

Use of historical data for RoC

The PA has an abundance of digitized historical data. A first challenge is that this data is often fragmented, and we have to check the quality (e.g. how many observations are there for each code, are the units used appropriately?) and characteristics (e.g. is there a reference cost available?) of the data. Therefore, before starting the analysis, some preparation and exploration of the data is necessary.

In defining the dataset to use, some choices have to be made. E.g. we chose not to include renovations because of the high variability of prices, we chose to only include investment codes with at least 5 qualitative observations, and we divided the analysis in investment codes with a reference cost and investment codes without a reference cost. This means that for a substantial proportion of investment codes, we could not use historical data. However, these investment codes only represent a very small number of actual investments.

For investment codes that already have a reference cost, historical data can be used to validate and if necessary update the reference cost. It is possible to detect investment codes that might be under- or overfunded, or where the spread is very high and the use of a different unit might be appropriate.

For investment codes without a reference cost, we can use the historical data to create one. This led us to the development of our RoC-tool (demo), using historical data to develop reference costs. The data that is used is updated every 6 months. On average 15 invoices are used per investment code, which is much higher than the required 3 offers. The robustness can be checked through the variation coefficient. Some very similar codes were merged to get more observations and make the reference cost more robust.

The evaluation of the reasonableness of the costs is based on the 75-percentile (P75), because the median is considered too low. If the support is low, a lock-in effect can be created and it hinders innovation, because more innovative options are often more expensive. It might stimulate farmers to go for the cheaper, less sustainable options.

When the amount claimed in the invoice is higher than the P75, an evaluation is necessary. A higher amount could be accepted if it is motivated (a more performant installation, new technologies, extra features, etc.). If the amount is higher than the P90, a very thorough motivation is needed before the amount is approved. If the motivation is not sufficient, the support is cut-off at the reference price.

There are still some challenges and points for improvement. E.g. what to do with new investment codes, for which historical data is not yet available (or less than 5 observations)? We are thinking of asking farmers in this case to provide 3 offers. We also noticed that for some investment codes the units of measure are not optimal. Furthermore, we want to perform a more in depth analysis of the variation to gain more insight.

Brainstorm on the RoC

Situation in the other PAs: the Estonian PA is looking into a system where the e-procurement system that is now used for public procurement can be used as a platform for private actors as well. The Croatian PA is already using such a system. Investors have to publish the call on the procurement site (for investments of more than 5000 EUR/subinvestment) and all the offers received have to be taken into account (not necessarily 3). The experience from the PA is positive: prices for many investments have decreased. The procurement process takes place before a project is selected for support, but a majority of projects gets financed. The experience from the farmers is less positive. A major disadvantage is that the procedure is quite burdensome and it is complex to write a good procurement call and evaluate it. It also limits the options for a farmer, e.g. if they have an idea of what they want, it might turn out not to be the cheapest option. It is also difficult to factor in other considerations than price, e.g. service provided by a neighbouring garage.

The following questions were asked during the brainstorm:

1. What are the pros and cons of the different systems related to e.g. objectiveness, transparency and fairness, administrative burden (for farmers and for the administration), ease of updating, perception of the beneficiaries, over- or underfunding,… (Systems include: 3-offer system, market surveys/reference price list, historical data, expert panels, SCOs, or other systems.)

2. Imagine yourself working for the Flemish government and somehow kindly steered to the option of using historical data for the SCO option. How do you calculate the SCO? What value do you chose? What do you do with outliers? How do you make sure there is no frustration with beneficiaries because of underfunding, yet also no overfunding? How to update the SCO values? How to tackle new codes?

Many advantages and disadvantages were listed for the different systems.

- Many participants agreed that the 3-offer system is not ideal, although encouraged. It is also not the preferred method for farmers, because it is perceived as burdensome. Many participants find this the most fraud-prone system since there is a high probability of false offers and fraud with offers can be very hard to detect and prove.
- Many participants liked the private procurement option form Croatia. Many advantages there: competitiveness, transparency, you know for sure that the offers are all describing the same investment. Contras are the high administrative burden for farmers as well as for the administration and that a farmer has little decision rights in which supplier he wants to work with.
- One PA worked with a central catalogue with prices for machines. If beneficiaries chose a machine from the catalogue, 3 offers are no longer needed. This unburdens farmers and the machine suppliers do the effort to be included in the catalogue. The catalogue is maintained by an organization independent from the PA. Before inclusion, experts evaluate the proposed prices. This option is much harder for e.g. projects or building costs.
- The option was raised to have a European-wide or at least similar regions reference cost database. Now every member state is facing the same problem, why not cooperate on that for e.g. for neighbouring countries that have a similar living standard.
- A system based on historical data although reflecting real market prices will ask a lot of detail to make investments comparable. Price changes in the market are not so easily followed as with the three offer or procurement option.

The options for SCOs were also discussed:

- If you do all the work to calculate very detailed reference costs, it seems a small step to go all the way and use SCOs, which makes the checking of invoices

unnecessary. There are some drawbacks, however. If you no longer ask invoices, then you lose information to update the SCO. If you still ask invoices, you lose a lot of the administrative simplification of the SCO. When using SCOs you also lose much flexibility, which makes it harder to fund innovative investments.

- It would probably not be allowed to use the P75 as SCO, so the financing would have to be cut-off at the P50 or P60. Thus, the support rate would be lower for many projects than is the case now. On the one hand, this might mean that more investments get funding, but on the other hand, it might stimulate farmers to choose cheaper options and not go for the more expensive but more sustainable or innovative options.

Selection methodology for M04

Some background on the selection procedure in the Flemish PA

Before 2015, there was an open budget, so all the eligible investments were accepted and funded. From 2015 onwards, there was more pressure to use a closed budget and selection criteria (both from the side of the European Commission and the Flemish Inspector of Finances). The main advantage of the use a selection procedure is the higher effectiveness of investment support in achieving (CAP) goals.

In the Flemish PA, the selection score is calculated based on 3 criteria:

- A score on sustainability;
- A deadweight (e.g. payback period), a reflection of the feasibility of the project without funding;
- Age (younger than 41).

The sustainability score is based on a study by Boone et al. (2012) from the University of Wageningen. It also entails 3 pillars: 1) economical sustainability (labour productivity, innovation); 2) ecological sustainability (energy saving, renewable energy, climate mitigating or adaptation, emission reduction, water quality or quantity, etc.); and 3) social sustainability (spatial quality, animal welfare, employment, food safety, etc.). The total sustainability score also determines the subsidy percentage (40% if above a fixed score, 30% if below).

After the calculation of the selection scores (based on sustainability score, deadweight score and an age score), a ranking is made from high to low. The maximum budget is used to select the investments that will receive funding.

The main advantages of a selection system are:

- There is an objective and transparent way to report on different parameters, e.g. what the contribution is of investment support to (European) goals, such as ammonium reduction.
- The technical parameters can be coupled with different investment types, and make sustainability reporting on impact level possible (see further).
- Reference costs can be used for controlling the reasonableness of costs.

The main disadvantage is that it is a very administratively demanding system, both for the applicant/farmer (who needs to give a very detailed description of the investment/project and select the right subinvestments), and the administrative control agent (e.g. invoices must be divided at the level of the investment types).

The environmental effects of investment support

As described above, investment support is focused on sustainability criteria. Because a sustainability score is calculated for all investments, we have a sustainability database that makes it possible to quantify the contributions of most investments supported by the RDP to certain environmental objectives. There are specific calculation methods for each investment type, set-up in coordination with internal and external experts and regularly updated and refined.

This way we have detailed calculations of the effects of individual investments. This information is useful for evaluation purposes, policy development,... However, it is a continuous dynamic project, for which continuous updates and refinements are necessary.

Lessons learnt

One of the big challenges in the implementation of investment support, is finding the balance between detail and simplicity. The Flemish PA works with very detailed investment codes. This allows us to extract very detailed information for evaluation purposes and to target the support to maximally contribute to (sustainability) objectives. More investment codes also mean more accurate data with less variation within each code. This is an advantage for evaluating the reasonableness of costs. On

the other hand, more different codes also mean fewer observations per code, which make the results less robust. While detailed division in subinvestments with a lot of different detailed investment codes increases complexity and workload, simplification might lead to a loss of information, less potential for detailed analysis, more variation and difficulties to determine reference costs, and less information for detailed reports and to support policy choices. Therefore, finding a balance between detail and simplification is essential.

The question was raised if an administrative check on the application before selection is executed. In first applications periods in 2015 this was done, but now it is the responsibility of the applicant. If a mistake is made the applicant can choose to redo the application. In that case the entire first application is cancelled and also a possible good selection result. Since 2018, a warning is given on the electronic locket if a value is entered that is outside the typical range. The reaction of the other countries was that this rather a strict way of working. Concerning the calculations of the environmental impact of investment support it seems it is not an as important focus in their countries.

PART II Experiences of using Arachne risk scoring tool

This part:

- ***Maps the challenges of using Arachne for ERDF projects***
- ***Shares Arachne tested solutions (tips) for ERDF projects***
- ***Gives ideas of using Arachne as the tool in agricultural funds***

The problem

The Flemish PA has not started using Arachne yet, because we still have to clarify some data-protection issues before being allowed to use it. Therefore we invited a colleague from the European Regional Development Funds to give a presentation on her experience with Arachne.

Our starting point

The CPR (EU) No 1303/2013, art. 125 (4)(c) states: "*Managing authorities have to put in place effective and proportionate anti-fraud measures taking into account the risks identified*". For the ERDF a new tool was available, Arachne, an (at the time) relatively new risk scoring tool developed by the European Commission. The objectives of the tool are: 1) to identify the most risky projects, beneficiaries and contracts, links between beneficiaries and contractors, and potential systemic errors; 2) more effective and efficient controls; and 3) to decrease error rates.

Arachne works through an enrichment of internal data with data from external databases (ORBIS, VIES and WorldCompliance). Seven broad risk factors can be calculated: 1) public procurement, 2) contract management, 3) eligibility, 4) performance, 5) concentration, 6) reputation and fraud, and 7) other risks. In addition, a global risk score is calculated. The results are red/orange/green/grey flags for each project. This gives an indication of the risk. Each case has to be evaluated to determine whether there is really a risk for the fund. This is done through a fixed cycle: verification of the file, interpretation and if necessary, action.

In order to do the verification and interpretation, there are several visualization dashboards within Arachne. It is easy to visually list the most risky projects, beneficiaries or contract/contractors, or links between organisations and/or individuals.

The calculations are based on 102 risk indicators. Not all these indicators are always available. If not provided with information, the program will not calculate the associated risk scores.

Some challenges to start using Arachne:

- Technical: data has to be available, an XML-file has to be created, user management;
- Organizational: the MA or PA has to define procedures to implement Arachne in file processing.

Our solution

In the ERDF, Arachne is implemented as follows:

- Data is uploaded approx. 4 times/year. The focus is on project data, public procurement and expenditure. Not all risks are always calculated. E.g. although public-procurement risks are important in ERDF measures, it is not applicable to all projects, so the risk is only calculated when applicable. The Performance risk is a risk that is not very informative in the Flemish context. Mainly innovative projects are funded, while this risk heavily relies on comparison with a 'peer group', which is often not relevant for a new innovative project. A tip for starting PAs is not too include too many data and calculate uninformative risks. This only leads to additional red flags that are not informative, not useful (but extra work) and might skew the global risk scores.
- As output, the top 10 most risky projects are selected.
- These 10 most risky projects always receive an on-the-spot control.

Lessons learnt

Advantages of Arachne:

- In the context of ERDF, the tool makes is possible to comply with the requirements on anti-fraud measures with minimal effort (otherwise an alternative would be needed).
- It is a state-of-the-art tool and continuously refined by the Commission experts.
- It is free (for now at least).
- You can perform quick searches.

- A proportional approach is possible. You do not need all indicators to make the tool useful. You also determine yourself how many risks you verify and how the handle follow-up.
- There is digital storage of project data.

Disadvantages:

- The tool is mainly suitable for companies as beneficiaries, but less if the beneficiary is a natural person or a public body.
- The tool is less informative for non-suitable project types (e.g. when the peer group is not representative).
- The tool generates many ‘false’ red flags and there is no quick way of removing these flags. Feedback can be given through a feedback loop, but this takes time. It is impossible to ‘remove’ a red flag from a project, so next run the same false red flag might appear again.
- There are not enough users (OPs), the more users, the more useful it becomes.
- There is no automatic check on the European SME definition (although the Commission experts are working on this).
- There are only indirect, manual checks on double financing.
- There are delays in the availability of data from the external databases (national data to ORBIS database takes 6 months, from ORBIS to Arachne takes 3 months, and Arachne to the MA takes 2 weeks, this means that the latest information that is used is already months old).

Conclusions:

Arachne is a useful tool that can generate a huge amount of useful information and gives many search options. However, there is room for further improvement (see disadvantages). Some critical success factors are the availability of internal data, training of the staff, and administrative capacity.

Conclusions

In the previous chapters, we presented many opportunities and challenges of new technologies and data for ensuring correct spending of public funds.

First, we discussed the importance of good data management and a robust data strategy. Its necessity was clear to everyone. The main challenges concern 1) data sharing (especially with private partners) and related GDPR issues (and their interpretation); 2) what to do with older data and the right to be forgotten; and 3) developing procedures to ensure good data quality. It was clear that the GDPR rules were interpreted differently in different organizations. It would be useful to get some clearance on its interpretation. Each Paying Agency is also developing its own procedures of how to handle older data. Solutions have to take into account the national laws, so they differ, but an exchange of views on this topic was well-received.

Second, we explored whether it was possible to extrapolate experiences with modern technologies from the IACS measures to the non-IACS measures. Control by Monitoring using satellite images has many advantages, but cannot readily be extended to most non-IACS measures. Difficulties include: 1) evidently satellite images cannot be used for the many non-areal based measures; 2) a robust set of data is necessary; 3) investments might not be visible with the Sentinel data, requiring aerial photographs, that are not yet available when needed. However, there is potential for specific non-IACS checks, e.g. for certain long-term investments, such as non-productive investments. There is also a lot of potential for the use of geotagged photos.

Third, the use of data analytics to improve the effectiveness of risk analyses is discussed.

Forth, in the context of the usefulness of data visualization tools in supporting the management of non-IACS measures, a demonstration was given of the software TIBCO Spotfire. We stressed the need of good training and support of the staff using these tools. Decent data analysis skills will become more and more important within all divisions/services in the future and should not be reserved only for IT people. The training of (operational) staff is therefore very important.

Fifth we zoomed in on the investment measure (M04). We discussed the different methods and challenges of a reasonableness-of-costs (RoC) assessment and the potential of using selection criteria to reach objectives. 1) For the RoC checks, we

found out that many Paying Agencies struggle with the same difficulties. It was very useful to exchange views and experiences. It was clear that the perfect method does not exist and that a combination of methods might actually give the best results. However, this makes the system even more complicated. A lot of potential is seen in the use of historical data, but it is unclear how this is evaluated by DG AGRI. 2) In the Flemish Paying Agency an extensive selection procedure is used to select subinvestments for funding. Examples were given of the advantages of this method. A mayor challenge is finding the balance between detail and simplicity.

Last but not least, we exchanged experiences with the risk scoring tool Arachne. Although all participants saw potential in the tool, some important challenges remain: 1) the tool is mainly suitable for projects and companies as beneficiaries, limiting the usefulness if beneficiaries are mainly natural persons or public bodies; 2) the tool is less useful if there is no comparable peer group; 3) many ‘false’ red flags are generated, which make it harder to identify the ‘real’ risks; 4) there are only indirect, manual checks on double financing; 5) there are delays in availability of the data in the external databases.

Most of all we concluded that exchanging experiences and ideas across different member states is truly enriching and allows oneself to put your own frame of reference and assumptions into question and open the mind to consider new possibilities.