Smart Pro CAP

SMART PROtection of the EU financial interests in the field of CAP

A compendium of ideas on experiences of using data-driven approach and ARACHNE risk scoring tool to protect financial interests of the EU`s Common Agricultural Policy

Flanders
is agriculture and fisheries

(FLANDERS-BELGIUM)

AGENCIJA ZA PLAĆANJA U POLJOPRIVREDI, RIBARSTVU I RURALNOM RAZVOJU

(CROATIA)

AVEPA
AGENZIA·VENETA PER·I·PAGAMENTI

(VENETO – ITALY)

REPUBLIC OF ESTONIA
AGRICULTURAL REGISTERS AND INFORMATION BOARD

(ESTONIA)

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Content

Introduction

Good reader! This set of ideas is the result of an exchange of staff and exchanges of best practices between CAP paying agencies participating in the Smart Pro CAP project. The project took place from 01.01.2021 to 31.03.2022 and was financed by OLAF under the Hercule III program together with the Agricultural Registers and Information Board (ARIB), the CAP paying agency operating in Estonia. In addition to the Estonian paying agencies, the Flemish paying agency from Belgium (VO - Dept. LV), the Croatian paying agency (PAAFRD) and the Italian paying agency in the Veneto region (AVEPA) were involved in the project. Gianluca Frinzi, DG AGRI's anti-fraud correspondent, was also present at the final seminar of the project.

The main goal of the project was to collect and share different smart data-based practices that would help protect the EU's financial interests in distributing the CAP funds. Classically data-based risk analysis is known as an obligatory practice that protects the EU's financial interests. The required control samples are based on a data-based risk analysis. The current strategy of the EU Anti-Fraud Strategy also calls for the wider use of data to enhance the protection of financial interests.

As it turned out during the project, the modern data-based approach must distinguish between the classical data-based approach and the modern use of data based on machine learning and artificial intelligence. Moreover, as modern AI-enhanced use of data provides new and even surprising opportunities to strengthen the prevention of protecting the EU financial interest.

As participants repeatedly admitted, dealing with modern ways of using data, there is even no need to use the words like "fraud or irregularities" while at the same time dealing preventively mitigation of the risk of harmful practices or misuse of EU funds.

More data-driven approach- needs historical data in time series. Data is an objective category, and a more data-driven approach raises transparency which is one of the most effective factors of reducing the risk of misusing the EU funds.

Modern machine learning and AI-based data open new perspectives and urge us to develop unseen proactive administrative procedures which ultimately increase preciseness, objectivity, transparency of sound use of the EU CAP funds.

A good example of the EU`s readiness to accept the AI-based design of new result-based approach of CAP can be seen in IACS based interventions, where the Area Monitoring System (AMS) system enhanced with an AI-based automatic monitoring system must be set up during upcoming CAP period before 2027 in all member states.

Of course, there are a number of challenges associated with the use of modern machine learning and AI-based data use. For instance, there is a need for common understanding and interpretation of GDPR rules up to a general readiness to accept (even partially) AI-made decisions or recommendations for financing.

This compendium of ideas was originally intended to be published in the format of a handbook. When compiling the collection, it became clear that based on the presentations and discussions made during the visits, an inspiring collection of ideas would be formed instead of a clear step by step instructional handbook.

Rather than a formal handbook format, the collection of ideas should encourage all readers to experiment and also to fail in the use of modern data at different stages of CAP rural development support and to share their experiences with others. One part of modern machine learning and the use of data through artificial intelligence is the teaching of models. Failure is also an integral part of the teaching process. The more experience you share in this, the greater your chances of success.

A separate topic was also the exchange of experiences between CAP paying agencies on the use of Arachne risk scoring software developed by the EU. Arachne definitely needs to be developed to better fit the needs of the CAP. The common line was to suggest that the development of Arachne's risk scoring functionality could be more focused and focus only on scoring those risks that are more related to the strengths of Arachne i.e. global business and personal networking and connections with the EU funding.

As the one aspect that was researched during the Smart Pro CAP project was using modern Machine learning and AI-based data analysis, we found that risks are evolving but Arachne`s wide variety of rule-based risk has a tendency to be too static. Therefore it might be interesting to develop Arachne more AI-based as it is already using bankruptcy scoring according to VADIS AI-based methods.

During the Smart Pro Cap project, it was tested using historical data for predicting control samples by AI instead of human rule-based risks as also AI-based selection of EU aid-applications instead of formal humanly carried out the process. In both AI was more effective!

This compendium is structured into two main sections.

The first section gives a general overview of modern data-driven approaches and their prerequisites and is divided into 3 subsections. The first subsection gives an overview of experiences of different integrated systems in agencies that are drivers of data-driven approaches to find smart ways of protection of the EU financial interests. The second subsection covers different important aspects which are important to bear in mind while developing a data-driven approach (i.e data adequacy, quality etc.). The third subsection shares practices and ideas hoe the classical or modern data-driven approach has been or might be used for smart protection of the EU financial interests.

To describe classical or modern data-driven approaches of protecting the EU financial interests in the field of CAP we tried to visualize on the next scale of preventive and detective measures taken. In the following scale, it can be seen that throughout the whole lifecycle of the EU aid application process data-driven approach has a wide variety of uses. The earlier measures are taken and data-based approaches launched the more preventive and proactive and softer they are going to be and less vulnerable to the partnership with applicants and beneficiaries which is clearly a positive trend if look at the new perspectives and approaches proposed by European Commission as it is a result-oriented new delivery model for CAP. On the next scale (see figure1) also some options of data-based approaches are marked which are going to be explained in this compendium.

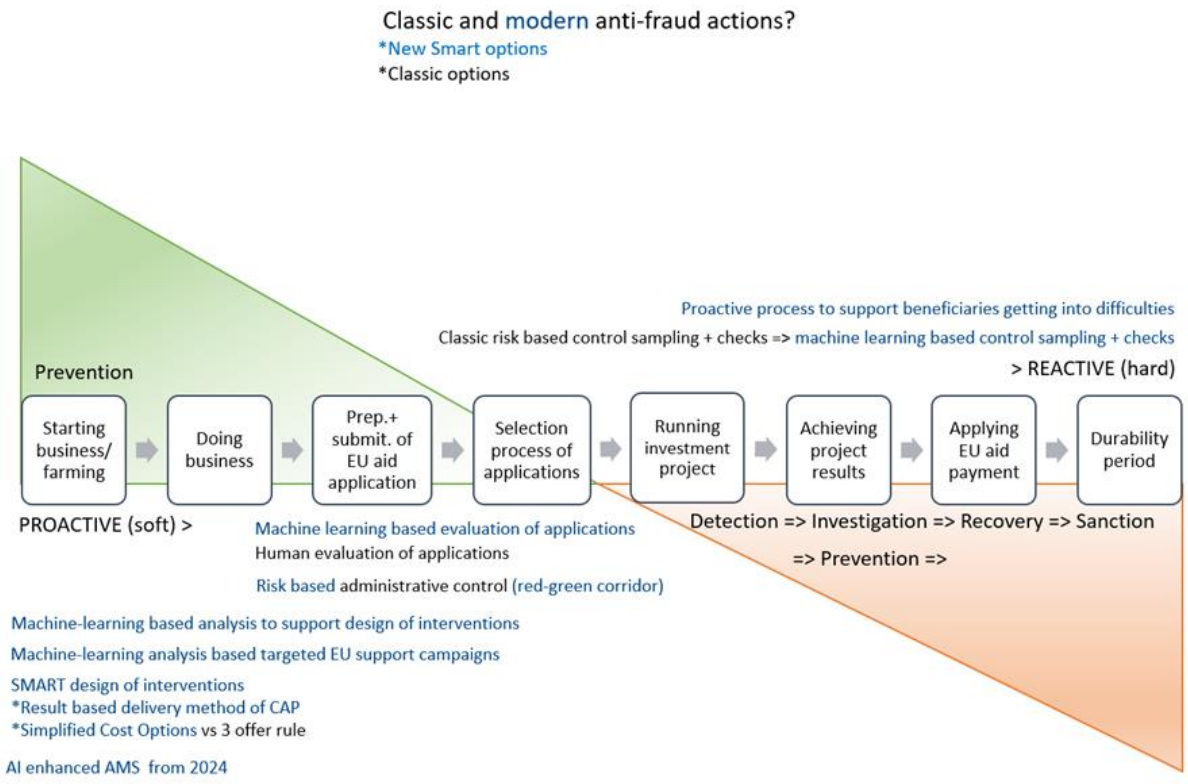


Figure 1

The Second main section is dedicated to the experiences of Arachne by participating paying agencies. Regarding Arachne our goal was to map the weaknesses and strengths of Arachne for CAP needs and the perspectives of its improvements.

As project partners and DG Agri concluded, this focused thematic working format consisting of different paying agencies is a very effective method of deeply researching specific topics and building up stronger networking across EU paying agencies. It is also foreseen by the HZ regulation 2021/2016 in article 13, that the Commission shall promote the exchange of best practices between the Member States, in particular as regards the work of the governance bodies.

As it was demonstrated repeatedly during the Project, effective prevention to protect the EU financial interests starts already from the design of the interventions and policies. So it was found that cooperation for finding best practices of using modern data-driven approaches should not be only the matter of the OLAF or Hercule program initiatives and it would be highly welcomed if such an initiative is taken by DG AGRI.

Most of all we suggest readers be open-minded and feel free to contact paying agencies involved in the Smart Pro CAP project.

The project partners at a glance

Indicator	AVEPA ITALY	PAAFRD CROATIA	ARIB ESTONIA	Flanders-BELGIUM
Implementing funds	EAGF, EAFRD, ERDF, National, Regional	EAGF, EAFRD, EMFF, national	EAGF, EAFRD, EMFF, national	EAGF, EAFRD, EMFF, national
Number of employees	379	748	335	600
Number of single payment applications	63747	110951	14500	38000
Amounts paid in 2021, €	543,754,920	1,157,410,347	338,063,303	346,615,091
Amounts paid in 2021 for EAFRD, €	153,272,854	432,153,689	109,302,561	92,423,278
Number of RD irregularities 2016-2020 (PIF2020)	715	113	168	55
EUR of RD Irregularities 2016-2020 (PIF2020)	81,070,472	4,636,243	8,053,817	1,393,796
IDR (Irregularities detection rate) for RD2016-2020, (PIF 2020)	1.46	0.4	1.49	0.45
Number of RD suspected fraud 2016-2020 (PIF2020)	27	9	28	0
EUR of RD suspected fraud 2016-2020 (PIF2020)	3,312,383	1,453,557	5,572,692	0
FDR (fraud detection rate) for RD2016-2020, PIF 2020	0.06	0.13	1.03	0
ISO 27001 certificate	YES	YES	YES	YES

Keywords (Word cloud)

List of acronyms

AI	Artificial Intelligence
AMS	Area Monitoring System
ARIB	Agricultural Information and Registers Board (Estonia)
AVEPA	The Venetian Payments Agency (Italy)
CAP	Common Agricultural Policy
CbM	Control by Monitoring
EC	European Commission
EU	European Union
GDPR	General Data Protection Regulation
IACS	Integrated Administration and Control System
ISSP	Structural Support Information System in Croatia
LPIS	Land Parcels Information System
MDS	Master Data Service - component of SQL Server for master data management
ML	Machine learning
MS	Member States
NDVI	Normalized Difference Vegetation Index
PA	Paying Agency
PAAFRD	Paying Agency for Agriculture, Fisheries and Rural Development Agency (Croatia)
RD	Rural Development
Vlaanderen	Flemish Paying Agency (Belgium)

Section 1 - Modern data-analysis opportunities

1.1 Integrated systems supporting modern data-driven approaches for sound management of EU funds and anti-fraud actions - system

1.1.1 Data management and quality as basis for any data related actions

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 organisatsion. We discussed elements of data strategies, data quality and some challenges concerning sharing data, data sources and the GDPR. As the main conclusion we state that **it is important to develop a modern and robust data management plan and an explicit data strategy within each organisation**.

Data comes from different sources, so it is important to notice:

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

In order to ensure data quality, we identified 2 main approaches for project participants:

- the quality checks are mainly embedded in the processes;
- general data quality manager with proper abilities and power to demand for corrections and changes in the systems.

These approaches can be used in a mixed manner.

1.1.2 Integration of data and processes as the primary source of innovation in the sound management of EU funds and anti-fraud actions

Integrated risk management, Estonian sample

At the beginning of the programming period of 2014-2020 ARIB was at the point when we decided to start using a more proactive approach to fraud detection and bring risk based samples to new levels through promotion of data-based risk analysis.

Also the need for data-based risk management in aid management processes came from the developments in fraud detection processes - in order to detect fraud we need smarter processes since there is never enough resources to deal with every application in depth fraudulent cases require. So finding risks and scoring applications led us to the red-corridor approach and helped finding fraud more easily.

At this point in time the whole risk management process in ARIB was functional but fragmented, risks were assessed formally and they were not the real basis for management decisions. Making

new developments in aid related risk management gave us the chance to gradually improve the whole system.

By 2020 ARIB has risk management system that consists of six elements:

- Work environment risks - based on national law.
- Operational risks - based on accreditation criteria.
- Information security risks - based on ISO standard.
- Data protection risks - based on GDPR requirements.
- Risks related to aids.
- Risks to registries.

The risks related to aids and registers are based solely on data analyses, the rest of elements use data when it is available (e.g. information security has input data on the number of data security incidents). All these elements are included in annual risk analyses showing to the organisation the developments and findings of all risk management areas. Annual risk analyses also binds these elements into one unified risk universe of ARIB which shows in a visualized way all areas and risks of ARIB, also changes between years can be observed in order to evaluate the changes occurring and it also helps to prioritize mitigation activities.

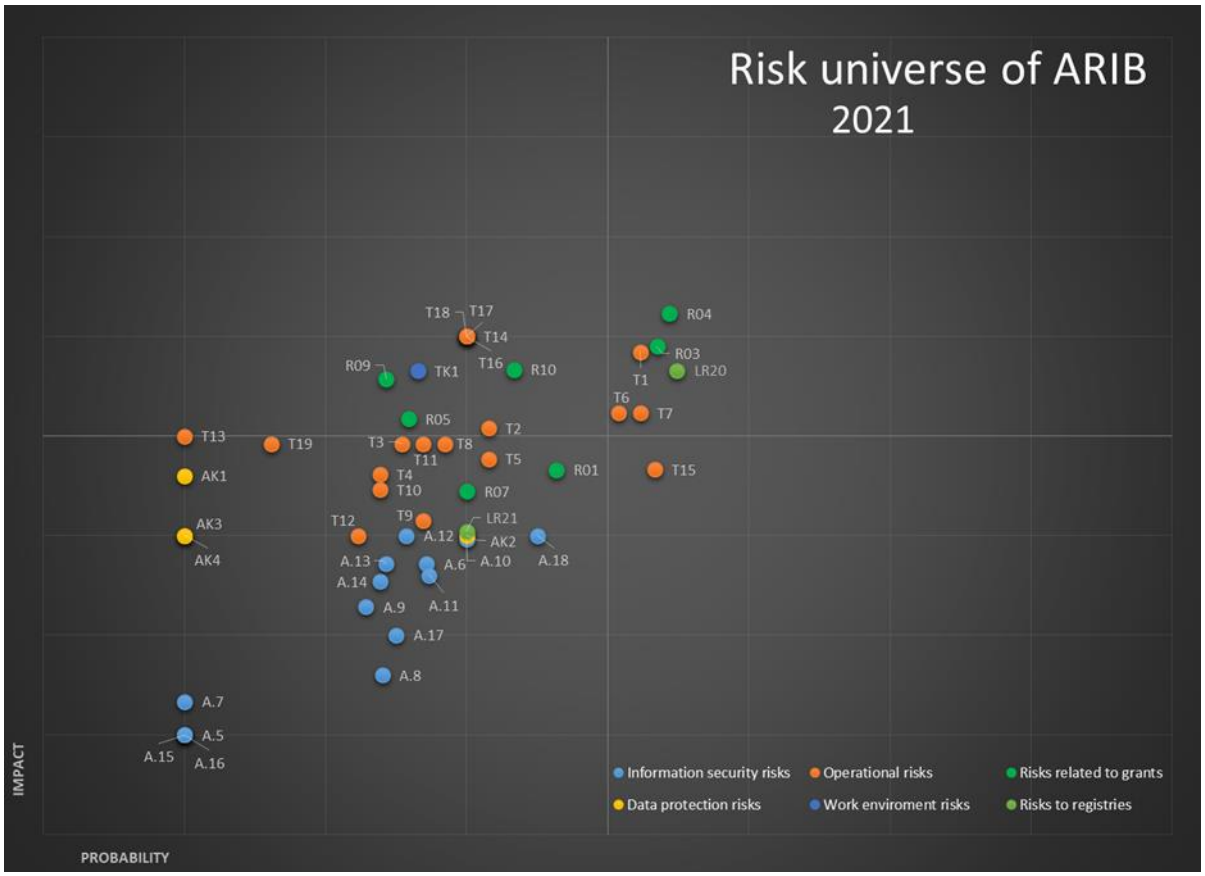


Figure 2, ARIB´s Risk Universe

Annual risk analysis gave us a chance to integrate all the elements of risk analysis. Concise and visualised manner of this document grew the interest of all parties in the organisation to understand the nature and results of risk management. Therefore in order to raise awareness all elements of risk management were all gradually included into one. It was easier to do so since we had had a principle of using the same scale in risk assessment for all elements prior to integration info annual risk analyses.

The second step in making integrated risk management more practical was to integrate mitigation activities into the annual working plans of the units. This process was supported by a project with the aim to map and describe the entire management system in a single management system description. Through this document, all elements of the management system like strategy, budgeting, work plans, risk management, etc, were tied together and described as a management year clock and it is the basis for all managers' working plans. This added the actual requirement to use the results of risk management in daily processes.

The main issue of the data-based approach is the issue of data availability. On the one hand, the IT systems designed for processing of aid applications and saving audit trails may not be as good for data analyses - the data may be saved in a format that is not analyzable or all kinds of real-life special situations are stored differently so the data cannot be used uniformly and directly for analyses. And on the other hand, in order to do quality data-based risk analyses you need more data than just data from aid implementing IT systems have.

Also, this is an issue of constant change of actual risks - risks cannot be constants once made up and only weighed regularly. Especially in fraud prevention where fraudsters always think of new ways to unduly receive funds from aids. It means that risk management systems must be very flexible and always look for new trends and information. This also makes it difficult to automate risk scoring as by the time something is automated it might already be expired.

Processes of integrating all risk management elements and integration of the risk management as a whole into a comprehensive management year clock have made the whole risk management system a practical working tool but the data-based and visualized presentation have made it more easily acceptable for managers to use.

In the future we see the annual risk analysis to grow even wider in range as not only data analysts are building its contents but the results and findings will be analysed by a wider range of parties who have used data-based input in their work.

Farm register, Italian sample

When they want to apply for a request for support, farmers must supply to the Payment Agency several data concerning their activity (i.e., crop cultivated, animal breeder, machinery owned, buildings available, people) and if they want to apply for several requests, they must replicate these data each time. This situation can lead to mistakes in filling the requests and at worst makes it possible for unreliable applicants to declare voluntary wrong data in a part of the requests, in order to show a farm situation different from the reality. Beside this, there is often a repeated activity in checking the same data for different requests and a resulting heavier burden for inspectors.

That is why a farm register was set up, which was legally established in 2000. Simplifying, Farm Register represents the photograph of the farm - It is the sum of paper documents provided by the farmer, with various information he can declare and the data that may be available on several databases managed by public authorities. Farm Register is also a platform that is strictly linked to internal and external databases that are available in the PA organisation.

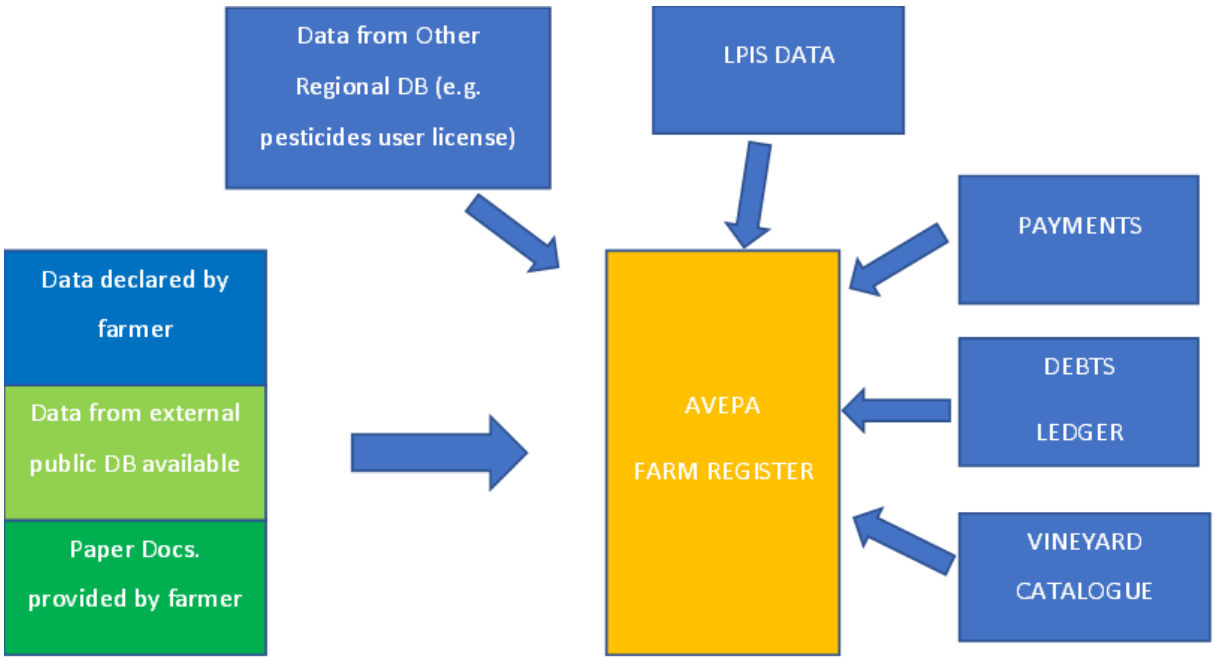


Figure 3

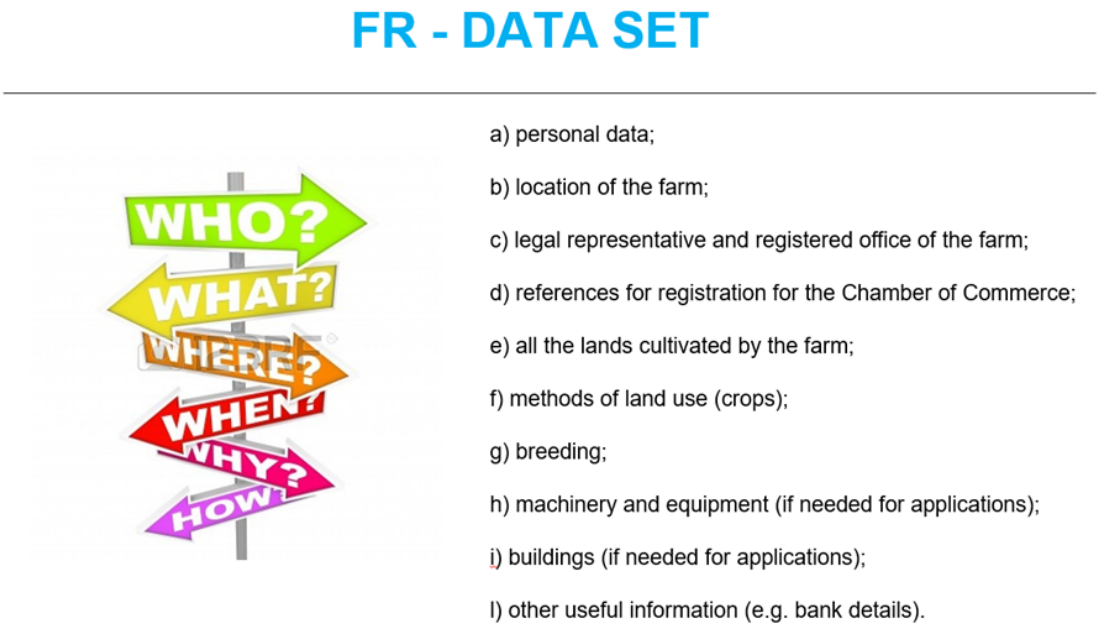


Figure 4

The use of a tool like Farm Register allows some specific advantages in the organisation of AP activity:

- data are declared by farmer and uploaded only one time;
- different applications may use the same data;
- ease applications checks;
- ease the checker officer activity;
- ease accounting unit activity;
- flexibility and its development.

To conclude - the experience of the Italian Farm Register system demonstrates the importance of the collection of data from integrated and complex systems where also data quality and adequacy is guaranteed. As we see in further sections, historical data series in good machine readable quality is a very important prerequisite to develop modern data driven procedures as also protection of the EU financial interest.

Importance of central reporting module OLAP, Croatian sample

In 2018 the Agency began with development and implementation of the OLAP reporting system for non-IACS rural development measures. The reason behind it was the growing amount of data and the need to link and consolidate it.

Looking at the data from 2015 to 2021, there has been a considerable increase in the quantity and quality of data collected. Moreover, the use of OLAP has identified certain errors in the system itself, shown good practices in data collection and enabled more complex analyses and decision-making based on up-to-date and accurate reports.

The primary result of the development of OLAP is a very significant acceleration of the business processes of the Reporting Service and the up-to-dateness and accuracy of reports. It is possible to prepare specific reports for different analytical needs of different ministries, universities, organisations and other interest groups. Decisions and policies are not based on quickly available up-to-date and accurate data.

The response to new reporting requirements is the growth, development and connection of databases in the coming period. In addition to giving solutions concerning reporting, linking and further development of databases will lead to the automation of certain processes, reduction of possibility of errors and overall increase the quality of the administrative process and ex-post analyses.

Extrapolating experiences with "modern technology" from pillar 1 to non-IACS measures, Belgian sample

The experience in LPIS developments, CbM and geo-tagged photos 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 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).

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, etc) 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 making use of photos of persons.

Towards data-oriented organisation, Belgian and Estonian sample

In order to take advantage of the possibilities, data is giving it is wise to create a systematic approach to data-driven organisation as a strategic goal. Usually the problem without it is that the organisation has lots of data but it is fragmented between different units which make it challenging to use horizontally. But with scattered use, there are blindspots in processes (e.g. collection of the same data from beneficiaries which gives fraudsters a good chance to design it to be more appropriate) and no new knowledge is formed from data.

Belgian sample. In 2016, it was realised 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. 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. To combine databases the option of a logical data warehouse was chosen over a physical one. This led to the option of wider data sharing within the organisation, other government bodies and the public.

Estonian sample. In 2020, the ARIB's new development plan was laid. As an information agency (reference to the name of ARIB), focusing on the data-related direction was one of the main topics. The existing central analysis unit and data warehouse provided a good starting point for this. Thus, one of the directions of the ARIB 2022-2027 development plan is knowledge services, the aim of which is to provide knowledge services based on different data sources in the entire field of rural life. This means high-quality open data on the one hand, but also personalized services based on the data and circumstances of a particular customer. For example, fertilizer recommendations, calculators, benchmarking etc. One of the first steps towards this goal is the agricultural big data Project which was started in 2021 and has the aim of connecting data from all rural authorities Under the Ministry of Rural Affairs.

1.2 Data need for new approaches - adequacy, usability, structuring and quality of data.

When there is need for development in cases of data analysis, manipulation and visualisation, there are always steps that need to be figured out and dealt with beforehand. It is important to keep in mind the long term goals when dealing with data. From the paying agencies who have been participating in this project, all the developments have started with problems with data usability, quality, accuracy or structure of data. Those are the main pain points that usually lead towards new approaches and developments. But in order to take new software, approach or business processes into use, it is important to solve these issues beforehand. That is one of the reasons why the development process is a time consuming process.

Data strategy and philosophy in organisatsional and EU level

One of the most important steps to figure out is the data governance and strategy of the whole organisational level. The Flemish PA case was that data was handled separately in every unit or division. 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. One of the strategic goals was to become a data-driven organisation and another to be authority of data for the agricultural and fisheries sector. Therefore, a central 'Clients and Data' unit was created with members from all divisions, the Data Protection 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 different divisions.

The Estonian PA has also started to move towards becoming a data-driven organisation as the new strategic plan is to develop data-driven knowledge services for all clients and shareholders who have any relations with living or making business in rural areas or in agriculture. These data-based services have a higher purpose of developing smart support schemes in the future. Data-based knowledge services are also supporting the digitalisation of agriculture and helping to achieve EU Green Deal goals. Another hidden purpose it serves is preventing fraud - it will be much more difficult to manipulate with data when there are more and more data sources and new linkages between different systems involved.

In order to introduce data-driven strategy within the organisation it is highly relevant that the general strategy of the organisation is known and understandable to each organisational level. **Moreover, the organisation's management should understand and support the needs of data-driven strategy at a general level.**

In addition to organisation, it is highly relevant to receive support and unification of approaches from the European Commision in order to harmonize different interpretations of GDPR (General Data Protection Regulation) and data protection matters (such as reasonable retention period requirement or right to be forgotten) in different paying agencies. If these preconditions have met then the data-driven strategy will have higher impact in the long term.

Data structuring

One of the most common and difficult challenges when establishing data-driven strategy is the structure of data. There needs to be a systematic way to analyse and interpret data. As the data serves different purposes depending on the activity or reporting, it also has to be consolidated and follow the same structure. Data consolidation should be taken into consideration in all measures and systems used.

The Croatian PA started to develop the OLAP reporting system for non-IACS rural development measures in order to report accurate and up-to-date data in order to provide knowledge from the data. The development led them to consolidate and link their data with other systems and data sources. They used a data labelling system, where all labels were unified. As part of their integration process within different systems (ISSP, register for Agricultural Holdings, Module for Payments Approval) through OLAP cube, they needed to start structuring their data. The labels on the data were harmonized where possible. All lists from all Calls for a particular term (taxpayer, education, type of investment etc) were taken and mapped to have a uniform output depending on the beneficiary's response. Additional codebooks and additional data were created in the MDS (Master Data Service - component of SQL Server for master data management, MDS allows the creation of a centralized data source that will be synchronised with the applications that processes those data, in this case - the OLAP cube) to show the requests per sectors, object of investment, capacity and other parameters. The result of the development was up-to-date and easily accessible on-demand financial reports concerning project/beneficiary/operation/sub-measure/measure or programme. They have used OLAP reports in their daily processes, such as OTSCs, input for data visualisation and preparing specific reports for different analytical needs etc. In the future they are expecting that it will provide even more possibilities and opportunities.

One of the learning points of dealing with data structure after data is already gathered, is that **analysts or specialists who deal with data reporting, statistics and analysis should be part of the data structuring process as early stages as possible**. Therefore, the problems and issues regarding data structure can be mitigated or even eliminated before they arise.

Data adequacy

In order to keep in mind that the data in systems should be up-to-date and most accurate, integration between systems is essential. The Croatian PA example of integrating their ISSP system with Agricultural Holdings register helped to deliver fast, up-to-date and easily accessible on-demand financial reports concerning project/beneficiary/operation/sub-measure/measure or programme. It was not sufficient, but pointed out the errors that occurred and needed to be dealt with.

Previously many PAs have experience with different registers that are kept in separate Excels and not integrated in the system. The Croatian PA had historical data about processing manual calls and with developments, which they transferred to MDS. The data was mapped and unified depending on the beneficiary's response. Additional codebooks and additional data were created in the MDS to show the requests per sector, object of investment, capacity and other parameters.

ARIB also has historical registers that are not managed within the IT system. In one of the last development projects (EU Structural Funds financed IT development project to enhance the protection of the EU financial interests) some of these registers are being integrated into the IT system, such as risk assessment for administrative checks or administrative investigations.

Integrating these into the system helps to reduce the administrative burden, but moreover to store the data within the system and get accurate and up-to-date data from one source.

Data linkage is one of the topics that is directly related to data structure and integration process. **For the data to be accurate and adequate, the system has to have synchronisation with other related data sources.** In AVEPA's example of the National Farm Register and their national Regional Paying Agency Farm Register (SIAN) there is a synchronisation going on both ways. More specifically, when a register is validated, within 5 minutes the synchronisation process starts. This process concerns the single register. SIAN will check the incoming data and if everything is in order, in a few hours the data will be viewable on that system. If there is something wrong (for instance the register is not under our competence) detailed view of the problems encountered will be shown in a special farm register section. The second type of synchronisation is scheduled every night and it concerns a massive updating of some data for all the registers.

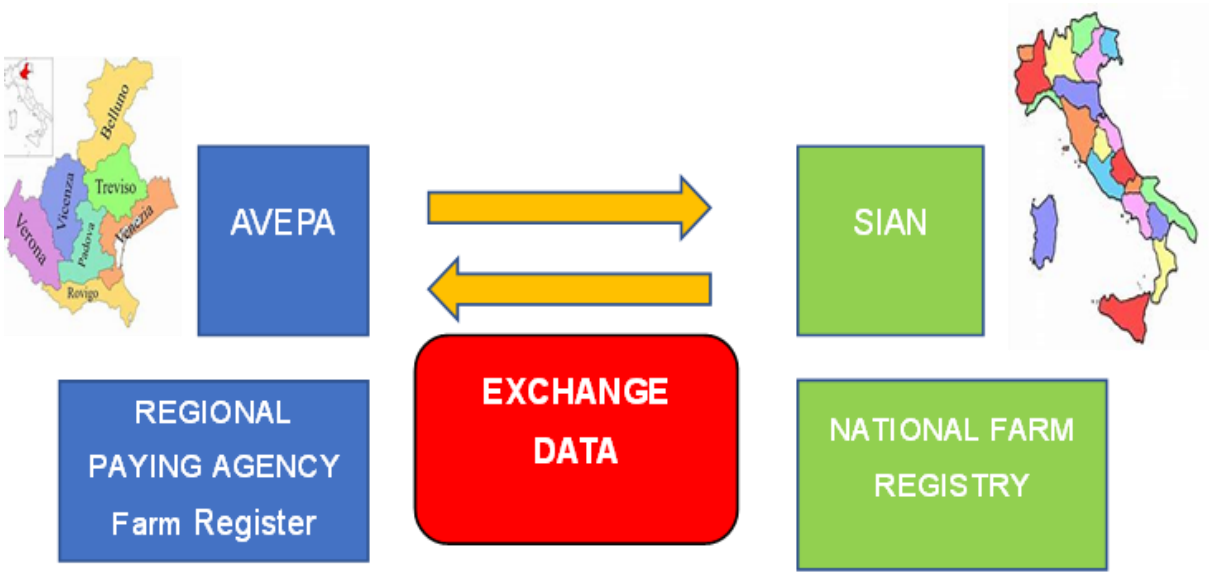


Figure 5, AVEPA's data linkage with national Farm Registry

One of the challenges of having accurate data is the quality of data. In AVEPA's case the farmer is directly responsible for the data quality as he should make sure the data is valid and accurate in the National Farm Register if he wants to apply for funding. This is beneficial for both - for AVEPA and the farmer, because the data is uploaded once and can be used in different applications. **Dealing with data quality in the early stages reduces the risk of manipulating data when considering different funding schemes.**

In ARIB's case there is a data quality manager responsible for the quality of data. He is part of the development department and in a neutral position (no link with certain measures) and has power to demand changes in the system. In Flemish PA, AVEPA and the Croatian PA there is no specific person responsible for data quality, but there are processes that involve making sure the data is in high quality. In AVEPA the IT department has an important role in following up on data quality.

For making sure that the data is in high quality and accurate then one of the ways to ensure it is to use automatic checks between the system or data sources. In AVEPA's case Farm Register makes automatic checks when data loading is considered completed, regarding the applications the farmer wants to apply and the available data on external databases. For example, Tax Agency, Land Registry, National Veterinary Service. In ARIB's IT system there are also automatic checks

used for checking if the data is in compliance with external sources. ARIB automatic checks are done against Land Register, Business Register, Population Register, Building register etc.

Data sharing

Data sharing is becoming more relevant in terms of using information from different sources instead of collecting data for every application. All the paying agencies that were part of this project had gone through data exchange with both internal and external data sources.

AVEPA introduced their Farm Register, which is an example of using information from different data sources. Their data sharing is through integration between internal and external sources and is synchronised once validated.

The Flemish PA is also exchanging data with different sources, such as government bodies, internal data or with the private sector. 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 both for the farmer and the administration, the Flemish PA is currently investigating 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.

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. This also becomes an example of how interpretation of the GDPR rules becomes more important.

There are also different approaches for reasonable retention period requirements and the 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 is 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 is 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.**

As exchanging data with different data sources (both internal and external) becomes more important, all the paying agencies in the project have agreed that it is essential to keep these negotiations and processes under development. Synchronizing and linking data with different sources helps to decrease manual workload as well as mitigating the manipulation risks, which helps to protect the EU's financial interests in the long term. Data-driven approach reduces subjectivity in granting of support.

Different interpretations of regulations is another area that requires further consolidation and investigation between the member states and European Commission.

Popularization of data

Once the data-driven strategy is implemented and thriving, it will become more important how the data is interpreted. **In order to facilitate the interpretation, data visualisation and reporting become an essential part in popularizing data to different shareholders.**

The Flemish PA showed their data visualisation and reporting tools, one of them was TIBCO Spotfire. They use it for data visualisation, moreover identifying outliers, judging quantities and proportions, identifying big cases/big beneficiaries/beneficiaries that submit many claims, variability within the data, geographic spread over different cities or provinces etc.

The Flemish PA also introduced data mining tool Orange Data Mining. This is a tool used for advanced data mining and modelling processes. From their case example the results were that model predictions worked very well compared to historical data results.

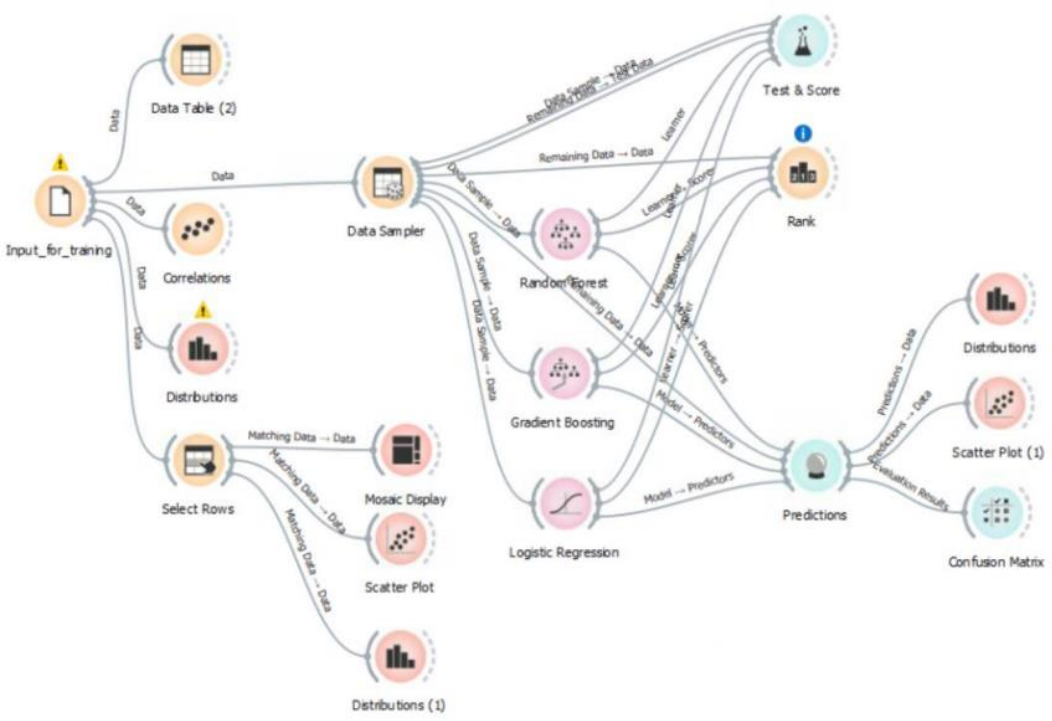


Figure 6, Orange Data Mining tool example

ARIB is using Microsoft Power BI for data visualisation. The system behind that is that only the results of data visualisation are shown to shareholders. Although, while visualizing the data, different shareholders who know the content are involved in the process.

There is often a disconnect between the shareholders that have the know-how and context of the data and data analysts who have experience with data collection, analysis and visualisation but may not know about the context. While data analysts are responsible for the graphs, there is a threat that data analysts don't know the actual meaning of the data that well, but Estonian experience is that there should be one central unit who should be responsible, specially when errors or anomalies occur.

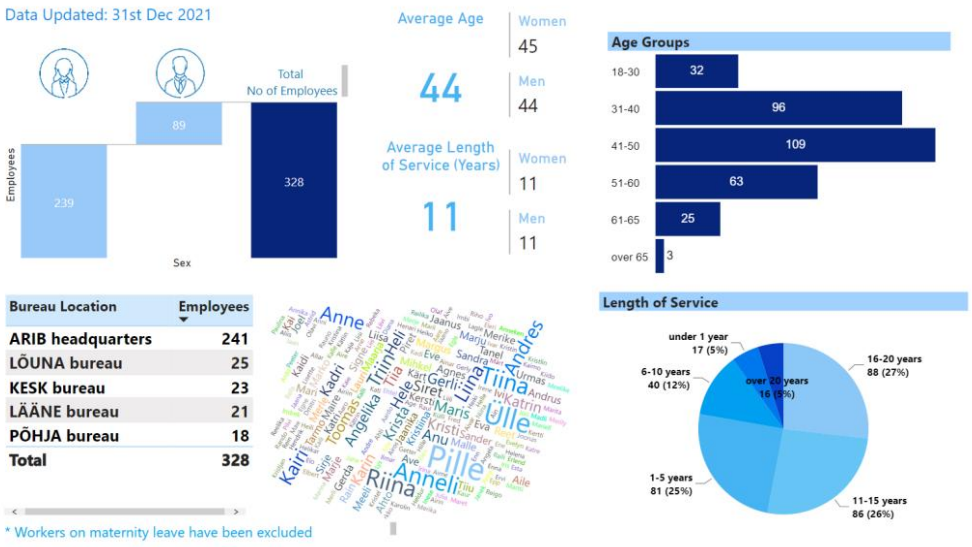


Figure 7, ARIB team (visualisation on MS Power BI)

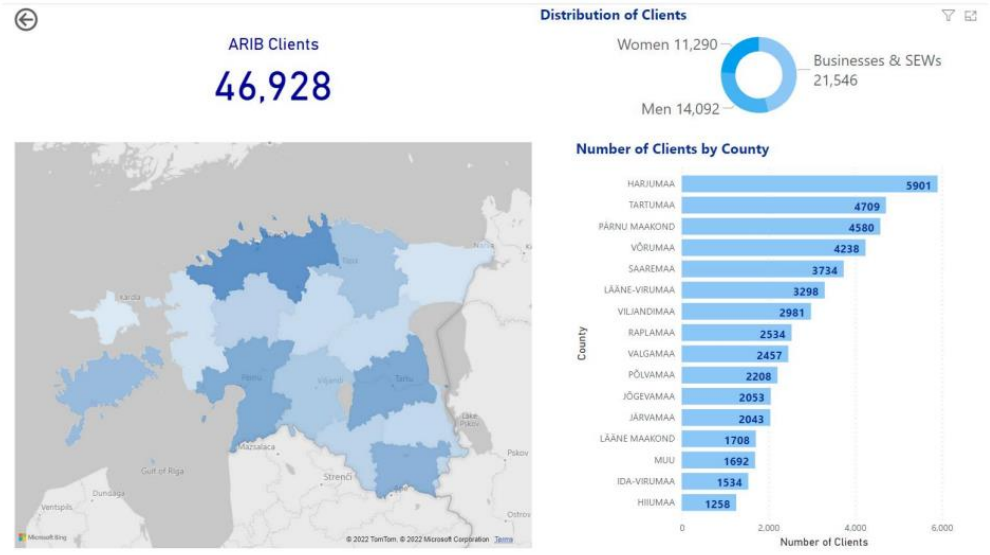


Figure 8, ARIB clients (visualisation on MS Power BI)

1.3 Area Monitoring System (AMS) supplemented with AI as a pioneer of a new era data-driven approach

During the Smart Pro CAP project, the Flemish paying agency in Belgium, Italian paying agency (AVEPA), and Croatian paying agency presented their experiences in implementing machine-learning for IACS support measures and preparations for implementation the full Areal Monitoring System (AMS) for ICAS measures.

The new Common Agricultural Policy (CAP) provides for the compulsory use of the Area Monitoring System (AMS) in Member States to monitor performance with and outputs of participation by beneficiaries in various land-based CAP interventions.

Also in Estonia AI is used by Agricultural Registers and Information Board (ARIB) in order to detect whether the agricultural grasslands have been mowed or not using image recognition. This system, called SATIKAS, uses deep learning methods and convolutional neural network approaches to analyse the satellite data coming from the European COPERNICUS programme to automatically detect whether mowing has taken place on the Estonian grasslands. The goal was to automate the EU's agricultural subsidy checks – what should help to decrease and replace the inspectors' field visits.

While the focus of the Smart Pro CAP project was primarily on identifying clever ways to protect the EU's financial interests in CAP rural development support, the development of IACS support has taken the direction of enhancing the control system through machine learning models and artificial intelligence immersion. This trend is also supported by the European Union through the creation of a legal framework.

INSPIRATION: Therefore the implementation of machine learning and AI methods to increase the efficiency of EU funding for IACS measures has become a pioneering approach. That should encourage to take same steps also for non-IACS, CAP rural development measure schemes.

As the Smart Pro Project has shown, there are also possibilities for future use and further development of machine learning models developed for IACS measures for rural development support.

As we have heard from the experiences of the Flamish paying agency, the initial use of remote sensing (satellite images) for classical land parcel controls started early 2000-s. The new approach introduced, Control by Monitoring (CbM) procedure, for controlling land parcels, based pillar I IACS measures from 2018 onwards.

In the new Control by the Monitoring system, all relevant field activities and changes are monitored on all parcels during the entire year. This has significant advantages over the classical risk-based field control system of only 5% of parcels that is done once a year.

The same goal was exposed by all paying agencies that develop machine-learning-based models to reduce administrative burden but increase coverage and accuracy of controls of arable lands. This new approach also allows moving from the "detect and sanction" approach towards a preventive approach, while protecting EU financial interest.

How does AI help CbM ?

There are 3 data sources for CbM are used:

- Copernicus (ESA) satellite images with free access;
- Sentinel 1 radar (radio waves) information that is not hampered by clouds ;
- Sentinel 2 images (approx. 1 image/5 days);

The easiest to use is 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. The downside comes with Sentinel 1 data due to its complexity which makes the interpretation of data 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.**

That's why using AI 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%).

GOOD EXAMPLE: AI helped reduce burden of OsC (3-5% => 0,8%) while verification coverage increased 3-5% => 96,8%

From a technical perspective as claimed by the Flemish paying agency, 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 have 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 paying agency 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.

Efficiency of using AI enhanced use of Sentinel 2 data instead of remote sensing through a drone (UAS, Unmanned Aircraft Systems) has been demonstrated also by Italian AVEPA paying agency experiences.

AI enhanced Sentinel 2 allowed AVEPA to have in the short time more multispectral multi-temporal images, even if resolution is lower than of drones. Summarized advantages of AI enhanced Sentinel 2 comparing to remote sensing of drones are following:

- Resources involved: 3 people vs 0 (automatic process in production environment);
- Time resolutions: once per mission vs 1 every 5 days;
- Space Resolution: 2 cm/px vs 10 m/pixel;
- Spectral resolution: 4 bands vs 13 bands.

Additional interesting aspects supporting new AI based approach of Sentinel data pointed out by AVEPA were:

- A strong Ground Truth is essential to have robust results;
- Extending crop types to analyse needed - at pilot phase AVEPA experienced only with 3 crops: Grassland, Soya and Beet;
- It could be useful to extend markers, adding other information occurred in year (weather, drought, adverse events, etc);
- Publishing results for expert judgement preliminary evaluation could be a useful result. At the moment we give ready-to-use classification, without further explanations;
- Approach “Near real time monitoring” can permit to build markers as soon as possible, not only at the end of the season;
- Strong weather integration enforces good results: we saw that rains and droughts influences NDVI;
- Results could be available and useful to farmers, giving them feedback and information;
- Integration with other payment or monitoring contexts can improve data knowledge on land;
- Further satellite constellations can lead to quality improvements, for example in no-data and clouds pixels;
- Better results with contribution of knowledge from different fields (multidisciplinary).

Challenging issues mentioned by AVEPA were:

- There are some topographic errors on source geometries;
- Small geometries must be excluded (due to S2 resolution);
- Clouds can interrupt time series (no-data problem);
- NDVI variability connected to same crop at different altitudes;
- A geometry can have different crops in the same season;
- A geometry can have multiple crops at the same time;
- Season water availability influences NDVI trend;
- Need for processing capacity (disk, cpu);
- Need for dedicated human resources.

AI based Sentinel data usage options for non-IACS measures.

As experiences rise, also new ideas to use AI monitored Sentinel data and remote sensing images are popping up also for other CAP measure schemes than only IACS.

According to Flamish PA experiences it 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 for example the case 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).

Geotagged photo apps

One clever approach, which was also greatly amplified by the COVID19 crisis, was the use of geotagged photographs to carry out on-site inspections.

So far the Flemish PA has not yet used a geotagged photo app, but is looking forward to using one in the future. An app is currently in development, to be launched in 2022.

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 yet, 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. Regarding developing the AMS system also specific geotagged photo app for carrying on the on the spot checks is under consideration.

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.

Opportunities and challenges of using geotagged photos.

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.

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.

This may be useful to 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 take a photo of the investment, or an advisor could take a photo during the visit on the farm to prove that he was there, a teacher could take a photo during the lesson to prove that the lesson took place.

One of the challenges are restrictions by GDPR rules or its different interpretations, when using images of persons.

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 and 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 making use of photos of persons.

The use of machine learning models and artificial intelligence can be of great help in data mining. In the case of IACS control systems, this has been proven to increase the efficiency and coverage of controls, while reducing the administrative burden of controls. **The use of AI for automated remote sensing has enabled a shift in focus from detection to prevention.** Undoubtedly, it has also significantly enhanced the protection of the EU's financial interests.

1.4 Classical data-based approaches for prevention and detection for rural development investment measures

This section will reflect the different data-based practices by the paying agencies involved in the project, in enhancing the protection of the EU's financial interests. The set of different practices is divided into preventive and detective practices and finally covering other general data use practices that support the sound use of EU funds and the protection of financial interests.

1.4.1 The data-based approach of selection system and detecting the reasonableness of the reference costs for rural development interventions - PREVENTION.

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 set up 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.

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.

- Three-offer 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?
- Reference costs: Some problems for this system are the need for a detailed database that is updated regularly and that catalogue prices do not always reflect market prices.
- Evaluation committee: The main challenges here are guaranteeing that there is sufficient experience, that judgement 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, 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 reasonableness of costs 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 the reasonableness of costs

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 into 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 reasonableness of costs -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.

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 of 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 mitigation 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 etc. 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 the first application 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.

To summarize, the Flemish approach described sounded very innovative and aligned a lot with the goal of the result-based CAP funding system. It can be also concluded that a data-driven approach is essential to design a system that is able to select the most capable project of achieving goals as it was sustainability in this case and for determining reasonable and optimal reference prices of the investments.

From the perspective of the protection of the EU financial interest, this mentioned approach has a clearly preventional impact. Despite challenges described by the Flemish paying agency, it can be concluded that data-driven approach for better targeting and selection of the applications as also for elaborating reference price system of investments are motivating to apply EU funding for investments that really matter and are aligned with the EU goals of natural sustainability as also aiming to simplify the whole process thigh using simplified cost option. It is also clear that more targeted and simplified EU granting systems leave less room for misusing EU funds.

1.4.2 The data and algorithm-based approach of machine price list (reference cost)

Italian PA (AVEPA) introduced an interesting approach of creating an automated system (reference prices) for handling the reasonableness of costs for machinery and equipment in a data-driven, algorithm-based way.

Administrative check on applications for supporting purchase of machinery and equipment by farmers must include an assessment of the reasonableness of the costs, a task that should be carried out according to appropriate procedures. Until 2018 AVEPA, carried out such an assessment by comparing three different quotes relating to the same item (i.e., the “three-offer-rule”).

The Paying Agency considered it difficult to dismiss the three-offer-rule as a tool for assessing the reasonableness of costs, but the problem was raised to the Managing Authority anyway, explaining that it was advisable to develop an evaluation tool that could support or, in the best scenario, even replace that method.

The goal was to overcome the well-known implementation issues, thus ensuring a more uniform evaluation by all the assessors involved. Other goals to be simultaneously pursued concerned the downsizing and streamlining of the controls to be carried out, and, finally, a substantial reduction of the bureaucratic burden on beneficiaries, so as not to discourage them from applying for aid, thus ensuring a numerically adequate participation in the RD calls.

To overcome this challenge the development of a machine and equipment price list, an idea inspired by the positive experience gained from the agro-forestry price list used for the itemised estimates required within the structural intervention procedures. The working hypothesis was that the database would set the maximum cost of a given item on which both the eligible amount and the amount to be financed could be based. Therefore, the database had to possess certain characteristics in order to be useful for the purpose, namely:

Accuracy: the prices of the price-book had to reflect market values and, therefore, derive from a survey that was not limited to a mere collection of pricelists or data retrieved from suppliers.

Up to date: the price list had to be regularly updated, in order to reflect market trends which, in recent years, have shown considerable volatility due to the underlying economic crisis.

Comparability: the system had to arrange prices collected from suppliers into homogeneous groups, classified by types of machinery and equipment, and compare them based on precise quantifiable technical characteristics that are specific to the intended use (e.g., engine power for the tractor).

In Veneto Region there are several kinds of environments, many and various soils and grounds with different slopes, a large variety of cultivated crops, of livestock breeding, and different farm management systems (intensive, organic, integrated, etc). This heterogeneous context implies that the Agricultural machines, in their variety and heterogeneity, can feature multiple parameters and functional characteristics influencing not only their performances but also affect their price. **The aim was identifying, for each category of traction and operating machines, those homogeneous and univocal parameters most affecting their purchasing price, as well as in quantifying their impact. The goal was to elaborate an algorithm calculating the reference cost for a given piece of machinery.**

Elaborating the model

The categories of agricultural machinery considered in the survey are:

- tractors (conventional, tracked, specialised, isodiametric and telehandler);
- large harvesters;
- machinery for soil tillage, crop protection (i.e. atomizers), mineral and organic fertilization (fertilizer spreaders), haymaking;
- agricultural trailers;
- mixer wagons;
- machinery for viticulture, olive growing and forestation.

The activities carried out by Edizioni L'Informatore Agrario s.r.l. to achieve the goal were carried out as follows:

- updated pricelists of the main manufacturers and retailers operating in Italy and in the Veneto Region were retrieved. The database used by Edizioni L'Informatore Agrario includes technical characteristics and list-prices updated to 2017 for tractors and self-propelled vehicles and to 2016 for other agricultural machines marketed in Italy. Before delivery, the database underwent a further check and a filtering process. Data was also filtered and processed before being used.

- A subdivision of the categories of machines into homogeneous sub-categories was carried out, and the mechanical characteristics that specifically and unambiguously differentiate the categories and sub-categories were subsequently identified; the technical parameters most affecting the price were then investigated by using traditional descriptive statistics tools (indexes of central tendency and data variability, box plots, histograms, etc.).

A statistical analysis was carried out to identify the most significant correlations between the (numerical and non-numerical) parameters considered and the selling price for each sub-category of machinery (dependent variable) using one of the following methods:

- Simple or non-linear linear, polynomial, multiple regressions.
- Multivariate methods.

The appropriateness of the regression models designed, and the statistical significance of the estimated parameters were then evaluated. When relevant, checks on statistical goodness of fit and significance levels include:

- estimation of correlation indexes r and/or determination index R^2, testing correlation hypotheses by means of Student or Pearson tests;
- analysis of residuals;
- Estimates the standard error and confidence interval.

Verification of hypotheses by means of Fisher tests on the slope of the regression lines.

Algorithms were then defined, and user-friendly models were developed for estimating the reference price for each sub-category of machine.

The statistical analysis was carried out by Edizioni L'Informatore Agrario using Excel built-in functions and Adalta's statistical package Statgraphics Centurion XVI.

With reference to Article 62, paragraph 2 of EU Regulation no. 1305/2013, which provides, even in cases of adoption of a price-book, that the Managing Authority shall ensure the accuracy and adequacy of data through a fair, equitable and verifiable calculation, the Department of Land and Agro-forestry Systems of the University of Padua (TESAF) has been identified as a functionally independent institution possessing the necessary expertise to validate the accuracy and adequacy of the calculations. On September 25, 2017, TESAF issued a statement certifying the accuracy and adequacy of the calculation methodology implemented for the maximum cost reference price-book.

Once the algorithm was developed, its performance was verified - for each type of machine considered - based on 1.034 quotes (which included discounts applied by dealers on list prices) provided by AVEPA for the machinery and equipment positively appraised in 2016-2017 for the applications submitted under the 2014-2020 RDP calls for proposals. These estimates have been compared with the simulated values to identify the goodness of the model and the average discounts to be applied.

Adjusting the reference cost model

In particular, the analysis of the estimates showed that the model overestimated the actual values; in order to achieve a better accuracy, a correction coefficient was calculated and applied to the model so that most of the data would not exceed a ±20% deviation from the actual figures. The coefficient is 0.775, which represents a 22.5% reduction in the price estimated by the model. This value can be considered reasonable based on two seemingly opposite factors, both of which may explain this variability.

The first one concerns the list price, on which the simulations are based, which is never the final purchase price, as it can be modified because of discounts applied by the seller, payment methods, existence of tax benefits, second-hand goods return, etc.

The second one regards the estimates provided, which often include the provision of add-ons or accessories that are difficult to estimate with the available data. At the end of the project, by decree of the director of the Directorate EAFRD Managing Authority, Parks and Forests n. 111 of 18/12/2017 the price-book of maximum reference costs for agricultural and forestry machinery and equipment for the Veneto Region was approved to replace the “three-offer-rule” for the purpose of submitting applications for support under the Rural Development Programme of Veneto 2014-2020.

The pricelist is also made available to operators as a reference price calculation app; it is downloadable form the Internet and works with both Windows and Apple operating systems. Edizioni L'Informatore Agrario s.r.l. has agreed with the Region to implement three updates by 2021 but is available right from the introduction of the price list to integrate or update it in a timely manner whenever the relevant departments of the Region deem it appropriate.

The machinery and equipment price list were updated twice in August 2018 and in December 2021 including new items and revising the prices of those already included based on the optional equipment concerned. With reference to the documents to be attached to the submission of the application for support, the introduction the new system allowed a simplification of the calls relating to those types of intervention of the RD involving the purchase of machinery included in the price-book among the eligible expenses, since applicants shall attach only the report produced by the app.

Since private applicants are no longer required to get three quotes from three independent and competing suppliers, a significant reduction of the bureaucratic burden has been achieved. Moreover, AVEPA has been able to simplify its own procedures, not having to check and fill-in the checklist relating to the verification of the three quotes on a sizable share of applications regarding machinery and equipment.

As far as the analysis of the add-ons to the basic models is concerned, the decision was made to take into consideration - as a starting point - only the ones deemed necessary to put the equipment in use. For each basic model, the pricelists the most frequently purchased add-ons in the reference market have been included, thus allowing the applicants to choose her preferred set-up in the subsequent application for support. Moreover, add-ons that are deemed not in line with the RDP grant are not included in the price-book.

Lessons learnt

The ongoing evolutionary process pursued in terms of both simplifying administrative procedures and adopting innovative IT tools has triggered the development of this new procedure to assess the reasonableness of costs.

The development of such a "reference cost" database requires the availability of a significant amount of data. In the case covered in this paper, the project started from a price collector organized by category of machinery and equipment and the collection of the quotes that AVEPA gathered during the RDP 2014-2020.

The challenges of elaborating the model were related to the proper compilation of data.

In order to serve the highest possible number of applications for support, it is necessary to focus on those pieces of machinery and equipment that are most widespread in the pertinent territory and then, at a later moment, also goods characterised by a more restricted market, but for which a sizeable demand exist, can be included.

At the same time, the add-ons to be combined with the basic versions should constitute a rather restricted set and include only the most purchased ones in the reference market and the ones deemed necessary to put the equipment in use. It should be noted that the database should be organised by categories and corresponding sub-categories to ensure comparability.

The regular update of the database is crucially important, and it should not be carried out following a rigid calendar but, as far as possible, on the basis of the evolution of relevant market conditions, so that real values can be effectively monitored.

Each revision should be followed by informative notes alerting users and specifying which part of the database has been modified and/or integrated**.**

The pricelist should provide the maximum eligible cost for the purchase of a particular asset. The introduction of maximum eligible costs should allow the simplification of the application submission.

Costs should not merely derive from producers' official price lists but should be calibrated on the discounts usually applied in the territory, in order to ensure the reasonableness of costs principle.

Anyway, the "three-offer-rule" - where the offers are reported also in a technical paper explaining the final choice - cannot be totally replaced as not all categories of agricultural and forestry machinery and equipment fall into the "price-book of reference unit maximum costs". Also, high technology peculiarities or rareness of some market eligible items do not make them available to include in the price-book because of missing comparability of characteristics

The passage from the evaluation of the reasonableness of costs based on the three quotes to the one based on the reference maximum unit costs list of agricultural and forestry machinery and equipment, has been meeting since the beginning a significant appreciation by AVEPA's assessors, beneficiaries and consultants.

Although the system has been only recently adopted, all actors involved agree that the price list allows a better identification of real market prices while providing a smart solution to the issue of the add-ons that often made the three-offers hard to compare.

Current appraisal procedures have shown a significant streamlining of AVEPA's investigation process, thus facilitating managers in charge of the administrative procedure during the decision phase on the admission to funding.

Moreover, a more uniform application assessment has been achieved, thus ensuring that the same funding is given to beneficiaries requiring the same items.

However, potential areas for improvement are already evident:

The model is reliable for ordinary machines while it seems to underestimate high tech machines (so in a few cases we came back to the three offers).

Very complex to update: this method has worked well until 2020 but now it seems to be not able to intercept the current market dynamics both in case of price decreases and increases (in December 2021 came the first update since 2018).

Price updates publications should be synchronised with calls publications (avoid adopting price updates during the submission of applications phase) otherwise there could be the risk of different prices for the same good among applications.

Technical assistance provided by the suppliers should be considered in the eligibility cost of machinery.

The downloadable «local» copy of the software programme once downloaded should be updated; anyway, it has often happened that applicants do not have the latest version available at the time of submission. Therefore, it could be interesting to switch to a web-based application and/or a mobile app **to better manage the updates.**

1.4.3 Private procurement system as an alternative approach to ensure reasonable costs and transparency

Croatian paying agency (PAAFRD) started the 2014-2020 period using reference prices as the main method for assuring cost reasonableness. Given that the interest of beneficiaries, the number of Requests for support and consequently the variation of different investments has increased significantly, compared to the pre-accession, it was very difficult and burdensome to establish and maintain such a comprehensive reference price database.

Therefore, in 2016, they have started exploring possibility of establishing system of public procurement for private beneficiaries. In 2017 PAAFRD deploy a web portal **called "portal of offers"** (Croatian: "portal ponuda") where beneficiaries were obliged to publish their calls for tenders. **The system was designed to assure we respect basic principles of public procurement: transparency, equal treatment and open competition**

After almost four years of working with the system of "private procurement" we were very satisfied with the results. The system has undoubtedly resulted with real competition among bidders and consequently the real market prices in the offers which was primarily the goal of the system.

Nevertheless, there are some areas we have recognized to need some improvements.

First of all is making the process of publishing calls for tenders more guided and streamlined. Considering private beneficiaries lack of experience with private procurement they are often misunderstanding procurement principles (eg. restrictive technical specifications, not applying award criteria correctly etc) and that results with the financial corrections and reduction of support.

Another area for improvement is registration of bidders. In the first version of "portal ponuda" there was no obligation for bidders to register. The intention was to keep the bidding process as simple as possible. However, this approach makes keeping track of one's bidder offers and comparing them very difficult, and also it creates risk that some offers may not be created by the bidder himself.

Source of operational data for the data-driven approach in future

In conclusion, such an offer portal is also useful for the development of a data-based grant system. The data collected by the portal is an excellent source of historical data for the future, which is especially important for training machine learning models. However, this presupposes that the structure and quality of the data collected will allow them to be used later for machine learning models.

There are also two examples in the Estonian paying agency where data collection has created a good time series of historical data today, which is also valuable input for the use of machine learning data analysis opportunities in the future.

There are also two examples in the Estonian paying agency where data collection has created a good time series of historical data today, which is also a valuable input for the use of future machine learning opportunities.

The first example is the collection of structured construction bids from 2016.

A structured collection of machine-readable data of all submitted bids allows us to easily provide this data also to the Arachne system and also carry out our own risk analyses. For example, in 2017 we started to monitor horizontally possible patterns of the collusion of bids. Especially problematic seemed to be a situation in the field of the construction area, where patterns of collusiveness of bids were revealed.

The result of horizontal data-analysis bids in 2017 revealed that 32% of constructional bids were won by 3 bigger companies that never competed against each other. But also that 6 of top10 bidders had a tendency never to win. In conclusion for the construction sector, we concluded that 18% of all types of bids (including constructional bids) were suspected collusive bids in the amount of 35 mln€ out of 195 mln€.

	Name of bidder	Number of BIDS	BIDS won	Turnover
1		160	112	46 006 769
2		142	115	33 036 795
3		97	76	2 252 250
4		53	5	1 494 324
5		37	0	466 346
6		35	20	5 123 639
7		32	0	262 801
8		32	0	1 878 933
9		27	0	407 341
10		26	1	1 468 875

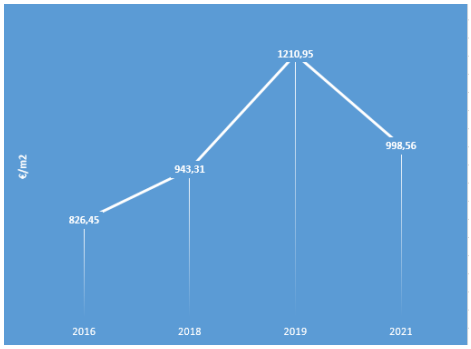
32%

TOP3 never competed against each other

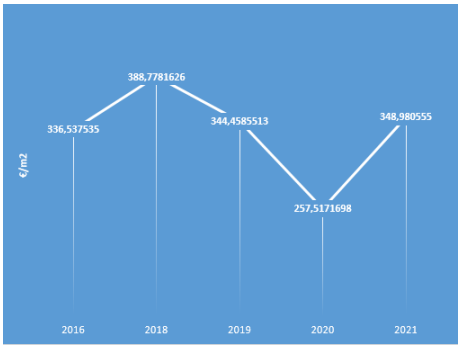
Figure 9

Another example is the collection of structured construction bids information in an IT system. Since 2016 we have data in total of 2692 won objects in amount of 400 385 000 eur (data of 2021). The construction database is used to analyze the dynamics of the construction costs of different types of buildings and to identify deviations in the costs of new tenders.

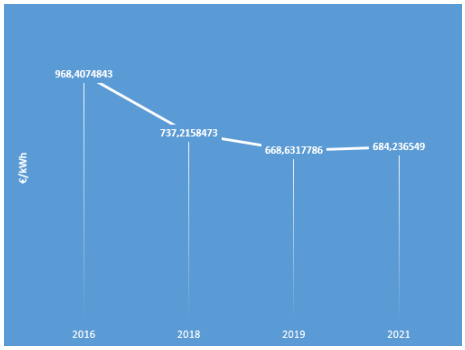
Dynamics of building cost over the years according to submitted bids in ARIB system 2016-2021



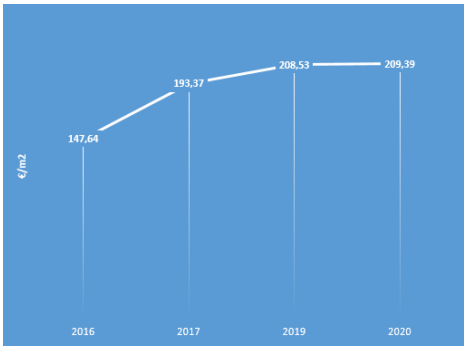
Cost per m2 of residential buildings



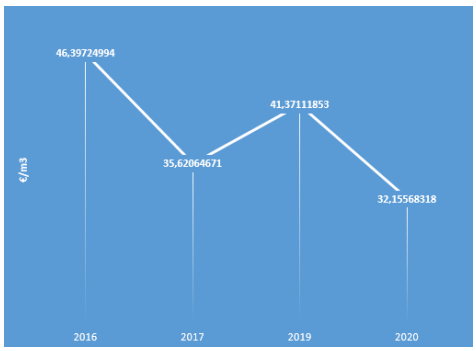
Cost per m2 of production buildings



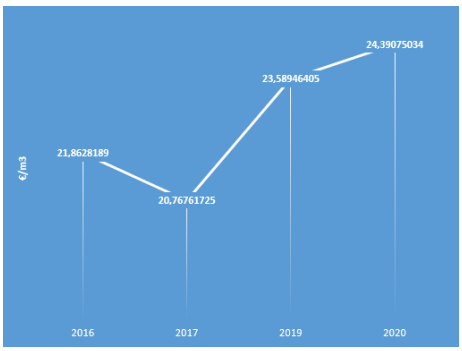
Cost of a kWh solar power plants



Cost of m2 of barns per years



Cost of m3 of manure and silos



Cost of m3 of liquid manure storages

Figure 10

1.4.4 Introducing the risk-based administrative checks of rural development grant applications in Estonia (red corridor approach) - PREVENTION.

Developing anti-fraud system in ARIB

The anti-fraud system in ARIB starts with risk-based administrative controls which supplement traditional mandatory check-list based control systems of all conditions.

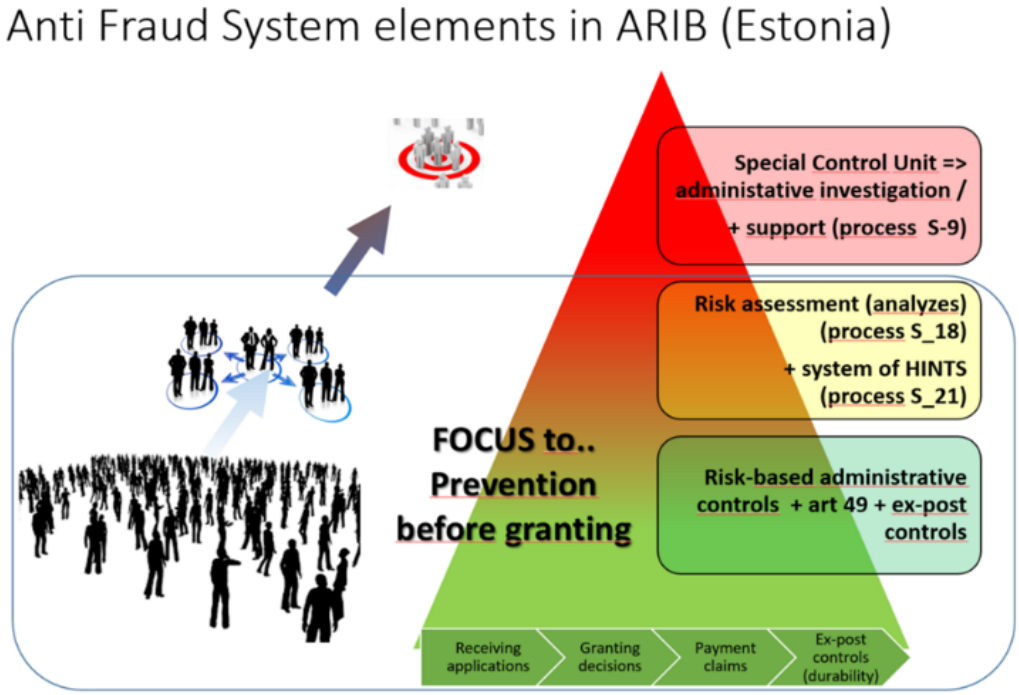


Figure 11

A risk-based approach to administrative controls takes into account risk assessment and hints systems and then if needed for more complex issues, cases can be taken to assistance advice to the Special Control Unit.

The Special control unit:

- is carrying out special administrative investigations;
- is the contact point in the communication of law enforcement institutions;
- has an internal advising-assisting function to support units in complex or suspected fraud cases.

Over time the Control Unit has been developing new practices and taking more actions in the stage of applying in order to prevent possible fraud before granting or payments are made. A positive side effect of this preventive approach is directing grants to non-risky applications in the same round. As ARIB has noticed, mostly riskier applications apply the maximum possible amount of EU grant and less risky applications only according to their needs. This means that rejecting one risky application gives the opportunity to finance more than one non-risky project.

GOOD EXAMPLE! Example of the risk-based new approach of modifying practice of proceeding applications. In 2021 the new risk-based approach was granted with the additional ancillary condition to those applications where the self-financing capacity was lower and who could not sufficiently prove the self-financing capacity even during the administrative control. An additional condition was the obligation imposed on the applicant by the ARIB to submit additional documents certifying the ability to self-finance by the specified time.

Consulting and assisting application reviewers

The main goal of advising is to increase the skills and knowledge of application reviewers in controlling risks and use the experiences and knowledge of the Control Unit investigators in handling complex cases and collecting evidence.

The statistics show also that the number of time-consuming special controls cases has decreased over the last 2 years and the number of consultation cases has increased.

We have found that learning through doing daily practices - is the most effective way of training and risk-based administrative control still needs to develop further in order to prevent possible infringements and fraud even more effectively.

Based on the ARIB's experience, risk analyses help to successfully identify support applications that indicate the risks of creating artificially created support conditions.

However, proving artificially created conditions is a very difficult task due to the short deadline for processing the grant application.

Possible new risk-based preventive approach

As the ARIB has the ability to identify the risks related to the application before processing the applications, we have considered the possibility to inform the applicants about the risks related to the application before they start processing, with the possibility to withdraw the application. If the person has been informed in advance of the risks associated with the application and the application has been withdrawn before a formal decision is taken on the application, this would allow the person to withdraw the application without any possible additional sanctions or consequences. If a person continues to apply despite prior notification of the risks, there would be no possibility of excluding administrative penalties at later stages of the proceedings if the risks

are proven. Restricting a person's access to EU funding for a certain period of time can also be an administrative penalty.

The advantage of this approach is that the applicant has the opportunity to withdraw the illegal application honestly and without detrimental consequences. In addition to the deterrent effect, it avoids unnecessary administrative burdens for both the applicant and the paying agency. The negative aspect of pre-notification of risks can be the emergence of false-positive risks, leading to inaccurate pre-notifications to persons who are not actually exposed to the risks. The negative effects of false positives can be mitigated by well-thought-out wording of risk announcements and by informing the public about the new approach. Such an approach would also be in line with the new results-based grant system, where the EC has also favoured a more "preventive, guiding and advisory" approach, rather than the current "control and punishment" approach.

Shortcomings of the reporting system (IMS)

The cases of infringements, which are reported to the IMS system, can decrease over time, but there are no actual statistics about the results of prevention at the European level.

In the Estonian case, we have analysed the results of prevention achieved during consulting application reviewers during administrative checks before granting (prevention in early stages). For example for measure 4.1 in 2020 the prevented damage reached 6,8 million euros - while rejecting 51 risky projects during the consultation process of risk-based administrative checks which gave the opportunity to finance 82 financing non-risky projects. As this result has been achieved before granting decision is made, the IMS report doesn't include this kind of countable achievement against fraud.

The red corridor or risk-based administrative control approach has been used since 2016, but based on a common methodology, it has been used for riskier support measures since 2017 in the 16th round of applications, in which a total of 236.98 million euros has been requested.

Results of rejected or withdrawn risky applications during the administrative check have been typically higher than non-risky applications.

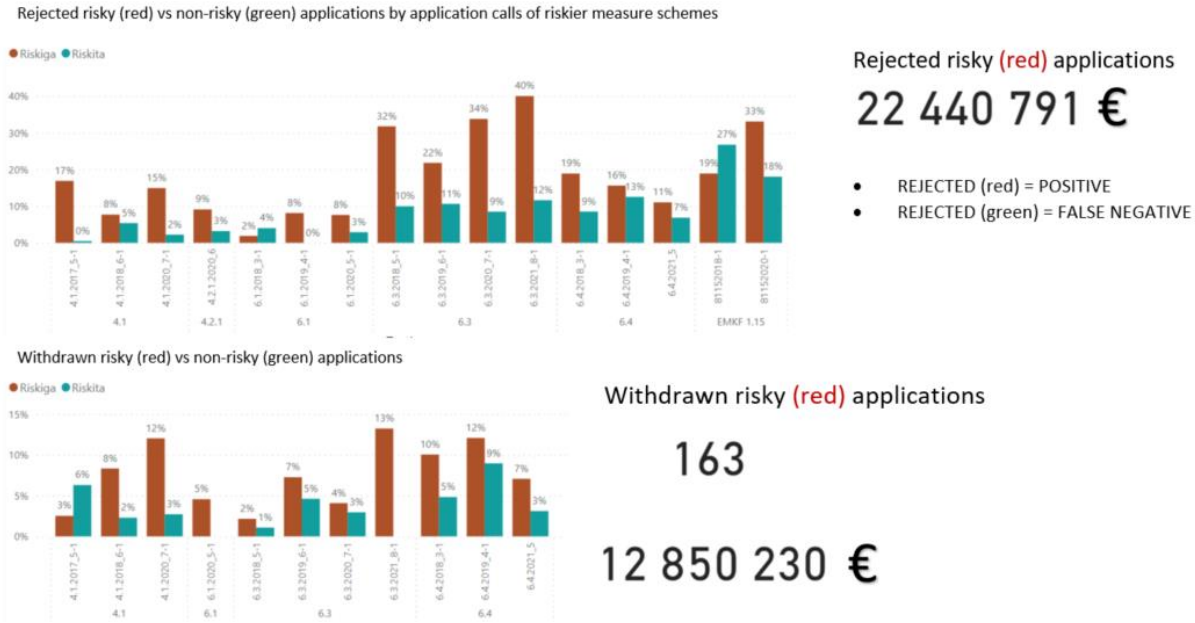


Figure 12

In summary, EU IMS reporting only collects information on irregularities detected after the grant has been awarded, but does not allow the collection of information on potential violations that have been prevented. It is therefore not possible to assess whether or to what extent the reduction in infringement statistics may be linked to successful prevention.

IT developments: integrating risk-based approach

As we have practised a lot of risk assessment and using results for supporting administrative checks outside of our systems, it is becoming more and more crucial to take the process into our IT system in order to have a more concise system for managing risks in order to decrease manual administration workload.

The risk assessment process at the moment is not flexible enough and does not support functionalities that we will be needing in the long term (such as automatic risk scoring for example).

Figure 13

The process starts from the basics: upgrading the risk register for more flexible administration. This is the first step we are taking. The next one will be a warehouse for risk score tables, then the risk scoring process should be automated and in the end, the scored applications risk information should go to checklists for application reviewers. This is the long-term plan.

We started by rearranging the risk register, whose purpose is to manage valid risk factors.

Here the important step was to group risk factors into two categories: 1. measure risks – related to the project and 2. horizontal risks – related to the client. We also had to keep in mind to keep the system as flexible as possible, because we have experienced that risk factors are constantly changing and we have to keep this possibility in mind. Another important aspect was to ensure that the new system should be able to interface with different other systems or external data sources if needed.

The second step in the project was to have a warehouse of risk scores, where we can see all the up-to-date and historical risk scores and make inquiries if needed. In the system, the warehouse shows the most recent scores, but you can make data inquiries about some historical scores if needed in the data warehouse system.

The purpose is to make the scoring more automatic and independent from application rounds and less dependent on risks calculated at different times and with different frequencies.

Furthermore, the system should be more flexible and the system has to be ready for automatic risk scoring in the future.

The third step is actually the one that was eventually left out of the project but it is the most important one in the long-run – automatic risk scoring tool in order to decrease manual risk scoring using up-to-date data. The reason why it was left out was that not enough preconditions were filled and also it would have been quite resource-intensive for this project. The preconditions were that there is an interface between external data sources, it must have some flexibility – not needing further developments in every step. At the moment we have started negotiations with the external data sources and after that, we will start piloting risk scoring automation in order to know how it would be reasonable to continue.

The last step is making risk factors available to application reviewers in the checklists. The main purpose is for risk management to be part of a core process in order to prevent fraudulent behaviour as soon as possible. If the risks would be effective enough, it can reduce application reviewers' checklist, therefore reducing manual workload.

Checklist for risks - added functionality into IT system

The goal for bringing risks into checklists is to make risk analysis results transparent for application reviewers so that risks would be mitigated. Another purpose is to have a transparent audit trail to ensure focusing on the risks throughout the whole lifecycle of the project.

At the moment, there are already cross and logic checks, which are done against external registers while the client is filling in the application. If the checks fail, the system does not let one submit the application.

There are three types of administrative checks: fully automatic, semi-automatic and manual. For example, in the administrative checks process, there are automatic checks against Land Register, Business Register, Population Register, Criminal Records Database, etc. In ARIB if the application

reviewer suspects something suspicious, the hints system is used. Hints are connected to either the application or client and are shown on every checklist.

Integrating risks into daily procedures is relevant because it is crucial that application reviewers should take into consideration all the risks behind the project in order to make the final decision. Another important objective is to get feedback for each risk factor in order to analyse what risk factors were effective and also to get the application reviewer's direct feedback. For application reviewers, it also gives the opportunity to make proposals for changing the risk factors and have a complete overview of previously rated risks and feedback.

Lessons learnt

There are different challenges involved in risk assessment for administrative checks. This chapter focuses on the general challenges that have an effect on the process and mitigating risks. There are four sub-categories for general challenges: data challenges, organisational challenges, IT development challenges and future challenges that we have to take into consideration.

Data challenges

With data we are facing similar challenges that Flemish PA does. Data availability, more specifically collecting and analysing historical data, is an essential part of the whole support lifecycle. Challenges arise when there is a new programme period and/or measure regulations change, then also data needs change. Therefore, it is important that the procedural process supports collecting the right data with the right structure from the beginning in order to create and maintain consistency of data structure.

There are some risks that are supported by the data analysis, but are difficult to prove and find evidence on. For example, creating artificial conditions in order to fit into the measure scheme. The difficult part of that is how to prevent it from happening and how to prove artificially created conditions if there are limited resources such as limited time and skills.

Organisational challenges

The challenge that we tackle with risk assessment is organisational understanding and point of view - risk analysis is not part of the core process in the whole application life-cycle. We have developed the process outside of our IT system, but we have not been integrating it into our IT system. Therefore, the next steps would be integrating risk analysis results more into our IT system with the purpose of making risk assessment more as part of a core process.

In addition, when we are making new discoveries horizontally then there are obstacles to overcome - for example proactively taking action when some events take place. If there are new business processes involved then there are often a lot of unanswered questions: who is responsible and who should decide or deal with the claims. The main goal in the end is to prevent fraudulent behaviour and deal with problems as soon as possible to avoid dealing with more harmful consequences. That is why this is a challenge for us on the organisational level.

Challenges with new IT developments

Another challenge comes along, which is keeping in mind the long-term plan and the big picture. A question that arose was how to automate the process, but also to keep it as flexible as possible for changing the risk factors. This made the elaboration of the requirements description more complex.

Additionally, another challenge we face is legal considerations - in order to conduct new developments, there might be legal issues to be resolved. These cases can be challenging and take a long time. Additionally it can be difficult to find common priorities, especially when there is cooperation required with external parties.

Future challenges

There are definitely many challenges ahead in the future that we have to take into consideration. At the moment we have to think about what a risk management system would look like in the upcoming years - will it be a rule-based version as it is now or using machine learning models or something in between. Then the questions arise such as how will the transition take place and how to implement machine learning models into risk management.

One idea to test is if the risks calculated by Arachne and only those that suit us - can be used as ready-to-go input into our risk management processes. If this were possible, the need for ongoing calculation of these risks would be reduced and only the updating of our basic data in Arachne should be ensured. This would save risk analysts time for more complex and sophisticated data models and analyses.

1.4.5 Data analytics to improve risk analyses for the sampling of the on-the-spot checks — DETECTION.

Flemish PA introduced the perspectives of improving data-based risk analyses for a sampling of on-the spot–checks.

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 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.

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, etc);
- 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 optimise 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.

1.5 AI (artificial intelligence) based and other experiences of using the full potential of data

1.5.1 Experimental horizontal data-driven risk analyses

In Estonia we do practice so called Examples of experimental (ad-hoc) horizontal risk analysis to test new approaches of risk scoring.

In 2020-2021 it was tested with 2 new analysis:

- Geographical cumulation of RD grant;
- Disappearing client risk analysis.

The main results of these horizontal analyses are that quite often it is important to analyse some hypotheses horizontally because horizontal analyses help to generate new horizontal risk factors to take into use for different measures. For example, from the geographical cumulation analysis, the main result was that we took cadastral parcel risk factor into use for risk-based administrative checks (red corridor) as also for on-the-spot control sampling and for different measures.

Excample of geographical cumulation of RD grant

Rural economic diversification (6.4) call 5	Number of Applications	Applied/€
In total	504	31 114 847 €
Cadaster represented also in other applications of the same call of applications	27	2 738 459 €
Share (%)	5%	9%

Table 1

From disappearing client risk analysis we found out that we should use more external data in order to prevent fraudulent behaviour and one way of doing that is through data sharing with other public sector organisations. At the moment we are working on it and also developing a new business process for that.
While developing our risk analysis capabilities we also saw that some new daily business processes should be developed. **If the ordinary approach of paying agency business processes is designed to react to the client's applications, meaning that interaction is initiated by clients. In the case of proactive actions, the interaction should be initiated by the agency and quite often it becomes obvious that we have to deal with the client as a whole not only with one specific issue.** In case of risk of disappearing, all running projects or commitments with IACS or non-IACS measures are under the threat and possible financial losses should be proactively prevented or mitigated in trustful cooperation with the client.

The most important is prevention, so we should make our processes more supportive towards discovering and detecting the signs of disappearance as soon as possible, which is also one of the processes for protecting the EU's financial interests.

1.5.2 Data popularisation and visualisation in an organisation

The widespread popularisation and visualisation of the use of data as one of the strategic objectives, following the example of the Flemish paying agency, has already been mentioned. In this section, we refer to it again because it also has a positive effect on the protection of the EU's financial interests.

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).
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, democratisation and data-lab strategy of the department.

Goal 1: data visualisation to inform citizens (demo 1: website)
In 2021, the Flemish department of Agriculture and Fisheries launched a new website (https://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 visualisation 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 visualisation.
Some uses of visualisation are: identifying outliers, judging quantities and proportions, identifying 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 visualisation and exploration and uses these skills to improve the measure management.

Goal 3: integrating advanced analytics in data visualisations
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.

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

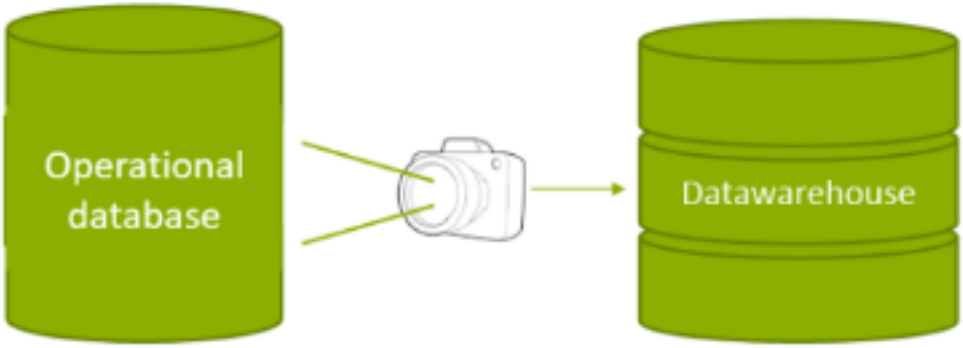


Figure 14

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

Figure 15

Lessons learnt

Since starting to use the visualisation software, the potential for measure management and general organisation management has clearly been shown.

The Flemish PA is convinced of the importance of integrating data visualisation 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.

1.5.3 Perspectives of using new machine-learning and AI-based methods for CAP rural development interventions

Based on the presentations and discussions presented during the project, it can be concluded that the use of machine learning and artificial intelligence enables the use of data more efficiently than classical data analysis.

For example, data analysis through machine learning and AI increases the accuracy of control samples, allowing fewer controls to be carried out, ie the administrative burden, while maintaining a sufficient deterrent effect of controls. From the point of view of the protection of the EU's financial interests, this will significantly increase the capacity to detect fraud.

At the same time, the project showed that modern data analysis based on machine learning models and artificial intelligence offers new and completely out - of - the - box approaches to fraud prevention. This has also been demonstrated by the use of machine learning and AI as part of the IACS remote sensing system, where the coverage and detection accuracy of automated checks has increased to such an extent that the use of machine learning and AI has become more accessible and useful in the preventive phase.

It is also important to note how the use of machine learning and artificial intelligence is indispensable in modern agriculture and how, by the end of the day, it will contribute to the protection of the EU's financial interests but, even more so, to the objectives of the Green Agreement.

In this section, we will introduce the ideas that have emerged during the project about new uses for machine learning and artificial intelligence.

The wider application of machine learning and artificial intelligence to improve the distribution of EU funding and to protect the EU's financial interests in both the detection and prevention phases also involves challenges that need to be overcome and agreed upon, which we also reflect in this section.

1.5.4 The modern data-driven approach of farming promotes increasing transparency which is needed for carbon farming as also for the protection of the EU financial interests. (PREVENTION)

Supporting MS and on EU level data-driven carbon farming and by creating a trustful common and widely accepted carbon credit system which also urges farmers to act more transparently and implement sustainable nature-friendly farming practices.

eAgronom which is a rapidly growing Estonian start-up providing innovative e-services and IT solutions for farmers shared its ideas about what they see to be important to keep in mind while supporting developing the digitalization of farming and supporting carbon farming in the framework of the CAP.

At the same time, it is important to note how digitalisation in agriculture increases its transparency, which is also an important factor in preventing irregularities and fraud in EU subsidies. This also explains why it is important for EU funds to support the introduction of new practices in agriculture.

Summary thoughts about farm digitalisation by eAgronom:

- Farmers need holistic digital tools. Building effective software solutions is expensive. Maintaining costs 4x more than building.
- Farmers only enter minimum data into government tools.
- Allow commercial farm management system (FMS) solutions to integrate and simplify all tracking of practices for government reporting.
- Standardise reporting needs across the EU.

eAgronom summary conclusions of CAP and carbon farming:

- Build the infrastructure for market-based carbon programs.
- Standards for project validation, methodologies, baseline calculation, and MRV (monitoring, reporting and verification).
- Support thorough soil sampling.
- Sync requirements with carbon farming MRV standards.
- Fund costs to support the transition from action-based to results-based carbon sequestration.
- Support capital investments into conservation agricultural equipment.
- Guarantee a floor price for certified credits.
- Direct payments to farms already practising conservation agriculture.
- Advisory support to educate about regenerative farming.
- R&D in conservation agriculture.

Digitalization of farm management gives the opportunity to use data to enhance transparency farming practices and it has a positive environmental impact and its transparency mitigates risk for harmful practices against EU financial interest.

Financing regenerative farming practices through direct payments at the expense of EU taxpayers could discourage farmers from developing environmentally friendly practices and entering a market for carbon credit that requires a high level of transparency but could provide additional income financed by private companies that are not carbon neutral.

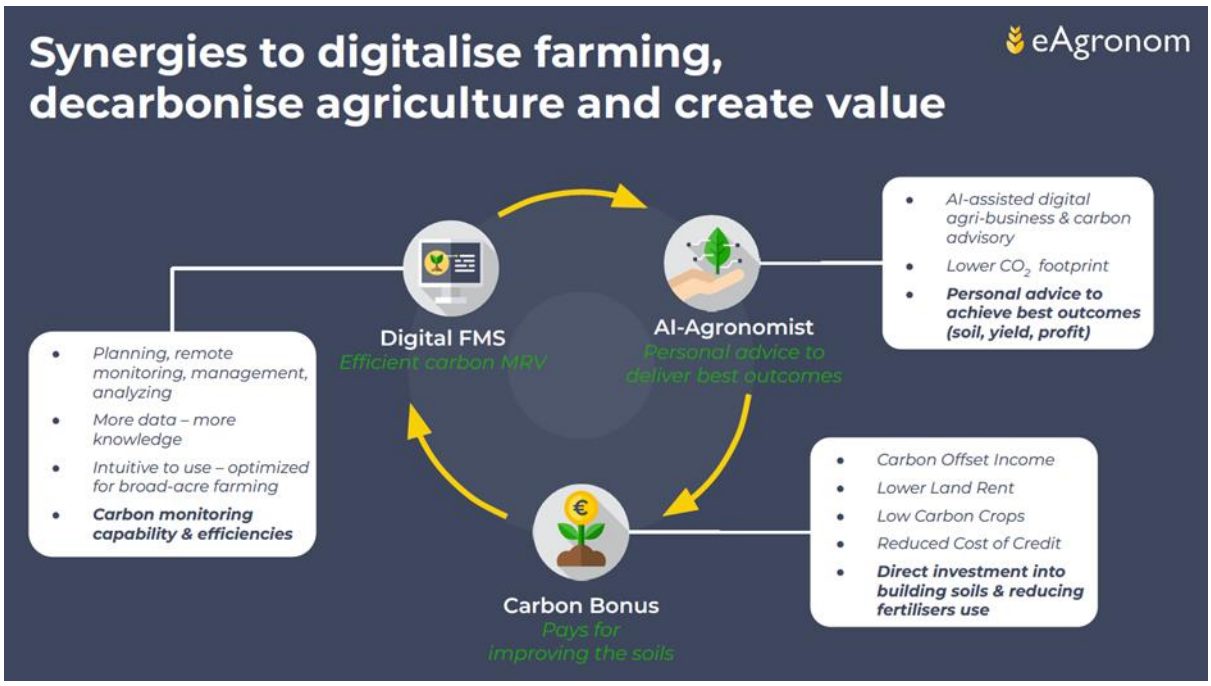


Figure 16

NOTICE! AI in agricultural business creates transparency which is preventionally beneficial also for protecting the EU financial interest.

Using AI for daily farm business and in "carbon farming" is the great tool to increase the transparency of agricultural business, which is very needed and important to protect credibility of the carbon credit market as well for protecting the EU Financial interests.

1.5.5 ML (machine learning) and AI (artificial intelligence) based data-analysis to support precise targeting and design of the new interventions (PREVENTION).

As the first example, it can be established from the human rules that in order to achieve the target of job creation, it is reasonable to give preference to persons who have historically had more experience in job creation. It is quite easy to prove or disprove this assumption on the basis of historical information and statistics and correlations on job creation. In order to use machine learning models, a sufficient amount of historical data can be input to find the job creators, which does not have to contain any information about the jobs created. The aim is to allow machine learning models to find groups that predict, for example, a low or high job creation capacity based on unnoticed connections.

In ARIB the machine-learning data analysis was tested to support the design of a new CAP period for RD interventions where the target was job creation in rural areas at the determined salary level. For this, the similar aid scheme data of the 2014-2020 CAP period was analysed.

This pilot project was carried out in cooperation with the STATS Unities team, according to the SEMMA model - the sequential methods to build machine learning models incorporated in 'SAS Enterprise Miner', a product by SAS Institute Inc. SEMMA is an acronym that stands for Sample, Explore, Modify, Model, and Assess. SEMMA steps are explained according to Wikipedia as follows

Sample. The process starts with data sampling, e.g., selecting the data set for modelling. The data set should be large enough to contain sufficient information to retrieve, yet small enough to be used efficiently. This phase also deals with data partitioning.

Explore. This phase covers the understanding of the data by discovering anticipated and unanticipated relationships between the variables, and also abnormalities, with the help of data visualisation.

Modify. The Modify phase contains methods to select, create and transform variables in preparation for data modelling.

Model. In the Model phase, the focus is on applying various modelling (data mining) techniques on the prepared variables in order to create models that possibly provide the desired outcome.

Assess. The last phase is Assess. The evaluation of the modeling results shows the reliability and usefulness of the created models

Following sets- data for analysis were used:

- **External data for years 2015-2020**
  - Data from Business register:
    - Query of simple company data => Output data;
    - Representation rights of all persons related to the undertaking ;
    - Service of issuing breakdowns of sales revenue according to the annual report according to EMTAK (NACE code) => Output data;
  - Open Tax data: Taxes paid, turnover and number of employees – on a monthly basis.

- **Internal data from ARIB**
  - All information available in the ARIB IT system regarding submitted applications of the sub-measure 6.4 - Investments in the development of non-agricultural activities 2015-2020.

TARGET determined as => Entrepreneurs who created at least +1 additional jobs to existing jobs between 2020 and 2021 with an average salary of 800 EUR per month.

Results demonstrated that the machine learning model predicted accuracy for the same target was 80% instead of the classic selection model accuracy of 53%.

Accuracy comparison of models	Correct selection	Total	Accuracy
Classic model selection accuracy (correctly accepted and rejected)	357	670	53%
Machine learning predicted selection accuracy	210	263	80%

Table 2

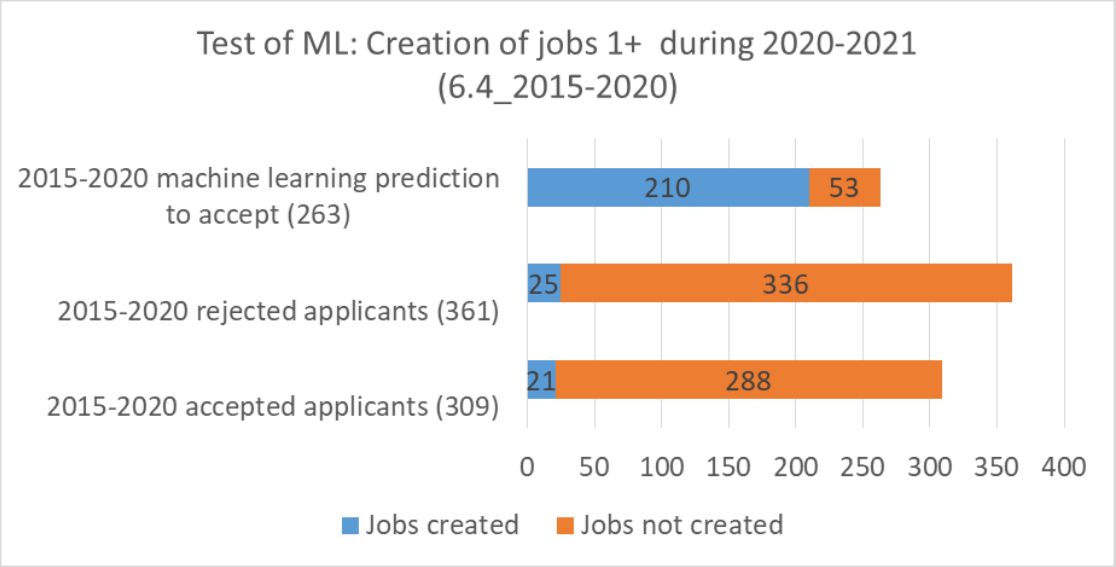


Figure 17

Challenges

The use of machine learning presupposes the existence of a sufficient amount of historical data, and for a much larger group of persons than the selected beneficiaries. Often, the lack of historical data is an obstacle to the use of machine learning models.

In human-controlled processes, such as the delivery of EU CAP grants, the challenge is whether or to what extent the results of machine learning models are trusted in decision-making.

Advantages

However, the advantage of the machine learning model is the lack of human subjectivity, which makes it quite impossible to change the results in the desired direction by changing the criteria or artificially creating them.

For the new CAP period 2023-2027, a significant EU initiative on area payments is to move to a full area monitoring system (AMS) and the artificial intelligence based analysis and control system. EU initiative in promoting AI enhanced AMS will encourage the use of machine learning models in other areas and phases of EU CAP support.

As our test has shown, machine learning models can also be used successfully to design new CAP interventions. When implementing machine learning models, it is important to correctly define the tasks assigned to the model (ie TARGETs). This is also in line with the new CAP results-based support system. The target used in the test was the ability to create jobs in a rural area at a certain level of pay over a period of time. One of the results of the testing was also the understanding that when designing an intervention, the goals of the intervention can be formed as a combined result of several different targets. This requires a separate analysis for each target and possibly a data set, as well as a definition of the impact and share of each target in relation to the whole.

The test also showed that the effectiveness of interventions, such as the ability to create valuable jobs in rural areas, depends to a large extent on the individuals behind the companies (management and owners) who have experience in labor-based entrepreneurship. This

knowledge is also planned to be taken into account in shaping the rules for performance-based interventions in Estonia in the new period.

Another option that needs to be tested is to combine machine-learning models with two or more targets. For example, this would mean that, in addition to the ability to create a profitable job, meeting the goals of digitalization or the Green Agreement, for example, would change part of the purpose of the intervention. The challenge will be of course precise determination on those additional targets.

In conclusion, the inclusion of machine learning models in the design of CAP performance-based interventions will help to discover new nuances and perspectives that could be taken into account in shaping the rules. From the point of view of the protection of the EU's financial interests, this is a clearly preventive approach.

1.5.6 ML (machine learning) and AI (artificial intelligence) based data-analysis for new proactive targeted support campaigns- as smart prevention of the EU financial interests. (PREVENTION)

A completely new proactive approach to shaping the CAP intervention process may be to use machine learning models to find potentially suitable beneficiaries and to offer them personalised offers for applying to EU fund (campaigns). This approach is familiar nowadays through personal marketing, which is widespread through the activities of Google, Facebook and other major online giants. Credit institutions have also sometimes used such a personal approach to finding customers, for example in the form of offering pre-arranged small loans or loans to a pre-analyzed target group.

Of course, such offers are often pre-analyzed using artificial intelligence, which is quite advanced in assessing a person's creditworthiness. The use of machine learning models to map and target customer groups is also widespread among telecommunications companies.

With regard to public services, which also includes the provision of subsidies, the opportunities for machine learning in the new era are not yet widespread. At the same time, in the design of a results-based EU support system, machine learning and artificial intelligence could help to achieve the desired results with public funds. Why not personalise it through certain support campaigns designed for this purpose in the form of near zero bureaucracy by by pre-filled applications.

It could also mean that customers are integrated into the paying agency's client program, which provides an overview of the customer's life cycle and investment and support needs and opportunities. The prospect of receiving grants is predictable, through different levels of achievement. Such a customer program will certainly also ensure a trusting customer relationship and is an effective preventive measure to protect the EU's financial interests.

Testing of machine learning models has shown that the the precision of the results can also bring completely new approaches to grant-making processes. In a situation where machine learning models have a high ability to predict the target group of people who are more likely to achieve results, support campaigns targeted at a higher potential target group could be considered.

This would have a general positive effect on the more smart use of CAP funds. It would also have a deterrent effect, as it restricts access to "fishing" the grants by those who may want nothing more than financial support at the expense of EU funding.

Thus with the help of machine learning models, it is possible to target grants more precisely and more consciously to the target groups for whom they are intended, instead of passively waiting for suitable target groups to find the grants intended for them. Through a proactive approach, such as the active provision of grants, there is a growing likelihood that grants will reach a more targeted, credible and effective target group, leaving fewer opportunities for those whose intentions may not be honest.

As it turned out from the presentation of the STATS Unities team during the visit to Estonia, effective data analysis based on machine learning models always reaches the point where it is reasonable to use it for automated and precisely targeted campaigns (see action no 3 on the following diagram) to achieve the desired public goals, be it COVID19 to distribute grants.

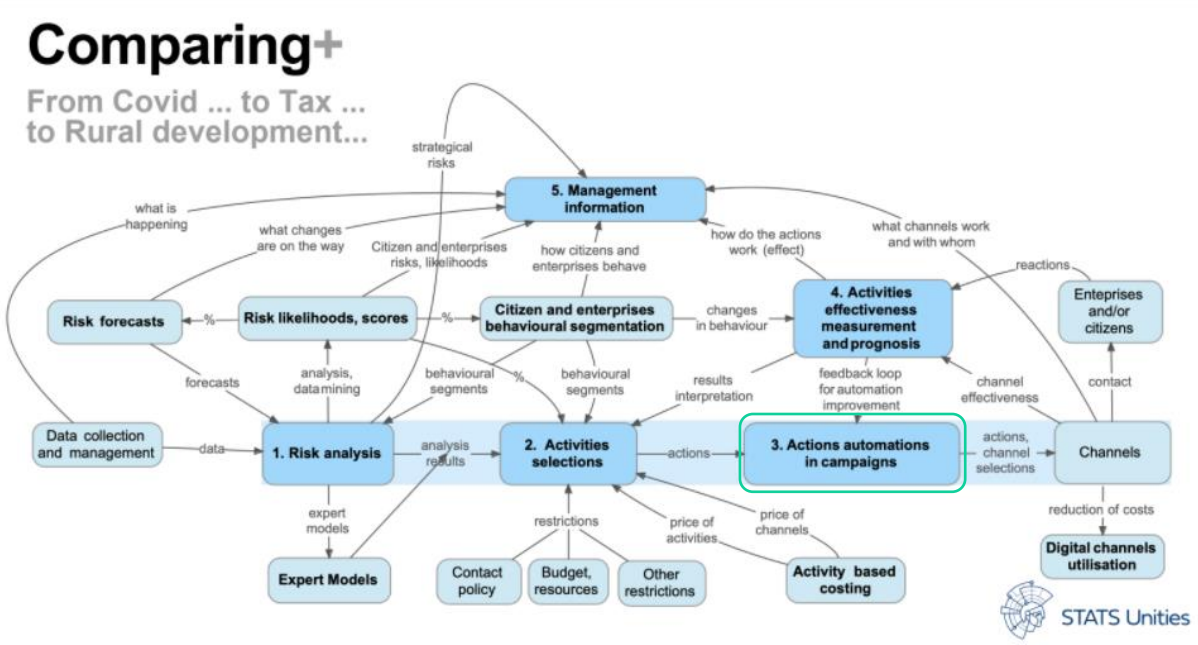


Figure 18

This is a common evolutionary model, from classical human rule-based risk analysis to data analysis based on machine learning models. In practice, it has become more and more apparent that machine learning models are more efficient and accurate not only in discovering new patterns and connections but also in predicting the future. The latter is also important for enhancing the preventive phase of the protection of the EU's financial interests.

In conclusion, the implementation of machine learning models for personalised CAP support campaigns will help to achieve the desired results with EU support instruments, while being effective in preventing irregularities and fraud due to a very good knowledge of the client's background and capabilities.

1.5.7 ML (machine learning) and AI (artificial intelligence) based data-analysis help to increase the accuracy of control samples as an option to reduce the administrative burden but preserve. (DETECTION)

Another example is the Flemish Paying Agency's attempt to improve the accuracy of risk analysis using machine learning models. On-the-spot sampling of the population is usually based on risk criteria established on the basis of human expertise, which is the usual approach to data analysis. In the modern approach, instead of man-made risk rules, potential control objects are allowed to be found by machine learning models based on historical data.

The Flemish PA test showed that, based on historical data, the accuracy of the classical control sample was 18% and the accuracy of the control samples predicted by the machine learning model was 94%. This would allow with fewer controls and higher accuracy to achieve the result which is similar to the classical approach. In numbers, this means that:

- On the basis of classical risk control samples on the basis of classical risk analysis 4757 objects were controlled and 3893 inspections were completed without findings, and 864 inspections with the findings.
- With the machine learning model, the number of applications to be inspected would have been 650 instead of 4757, of which 94% or 613 would have resulted in a finding and 37 without an invention.
- Decrease of the number of OSC-s by 4107 pcs (4757-650) but increasing of accuracy from 18% up to 94% would still have secured a deterrent impact of the inspections, because 613 findings instead of 864 would have been found with the help of the new machine learning approach at the same time with the robust declining of the administrative burden for clients and for PA. This example demonstrates that the use of machine learning models can help to make control samples more accurate and thus reduce the control burden at the expense of those who do not need control.

Traditional vs machine learning risk assessment(Flamish PA mini POC)	**Number of OSC**	**Number of findings**	**Accuracy**
Traditional risk assessment	4757	864	18%
Machine-learning predictions	650	613	94%

Table 3

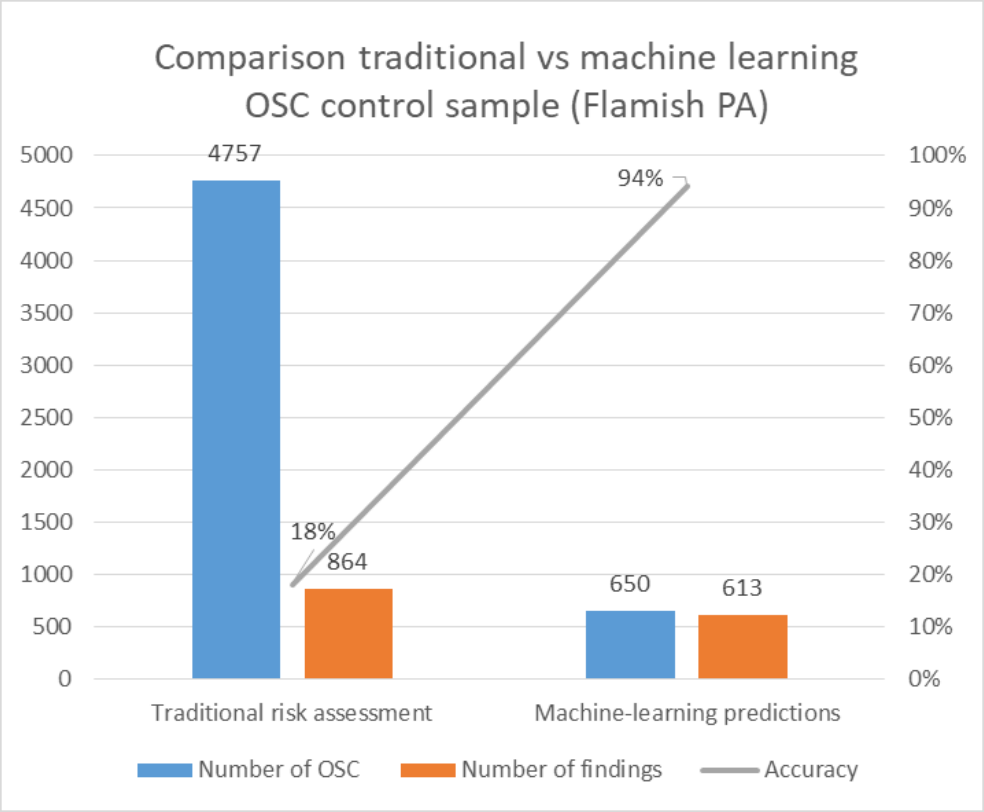


Figure 19

This is another good example of how the implementation of machine learning models can make the distribution of CAP payments more efficient by reducing the number of inspections. At the same time, the accuracy of the control sample will increase significantly, which means that with a smaller number of controls, the deterrent effect of controls will remain, making the EU much more effective in the detection phase of the protection of its financial interests.

The challenge here is once again the willingness of the EU and Member States to recognize the use of machine learning models in the selection of control samples as part of the formal process.

1.5.8 ML (machine learning) and AI (artificial intelligence) as part of the pre-selection or post-selection process of applications complementing fully automated rule-based or/and human-based evaluation processes (PREVENTION)

This idea that could be considered in the future is using a machine learning model as part of the application selection process, similarly as it is widely known in the private credit institutions, where AI-based credit ratings are widely used and also the final decisions for smaller loans are trusted to be made by AI.

In the application selection process, the use of risk analysis based on machine learning models can be seen as a useful automated process for pre-or post-evaluation of applications, where machine learning models would be trained to find grant applications with a higher probability of achieving

the desired results. Such an approach would also be directly in line with the new EU 2023-2027 performance-based CAP principle.

As AI-powered systems can appraise customer credit histories more accurately to avoid losses for banks, or create tailored loans and provide scoring free of human biases - the same ideology can be introduced for developing the AI-based automated evaluation and selection processes of grant applications

The challenges here are, of course, whether or to what extent the EU grant entitlement framework allows the application process to be entrusted to artificial intelligence to replace, to some extent, human rule-based or evaluation committee choices.

The positive aspects of this approach are that the share of human subjectivity in the grant selection process is reduced. The possibility of obtaining support to create artificial conditions would also be significantly reduced, as the amount of data and possible patterns that could not be foreseen by artificial intelligence or machine learning models would be significantly reduced. Also, these patterns are constantly changing over time as the data is updated.

As concluded by the Corporate Finance Institute [1]

- Machine learning is a branch of artificial intelligence that uses statistical models to make predictions.
- In finance, machine learning algorithms are used to detect fraud, automate trading activities, and provide financial advisory services to investors.
- Machine learning can analyse millions of data sets within a short time to improve the outcomes without being explicitly programmed.

We believe that as part of the financing system also EU funding's schemes should benefit from implementing machine-learning methods, in order to increase efficiency and precision of distributing the public funds and reducing administrative burden at the same time.

[1] https://corporatefinanceinstitute.com/resources/knowledge/other/machine-learning-in-finance/

Section 2 – Experiences of using Arachne risk scoring tool

2.1 Overview of Arachne

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:

- to identify the most risky projects, beneficiaries and contracts, links between beneficiaries and contractors, and potential systemic errors;
- more effective and efficient controls;
- 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;
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 visualisation 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.

Arachne has 3 main functionalities:

1) worldwide individual inquiries concerning the business connections and commercial background information of the persons involved in the support applications (manual searches on persons entities /groups;
2) an automatic risk scoring tool of applications, applicants, and involved businesses;
3) case management.

According to DG AGRI Arachne expert group meeting on 20th of Dec 2020 European Comission found that Arachne can be used for the CAP:

1. Generally to identify:

- the most risky projects/contracts through risk scoring;
- potential links between stakeholders;
- potential conflicts of interest.

2. More specifically for:

- **Project selection** - where Risk calculations help identifying the most risky projects/contracts
- **Administrative checks on eligibility conditions** -
  - through single inquery functionality helping identify company status (e.g. number of employees, operating revenue, NACE classification, viability based on ORBIS database information) and
  - reports on related companies, subsidiaries, shareholders etc (e.g. SME condition).
  - Also possible double-funding risk can be checked if Arachne includes data of all possible EU fundings of beneficiary from differnt EU funds.
- **Administrative checks on the reasonableness of costs -** as Arachne helps identifying concentration of projects at contractors level.
- **Checking on potential conflicts of interests -** as Arachne helps identifying links between beneficiaries and contractors or other stakeholders
  - Legal links (links between shareholder and subsidiary)
  - Private links (links between company and manager)
  - Affinity links (links between managers)
  - Memberships (links between company and group)
  - Involved companies (e.g. all beneficiaries in a specific OP)
  - Involved persons (related people in a Project
- **Fraud prevention** - while WorldCompliance data helps identify red flags of persons political involments or history of criminal involments etc.
- **Ex post checks** - as Orbis data helps detect risks as to the 5 year durability clause for investments (e.g. company status and viability after project

2.2 Experiencies of using Arachne

The experience of 4 countries in testing and using Arachne varies widely. We will try to give an overview of countries that are still in the early stages of using Arachne, as well as the experience of countries that have already used Arachne. Experience has been gained under both the EAFRD and ERDF funds.

Some challenges to start using Arachne:

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

Experience 1

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 our 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.

Experience 2

Arachne uses data from the internal (operational) databases of Member States and from 2 external databases. The PA is responsible for collecting and extracting data out of their local computerised systems set up according to Article 72 of the Commission Regulation (EC) 1303/2013 and to upload this data to Arachne in xml format.Regarding the population to upload, we have decided to upload data about all projects we had in our database.

Preparation of data for the upload required some analysis regarding what data we are supposed to upload in certain data fields, but with some steering from the Arachne team in EC, we have managed to prepare our first upload. This upload was prepared with relatively basic set of data required, considering that, in our database, we didn't manage all the data foreseen by Arachne risk calculations.

Once we started analysing our first results in Arachne we have discovered that because of our lack of data, we weren't able to see risk calculations for some important risk categories, specifically for the category "Reputational and Fraud Alerts".
In order to see full potential of Arachne risk analysis we needed to start collecting structured data about contractors.

Until 2019, information about contractors was available only in the form of the selected offer/invoice that beneficiary has uploaded in pdf format with his Request for support, but this information was not stored in a way readily available for reporting in our internal database.
In 2019, motivated by the Arachne project, we have decided to start collecting and maintaining this data. For this purpose, we added data fields in Request for support and obligation to the beneficiary to input data about the contractor (name, VAT number, address…) and contract amounts. This gave us necessary data for the calculation of risks like:

- Links between beneficiaries/project partners and contractors/Consortium members;
- Links between contractors/consortium members;
- Directors/owners with high number of mandates;
- Registration of multiple companies on the same address.

We considered this type of indicators to be good starting point for the implementation of Arachne into administrative controls, because we have similar controls already in place and if we would be able to replace/supplement them with Arachne it would be perfect example how Arachne could be useful.

Currently we still haven't introduced these checks as part of our administrative controls, but we are making necessary steps in order to do so.
In order to include Arachne into our everyday work we need the ability to prepare and upload data very quickly and very frequently so the first step we need to take is to develop an IT solution that will make preparation of reports with necessary data easy and fast.

The second step is to prepare guidance for our employees performing administrative controls on how to make checks using Arachne. Our initial intention is to use Arachne for checking links between beneficiaries and contractors. In this first phase we plan to make this check parallel with our usual check for links between beneficiaries and contractors.

The final step will be to evaluate effectiveness of this control compared to our usual controls for links between beneficiaries and contractors.

Experience 3

Testing activities were carried out by a team of employees belonging to different areas of the Agency and the testing project was developed in close contact with the services of the European Commission in charge of the development of Arachne.

The following steps were followed:

1) Identification of the sample
2) In order to verify the functioning of Arachne, the consistency and the nature of the return data, it was chosen to send a set of information present in our databases related to one specific intervention type - "Investments to improve the overall performance and sustainability of the farm". This type of intervention was chosen for the following reasons:
    (a) The high number of applications submitted provided a lot of data with great heterogeneity of the data;
    b) The applications were in a "CLOSED" status, therefore it was possible to select and send information concerning all the project implementation phases.

3) Identification of valuable risk indicators and outputs
4) Based on the document " Arachne - Risk calculations", the preparatory activity for the sending of data was as follows:
   a) Identification of the individual risk indicators, for which they could provide information and data, with delimitation of the type of intervention analysed and nature of the data available;
   b) Identification of the related inputs that could be used (detailed data that could be extrapolated from individual projects). It emerged that the availability of data mainly concerns monetary data, on project expenses, while organisational, economic, financial and statutory data of the applicants/companies are scarce or incomplete).
   c) Processing of the data held by the agency, coding of the same and compilation of the .xlm files to be sent to Arachne.
   d) Sending data.

A sample analysis carried out on the return data from Arachne revealed the following observations that can be grouped into two macro-categories:

GENERAL observations:

- Arachne assesses every single application as a 'project'; this affects the meaning to be given to some return data because changing the size and scope of a 'project' also changes the interpretation to be given to a data. Consider, for example, the individual risk indicator "overall eligibility score" and one of its risk factors "high percentage of costs awarded at the end of the project". If the factor were analysed on the totality of applications submitted, it is likely that the incidence of "risk" would be proportionally reduced. On the other hand, if the risk factor were analysed at the level of the individual project application, the beneficiary who does not ask for interim payments but goes directly to the final payment would obtain a "high risk" indication. What for Arachne represents a serious alert, for the agency is not a problem due to the fact that each beneficiary can be allowed to report the whole initiative on the balance.
- The phase in which the project-application is sending the data to Arachne, the great variability of the types of interventions financed by the project-applications and the consequent heterogeneity of the types of expenditure, could lead to a different reading of the individual risk factors that Arachne highlights. The cross-referencing of the data provided by the agency with data of a different nature and origin present in other European databases could also alter the meaning of the results. The standardisation of risk factors at European level makes the system rigid in carrying out the assessment despite the interpretability of the results in relation to the context. Perhaps we should have a clearer idea of the 'basic context' used as a model and on which Arachne was built so that we can compare it with our own.
- Each piece of data sent to Arachne represents an input for multiple risk factors; the combination of these inputs leads to the processing of the risk factor regardless of whether all the inputs it requires are present.
- Given the peculiarities of the agricultural, forestry, training, partnership, etc. realities where there are companies exempted VAT regimes, without the obligation to deposit the balance sheet in the Chamber of Commerce and exempted from depositing the information required by the algorithm, the few inputs sent create a high number of risk reports, due mainly to the very lack of inputs in the reference banks.

DETAILED observations:

- Arachne returns two types of assessment:
  - A global risk assessment on the application - project (OVERALL application score);
  - A risk assessment on the individual factors determining the global risk assessment (warnings/alerts within the 7 risk categories):

    - The fact that the risk assessment on the single factors determining the global risk assessment is referred to the single application implies that, in order to ascertain the actual existence of a reported risk, it is necessary, application by application, to refer the corresponding factor (risk report) to the data codified in the sending table and therefore to the corresponding data in the application. This procedure becomes, in fact, a sort of ex-post investigation. Consider, for example, the sample under analysis made up of more than 980 project applications, the majority of which had a detailed risk factor highlighted (yellow to red dot).

    - If each "high" risk factor contained in a single project-application had to be followed up or justified, this would become extremely burdensome in terms of resources and time and would require the constant supervision of a working group dedicated exclusively to this task.

Experience 4

Preliminary work for the use of Arachne started already in 2019 with the establishment of contacts, the first instructions for the use of Arachne and the mapping of data.
We set ourselves the following goals to pilot Arachne. The first steps were;

1) to get acquainted with the structure of data necessary for Arachne and their availability from our systems and to compile and upload the first test data to Arachne,
2) to get feedback to the quality of the first test data and repetition of the data request regarding all possible data and the question of how to automate the collection of these data as much as possible,
3) to extend the number of Arachne users to all officials involved in the application process who wish to receive and receive feedback on which functionalities are most useful to users,
4) to test whether and to what extent the risks of Arachne overlap or harmonize with the risks calculated in our own risk management system.

We started testing Arachne in March 2020 with the first data uploads for two measures. The Arachne testing and deployment team will initially consist of 4 people - an anti-fraud advisor and 3 risk analysts. With the loading of the first data, we also received feedback on data quality to address further. During the year, a number of data loads were carried out and efforts were made to find automated solutions for data aggregation. In April, users from different units (from all implementing and investigating units and also analysis department) were added to test Arachne E. In december 2020, Arachne introduced in procedures of measure schemes 6.4, 4.1, 4.2.1. Focus was on background and connections information especially regarding foreign connections. In 2021 we continued testing Arachne risks vs our risks. We asked for a Web-based Arachne training for all users in PA and it was organised by Wim Smets (EC) in early 2021. By the end of 2021, we will have made a total of 5 data uploads and will have uploaded all CAP and EMFF projects. In total 7116 applicants for 11303 projects. The most difficult part of the data loading was the structural matching of the data with the structure provided by Arachne.

Out of the 17 data sheets provided by Arachne, we have only been able to complete 7. There was also a need to find a way to merge data in predefined fields. For example in project level:

- Project ID – application file ID;
- Project name – application file ID + application round ID;
- Beneficiary ID – beneficiary's registration number;
- Turnover, Number of employees – filled if the data is available (depends on measure);
- Start date – approval date (signed);
- End date – durability period end date.

For several fields we do not have the data available (for example Income and Thematic Objective). In contract level we found the following solution:

- Contract ID – object ID;
- Contractor ID – won contractors' register number;
- Contract name=Contract description – object description;
- Amount – object's cost;
- Procurement Valid tenders – nr of contractors per object.

There were even more fields at this level for which we do not have any data. For example:

- Contract Type;
- Contract modified;
- Signature date;
- Initial end date;
- Final end date;
- Addenda Amount;
- Number of addenda;
- Procurement Type;
- Exclude tenders;
- Total tenders;
- Publication date.

The biggest problem with the data was with the entities where we don't have data about all contractors. In the case of related persons, information is available on the representatives but not on the board members of the beneficiary.

A big issue is the interpretation of the data - what field do we have that could fit the given criteria.The data will also vary depending on the different measures and what data are collected under specific measures. And data quality is always a problem too.

Data interpretations

The challenge is that Arachne´s data needs to follow the natural data structure and logic of the public procurement process for EU SF funds, but for rural development support most projects are not related to the public procurement process but the conventional 3 tendering system, through a system of price catalogues for machines that are reasonably guaranteed.
In our conditions, we also foresaw the problem that while Arachne collects information on already funded projects that have passed the selection procedure, our own risk management system for risk prevention assesses the risks of applications before and during the selection procedure.

If you want to use the Arachne risk scoring functionality to support the selection procedure as well, you can compare Arachne's risks with your own calculated risks. For this purpose, we also had to add to the Arachne database the data of the applications that were submitted to us but which did not reach the financing decision, i.e. were rejected. In order to differentiate between rejected applications, we also marked these applications in the Arachne datasets as completed projects in subsequent data uploads.

Implementing Arachne functionalities:

1) Manual single searches on persons/entities /groups and related business data and connections.

We found that Arachnes` most valuable functionality at the moment is to have the ability to monitor by single case-based inquiries global-wide business connections and relevant business data in order to support administrative checks. Especially valuable and quick in the cases that have foreign contractors, stakeholders, persons are involved.
Therefore Arachne was officially introduced as an additional source of information introduced to support administrative cheks in the working procedures of measure schemes 6.4, 4.1, 4.2.1.

2) Searching conflict of interests by Internal Audit

As another option, we have tested Arachne in the context of internal conflict of interest prevention in the internal audit department. We checked the connections of the employees with the applications during several audits. Arachne E works well for such a check but this is manual control. We also tested Arachne for reporting ancillary activities to our employees.
The problem that we found was that through the Arachne, you can only see that you are on the board, but for example, other contractual employment relationships are not reflected there.

3) Testing Arachne vs PA risk scoring

We tested the Arachne risk assessment on the basis of 2 measures. The aim of action 6.1 was to see if the risks of Arachne and our risks are different. 9 projects were examined. The main differences, or two major differences, are as follows. First of all: for 6 projects, no risks were identified at all or risks were low according to Arachne. In our data, the projects had a high risk score. As reasons for the difference, we identified that Arachne does not have enough scored risk factors using in-house data (beneficiaries' board members network, cadastral parcels cumulation etc). And the second reason was that there is no historical data about new enterprises in Arachne. The second one was just the opposite. Low risk score from our scoring and high risk in Arachne with other 3 projects.
Results of measure 4.2.1 examination. 38 of 102 risks were scored in Arachne and we identified 8 risks that were similar to our risk list. As an example of the reasons why only 8 risks were added up, it can be pointed out that the risks of the paying agency are often more detailed or vice versa. There were situations where one Aracne risk was matched by our 3 risks or vice versa.

2.3 Lessons learnt

Arachne is a risk analysis system and Member States, together with the EC, have to find a way to use it the best. Proper risk scoring tools should detect us the riskiest projects overall so it is for both MS and EC to make a decision to entrust this to Arachne or not. Every risk scoring method, as well as Arachne, will undoubtedly leave some residual risk uncovered, and this is something that both MS and EC must accept and periodically evaluate the impact of this residual risks on the overall efficiency of risk analysis and then use this information to further improve risk analysis to better detect potential irregularities.

The first look at Arachne is a little overwhelming and intimidating because, when you see all those risk indicators that are being calculated, and there are more than 100 of them separated in 7 categories plus an overall score, one has to ask himself how can we manage all this.
This is emphasized even more with Arachne manual where it states:
"Arachne does not aim at assessing the particular individual conduct of fund recipients and does not as such serve to exclude automatically any beneficiaries from the Funds. The tool provides highly valuable risk indicators to enrich management verifications, ***but it does not supply any proof of error, irregularity or fraud."***

Basically, how we initially interpreted this is that we have a tool that is giving us more work to do and more checks to perform but little real solutions in fighting irregularities.
From our everyday experiences with detection of potential irregularities and with using a system of red flags we have learned that it is relatively easy to detect irregularity indicators. What becomes difficult is putting these indicators into the right context, performing sufficient and proportionate additional checks and making a decision on irregularity with sufficient evidences that will hold the test of court trial.

This part of work, making a case about irregularity, is the most burdensome and time-consuming part of irregularity management and as it looks Arachne is not helping us very much in this area, but there may be another way to approach this new tool.

Considering that there is an ongoing pressure on the PAs to reduce administrative burden, to speed up their controls and to issue decisions faster and faster, the way we may approach to incorporate Arachne in the internal controls system is to replace some of our usual checks with Arachne. With this approach we would simplify our control system, because we wouldn't have to make some specific checks for every beneficiary but only for those where Arachne indicates.
For this approach to work well it would be important that data from external databases Arachne use for enrichment of MS operational data is up to date as much as possible. Currently this is not the case and some of the data is a couple of months old and that can present a problem if we rely on Arachne for some checks.

The role of the European Commission in giving clear guidance and best practices on how to make Arachne part of the internal controls systems of the MS is also very important. Considering that auditors can be allowed to use Arachne for the preparation of the audit missions it is very important that MS are not sanctioned if they didn't follow through on some red indicators, because it would be almost impossible to create a system where we would check every possible indicator.

From the analysis of the critical points, it emerges that the findings of Arachne are based on an extremely large variability of factors. It is therefore mainly the context to which Arachne is applied that makes it a more useful or less useful tool. The future introduction of Arachne in the procedures adopted by the Agency could be very complex. Selecting the most appropriate stage of the project applications, extracting the useful data, processing them, sending them, interpreting the results and identifying what corresponds to a risk and then decoding it in a specific control procedure, as Arachne is now, is a process that implies a substantial workload and the involvement of different sectors of the agency. It is certainly desirable to further explore the Arachne tool from several points of view:

- How it was developed (basic analysis and context);
- Specific training on its use for all the actors involved;
- Impact of the findings on the administrative process;
- Positive and negative implications of its use.

Arachne's strength can certainly be considered to be part of individual queries, although here, too, some data quality issues may prevent you from finding the right companies due to the different spellings in different languages. There may also be situations where Arachne is unable to identify all of a person's business relationships because the same person may appear in Arachne's data in a number of different forms with partially incomplete data.

It is also appropriate to clarify with the services of the Commission how flexible and/or modifiable the tool can be in order to adapt it to the needs of a more restricted area of use (e.g., RDP measures of specific Region or country), or if there is the possibility to downgrade ad hoc some risk factors (which we will demonstrate do not represent indicators of problems). It would also be desirable, before implementing it in the Agency's procedures, to start an additional testing of the tool in order to adapt it to the agricultural-forestry reality. We believe that this sector can broadly differ from that of the structural funds for which Arachne was conceived.

Overall, Arachne has a strong strength in the global capabilities of all related EU grants and interpersonal links and primary business data.

Advantages of Arachne:

- In the context of ERDF, the tool makes it 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 they 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).

After some testing with Arachne, we recommend that you create an initial SWOT that identifies all your strengths, weaknesses, opportunities, and threats. We can present one variant based on the initial test results.

STRENGTHS	WEAKNESSES
✓ Added value (new datasets, more data) ✓ Automatic risk scoring ✓ Internationally approved risk scoring tool ✓ Data is visualised	☒ Have to update and upload source data manually (no linkage) ☒ Not every risk factor has defined data origin ☒ Not very user friendly ☒ Not enough experience in house ☒ Not enough flexibility with data sources (needs some extra data) ☒ Built up for public procurement ☒ Not for simplified cost method ☒ Not all internal data is included
OPPORTUNITIES	**THREATS**
✓ Detailed client view ✓ International relationships	☒ Not trustworthy, because not widely used ☒ Threats with interfacing

Figure 20

The SWOT analysis should certainly be updated as new information becomes available following testing and Arachne developments.

We have also learnt that it is necessary to further test the use and further development of Arachne with different measures and we will do this next with measure 6.4. Through testing, we can provide feedback for further developments that are more suited to our needs. Using Arachne for searching networks case-by-case and single search is very good and useful. As of today, Arachne is not suitable for risk assessment. Based on our experience, we can see that Arachne could learn more from existing information and use machine learning techniques to display new information.Arachne could also be more flexible to meet national needs. If Member States were able to set their own risks according to the specificities of their country and measures, Arachne would offer greater possibilities for its use.

DG AGRI already mentioned at the Arachne expert group meeting in december of 2020, there are several challenges to the full implementation of Arachne for the CAP;

- Data availability and data collection process from PA databases (e.g. data on contractors);
- Data availability in company registers (depending on national rules on financial data publication);
- Small project size in the agricultural sector;
- Interpretation of scores.

Overall, their conclusion can be accepted. However, based on practical experience, they can be specified. For instance from the practical point of view we can point out that:

- Arachne input data and risk calculation logic were not originally developed for CAP rural support and do not support the application evaluation and selection process.
- There is a complete lack of input and output information on CAP direct payments.
- ORBIS data update interval after 3 months is too slow. For example, for certain support schemes, it is also possible to apply to a company set up less than 3 months ago.
- Arachne cannot identify applications related to the same persons in the same or different grant rounds or grant schemes, although the identification of the link between the beneficiary and the supplier Works.
- There are many rules-based risks and they are too broad, leading to a very large number of false-positive matches.
- Many risks remain uncalculated as far as rural support is concerned because of lacking data in CAP field or risks are too much focused on Public Procurement specific risks.
- Missing flexibility to adjust risks more suitable for the paying agency needs or to create or test new risks from a practical point of view.

The latest developments in Arachne, which partially solve the above concerns, can also be pointed out as positive.

As we know in January 2022 - expected developments, modules, functions of Arachne are following.

- Data updating of ORBIS data => 1 month instead of 3 months;
- Tuning Arachne more suitable for CAP needs including EAGF (direct payment schemes) => DG AGRI Arachne development team is in place;
- New module to support selection process (ex-ante module) ready to be launched => 1Q 2022;
- Final beneficiary detection function (up to the individuals) => 4Q 2022 =>Supports HzR (2021/2116) art 59 (4) => Member States shall ensure that beneficiaries of the EAGF and EAFRD provide them with the information necessary for their identification, including, where applicable, the identification of the group in which they participate, as defined in Article 2, point (11), of Directive 2013/34/EU of the European Parliament and of the Council.

As explained by DG AGRI's representative at the Smart Pro CAP seminar in Tartu, the claim of the beneficial owner and the functionality of Arachne are aimed primarily at increasing the transparency of EU grants in the eyes of society and do not currently have a restrictive or favorable legal effect.

The long-term goal of the risk management of Estonian PA grants is to rely on the risk scores calculated by Arachne and to integrate and interface them with the IT systems of the PA procedure.

This presupposes in the future:

- The suitability of Arachne risks with the risks in the PA risk register.
- The Arachne risk calculation system should become more flexible as risks are constantly evolving and make more use of machine learning and artificial intelligence.
- Possibility of Arachne calculated risk score data exchange machine interfaces with our IT systems.
- PA's ability to automatically keep updated support data in Arachne.

As a result, we see the potential to reduce the time spent by data analysts on repetitive risk assessments and the detection of 'risky' grant applications once reviewing process of applications has started. Instead, we could use the competence and skills of data analysts to perform more specific analyzes in the earlier stages of the support lifecycle for prevention.

2.4 Conclusions and suggestions regarding Arachne

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.

Considering that the aim of this project is to explore the use of new technologies, for a risk analysis based approach to managing irregularities, we have stressed the importance of proper data management, because having good quality, readily available data is the cornerstone of every risk analysis. We consider that we are on a good path but in order to make things better we need to improve our access to data from other public institutions and even within the PA.

By better maintenance of internal data and with connections to external registers to make cross checks we hope to achieve a substantial level of automation in the system of internal controls. Hopefully this will free some of our administrative capacities that could work on further system developments.

The current upgrade of the private procurement IT solution will give us valuable data that should allow us to make advanced data analysis about contractors and bidders and that, hopefully, may lead to further simplification by focusing our controls to the riskiest procurements.

For the Arachne we also expect more assurance and guidance to be prepared by the EC, especially for cases where MS don't follow through each and every "red" indicator, but decide to keep the approach based on overall score or even on some kind of customised settings.

It is very important that EC gives clear guidance on what are the criteria based on which use of Arachne would be considered as successful in order for the MS to be able to evaluate have they *"put in place effective and proportionate anti-fraud measures taking into account the risks identified".*

If it should be possible in the future to integrate Arachne risk scoring functionality into MS risk assessment system – it may provide the opportunity to free up risk analysts' workflow from doing routine and repetitive tasks for calculating risks. **A prerequisite of this vision is an improvement of the Arachne risks to correspond to our needs and reality and interfaces of sharing risk scoring information with our IT system are developed as well.**

But there is also the alternative approach that Arachne will focus more narrowly on specific risks as a tool of providing enhanced transparency of EU-funded projects and will not challenge to cover all possible risks- which might be obviously impossible**.**

One main common understanding and suggestion among the Smart Pro CAP partners was found and exposed that Arachne should focus on developing the strengths that it has. This means enriching EU support data uploaded by MS with ORBIS and World Compliance and etc data in order to observe deep connections behind EU fund beneficiaries to increase the transparency of EU funds. It also means that a set of risks related to transparency issues should be developed further, not all available risks which are often too country or EU aid measure specific. In conclusion, we found that Arachne has great potential to supplement existing National risk assessment systems

not fully but not substituting them. Smart Pro CAP project partners are ready to be constructive partners to help improve Arachne's usability for CAP.

In this compendium the experiences of the Agency in dealing with these topics, have been outlined and brainstorming outcomes and suggestions for EU particularly related to Arachne are listed as follows:

- Additional guidance from EC on how to use Arachne in a proper way would be needed. Clarifications on financial implications (financial corrections) in cases of limited / partial / non-check of indexes by PA would be necessary.
- As a general recommendation this tool should ease controls and not impose an excessive additional burden to PA - so there is a clear need to strike a balance between additional administrative burden imposed to PA and effectiveness of this tool.
- The Arachne risk calculation system should become more flexible as risks are constantly evolving and make more use of machine learning and artificial intelligence.
- More flexibility on the investigation of indicators' results should be left to PA. The suitability of Arachne risks should be consistent with the risks in the PA's risk register
- A revision of aggregation of scores fitting into a unique aggregated index should be possibly taken into consideration.
- **ALERT!** Countries adopting Arachne as a risk management system. It should be noted that ARACHNE does not cover the whole risk management system.
- Issues arising from the GDPR need to be harmonized across all Member States for using Arachne.

Recommendations to Member States wishing to start using Arachne:

- **Start with one measure.**
- **Map the data you can upload and find consistency with the fields that are being asked.**
- **Think about what you need to process the data when you download the results.**
- **Provide feedback for development on your experience.**
- **Test more and more with new data.**
- **Use the experiences we have covered in this compendium.**

As a general remark Arachne can be a useful tool that generates a huge amount of information and provides many search options but there is still room for improvement.

Afterword

Many thanks to the partners who participated in the project for their active and valuable contribution to introducing the opportunities for smart protection of smart EU financial interests and discovering new opportunities. Despite the global COVID19 crisis, we found the opportunity for face-to-face meetings which was the main idea of the staff exchange program and once again we discovered that teamwork cooperation is the home of inspiration and the highway of finding solutions even of most complex challenges.

Greatest thanks also to the EU for supporting staff exchange programs such as this one under the OLAF`sHercule III program .

Dear reader! We hope that you have found a new ideas and thoughts in this compendium for you to apply in your daily life to protect the financial interests of the European Union. For us it has been very interesting to compile this compendium and each partner has done their best to share their knowledge and experience in English.

If you have any questions that you would like to have answered while reading this compendium, feel free to contact the authors.

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